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THE

NATIONAL STANDARD

DISPENSATORY.

CONTAINING THE

NATURAL HISTORY, CHEMISTRY, PHARMACY, ACTIONS, AND USES OF MEDICINES.

INCLUDING THOSE RECOGNIZED IN THE

PHARMACOPŒIAS OF THE UNITED STATES, GREAT BRITAIN, AND GERMANY, WITH NUMEROUS REFERENCES TO OTHER PHARMACOPŒIAS.

IN ACCORDANCE WITH THE EIGHTH DECENNIAL REVISION OF THE UNITED STATES PHARMACOPŒIA, 1905.

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AUTHORS' PREFACE.

THIS Dispensatory is designed to succeed the *National Dispensatory* of Stillé and Maisch, which for so many years has held its place as a standard work of reference with the professions of medicine and pharmacy. It contains not only every article in the new United States Pharmacopœia with comments and explanations, but it covers as well the additional and very extensive territory of the unofficial drugs and preparations largely in use, and so offers to its readers information concerning all substances used in pharmacy and medicine at the present day.

The rapid advances in the various sciences closely connected with its scope, and the appearance of the new United States Pharmacopœia, with its radical changes in many important matters, have necessitated a careful and adequate consideration of many new subjects.

In the department of Pharmacognosy the Author has covered the minor drugs as well as those of greater importance, in their due perspective. This constitutes a new departure of value to those who wish information concerning remedies which have only a local reputation, and about which little is to be found in ordinary literature. In the discussion of additional species, advantage has been taken of the opportunity to refer to the principal economic members of the groups, so that the book is a fair index to the economic botany of all the more important families of medicinal plants. A sufficient amount of information has been given for the practical identification of drugs rather than full technical descriptions. This is especially true in regard to powdered drugs. Botanical descriptions of drug-yielding plants have been introduced only in the cases of those likely to be met with by the general reader, or when the information is desirable for some special reason, as, for instance, in regard to plants capable of causing poisoning. The illustrations of typical specimens of drugs mostly executed by the skilful botanical artist, Mrs. Beutenmüller, have been drawn so as to represent as nearly as possible their appearance as they occur in commerce. In order that the reader may find any name encountered in the descriptions of vegetable drugs, the greatest fulness in nomenclature has been resorted to. Nearly all recorded common names of drugs or medicinal plants have been given, and in addition all botanical synonyms, the oldest names, both generic and specific being preferred, since this has now become the guiding principle in botanical nomenclature.

In the pharmaceutical sections full information will be found regarding methods and products, with descriptions and explanations of the most approved apparatus and tests. This material is particularly useful to the druggist, because the Pharmacopœia is of necessity devoid of explanatory notes. In addition to this

information all important facts contained in the new editions of the chief foreign Pharmacopœias have been introduced. It has been the endeavor of the authors to supply in every article the latest information. The subjects of alkaloids and fixed and volatile oils have been considered with especial fulness, and much additional matter relative to new synthetic and other remedies will be found.

The Pharmaceutical Author has received valuable assistance on special lines from gentlemen whose names carry the greatest weight of authority. The articles on Inorganic Chemicals have been prepared by Daniel Base, Ph.D., Professor of Inorganic and Analytical Chemistry in the University of Maryland. The section on Volatile Oils and their Constituents is from the pen of Edward Kremers, Ph.D., Professor of Chemistry in the University of Wisconsin, a recognized authority and specialist in everything pertaining to this interesting and important class of plant products. Much valuable assistance in the sections on Organic Chemicals has been rendered by Joseph F. Geisler, Ph.C., Chemist of the New York State Department of Agriculture, whose great experience in the handling of commercial and other products has enabled him to contribute a large amount of useful information.

In the sections on Action and Uses the Medical Author has endeavored to give a direct and compact presentation of modern therapeutics, avoiding historical and theoretical matter. The information given in connection with the various drugs is placed at immediate command for clinical purposes by means of the extensive *Therapeutical Index*, in which, under the name of each disease, will be found references to all the medicines employed in its treatment, and in the article relating to each medicine the condition calling for its employment. The usefulness of such a repertory of therapeutics to the physician in his daily practice scarcely needs to be pointed out. The author of these sections desires to thank a number of gentlemen who have given him valuable assistance in the preparation of the portion of the book under his charge: Dr. E. M. Houghton, pharmacologist to Parke, Davis & Company, who has written the articles on Physiological Assaying, Vaccine and the various Sera; Dr. E. Russell Kennedy, and Dr. Alfred Heineberg, Demonstrator of Pharmacy in the Jefferson Medical College.

The effort to cover a field so immense, even within a volume of generous size, has rendered the problem of selection the most difficult of all which the Authors have had to solve. They have been guided by the principle of introducing information which will prove of practical value and interest to active practitioners of pharmacy and medicine.

H. A. H.
C. C., Jr.
H. H. R.

PUBLISHERS' NOTE.

THE two professions especially interested in the subjects of this volume are fortunate in having at command the work of authorities whose eminence in their respective fields is recognized throughout the world. Professor Rusby contributes the sections on Pharmacognosy, Professor Caspari those on Pharmacy, and Dr. Hare those on Medical Action and Uses. The authors have furthermore had the assistance of experts in certain important special subjects. For their part, the Publishers may claim that an experience of twenty-five years, spanned by five editions of *The National Dispensatory*, has prepared them to appreciate the many requirements to be expected in such a work, perhaps the most elaborate and certainly one of the most useful in all medical literature. Together, the Authors and Publishers have spared no effort to mark a new departure with *The National Standard Dispensatory*. The new features are briefly indicated in the foregoing Preface.

The sweeping changes in the new *United States Pharmacopœia* are included with the official authorization of the Committee of Revision, and full use has been made of valuable information appearing in the latest issues of the chief foreign pharmacopœias. This Dispensatory, however, covers a much wider field, as it includes not only all official drugs, but also those which are unofficial and well established. The aim has been to make it a repertory of the highest authority upon the entire range of Materia Medica, Pharmacy and Therapeutics in their latest development.

Throughout the text all weights and measures are given in both the metric and ordinary systems, and many new tables and lists have been inserted which place before the reader a vast amount of information in a form combining compactness with ease of reference in the greatest degree. The text is supplemented with an Appendix which will be highly convenient for practical purposes. It contains a list of Reagents and Tests; Directions for Volumetric Assays; Official Acids and Alkalies; Formulas and Molecular Weights of the Principal Chemicals; Weights, Measures and Equivalents; Thermometric Equivalents, and an Alphabetical List of Drugs, showing the preparations of the United States and British Pharmacopœias containing them. The extensive *General Index* and the *Index of Therapeutics* close the volume. Ample illustrations have been introduced, a very large proportion being new and original.

ABBREVIATIONS.

B. or *Br. P.*, British Pharmacopœia, 1898.

Cc., Cubic centimeter.

Cm., Centimeter.

E., English.

Fam., Family.

Fr. Cod., Codex Medicamentarius; Pharmacopée Française, 1884, and Supplement, 1894.

F. It., Farmacopea d'Italia, 1892.

Fr., French.

G., German.

Gm., Gram.

It., Italian.

M., Meter.

Mgm., Milligram.

Mm., Millimeter.

N. F. or *Nat. Form.*, National Formulary.

Off. Prep., Official Preparations.

P. A., Pharmacopœia Austriaca, 1889.

P. G., Pharmacopœia Germanica (Arzneibuch), 1900.

Port., Portuguese.

Sp., Spanish.

Sp. gr., Specific gravity.

U. S. or *U. S. P.*, the Pharmacopœia of the United States of America, 1900.

The titles of many books and periodicals to which reference is made in the text are abbreviated, but not to such an extent as to necessitate their addition to this list.

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A.

ABRUS.

Arbre a Chapelets Fr.; *Abrus precatorius* L. (*A. pauciflorus* Desv., *A. squamulosus* E. Mey.—Fam. *Leguminosæ*).

The root, leaves, and seeds are of interest in materia medica, and have been examined. The plant is a nearly smooth, slender woody vine, climbing high upon trees and shrubbery in nearly all tropical countries, preferring a sandy soil and sunny positions in the edges of forests. It bears small rose-colored flowers, and fruits resembling very small pea-pods, containing about 4 to 6 seeds. Its historical interest is chiefly toxicological; its modern, chiefly ophthalmological.

Abrus Root (*Indian liquorice, Jamaica wild liquorice*).—Much-branched, tortuous, woody, hard, brittle, about 0.6 Cm. (¼ In.) thick, reddish-brown externally and through the bark fracture, yellowish-white through the wood fracture, bearing almost no resemblance to liquorice. Bark very thin, slightly sweet, acrid.

This root was recognized in the Indian Pharmacopœia under the mistaken notion that it could substitute liquorice. The result was quite unsatisfactory. It is recognized in India as being emetic, abortifacient, and poisonous in the same way as, but very much weaker than the seeds, and as containing the same or very similar compounds. Hooper found it to contain 8 per cent. of an acrid resin and 1.5 per cent. of glycyrrhizin.

Abrus Leaves.—Abruptly pinnate and possessing 10 to 20 pairs of nearly sessile, narrowly oval-elliptical leaflets, about 1.2 Cm. (½ In.) long, almost smooth, except the short petiole, entire, thin, pale-green, inodorous, distinctly sweet, slightly acrid.

The leaves have not been used, but Hooper has pointed out that, as they are the sweetest part of the plant, they, if anything, might be used as a liquorice substitute. His examination showed them to contain about 10 per cent. of glycyrrhizin ("glycyrrhizic acid"). He believed part of this to exist free, while the remainder might have been combined with potassium and calcium.

Abrus Seeds (*Jequirity, Chicken-eyes, Crab's-eyes, Prayer-beads, Jumble-beads, Love-peas, Retti, Gunj, Gunjha*, etc.).—Nearly globular, slightly elongated, about 0.6 Cm. (¼ In.) long, hard, smooth and brightly shining, scarlet with a large black patch around the hilum near one end, rarely white with a black patch or black with a white patch. The testa is rather thick and hard. The kernel consists, as in the bean, of two plano-convex cotyledons.

Fig. 1.

Abrus seed (× 2).

These seeds are employed largely for the making of rosaries and for other ornamental purposes. That they are dangerous playthings for children is attested by the records of a number of cases of poisoning which have occurred in this way. They have also been used in India from very ancient times for the purpose of weighing gold. Their medicinal importance is not great, but they have a notorious history in India as an agent in criminal poisoning. This practice has been directed chiefly against cattle and other live stock, but the poisoning of human beings has been not infrequent. Poisoning may result from the taking of the seeds internally, though not in the same small doses which will produce it when introduced directly into the circulation. Forty seeds have been ingested, with serious results, but

there was final recovery. The ordinary method of application for poisoning is by grinding the seeds to a very fine pulp with water, moulding the mass into a small sharp point like the end of a pencil, and affixing it to the end of a stick. This point is used to prick the skin of the intended victim, with a promptly fatal result. Two or three such prickings through the skin of an ox will, it is said, result in the death of the animal before the next morning. Such a hardened point is known by the name of *sui* or *sutari*. Instead of water, a vegetable milk-juice sometimes is employed for mixing.

The poisonous constituent of Abrus seeds long was known by the name of *abrin*, but later this was found to be a compound substance, consisting of a globulin and an albumose, both of them extremely poisonous. A temperature of from 75° to 80° C. (167° to 176° F.) at once destroys the globulin, while 85° C. (185° F.) is required to destroy the albumose. Any temperature above 50° C. (122° F.) weakens the action. The method employed by Hooper for the separation of the globulin was to extract it with a 15 per cent. solution of sodium chloride, acidulating with acetic acid, and precipitating by saturation with sodium chloride. This precipitate, containing some albumose, was mixed with distilled water and dialyzed in running water for several days, the globulin being precipitated, while the albumose remained in solution. The albumose was prepared by extraction with water and precipitation by filtering into absolute alcohol. The precipitate was redissolved in water and reprecipitated by alcohol at intervals. At the end of about eight months the globulin had coagulated completely, and the albumose was still soluble. The general composition of jequirity is similar to that of other leguminous seeds.

Action and Uses.—Abrus has been used by de Wecker and others in the form of an 0.5 per cent. infusion in the treatment of pannus, granular ophthalmia, and trachoma, but it has never met with favor in this country on account of the violent symptoms resulting from its use.

Applied to mucous membranes, the drug acts as an intense irritant, and if frequent applications are made causes violent inflammation and suppuration. Applications to the conjunctiva produce œdema, swelling, and some serous discharge. Later the discharge becomes purulent, and there may be suppuration of the parotid and submaxillary glands as well. If used in too concentrated a form, it may cause corneal ulcers, or even produce panophthalmitis. The lower eyelids occasionally become gangrenous.

Introduced hypodermically into the subcutaneous tissues, it produces gangrenous ulcers, and when injected into the circulation it is a powerful cardiac depressant poison.

Solutions of the drug undergo rapid decomposition, and should either be made freshly each time they are used or be preserved by the addition of 4 to 8 grains (0.25–0.50 Gm.) of boric acid to the ounce.

If an excessive action of the drug is developed, it may be controlled by compresses moistened with hot and very dilute solutions of corrosive sublimate.

Allied Drug.—Cassia Absus L. has oval-oblong, flat, glossy-black seeds, which are used in Eastern countries in purulent conjunctivitis and as an application to sores. Used in the same way, in India, are *C. auriculata* L. (*Tarwar, Ranavara,* in China called *Kineh-mang*) and *C. Tagera.*

ABSINTHIUM.—Wormwood.

Maderwort, Mingwort, E.; *Wermuth, Warmot, Wurmtod,* G.; *Absinthe grande, Alsei, Aluyne,* Fr.; *Ajenjo,* Sp.; *Absinthis, Acintro, Losna,* Port.; *Assenzio,* It.

The dried leaves and tops of *Artemisia Absinthium* L. (*Absinthium officinale* Brot.—Fam. *Compositæ*).

Absinthium is official in most pharmacopœias, but not in the United States and British. The Dutch requires collection at the beginning of flowering and uses only the flowering tops. The Portuguese allows alternative use of the leaves of *Artemisia arborescens* L. ("Losna de Algarve"). The definition would be improved by saying "the flowering tops," etc., as the drug is then more active. The fresh herb is three or four times heavier, therefore weaker, than the dry.

Absinthium is a native of Europe, Northern Africa, and Asia, and is naturalized in most temperate and subtropical countries, being rather scarce in the United States. It is cultivated largely in Europe and in several parts of the United States for the manufacture of its oil. Under cultivation, its taste becomes milder and its aroma finer. In Europe it is used to a considerable extent for imparting a bitter taste to beer and for

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the preparation of the French absinthe, a liqueur which is found to be much more injurious to the nervous system than plain alcoholic liquors. The poisonous properties of this drink have clearly been shown to be due to the oil of absinthium present, notwithstanding that this conclusion has been disputed. With this oil, those of anise, coriander, fennel, mint, hyssop, angelica, and melissa are associated usually in absinthe.

Description (see Fig. 2, A and G).—Soft-shrubby, finely silky-hairy and glandular throughout, erect-branched; lowest leaves long-petioled, up to 12 Cm. (5 In.) long, roundish-triangular, thrice pinnately divided or lobed, the segments oblong to obovate, obtusish, toothed, or entire; upper leaves becoming gradually shorter-petioled, smaller, narrower, and less divided, the uppermost 2.5 Cm. (1 In.) long, sessile, oblanceolate or linear-oblong, entire; heads numerous, racemose-paniculate, on drooping peduncles, greenish-yellow, about 4 Mm. ($\frac{1}{8}$ In.) broad, globose-ovoid, the outer bracts linear-oblanceolate, obtuse, the inner becoming broader and with scarious margins, the receptacle hairy; flowers all fertile or the outermost sterile; aromatic and persistently bitter. (See also generic description below.) The radical leaves are rarely present, sometimes 19 Cm. (8 In.) long and broad.

Constituents.—The important constituents are volatile oil and bitter principles, associated with starch, a little tannin, succinic ("absinthic") acid, partly free and partly combined with potassium, and about 7 per cent. of ash.

Oil of absinthium (*Oleum absinthii*) is in variable amount, being obtainable to the extent of upward of 1 per cent. from the dry plant. It is brown, becoming green or occasionally blue on exposure, specific gravity 0.925 to 0.955, slightly viscid, very bitter and disagreeable, the taste closely resembling that of the drug, and is soluble in alcohol. Its principal constituent is *thuyone* ($C_{10}H_{16}O$, the same as *absinthol* or *tanacetone*). With this is thujyl alcohol ($C_{10}H_{18}O$), partly free and partly apparently combined with acetic, isovalerianic, and palmitic acids; phellandrene, and possibly pinene; cadinene; also a bluish oil which has not been determined (Gildemeister and Hoffmann). This oil is apt to be adulterated with oil of turpentine.

The bitter principles are the oil above described, the resin (probably because it contains the next), and *absinthiin* ($C_{15}H_{20}O_4$). Absinthiin is a glucoside, yielding a volatile oil. It crystallizes in white prisms, is soluble in alcohol, water, and ether, and is precipitated by tannin.

Pharmaceutical Preparations.—EXTRACTUM ABSINTHII.—*Extract of wormwood*, E.; *Wermutextrakt*, G.—It is prepared according to the German Pharmacopœia with a menstruum composed of 91 per cent. alcohol, 1 part, and water, 4 parts. The French Codex directs extraction with boiling distilled water.

TINCTURA ABSINTHII.—*Tincture of wormwood*, E.: *Wermuttinktur*, G.—The German Pharmacopœia directs maceration of 1 part of wormwood, finely cut, with 5 parts of 68 per cent. alcohol for 7 days. The mixture is then expressed and filtered.

Action and Uses.—Absinthium is sometimes used in household medicine. It acts as a tonic in small doses, and has been widely employed in atonic conditions of the digestive and genital tract. At one time it met with some favor as an anthelmintic. In overdoses it acts as a narcotic poison, affecting principally the central nervous system, producing headache, tremors, hallucinations, and epileptiform convulsions. It is an excitant to the circulation and an irritant to mucous membranes.

The drug is usually administered in the form of an infusion made with 1 oz. (30 Gm.) of wormwood in 1 pint (480 Cc.) of water. The dose is from 1 to 2 fluidounces (30 to 60 Cc.).

Other Species.—The genus *Artemisia* L. contains more than 200 species, well distributed through the northern hemisphere, with a number in South America. No less than 60 species have been named by Dragendorff as in medicinal use. Since most of these agree in their general medicinal properties, the recognition of the genus is a matter of some importance, so that its botanical characteristics are here given.

ARTEMISIA L.—Fragrant, alternate-leaved, usually hairy herbs or under-shrubs. the small heads usually pendulous, their involucres ovoid or broadly bell-shaped, the scales imbricated in few series, the outer successively shorter, their margins scarious; receptacle plane to hemispherical, naked or hairy; outer circle of yellow or yellowish-white florets pistillate, fertile, the corollas slenderly tubular (rarely wanting), the others perfect, fertile or sterile, their corollas broadened above; anthers obtuse and entire at the base, appendaged at the apex. Akenes various.

Several of the species are used so extensively as to require special mention. *A. maritima* will be considered under Santoninum; *A. Dracunculus* L. (Fig. 2, E), under Oil of Estragon. The volatile oils of *A. Gallica* Willd., *A. Barrelieri* Bess., and *A. glacialis* L. are more or less known.

A. VULGARIS L., the *Mugwort* (*Muggert* or *Mugweed*), *Sailors' tobacco*, *Felon herb*, *Bulwand*, also called incorrectly *Wormwood* (Fig. 2, C), has very widely been introduced to the United States from Europe and Asia. It is distinguished readily from the other species by its broad leaves and leaf-divisions, the upper surface bright green, drying brownish, the inferior silvery white. It is very inferior to wormwood, and is used as a bitter tonic in much larger doses. The fresh herb contains about 0.2 per cent. of an unimportant oil, said to contain cineol and having a specific gravity of 0.907.

A. FRIGIDA Willd. (*Wild sage*, *Mountain sage* or *Sierra salvia*) (Fig. 2, D, densely silky-canescent), is one of the most highly prized drugs of the miners and frontiersmen of the Rocky Mountain region in the treatment of their "mountain-fevers."

FIG. 2.

A, *Artemisia Absinthium*, stem and flower-branch; B, *A. Mexicana*; C, *A. vulgaris*; D, *A. frigida*; E, *A. Dracunculus*; F, *A. Ludoviciana*; G, hair from leaf of A; H, *A. Abrotanum*. All reduced one-half, except G, which is enlarged.

A. ABROTANUM L. (*Southern wood*, *Old man*, *Lad's love*, *Maid's love*, *Slovenwood*, *Smelling-wood*, *Sweet Benjamin*, *Stabwurzel*, *Aurone male*, *Citronelle*, *Abrotano*) (Fig. H, smooth or slightly pubescent), is a native of Southern Europe and adjacent Asia, largely cultivated both as an ornamental and a medicinal plant, and is lemon-scented.

A. MEXICANA (Fig. 2, B) is used largely in Mexico as the mountain sage is in the northwestern United States.

A. TRIDENTATA Nutt., or *Sage bush*, is a large species of the western United States, used similarly to the mountain sage.

Similarly used are *A. Ludoviciana* Nutt. (Fig. 2, F, white-woolly), the *Western mugwort* of the northwestern United States, *A. Dracunculoides* Pursh. of the western United States, and *A. Pontica* L., the *Roman wormwood*, native of Europe and Asia, very largely employed as an inferior substitute for absinthium.

ACACIA, *U. S.*—Gum Arabic; Gum Senegal.

Galam gum, *Gummi acaciæ*, *Gummi Africanum*, *Gummi Arabicum*, *Gummi Mimosæ*; *Gomme Arabique Vraie*, Fr.; *Goma Arabigo*, Sp.; *Gomma del Cordofan*, It.; *Gomma Arabica*, It., Port.

The dried gummy exudation from *Acacia Senegal* Willd., or from other species of *Acacia* (Fam. *Leguminosæ*).

Acacia is official in all pharmacopœias. Other species named by them as yielding the gum are *A. Arabica* Willd., *A. tortilis* Hayne, *A. vera* Willd., *A. Verek* Guill. et Per., *A. Seyal* Del., *Mimosa (Acacia) Nilotica* L., "and other species."

The term "gum Senegal" is not, strictly speaking, synonymous with "acacia," although it is commonly so used. Acacia is the name originally pertaining to Soudan, Kordofan, or Egyptian (*hashabi*) gum, which possesses properties rendering it superior and always preferred to any other known to commerce. During the political and military disturbances in Egypt between 1880 and 1890, this gum became so nearly unobtainable that occasional packages only were seen in market, their appearance being regarded as in the nature of a curiosity. Among the many substitutes then offered, the best was gum Senegal (*Varek*), which therefore was adopted as the official equivalent of acacia. In this way it naturally came about that the names were regarded as synonymous. In 1890, the original acacia again came into the market, and eventually became as abundant as ever, but it is no longer easy to separate entirely the two names.

Description.—In roundish tears of various sizes, or broken into angular fragments, with a glass-like, sometimes iridescent fracture, often opaque from numerous fissures, but transparent and nearly colorless in thin pieces; nearly inodorous; taste insipid, mucilaginous; insoluble in alcohol, but soluble in water, forming a thick, mucilaginous liquid.

Acacia should be slowly but completely soluble in 2 parts of water. This solution shows an acid reaction with litmus-paper, yields a gelatinous precipitate with basic lead acetate test-solution, ferric chloride test-solution, or concentrated solution of sodium borate, and does not reduce alkaline cupric tartrate volumetric solution.

The powder is not colored blue (absence of *starch*) or red (absence of *dextrin*) by iodine test-solution. It should yield not more than 4 per cent. of ash.

Neutral lead acetate does not precipitate it, nor does tannin. Acacia loses about 15 per cent. of moisture at 100° C. (212° F.). The British Pharmacopœia limits the ash to 4 per cent., the Swiss to 5 per cent.

The U. S. P. description was not modified in 1890 to accommodate it to the Senegal gum, then mostly in use. The description, "opaque from numerous fissures," rarely is realized by the latter, which is tougher, more glassy, rarely so white, and more slowly soluble. It occurs much less frequently in the small angular fragments so characteristic of acacia proper.

Most works, American and foreign, teach that both the Kordofan and Senegal gums are products of *Acacia Senegal* Willd., the range of which is thus given as Senegambia, in western Africa, the upper Nile region, in eastern Africa, with more or less of the intervening central region. Upon this view is based the statement that the two gums represent merely different grades of the same product. While the marked and constant difference between them renders this view extremely unlikely, the fact is of little importance from a practical point of view. It would be well, however, for the official definition to state "or from other species of acacia," depending rather upon the description than the definition to fix the limits of exclusion. *A. glaucophylla* Steud. and *A. Abyssinica* Hochst. are said to yield an equally good gum, but little of it is believed to reach the market. Some authors have named other species as yielding the Senegal article, but their reports are apparently too careless for dependence. Even if the gums are yielded by two species, the latter must be very similar, since all the gum-yielding acacias exhibit the same habit and general appearance, differing only in technical characters. They are spiny shrubs or small trees, with bipinnate leaves, preferring sandy or sterile regions, with the climate dry during a large part of the year.

Acacia, like other gums of its class, forms within the cells of the cortex and adjacent parenchyma, the process beginning in the cambium, by little understood processes, collectively named by the term "gummosis." It appears most likely that the gum is to be regarded merely as a waste product, though various other theories have been proposed. Lutz states that the first noticeable change is that of an alkaline to an acid reaction in the cell-wall, upon the inner surface of which the gum collects. The wall then becomes greatly thickened, with a corresponding diminution in the size of the cavity. Finally, the parenchymatic tissue degenerates into a gummy mass. It is believed generally that an unhealthy or poorly nourished condition favors gum-production. At certain seasons of the year, and only in certain years, at long intervals, the gum exudes through perforations, even very minute ones, accidentally occurring, or sometimes made by the collectors (especially for obtaining Gum Senegal). It is claimed that along the Senegal River the exudation is commonly through openings primarily caused by the germination

of the parasitic plant *Loranthus*. The gum usually forms upon the surface in the form of irregularly rounded masses called "tears," but sometimes in vermicular forms. It may be collected while adhering to the bark or after it falls to the ground. The entire product, often of various species, thus collected, is mixed and carried to the centres of accumulation, and then to the points of export, chiefly, for the Kordofan article, Cairo, Alexandria, and Trieste. It is then known as "acacia sorts" or "acacia in sorts," the term being thus equivalent to "unassorted acacia." In our market, this term is not used in exactly this sense, but refers more commonly to those portions of the former article which are so inferior in quality as to be deemed unworthy of farther assorting, or in the nature of refuse. The unsorted gum shows the widest variation as to size of fragments, whiteness, clearness, or transparency, and freedom from adhering foreign matter. It next is assorted or "picked" in accordance with these differences. The different lots are known then as "first picked," "second picked," and so on, down to the "sorts." Thirty-two grades are said to be recognized at Trieste. The "first picked" and "second picked" are very similar indeed, being indistinguishable to most persons unless the two are seen together, and much of the latter is sold for the former. It is a shade less white and less crackled or fissured, but is perfectly clean, free from impurities, and available for all uses except where the most perfect freedom from color is desired. The lower grades are manifestly unfit for pharmaceutical uses, and are employed chiefly and very extensively in the arts.

Composition.—Acacia consists principally of a compound of arabic acid with calcium, varying amounts of the magnesium and potassium salts of the same acid being present. It is believed also that small amounts of other salts of these bases occur.

ARABIC ACID ($C_{12}H_{22}O_{11}$) can be obtained by precipitating with alcohol from a solution of acacia acidulated with hydrochloric acid. It is then soluble in water, but becomes insoluble on drying. It is not crystallizable. *Galactose* and *arabinose* are yielded upon boiling it with dilute mineral acids. It is possible to convert a portion of acacia into sugar by repeated boiling with dilute sulphuric acid.

Adulteration.—Adulteration in the crude condition is confined almost wholly to the addition of similar and inferior gums, the detection of which requires only familiarity with the genuine article. In the ground condition, it is adulterated oftenest with starch and dextrin, tests for which are given in the official description. When inferior gums are ground with it, they are detected most commonly by the darkened color. Otherwise the tests for solubility and viscosity must be applied.

Action and Uses.—Acacia possesses little medicinal action. Locally applied, it is soothing to irritated or inflamed mucous membranes, especially of the upper air-passages. It has also been recommended in similar conditions of the gastro-intestinal and genito-urinary tracts. Its principal use, however, is as a vehicle for more powerful remedies.

Acacia is usually administered in the form of a mucilage (*Mucilago acaciæ*) in doses varying from 1 to 8 drachms (4–30 Cc.).

Other Gums.—Gums are divided commonly into those based respectively upon compounds of arabic, bassoric, and cerasic acids. Of the last class, none is of commercial or pharmaceutical interest. Those of the second class will be considered under Tragacantha. Of the first class, a large number are, have been, or may become of commercial importance. Their value depends upon the following properties, positive or negative: absence of impurities; insipidity; absence of color (or possibly special coloration for special uses); solubility; viscosity (often spoken of as the "stockiness" or "body"); permanency, or absence of tendency to sour or change color. In testing gums, or in considering their availability as substitutes for acacia, it is the above-mentioned characteristics which have to be measured. For detailed instructions concerning the investigation of gums, see Wasig's *Die Wichtigsten Handelssorten des Arabischen Gummi*. The large number of gums which have thus been suggested represent all grades and combinations of these properties. Most prominent among them is the group derived from other than the official species of acacia and related genera.

A. Nilotica Desf. is said to yield most of the *Barbary, Morocco,* or *Mogador gum*. *A. Arabica* Willd. and *A. Seyal* Del. often are named as sources of acacia, but their product is dark colored. That of the latter is called *Talea gum*. The names *Gedda, Ghedda, Gehzirah, Kassala, Massowah,* and *Sennaar,* are applied variously to these inferior Nile gums, which usually have a sour or fermented odor. Much poor gum is yielded also by *A. horrida* Willd. (*Cape* or *Angra Pequena gum*) and *A. giraffæ* Willd. (*Camelthorn gum*) of South Africa; *A. pycnantha* Benth. (*Golden wattle gum*—for its properties see *Proc. Am. Pharm. Assoc.*, 1890, 416), *A. decurrens* Willd. (*Tan wattle gum*), *A. homalophylla* A. Cunning. (*Myall gum* or *Myall-wood gum*), and various other species of Australia; *A. speciosa* Willd. (*Kurnool* or *Siris gum*), *A. leucophœa* Willd. (*Delhi* or *Coromandel gum*), *A. odoratissima* Willd., and *A. Sundra* of India;

A. gummifera Willd. (*Morocco gum*); *A. Ehrenbergiana* Hayne, *A. stenocarpa* Hochst. (one of the Nubian or Abyssinian gums called *Savakin* or *Suakim gum*, yielded also by *A. fistula* Schweinf.), and *A. Etbeica* Schweinf., all of northern Africa and all yielding dark-colored gums. *A. albida* Delile and *A. mellifera* Benth. are diffused widely through Africa. Of plants related to acacia, which yield such gums, mention may be made of *Prosopis juliflora* DC. (*Algaroba j.* Benth.; *Acacia j.* Willd.; *P. glandulosa* Torr; *Algaroba g.* T. et G.), of the southwestern United States, which yields an excellent gum (*Mesquit gum*), but in small and irregular quantities, as does *P. spicigera* L. One or more species of *Albizzia*, as well as of *Sophora*, are said to yield similarly. The gum of *Bauhinia retusa* Roxb. yields a mucilage about six times as viscous as that of acacia. Other inferior gums of India which are apparently derived from species of *Acacia* or related genera, are the *Amra*, or *Oomra*, and several varieties of *Amrad* gums.

Of gums of this class produced by plants not related to *Acacia*, few have here attained commercial importance, though a number are used rather extensively in India. Of these, the following deserve mention:

Jingan gum, from *Odina Wodier* Roxb. (Fam. *Anacardiaceæ*).—Abundant and widely distributed in India, exuding from wounds intentional or accidental, whitish to yellow, and much resembling gum arabic, or, if mixed with rain-water when exuding, blackish. Largely used in India, mostly mixed with other gums, for sizing calico and in whitewash. Soluble, if of good quality, in twice its weight of water, forming a thin mucilage about three-fourths as viscous as acacia mucilage (Dunstan). Insipid but containing a little sugar.

Assam or *Bangalore gum*, from *Azedirachta Indica* Juss. (Fam. *Meliaceæ*), dark-colored, the solution wine-colored, with a crystalline sediment; *Islambad* or *Deccan gum*, from *Conocarpus latifolius* Roxb. (Fam. *Combretaceæ*), light-colored and of good quality, but little accessible; *Lahore gum*, from *Anageissus latifolia* Wall. (Fam. *Combretaceæ*), very similar to last, but containing many impurities; *Guzerat* or *Wood apple gum*, from *Feronia elephantum* W. et A. (Fam. *Rutaceæ*), similar to last; *Schajua*, *Mocharras*, or *Jhelam gum*, from *Moringa pterygosperma* Gærtn. (Fam. *Moringaceæ*), reddish and yielding a red solution, believed to be artificially colored; one from *Buchanania latifolia* Roxb. (Fam. *Anacardiaceæ*), its mucilage about two and a half times as viscous as that of acacia; one from *Boswellia serrata* Roxb. (Fam. *Burseraceæ*); *Leopard tree gum*, from *Flindersia maculosa* F. von Mueller (*Elæodendroa m.* Lindl.—Fam. *Meliaceæ*), of Australia, is reported by Maiden as a good substitute for acacia. *Cochlospermum gossypium* DC. (Fam. *Bixaceæ*) yields the *Hogg-gum* or *Kathira* of India. *Hog* or *Doctor's gum* is yielded by *Moronobea coccinea* Aubl. (Fam. *Guttiferæ*), and probably *Rhus metopmum* L. *Chagual gum*, of Chili, is yielded by *Puya lanuginosa* Molina (*Pourretia l.* R. et P.), *P. Chileasis* Mol., *P. tuberculata* Mart., and *P. lanata* Schult. (Fam. *Bromeliaceæ*).

Of purely artificial substitutes, dextrin and starch are considered elsewhere.

Schumann's Universal Gum was made by allowing sulphuric acid to act upon starch at a high temperature and under pressure, neutralizing and drying to a proper consistency. On hardening, it closely resembles acacia in appearance and adhesiveness.

Another of these products is made by boiling 10 Kg. of linseed oil with 80 Kg. of sulphuric acid and 100 liters of water for 3 or 4 hours, filtering, precipitating with 4 times its volume of alcohol, washing, and drying the precipitate.

Acacine, another of this class, was found unsuitable for emulsions.

ACANTHACEÆ.—The Acanthus Family.

About 175 genera and 1400 species, common in most tropical, scarce in warm-temperate, and wanting in cool countries; largely cultivated for their showy flowers, otherwise of little economic importance; young shoots of a few species used as potherbs; constituents and properties resembling those of the *Labiatæ*, and even more so those of the *Verbenaceæ;* bitter principles are of first, volatile oils and resins of second, and tannin of third importance, with a few alkaloids. This composition indicates the properties.

Probably the most largely used drug of this family is the herb of *Andrographis paniculata* Nees, which is collected largely from both wild and cultivated plants throughout India for its medicinal properties. It contains an unstudied bitter principle, and is used as a bitter tonic, substituting gentian and chirata. Its identification is considered under the last-mentioned title.

Adhatoda vasica Nees (*Arusa*, *Adulsa*, etc.), an Indian shrub, is employed widely as an aromatic expectorant and anthelmintic, besides which it has a very curious use in the destruction of aquatic weeds which infest inundated rice-fields. It also possesses the power of destroying other low forms of vegetable as well as insect life. It contains the alkaloid *vasicine*, which appears to have the same destructive property. This alkaloid has been experimented with in medicine to some extent, but without definite result. *Ruellia hirsuta* Nees, of Java, and *Leptostachya nitida* Nees, of South America, yield blue dyestuffs. *Justicia Gendarussa* L., and many other species of *Justicia*, have domestic repute as astringents, while various others are used as aromatics. The wood of *Paulowilhelmia speciosa* Hochst. (*Adubiri* or *Aquapim*), of Africa, is used as a fish poison. *Asteracantha longifolia* (L.) Nees is used as a powerful diuretic and diaphoretic. *Ecbolium Linneanum* Kurz (*Udwjati* or *Ran-oboli*), of Arabia, is a much-used diuretic in renal and cystic calculus and gout, as well as an expectorant. *Barleria prionitis* L. (*Jhinta*,

Kantajati, Coletta, Veatla, etc.), of India, containing much resin, is also a much-used diaphoretic and expectorant. *Acanthus ilicifolia* L. (*Harkuchkanta, Marandi*, or *Moranna*), of India, contains an alkaloid, and the entire plant, as well as the root separately, is used as a mucilaginous expectorant. *Hygrophila spinosa* T. And. (*Talmakhara, Kolista, Ikshura*, etc.), and other Indian species of this genus, are diuretic and the seeds much-used aphrodisiacs. The seeds of *Crossandra undulæfolia* Salisb., and of *Blepharis edulis* Pers. (*Utanjan, Anjurah*), of India and Persia, containing a bitter principle, apparently a glucoside, are used also as aphrodisiacs. *Rhinacanthus communis* Nees (*Pelak-juhi*, etc.) is prized highly in India as an application in ringworm and other cutaneous diseases. Since it invariably appears to be used as one of several ingredients of a mixture, its effect is problematical.

(*References.*—Dymock and Hooper, *Pharm'g'a Ind.;* Dethan, *Les Acanthacées;* Boorsma, *Ueber einige neuere Analysen, Med. uit's Land Pl.*)

ACETANILIDUM, *U. S., Br., P. G.*—Acetanilide.

Antifebrinum, P. A.; *Phenylacetamide, Acetylamidobenzene, Antifebrin*, E.; *Acetanilide*, Fr.; *Antifebrin*, G.

Formula, $C_6H_5NH.C_2H_3O$ or $C_6H_5NH.CH_3CO$. Molecular weight, 134.09.

Preparation.—Acetanilide was prepared first by Gerhard in 1852, by acting upon aniline with acetyl chloride or with acetic anhydride. It is manufactured by moderately boiling in a retort, connected with a reflux condenser, equal parts of aniline and glacial acetic acid until a small portion, removed from the retort, will congeal on cooling; the mass then is distilled, when water and acetic acid will pass over, and finally acetanilide, which is recrystallized from boiling water. The new compound is formed by elimination of water, according to the equation: $C_6H_5NH_2 + CH_3COOH = C_6H_5NHCH_3CO + H_2O$.

Properties.—Acetanilide forms colorless glistening scales or a white shining crystalline powder, not altered by exposure to air or light, free from odor, but having a somewhat pungent, slightly burning taste. It melts at 113° C. (235.4° F.), boils at 295° C. (563° F.) without decomposition, and when ignited upon platinum-foil burns without leaving a residue. It is soluble in 194 parts of water at 15° C. (59° F.) (200 parts, Br.; 230 parts, P. G.); also in 5 parts (4 parts, Br.; 3.5 parts, P. G.) of alcohol, in 18 parts of ether, and is easily soluble in chloroform and benzene; but slightly soluble in carbon disulphide. At 25° C. (77° F.) it is soluble in 179 parts of water, 2.5 parts of alcohol, 12 parts of ether, or 5 parts of chloroform; it is also soluble in 18 parts of boiling water and in 0.4 parts of boiling alcohol (U. S.). The solutions have a neutral reaction to test-paper.

The tests of identity and purity adopted by the different pharmacopœias are nearly identical. The solution of acetanilide in sulphuric acid without the production of a dark color indicates the absence of dust, saccharine matter, and many organic compounds. On heating about 0.1 Gm. of acetanilide with 5 Cc. of concentrated solution (1 in 4) of potassium or sodium hydroxide, the characteristic odor of aniline becomes noticeable; on now adding 1 Cc. of chloroform and again heating, the disagreeable odor of *phenyl isocyanide* is evolved (distinction from *methylacetanilide* or *antipyrine*) (U. S.). Analogous reactions are produced by all primary amines, as was shown by A. W. Hofmann (1875), who discovered this compound, known also as *phenylcarbylamine* or *isonitrile*, C_6H_5NC, which has a repulsive, penetrating odor and is very poisonous. On boiling 0.1 Gm. of acetanilide for several minutes with 2 Cc. of hydrochloric acid, a clear solution results, which, when mixed with 3 Cc. of a 5 per cent. aqueous solution of phenol, and afterward with 5 Cc. of a filtered saturated solution of chlorinated lime, acquires a brownish-red color, becoming blue upon supersaturation with ammonia-water (U. S.). This is the so-called indophenol or indo-aniline reaction, which is shown also by phenacetin and other allied compounds, from which acetanilide may be distinguished by the melting-point and solubility. A cold saturated aqueous solution of acetanilide added to ferric chloride test-solution should not affect the color of the latter (U. S.). This test shows the absence of aniline salts, of antipyrine, hydracetin, and some other compounds; on the application of heat the mixture of acetanilide and ferric salt becomes deep red. On heating 0.1 Gm. of acetanilide with 10 Cc. of water, and filtering the solution when cold, and adding bromine test-solution, drop by drop, to the filtrate, a whitish precipitate of *parabromacetanilide* is formed (distinction from *antipyrine* or *acetphenetidin*) (U. S.).

A number of mixtures of from 50 to 90 per cent. of acetanilide with sodium bicarbonate, and in some cases with ammonium bromide, salicylic acid, and other compounds, have been introduced as proprietary articles and sold under copyrighted names.

Action and Uses.—Acetanilide was introduced into medicine first as an antipyretic, but later studies have shown it to possess even greater powers as an analgesic.

In ordinary dose the drug exercises a sedative influence upon the sensory nervous system, toxic doses causing paralysis, loss of reflex action, and anæsthesia. Upon the circulation it has little or no effect; in poisonous dose it acts as a cardiac and vascular depressant.

Acetanilide in overdoses reduces hæmoglobin to methæmoglobin, diminishes the oxygen-carrying power of the blood, and in excessive quantities produces corpuscular destruction. Ordinary doses, however, produce no such change. Temperature is lowered by increasing heat-dissipation and by decreasing heat-production, and not by the free sweating which commonly follows its administration. The excretion of urea and uric acid is increased by acetanilide, which itself is eliminated by the kidneys as paramido-phenol-sulphate.

In certain individuals who have an idiosyncrasy to the drug a number of untoward symptoms have been noted; the most common being cyanosis, excessive sweating, collapse, and occasionally erythematous rashes.

The treatment of poisoning by acetanilide consists in the application of external heat and the administration of stimulants. Strychnine and caffeine in full doses to aid the respiration, belladonna to maintain the blood-pressure, and if cyanosis be marked inhalations of oxygen, may be used with benefit.

Acetanilide, as an antipyretic, was at one time recommended and indiscriminately employed in the reduction of all febrile conditions, but is now used only where there are certain definite indications.

It is contraindicated in all adynamic conditions, especially the low fevers, as it tends to greater depression and in no way influences their course or duration for better. It is inadvisable to employ it as a remedy in tuberculosis, as it may cause profuse sweats, cyanosis, and collapse.

In the treatment of sthenic fevers the drug may be employed, especially in the exanthemata and in those diseases incident to childhood. It should be employed with caution in the treatment of croupous and bronchopneumonia.

The drug finds its true value in combating the various forms of nerve pain; for example, the crises of locomotor ataxia, gastralgia, and intercostal and other forms of neuralgia. It has been employed in sciatica, lumbago, chronic muscular rheumatism, and in rheumatic fever with benefit, although in the latter it may cause excessive sweating. Acetanilide has proved efficient in the treatment of certain cases of epilepsy, and in others has been given without result. It has been recommended in delirium tremens, congestive headache, pertussis, and other reflex coughs, and in the pain resulting from senile gangrene and cancer, but it is practically valueless in pain the result of inflammation or traumatism.

Locally, acetanilide has been employed in the treatment of epistaxis and as an antiseptic dusting-powder for dressing wounds, chancroids, and chronic ulcers.

As an antipyretic it is usually given in doses of from 3 to 5 grains (0.20–0.30 Gm.), as an anodyne, from 1 to 3 grains (0.065–0.20 Gm.), every 4 or 5 hours.

Allied Compounds and Derivatives.—ACETBROMANILIDE.—*Parabromacetanilide; Antisepsin; Asepsin.* $C_6H_4Br.NH.CH_3CO$.—It is obtained by adding 160 parts of bromine to a solution of 135 parts of acetanilide in glacial acetic acid, and subsequently crystallizing the resulting white precipitate from hot alcohol. Colorless needles, melting at 165.5° C. (330° F.), which owing to their sparing solubility are tasteless. Antisepsin should not be confounded with antiseptin, which is a mixture of zinc sulphate, thymol, zinc iodide, and boric acid. The former possesses analgesic and antipyretic properties, and may be employed for the same purposes as acetanilide. Dose, 3 to 10 grains (0.20–0.60 Gm.).

AMMONIATED ACETANILIDE.—Under this name the following mixture has been recommended as causing less depression than acetanilide: acetanilide, 25 parts; sodium bicarbonate, 5 parts; ammonium carbonate, 10 parts; and milk-sugar, 60 parts.

BENZANILIDE.—*Benzoylanilide; Phenylbenzamide.* $C_6H_5NHCOC_6H_5$.—It is produced by the action of benzoic anhydride, benzoic acid, or of benzoyl chloride upon aniline, and crystallization from alcohol. It forms small white scales of a pearly lustre, inodorous, tasteless, insoluble in water, and fusible at about 162° C. (323.6° F.). Benzanilide may be employed as an antipyretic. As it is less depressing than acetanilide, it is said to be the better remedy to employ in children. The dose is from 1 to 5 grains (0.005–0.30 Gm.).

DIACETANILIDE. $C_6H_5N(CH_3CO)_2$.—This compound is obtained by heating acetanilide with glacial acetic acid to 200°–250° C. (392°–482° F.) and extracting the mass with hot benzin, from which the diacetanilide will crystallize in colorless leaflets melting at 110° C. (231.8° F.).

Formanilide.—*Phenylformamide.* $C_6H_5NH.HCO$.—It may be obtained by heating aniline with ethyl formate or by distilling a mixture of aniline 93 parts and anhydrous oxalic acid 90 parts, and occurs in colorless prisms, melting at 46° C. (114.8° F.). Formanilide is fairly soluble in water and readily in alcohol; also soluble in glycerin and fixed oils. Formanilide is also an antipyretic and analgesic in doses of from 2 to 5 grains (0.10–0.30 Gm.). Locally applied to mucous membranes it produces anæsthesia, and a 3 per cent. solution when injected subcutaneously may be employed as a local anæsthetic.

Gallanilide.—*Gallanol; Gallinol.* $C_6H_5NH.CO.C_6H_2(OH)_3 + 2H_2O$.—If gallic acid be heated for 1 hour with an excess of aniline at a temperature of 150° C. (302° F.) and the mixture then treated several times with very dilute hydrochloric acid, the residue will consist of gallanilide, which may be crystallized from boiling water. The crystals are colorless and become anhydrous at 100° C. (212° F.). It is readily soluble in alcohol, ether, and boiling water; sparingly in cold water. Ointments containing from 5 to 20 per cent. of gallinol may be employed as substitutes for chrysarobin in the treatment of certain skin affections (see Chrysarobin), as it is stated to be less irritating than the latter drug and non-poisonous.

Methylacetanilide.—*Exalgine.* $C_6H_5N(CH_3)CH_3CO$.—It may be obtained by gradually adding acetyl chloride to monomethylaniline; heat is developed and the following reaction occurs: $2C_6H_5NH(CH_3) + CH_3COCl = C_6H_5N(CH_3)CH_3CO + C_6H_5NHCH_3HCl$; both methylacetanilide and methylaniline hydrochloride being formed, which may be separated by crystallizing from boiling water, when the former will be obtained in colorless needles or prisms. It is inodorous and tasteless, and melts at 102° C. (215.6° F.) in air or at 98° C. (208.4° F.) under water. It is neutral to test-paper, freely soluble in alcohol, chloroform, and boiling water; also soluble in 60 parts of cold water or 10 parts of ether. On heating it with potassium hydroxide and then with chloroform, the disagreeable odor of isonitril is not produced, but a faint, rather pleasant odor is observed (distinction from acetanilid). Exalgine may be employed interchangeably with acetanilide or antipyrine as an analgesic, but not as an antipyretic. It is commonly employed for the relief of pain occurring in certain nervous affections, for example, locomotor ataxia. Dose, 3 to 10 grains (0.20–0.60 Gm.).

Salicylanilide. $C_6H_5NH.C_6H_4(OH)CO$.—It may be obtained by heating a mixture of aniline, salicylic acid, and phosphorus trichloride. After washing the product with water it is dissolved in dilute solution of sodium hydroxide, precipitated by addition of hydrochloric acid, and crystallized from alcohol. It occurs in colorless prisms, melting at 134.5° C. (274.1° F.), and freely soluble in alcohol, ether, and chloroform, but sparingly in hot or cold water. This compound should not be confounded with the commercial article *salifebrin*.

ACETONUM, *U. S.*—Acetone.

Spiritus (*s. Æther*) *Pyroaceticus.—Pyroacetic spirit or ether, Dimethylketone,* E.; *Acétone, Ether* (*Esprit*) *pyroacétique,* Fr.; *Aceton, Essiggeist, Mesitalkohol,* G.; *Chetone, Metilacetone,* It.

Formula, C_3H_6O or CH_3COCH_3. Molecular weight, 57.61.

A liquid containing not less than 99 per cent. by weight of absolute acetone (dimethylketone). It should be kept in well-closed vessels in a cool place, remote from lights or fire.—U. S.

Formation and Preparation.—Acetone is formed on the dry distillation of wood, of acetates, citric acid, and, in the presence of lime, from sugar and other carbohydrates. It may be obtained nearly pure by the dry distillation of barium acetate (Liebig), but is prepared usually from calcium acetate or from a mixture of 4 parts of crystallized lead acetate and 1 of burnt lime; the distillate is neutralized with dry sodium carbonate, treated with calcium chloride, and purified by fractional distillation over lime.

Acetone may be obtained in large quantities by decomposing acetic acid vapor at a high temperature, between 500° and 600° C. (932° and 1112° F.), in specially constructed iron cylinders, as shown by Squibb in 1895 (*Ephemeris,* vol. iv.), and the product subsequently dehydrated with quicklime and redistilled. The decomposition of the acid vapor occurs as follows: $2HC_2H_3O_2 = C_3H_6O + CO_2 + H_2O$.

Acetone has been found to be a most excellent solvent for tannin, and has been used successfully in the preparation of oleoresins, in place of ether. It is the richest chloroform-yielding substance known, and since 1885 has been used for this purpose almost to the exclusion of alcohol in this country.

Properties.—It is a thin colorless liquid, which, when ignited, burns with a luminous, non-sooty flame. It has a peculiar ethereal, somewhat mint-like odor, and a refreshing but very pungent and sweetish taste. Its density at 15.6° C. (60° F.) is 0.800 or 0.790 at 25° C. (77° F.); it boils at 56.5° C. (133.7° F.). It is soluble in all proportions in water, alcohol, ether, volatile oils, and most compound ethers; dissolves gun-cotton, camphor, many resins (including copal), and fats; and forms crystal-

line compounds with the alkali bisulphites. Most of the salts soluble in alcohol are insoluble in acetone, which separates even from a concentrated aqueous solution of calcium chloride.

Tests.—Acetone should not affect the color of blue or red litmus-paper previously moistened with water. If 50 Cc. of acetone be evaporated in a clean glass vessel, no weighable residue should remain. If 20 Cc. of acetone contained in a clean glass-stoppered vial be mixed with 0.1 Cc. of one-tenth normal potassium permanganate solution, the pink tint produced by the admixture should not wholly disappear in less than 15 minutes (limit of *empyrheumatic substances*).—U. S.

Action and Uses.—Acetone was formerly used in medicine to reduce the temperature, allay the cough, and diminish the expectoration in pulmonary tuberculosis and chronic bronchial affections. It has been employed in rheumatism and gout, in vomiting the result of either functional or organic disease, and in diarrhœa and dysentery. In overdose it produces intoxication, and when inhaled is probably a slight anæsthetic, causing considerable bronchial irritation. Acetone is sometimes found in the urine in cases of advanced diabetes mellitus, and occasionally in that of healthy individuals who subsist largely upon proteid diet.

It may be prescribed in doses of 15 or 20 minims (1–1.3 Cc.) dissolved in spirit of nitrous ether.

Allied Compounds.—ACETOPHENONE; *Phenyl-methylacetone, Phenylmethylketone, Hypnone.* $C_6H_5COCH_3$.—This compound was first produced by Friedell by the dry distillation of a mixture of calcium benzoate and acetate in molecular proportions. It may also be obtained by the action of zinc methyl on benzoyl chloride, or by boiling benzene with acetyl chloride and aluminum chloride and subjecting the product to fractional distillation, that portion distilling between 195° and 200° C. (383°–392° F.) being collected separately and cooled until it crystallizes. Acetophenone is a colorless or yellowish mobile liquid, having a persistent odor of bitter almond and orange, and a pungent taste. It boils at 210° C. (410° F.), and congeals at —4° C. (24.8° F.), forming white laminæ, which if pure melt at 20° C. (68° F.). It has the specific gravity 1.035, remains for some time suspended in water in the form of globules, is almost insoluble in water, dissolves in 60 parts of glycerin, and is freely soluble in alcohol, ether, chloroform, benzene, and fixed oils. Hypnone, or acetophenone, is hypnotic and slightly anodyne. The drug is unreliable, and frequently fails to produce sleep in the presence of pain or great nervous excitement. It is objectionable also because it disorders digestion, imparts a disagreeable odor to the breath, and has a very offensive taste. Hypnone may be given in capsules containing from 1 to 5 minims (0.05–0.30 Cc.).

SALACETOL; *Salicyl-acetol, Sulantol.* $C_6H_4(OH)CO_2CH_2COCH_3$.—This is a compound resembling salol, except that the phenyl group, C_6H_5, has been replaced by the radical CH_2COCH_3, derived from acetylmethyl alcohol, also known as *acetol.* If sodium salicylate be heated with monochloracetone, sodium chloride and the salicylic acid ester of acetol are formed; thus, $C_6H_4(OH)CO_2Na + CH_2ClCOCH_3 = NaCl + C_6H_4(OH)CO_2CH_2COCH_3$. The sodium chloride is removed by treatment with water. Salacetol occurs in colorless scales or needles having a faintly bitter taste and melting at 71° C. (159.8° F.). It is soluble in 15 parts of alcohol, 25 parts of castor oil, or 30 parts of expressed oil of almond, but requires 2200 parts of cold water for solution. It is soluble in a 1 per cent. solution of sodium hydroxide, but undergoes decomposition. Salacetol should not be confounded with *salactol*, a solution of sodium salicylate and lactate in a 1 per cent. solution of hydrogen peroxide. Salacetol possesses germicidal properties, and has been employed in the treatment of summer diarrhœa, dysentery, and choleraic diarrhœa. It is stated that the drug is less poisonous than salol, and for this reason is especially serviceable in infantile affections. It may be employed alone or given in conjunction with castor oil. The ordinary dose for an adult is from 20 to 40 grains (1.30–2.60 Gm.), and for a child from 5 to 8 grains (0.30–0.50 Gm.) daily.

ACETPHENETIDINUM, *U. S.*—Acetphenetidin.

Phenacetinum, Br., P. G.; *Acet-Phénétidine*, Fr. Cod.—*Phenacetin, Para-acetphenetidin, Para-ethoxyacetanilide*, E.; *Phénacétine, Para-acetophénétidine, Amide acétique de l'amido-phénétol*, Fr.; *Phenacetin*, G.

A phenol derivative, acetparaphenetidin, the product of the acetylization of paraamidophenetol.—U. S.

Formula: $C_6H_4(OC_2H_5)NH.C_2H_3O$ or $C_2H_5O.C_6H_4.NHCOCH_3$. Molecular weight, 177.79.

The use of the official titles Acetphenetidin and Phenacetin is about equally divided among the leading pharmacopœias, the former being employed in the United States, French, and Austrian pharmacopœias, while the British, German, and Swiss pharmacopœias prefer the latter name.

Preparation.—None of the pharmacopœias give a process of manufacture. The following reactions occur during the preparation. When slightly diluted nitric acid, or a mixture of sulphuric acid and solution of sodium nitrate, is allowed to act on melted phenol, ortho- and para-nitrophenol are formed, the liberated water being taken up by the sulphuric acid, thus: $C_6H_5OH + HNO_3 = C_6H_4(NO_2)(OH) + H_2O$; as the para-nitrophenol is not volatile, the two varieties are separated by distillation with steam, the residuary para-compound being afterward decolorized with animal charcoal and crystallized. By action of sodium hydroxide, sodium nitrophenol, $C_6H_4(NO_2)(ONa)$, is formed, which is heated with ethyl iodide and converted into para-nitrophenetol, thus: $C_6H_4(NO_2)(ONa) + C_2H_5I = C_6H_4(NO_2)(OC_2H_5) + NaI$. The latter compound, by action of nascent hydrogen, obtained from zinc and hydrochloric acid, is converted into para-amidophenetol or paraphenetidin, thus: $C_6H_4(NO_2)(OC_2H_5) + H_6 = C_6H_4(NH_2)(OC_2H_5) + 2H_2O$. By prolonged boiling with glacial acetic acid, paraphenetidin is converted into para-acetphenetidin, just as aniline is converted into acetanilide.

Properties.—Acetphenetidin occurs as white, glistening, crystalline scales or fine crystalline powder, odorless and tasteless. It is soluble in 925 parts of water, 12 parts of alcohol, 63 parts of ether, and 20 parts of chloroform at 25° C. (77° F.), in 70 parts of boiling water and 2 parts of alcohol at 80° C. (176° F.).—U. S. Very sparingly soluble in cold water, more freely in boiling water, soluble in 20 parts of 90 per cent. alcohol, Br, ; soluble in 1400 parts of cold water, about 70 parts of boiling water, and also in 16 parts of alcohol, P. G. Its solutions are neutral. Heated to 135° C. (275° F.) it melts, and at a higher temperature burns without leaving a weighable residue. Acetphenetidin dissolves without color in sulphuric acid, but if shaken with nitric acid is colored yellow, which color persists when heated.—U. S. In the system it is decomposed into phenetidin, $C_6H_4(NH_2)(OC_2H_5)$, and amidophenol, $C_6H_4(NH_2)(OH)$.

Tests.—"If 0.1 Gm. of acetphenetidin be boiled for 1 minute with 1 Cc. of concentrated hydrochloric acid and the solution diluted with 10 Cc. of water, cooled, and filtered, it should yield on the addition of 3 drops of a 3 per cent. solution of chromium trioxide a ruby-red color. On heating 0.1 Gm. of acetphenetidin with 5 Cc. of a concentrated solution (1 in 4) of potassium hydroxide, the odor of aniline should not be perceptible. If 0.1 Gm. of acetphenetidin be boiled with 10 Cc. of water, it should yield a solution which, when cooled and filtered, should not become turbid upon the addition of bromine-water in slight excess (absence of *acetanilide*). If 0.1 Gm. of acetphenetidin be boiled for 1 minute with 3 Cc. of solution of sodium hydroxide (1 in 2), the solution cooled, and then agitated with 5 Cc. of solution of chlorinated soda, there should be produced a clear yellow liquid, and not a purplish-red or brownish-red cloudy liquid or precipitate (absence of *acetanilide*). A mixture of 0.3 Gm. of acetphenetidin with 1 Cc. of 90 per cent. alcohol should not acquire a red tint when diluted with 3 times its volume of water and boiled with 1 drop of volumetric iodine solution (absence of *paraphenetidin*)."—U. S.

The ruby-red color mentioned in the first test is caused by the action of chromic acid on the phenetidin liberated by the hydrochloric acid, and may be obtained with chlorine-water and other oxidizing agents as well. It serves to distinguish acetphenetidin from acetanilide and exalgine.

Action and Uses.—Acetphenetidin is employed in medicine for the reduction of fevers and the relief of pain. Although introduced chiefly for the former purpose, it is rarely used as an antipyretic at this time, its chief employment being for the relief of various neuralgic pains and of the nerve pains which arise from chronic diseases of the nervous system, notably locomotor ataxia. Its action in reducing fever is practically identical with that of antipyrine and acetanilide, the fall in temperature being due to a decrease in heat-production and an increase in heat-dissipation. Upon the heart it exercises very little effect, being a feeble cardiac depressant. Upon the respiration it exercises no influence. On the nervous system its dominant influence is upon the sensory portions of the brain, the spinal cord, and the sensory nerves. It has been employed in epilepsy as a nervous sedative, but with very little result. When used for neuralgic pains, it is commonly combined with caffeine and one of the bromides, which materially assist it in its direction. If employed for the reduction of fevers, it should be used in the treatment of acute sthenic fevers and not in the course of prolonged exhausting fevers like typhoid fever or the hectic fever of tuberculosis, in which latter disease it is apt to increase cyanosis and the night-sweats. Taken in overdose acetphenetidin produces

feebleness of the circulation and more or less cyanosis, which is chiefly due to the production of methæmoglobin in the blood. This cyanosis disappears as soon as the drug is eliminated from the body, from which it escapes chiefly through the kidneys. The dose of acetphenetidin is usually 5 grains, which may be repeated in an hour or two if necessary.

Acetphenetidin has the reputation among clinicians of being less depressant to the circulation in cases of feebleness than are antipyrine and acetanilide.

Derivative and Allied Compounds.—The following derivatives of phenetidin, and compounds allied to phenacetin are of more or less interest to physicians and pharmacists:

Amygdophenin.—*Amygdalyl-p-phenetidin.* $C_6H_4(OC_2H_5)NH(CO.CH.(OH).C_6H_5)$.—This is prepared by heating 137 parts of *p*-phenetidin with 152 parts of mandelic acid to about 150° C. (302° F.) until all water is expelled, washing the product with dilute sodium hydroxide solution, and crystallizing from ether-alcohol mixture. It occurs as a white crystalline powder, or glistening scales, melting at 140.5° C. (284.9° F.). It is readily soluble in alcohol, difficultly soluble in hot water, ether, benzene, and almost insoluble in cold water. Amygdophenin has been recommended in the treatment of rheumatic fever, but its use is limited. The dose is stated to be from 10 to 15 grains (0.65–0.97 Gm.) every 4 or 5 hours. It is best administered either in powder or in tablet.

Apolysin.—*Monophenetidin Citrate.* $C_6H_4(OC_2H_5)NH.[COC_3H_4(OH)(CO_2H)_2]$.—55 parts of *p*-phenetidin and 84 parts of citric acid are heated several hours between 100° and 200° C. (212° and 392° F.), the resulting product treated with solution of sodium carbonate, which leaves diphenetidin citrate undissolved. The soda solution is then acidulated with hydrochloric acid and the liberated monophenetidin citrate purified by recrystallization. A white crystalline powder, or large colorless hygroscopic crystals, having a peculiar odor, an acidulous taste, and acid reaction. The crystals melt at 72° C. (161.6° F.), and are soluble in 25 parts of cold water, in about 1 part of boiling water, and quite readily in alcohol and glycerin. They dissolve colorless in concentrated sulphuric acid, but yield a pale orange-colored solution with nitric acid. Dried at 100° C. (212° F.) the crystals lose 1 molecule of water and the product then has a melting-point of 129° C. (264.2° F.). The dose is from 5 to 10 grains (0.3–0.65 Gm.).

Benzacetin.—*Acet-amido-ethyl-salicylic Acid.* $C_6H_3(OC_2H_5)(NH.COCH_3)CO_2H$.—It occurs as colorless crystals, melting at 189° to 190° C. (372.2°–374° F.), which are soluble in alcohol and aqueous alkaline solutions, but difficultly soluble in cold water.

Citrophen. $[C_6H_4(OC_2H_5)NHCO]_3.C_3H_4(OH)$.—411 parts of *p*-phenetidin and 210 parts of citric acid are heated in presence of a dehydrating agent, the product washed with dilute aqueous solution of sodium hydroxide, and finally crystallized from water. A white crystalline powder having an acidulous aromatic taste and acid reaction, melting at 181° C. (357.8° F.). The crystals are difficultly soluble in cold water, but soluble in about 15 parts of boiling water. The aqueous solution is turned dark red by ferric chloride and violet by chromic acid. Or, if subjected to the fumes of nitric acid, and then treated with excess of ammonia, a bright-red precipitate results. Uses identical with acetphenetidin. Dose, 5 to 10 grains (0.3–0.65 Gm.).

Formylphenetidin.—*Formphenetidid; p-Ethoxyformanilide.* $C_6H_4(OC_2H_5)NH.HCO$.—Colorless, odorless, tasteless crystalline scales, difficultly soluble in cold water, soluble in hot water, in alcohol and ether, and melts at 69° C. (156.2° F.).

Iodophenin.—*Iodophenacetin; Tri-iododiphenacetin.* $(C_6H_4OC_2H_5NHCH_3CO)_2I_3$.—To a solution of phenacetin in glacial acetic acid are added some moderately diluted hydrochloric acid and a solution of iodine and potassium iodide in water, when upon cooling steel-blue crystals of iodophenin will be deposited. They are almost insoluble in water and difficultly soluble in benzene and chloroform, but are more readily soluble in alcohol, glacial acetic acid, and boiling hydrochloric acid. Iodophenin has a feeble iodine-like odor, a burning taste, and colors the skin yellow. It contains about 50 per cent. of iodine and melts at 130° C. (266° F.) with decomposition.

Kryofin.—*Methoxacetparaphenetidin; Methylglycollicphenetidin.* $C_6H_4OC_2H_5NH[(CH_3O)CH_2CONH]$.—Colorless crystalline needles melting at 98° to 99° C. (208.4°–210.2° F.), and soluble in about 600 parts of cold water, in 52 parts of boiling water, and in alcohol, ether, and chloroform.

Lactophenin.—*Lactyl-phenetidin.* $C_6H_4(OC_2H_5)NH.(COCH[OH]CH_3)$.—It is prepared by heating lactic acid with *p*-phenetidin to 180° C. (356° F.) until all water is expelled, and the resulting product then crystallized from hot water. A white colorless, odorless, slightly bitter crystalline powder, melting at 117.5° to 118° C. (243.5°–244.4° F.). It is soluble in 500 parts of cold water, in 55 parts of water at 100° C. (212° F.), in 8.5 parts of alcohol at 15° C. (59° F.), and difficultly soluble in ether and petroleum ether. The solutions are neutral to litmus. It dissolves in sulphuric acid without discoloration. Lactophenin gives the ruby-red coloration with chromic acid (see above). If 0.3 Gm. of finely pulverized lactophenin be mixed with 2 Cc. of nitric acid, and the resulting yellow solution be diluted after 1 hour with water, then filtered and washed with water, the insoluble residuum dried, and crystallized from benzene should have a melting-point of 96.5° C. (205.7° F.). By heating the residuum with alcoholic potassium hydroxide a dark yellowish-red solution results, which on cooling deposits red crystals having a melting-point of 110.5° C. (231° F.), Hager. 0.1 Gm. dissolved in 10 Cc. of boiling water, and the solution filtered after cooling, yields a filtrate which turns turbid on addition

of sufficient bromine-water to produce a yellow color (distinction from *phenacetin*). Its uses and dose are identical with acetphenetidin.

MALAKIN.—*Salicyliden-p-phenetidin.* $C_6H_4(OC_2H_5)N : CH.C_6H_4.OH + H_2O$.—Fine yellowish needles, melting at 92° C. (197.6° F.), insoluble in water, soluble in hot alcohol, in ether, and benzene. In sodium hydroxide solution the crystals dissolve with the production of a yellow-colored solution. Mineral acids decompose it into *p*-phenetidin and salicylaldehyde. Malakin contains about 50 per cent. of salicylaldehyde.

METHACETIN.—*Para-acetanisidin, Para-methoxyacetanilide.* $C_6H_4OCH_3NHC_2H_3O$.—This, the most formidable rival of phenacetin, differs from the latter, as the formula shows, in the substitution of a methyl group in place of an ethyl group. The process for its manufacture is identical with that for phenacetin, except that methyl iodide or chloride is used in place of the respective ethyl compound. It occurs in lustrous scaly crystals, colorless, odorless, and melting at 127° C. (260.6° F.). It sublimes at higher temperatures without decomposition. Methacetin is soluble in 350 parts of water at 15° C. (59° F.), and in 12 parts at 100° C. (212° F.); it is abundantly taken up by alcohol, acetone, chloroform, glycerin, and fixed oils. It may be distinguished from phenacetin by melting to an oily liquid if heated with water in insufficient quantity for solution, phenacetin being unaffected by this treatment; the liquid solidifies again on cooling. Its color-reactions are similar to those of phenacetin. It has been recommended as an antipyretic and analgesic in much smaller doses than phenacetin.

PHENOCOLL HYDROCHLORIDE.—*Amido-acetparaphenetidin Hydrochloride; Phenamin.* $C_6H_4.OC_2H_5(NHCOCH_2NH_2).HCl$.—By the action of chloracetylchloride on phenetidin and subsequent treatment of the resulting ethoxymonochloracetanilide with ammonia, a basic compound, known as amido-acetparaphenetidin or glycocollparaphenetidin, is obtained, to which the name phenocoll has been given. If the basic substance be neutralized with hydrochloric acid, the above salt may be obtained in form of a white crystalline powder, which is readily soluble in alcohol and also soluble in 16 parts of water. An aqueous solution of the salt upon addition of alkali hydroxides or carbonates yields a crystalline precipitate melting at 95° C. (203° F.). Ferric chloride should not cause a red color in the aqueous solution, showing the absence of phenetidin. If phenocoll be neutralized with acetic or salicylic acids, the corresponding acetate and salicylate will be formed, which have also been introduced into medicine. The latter salt is also known as salocoll. Like acetphenetidin and similar compounds, it is used as an antineuralgic and antipyretic. In larger doses than are ordinarily employed it has a beneficial effect in acute rheumatic fever. It is claimed by some investigators that the depression caused by the drug is less than that by most other coal-tar antipyretics, also that there is no destruction of red blood-cells. The fall in temperature is due to decreased heat-production, heat-elimination being but slightly affected. When large quantities are ingested, the urine assumes a dark, reddish-brown color. The dose is from 5 to 15 grains (.30–1.0 Gm.), in capsule or solution.

PYRANTIN.—*Phenosuccin; Para-ethoxyphenylsuccinimide.* $C_6H_4(OC_2H_5)N : (COCH_2—CH_2—CO)$.—It is prepared by melting together 1.1 parts of *p*-amidophenol and 1.2 parts of succinic acid at 150°–170° C. (302°–338° F.), and crystallizing the product from alcohol or acetic acid solution. It forms colorless prismatic needles which melt at 155° C. (311° F.). It is soluble in 1700 parts of water at 15° C. (59° F.), in 85 parts of boiling water, insoluble in ether, but readily soluble in hot alcohol and acetic acid, and in solutions of alkalies. The sodium salt forming an odorless crystalline powder of an acidulous saline taste, alkaline reaction, and is readily soluble in water.

SALIPHEN.—*Salicyl-p-phenetidin.* $C_6H_4(OC_2H_5)NH.CO.C_6H_4.OH$.—Colorless crystals, melting at 139.5° C. (283° F.). The crystals are insoluble in water, but soluble in acetone, ether, and boiling alcohol, chloroform, and glacial acetic acid.

THYMACETIN.—$C_6H_2.CH_3OC_2H_5C_3H_7NH.COCH_3$.—Prepared from thymol in a manner similar to that of phenacetin from phenol. A white crystalline powder, slightly soluble in water, soluble in alcohol, and melting at 136° C. (276.8° F.). It is used as an analgesic in doses of from 3 to 15 grains (0.20–1 Gm.).

TRIPHENIN.—*Propionyl-p-phenetidin.* $C_6H_4(OC_2H_5)NH(CO—CH_2—CH_3)$.—Prepared by heating *p*-phenetidin with propionic acid. It occurs as colorless, odorless, slightly bitter crystals, which melt at 120° C. (248° F.). It is soluble in about 2000 parts of water.

VALERIDIN.—*Valerydine; Valeryl-p-phenetidin.* $C_6H_4(OC_2H_5)NH(COC_4H_9)$.—Prepared by heating *p*-phenetidin with valeric acid or valeryl chloride. It occurs as white glistening needles which are soluble in alcohol, but difficultly soluble in ether, chloroform, and acetone, and almost insoluble in water.

ACETUM, *P. G.*—Vinegar.

Vinaigre, Fr.; *Essig,* G.; *Aceto,* It.; *Vinagre,* Sp.

Vinegar is an aqueous liquid, containing acetic acid, obtained by the acetous fermentation of a hydro-alcoholic liquid, such as wine, cider, beer, etc. The wine, cider, beer, grain, etc., vinegars thus obtained differ, according to source, in taste, color, flavor, etc., these physical differences in turn being due to differences in chemical composition. Most vinegar is now prepared from grain, principally Indian corn, though cider and

wine vinegars may still be found in the market. The French Codex still calls for true white wine vinegar—in the United States this term is now generally applied to vinegar manufactured from grain spirit; the German and Swiss Pharmacopœias do not define any particular kind, grain vinegar evidently being implied; whereas the U. S. and Br. Pharmacopœias have substituted a diluted acetic acid of desired strength. Wood vinegar, even when rectified (see Acetum Pyrolignosum), should not be confounded with the above kinds, all of which are made by fermentation.

Preparation.—Vinegar was known to the ancients, and resulted wherever alcoholic beverages underwent acetous fermentation. This acetous fermentation can be brought about practically everywhere by simple exposure of such liquids, because the necessary germ, *Mycoderma aceti*, is well-nigh universal. The oxidation of the alcohol to acetic acid, according to the old (French?) process, is very slow, because the surface of the liquid exposed to oxygen, which is necessary to bring about oxidation, is relatively small. The process can be facilitated somewhat by careful selection of the wine, inoculation of the ferment, and regulation of temperature.

The quick vinegar process depends primarily upon providing a sufficiently large surface for the oxidation of the dilute alcohol. This is done by filling the fermentation casks with beech-wood shavings, which are tightly packed. After the shavings have been inoculated, as it were, by means of ready vinegar, the alcoholic liquid is poured over the shavings, either continuously by means of a hydraulic tourniquet or periodically. Frequently the partly oxidized liquid is poured over the shavings a second time. The change is controlled further by regulation of the temperature within the casks, and this in turn is regulated by the flow of air (oxygen) into them. The most favorable temperature is given at 27°–35° C. (80°–95° F.). The alcoholic material used for the quick process is either white wine, resulting in true white wine vinegar (*Vinaigre de vin blanc*, Fr.; *Weiss Wein Essig*, G.); cider, yielding cider vinegar (*Frucht Essig*, G.); beer, yielding beer vinegar (*Bier Essig*, G.); but mostly dilute spirits from grain, yielding grain vinegar (*Getreide Essig*, G.) or spirit vinegar (*Sprit Essig*, G.), also commonly, though falsely, designated commercially as "white wine vinegar," evidently because this kind has displaced almost universally the former true white wine vinegar.

Vinegar is a clear, almost colorless liquid, of sour odor and taste. Spirit vinegar frequently is colored to resemble cider or wine vinegar. After neutralization with sodium hydroxide, the addition of a few drops of ferric chloride solution produces a deep-red coloration, due to formation of ferric acetate; upon heating, basic ferric acetate is precipitated.

Tests.—The German Pharmacopœia requires that vinegar shall contain 6 per cent. of acetic acid, and that 10 Cc. shall be neutralized exactly by 10 Cc. of normal alkali solution. (The Swiss Pharmacopœia demands but 5 per cent. of acetic acid, while the French Codex requires 7–8 per cent.) If to 20 Cc. of vinegar be added 0.5 Cc. of a 5 per cent. barium nitrate solution and 1 Cc. of decinormal silver nitrate solution, a filtrate should be obtained which will not be affected by a further addition of the two test-solutions, showing limit of sulphates and chlorides. Hydrogen sulphide should have no effect on vinegar, showing the absence of heavy metals; and nitric acid may be detected by the appearance of a brown zone if 1 Cc. of ferrous sulphate solution be poured carefully on top of a mixture of 2 Cc. each of vinegar and sulphuric acid. Upon complete evaporation vinegar should not leave more than 0.5 per cent. of residue, free from sharp or bitter taste, and not yielding an alkaline ash.

Acetum Destillatum. *Acetum purum, Distilled or pure vinegar*, E.; *Vinaigre distillé*, Fr.; *Distillirter oder reiner Essig*, G.—Ordinary vinegar is distilled from glass retorts until about three-fourths of its volume has passed over. It is colorless, leaves no residue on evaporation, is not colored by excess of potassium hydroxide (showing absence of aldehyde), and is free from mineral acids. It is practically identical with diluted acetic acid, containing 6 per cent. of absolute acetic acid.

Action and Uses.—Vinegar is seldom used internally in this country as a medicine. In small doses it may increase the gastric secretions and stimulate the salivary glands to greater activity. In large amounts it disorders digestion and weakens the patient, and should not be used in the treatment of obesity. It has been recommended in the treatment of diarrhœa, dysentery, diphtheria, and lead colic, but in these conditions has little medicinal value. The drug, when inhaled, frequently relieves vomiting, especially that following the use of ether and chloroform, and is said to be useful in the early stages of coryza and headache.

As a lotion, 1 part in 4 of water, it is used in night-sweats, to arrest small hemorrhages, and as a cooling application to sprains and discolorations of the skin due to injury. Rectal injections of vinegar are said to be useful in the removal of ascarides.

Poisonous amounts of vinegar produce nausea and vomiting, purging, and violent pain in the stomach and intestines. Later, symptoms of collapse may occur, the skin becoming cold and clammy, the temperature subnormal, and the circulation and respiration impaired. The treatment of poisoning by vinegar consists in giving large quantities of milk and mild alkaline drinks, as lime-water or solutions of soap. If symptoms of collapse are present, resort to stimulation with alcohol, strychnine, or belladonna, and apply external heat. Morphine may be given to relieve the pain. Dose, 1 to 4 drachms (4–16 Cc.).

Acetum Antisepticum, Fr. Cod.; *Antiseptic vinegar,* E.; *Vinaigre (Acétolé) antiseptique, Vinaigre des quatre voleurs,* Fr.; *Vierraeuberessig,* G.—Absinthe, Roman wormwood, peppermint, rosemary, rue, sage, and lavender, of each, 15 Gm.; calamus, cinnamon, cloves, nutmeg, and garlic, of each, 2 Gm.; vinegar, 1000 Gm.; macerate for 10 days, express, add 4 Gm. of camphor dissolved in 15 Gm. of glacial acetic acid, and filter. The *Aceto antisettico* of the Italian Pharmacopœia contains camphor and orange leaves.

Acetum Pyrolignosum Crudum, P. G.—*Wood vinegar. Pyroligneous acid,* E.; *Acide acétique du bois, A. pyroacétique, A. pyroligneux,* Fr.; *Roher Holzessig, Rohe Holzsäure, Rohe Holzessigsäure,* G.—Upon destructive distillation, wood yields a gaseous and a liquid distillate. The latter, upon standing, separates into two layers, an aqueous layer, and an oily or tarry layer known as wood-tar. The yield of aqueous distillate, tar, and charcoal does not differ greatly with different kinds of wood, but the percentage of acetic acid in the aqueous distillates varies considerably according to the nature of the wood. Hard wood yields more than that of coniferous trees; the wood of the trunk more than that of the branches, sound wood more than diseased wood or bark. The two principal constituents of the aqueous distillate are methyl alcohol and acetic acid. The former is separated by removing about one-tenth of the liquid by fractional distillation (see Wood Alcohol). The remaining nine-tenths are brought into the market as such, or after the removal, by distillation, of most of the tar, retained in solution as crude pyroligneous acid. The principal constituent is acetic acid, of which it contains from 10 to 13 per cent. (from hard wood) or only 5 to 7 per cent. (from pine). In addition it contains small amounts of the homologous acids up to 6 C-atoms. Of the numerous other products formed by the destructive distillation of wood, small amounts are contained in crude pyroligneous acid—*e. g.*, methyl alcohol, acetone, valerolactone, tetramethylene ketone, methyl pentamethylene ketone, methyl acetate, furfurol, pyromucic acid, pyridine, also numerous constituents of the wood-tar, notably phenols (see Wood-tar). To the presence of the latter are due the brown color and empyreumatic odor, also in large part the antiseptic properties of the crude pyroligneous acid. The German Pharmacopœia describes crude pyroligneous acid as follows: "A brown liquid, having the odor of tar and acetic acid, and possessing an acid, bitter taste, from which tarry substances separate upon standing. It should contain at least 6 per cent. of acetic acid, and 10 Cc. of wood vinegar should not react alkaline after the addition of 10 Cc. normal potassium hydroxide solution. Wood vinegar diluted with an equal volume of water should not be affected by hydrogen sulphide (absence of heavy metals), nor be colored more than light blue by potassium ferrocyanide solution (limit of iron), or become more than opalescent upon addition of either barium nitrate or silver nitrate solutions (limit of hydrochloric and sulphuric acids).

Acetum Pyrolignosum Rectificatum, P. G., Fr.—*Rectified wood vinegar. Rectified pyroligneous acid,* E.; *Acide pyroligneux purifiée,* Fr.; *Gereinigter oder rectificirter Holzessig,* G.—Rectified wood vinegar differs from the crude principally in its lesser percentage of tarry constituents. It can be prepared by distillation of the crude product, collecting 8 parts of distillate from 10 parts. The P. G. describes it as follows: A yellowish liquid having an empyreumatic, sour odor and taste, and containing at least 5 per cent. of acetic acid. Impurities may be detected as indicated under the head of the crude acid. If to 20 Cc. of potassium permanganate solution, a mixture of 1 Cc. of rectified wood vinegar, 9 Cc. of water, and 30 Cc. of dilute sulphuric acid be added, the red color should be destroyed completely within 5 minutes (distinction from diluted acetic acid). 10 Cc. of rectified wood vinegar should require not less than 8.4 Cc. and not more than 9 Cc. of normal alkali solution for neutralization. The French name *Acide pyroligneux purifiée* is retained merely as a synonym for *Acide acétique du commerce* or commercial acetic acid, containing 50 per cent. of $C_2H_4O_2$.

ACETUM AROMATICUM, *P. G.*—Aromatic Vinegar.

Aromatischer Essig, G.; *Vinaigre (Acétolé) aromatique,* Fr.

Preparation.—Take of volatile oils of cassia, juniper, lavender, peppermint, and rosemary, of each, 1 part; eugenol and oil of lemon, of each, .2 parts; alcohol (91 per cent.), 441 parts; acetic acid (30 per cent.), 650 parts; water, 1900 parts. Dissolve the oils in the alcohol, add the acid and water, set the turbid mixture aside, with frequent agitation for 8 days, and filter.—P. G.

It is a clear, colorless liquid, of an aromatic, acetous odor, miscible with water in all proportions without becoming turbid. The corresponding preparation of the French Codex is made from a tincture of fresh herbs, and has a pale-reddish color.

The Austrian Pharmacopœia directs aromatic vinegar to be prepared from peppermint, rosemary, and sage, of each, 25 parts; angelica, zedoary, and cloves, of each, 2 parts; vinegar, 1000 parts.

Action and Uses.—Aromatic vinegar is sometimes used as a cooling lotion or an inhalant in cases of headache.

ACETUM CANTHARIDIS, *Br.*—Vinegar of Cantharides.

Vinaigre cantharidé, Fr.; *Canthariden essig*, G.

Preparation.—The British Pharmacopœia directs that 2 ounces (or 100 Gm.) of bruised cantharides be macerated for 24 hours in 18 fluidounces (or 900 Cc.) of a mixture of equal volumes of glacial acetic acid and distilled water. The whole is then transferred to a percolator, and when the liquid ceases to pass, sufficient of the above menstruum is poured over the contents of the percolator to produce 1 Imperial pint (or 1000 Cc.) of percolate.

Action and Uses.—Vinegar of cantharides is employed externally as a vesicant, and if lightly applied as a rubefacient. Because of the softening power and penetrability of acetic acid, it is more rapid in its action than any other preparation of the drug. It may be used upon those portions of the body where the ordinary cerate cannot be kept in place, but should be applied over only a very limited area, on account of the danger of absorption. Its application is more painful than that of the other preparations of cantharides.

ACETUM IPECACUANHÆ, *Br.*—Vinegar of Ipecac.

Vinaigre d'ipecacuanha, Fr.; *Brechwurzelessig*, G.

Preparation.—The British Pharmacopœia directs a mixture to be made of liquid extract of ipecac, 1 fluidounce (or 50 Cc.); 90 per cent. alcohol, 2 fluidounces (or 100 Cc.); and diluted acetic acid (4.27 per cent.), 17 fluidounces (or 850 Cc.). The mixture is filtered, and if necessary sufficient diluted acetic acid is added to the filtrate to make 1 Imperial pint (or 1000 Cc.).

As the liquid extract of ipecac of the British Pharmacopœia is standardized to contain 2–2.25 Gm. of alkaloids in every 100 Cc., the above vinegar will represent about $\frac{1}{15}$ grain of the alkaloids of ipecac in each teaspoonful, or 0.00106 Gm. in each Cc.

Action and Uses.—Vinegar of ipecac is a useful expectorant in the early stages of acute bronchitis. On account of the irritant effect of acetic acid upon the mucous membranes, it should not be given in doses sufficiently large to produce emesis. The dose is stated to be from 5 to 40 minims (0.3–2.6 Cc.).

ACETUM OPII, *U. S.*—Vinegar of Opium.

Black drop, E.; *Vinaigre d'opium*, Fr.; *Opiumessig*, G.

Preparation.—The Pharmacopœia directs that 100 Gm. of powdered opium and 30 Gm. of nutmeg in No. 30 powder be macerated with 500 Cc. of diluted acetic acid during 7 days, with frequent agitation; the mixture is then strained through muslin of close texture and the liquid expressed. The residue is mixed with 200 Cc. of diluted acetic acid to a uniform magma, and again strained and expressed. The strained liquids are mixed and filtered, and 200 Gm. of sugar dissolved in the filtrate, sufficient diluted acetic acid being passed through the filter to bring the total volume up to 1000 Cc.

To prepare a pint of vinegar of opium will require 730 grains of powdered opium, 220 grains of nutmeg, 1460 grains of sugar, and a sufficient quantity of diluted acetic acid.

Vinegar of opium is of a reddish-brown color and rather pleasant, acetous odor. It is of the same morphine strength as tincture of opium (0.012–0.0125 Gm. in 1 Cc.), and may be assayed by the method given under the latter preparation, except that the acid present is neutralized first by addition of calcium carbonate (4–5 Gm. to 100 Cc.).

Action and Uses.—Vinegar of opium is used as an anodyne and hypnotic. As it contains no narcotine, it is not so liable to produce depression and nauseating after-effects

as the other preparations of the drug, with the exception of the tincture of deodorized opium, which is also free from the above-mentioned alkaloid. Vinegar of opium is usually given in the dose of from 5 to 20 minims (0.3–1.30 Cc.).

ACETUM SCILLÆ, *U. S., Br., P. G.*—Vinegar of Squill.

Acetum scilliticum.—*Vinaigre* (*Acétolé*) *de scille*, Fr. Cod.; *Meerzwiebelessig*, G.; *Aceto scillitico* F. It.

Preparation.—The U. S. Pharmacopœia directs that 100 Gm. of squill in No. 20 powder be macerated with 900 Cc. of diluted acetic acid during 7 days, with frequent stirring, then strained through muslin and the mass washed on the strainer with sufficient diluted acetic acid to obtain about 1000 Cc. Heat this liquid to boiling, filter while hot, and when cooled add sufficient diluted acetic acid to make the product measure 1000 Cc.

To prepare 1 pint of official vinegar of squill, macerate 722 grains of squill with 14 fluidounces of diluted acetic acid for 7 days, and after expression wash the residue with sufficient menstruum to obtain a total volume of 16 fluidounces.

The British Pharmacopœia orders 2½ ounces (or 125 Gm.) of bruised squill to be macerated for 7 days with 1 Imperial pint (or 1000 Cc.) of diluted acetic acid, then strained and filtered.

According to the German Pharmacopœia, 5 parts of squill, cut and dried, are to be macerated with 5 parts of alcohol, 9 parts of acetic acid (30 per cent.), and 36 parts of water for 3 days, at a temperature of 15°–20° C. (59°–68° F.); the mixture is then strained without forcible expression, and after 24 hours filtered.

Vinegar of squill is a clear liquid of yellowish color, an acetous odor, and an acid, bitter taste.

Action and Uses.—Vinegar of squill is at present rarely employed in medicine. It is recommended as a stimulant or irritant diuretic in chronic nephritis, and in renal congestion resulting from cardiac disease. It is stated that the preparation possesses some value in the treatment of pericardial, pleural, and abdominal effusions, but other more satisfactory remedies usually are given. It is rarely used at present in cardiac dropsy. Its average dose is 15 minims (1 Cc.), best administered in an aromatic draught.

ACETYLENUM.—Acetylene.

Ethine, E.; *Acetylen, Aethin, Steingas*, G.

Formula, C_2H_2. Molecular weight, 25.82.

History and Formation.—The name acetylene was first given to this hydrocarbon in 1860 by Berthelot, although the gas had been discovered by Edmund Davy in 1830 in an attempt to prepare potassium by the action of water on a mixture resulting from heating carbonized tartar and charcoal. Davy called the new hydrocarbon *klumene*. Berthelot obtained acetylene by passing the vapors of alcohol, wood alcohol, ether, etc., through a red-hot tube, and also observed its presence in illuminating-gas. He prepared it synthetically by passing a powerful electric current between two carbon poles in an atmosphere of hydrogen. Acetylene is the only hydrocarbon capable of production by direct union of its constituent elements. For a long time it was prepared by the action of potassium hydroxide on ethylene bromide, but of late years, since acetylene has come extensively into use as an illuminating agent, it is made by the action of water on calcium carbide in suitable apparatus, the following decomposition occurring: $CaC_2 + 2H_2O = C_2H_2 + Ca(OH)_2$.

Properties.—Acetylene is a colorless gas of unpleasant odor. It is about nine-tenths as heavy as air, and can be liquefied under a pressure of 21.5 atmospheres. Liquid acetylene boils at —83° C. (—117.4° F.), and 1 kilogramme of the fluid corresponds to 858 liters of gaseous acetylene at 0° C. (32° F.). Acetylene is soluble in an equal volume of water, and more soluble in alcohol and in ether. It is insoluble in concentrated brine. If pure acetylene be ignited, it burns with a very smoky flame; but if mixed with air in the proportion of 2 volumes of the latter to every 3 volumes of acetylene, the mixture will burn, from a suitable burner having a fine slit, with a dazzling white flame free from smoke. Mixtures of acetylene and air in various proportions explode if ignited; the most explosive being a mixture of 1 volume of acetylene and 12 volumes of air. The range of explosiveness lies between mixtures of 3 volumes of

acetylene with 97 volumes of air and 81 volumes of acetylene with 19 volumes of air. While acetylene is poisonous, it is far less so than illuminating-gas, and animals have been known to live in an atmosphere containing 9 per cent. of acetylene, without unpleasant effects. It does not appear to cause any change in the hæmoglobin of the blood, as was formerly supposed to be the case.

Acetylene prepared from commercial calcium carbide may contain from 1 to 3 per cent. of impurities, consisting of hydrogen phosphide, carbon disulphide, ammonia, carbon monoxide, etc. For purposes of purification the gas is first passed through water for the removal of ammonia, and next over moist chlorinated lime, whereby any hydrogen phosphide present is oxidized to phosphoric acid; it is then passed over copper sulphate or ferric hydroxide to remove carbon disulphide, and finally dried by passing over freshly burned lime.

Action and Uses.—Acetylene is said to possess narcotic properties, but its depressing action upon the heart prevents its employment in medicine. Maisson and Etheridge have employed suppositories of calcium carbide in the cavity of the uterus in the treatment of uterine cancer. Acetylene is given off from this substance in the presence of moisture, and it is claimed that its action has proved quite successful in advanced cases. Its application is painful for the first 3 or 4 hours, after which time little inconvenience is experienced. It is probable that the application of this substance possesses no distinct advantage over the thermocautery. The calcium carbide is introduced, and this is followed by a tight packing of iodoform gauze, which is allowed to remain 3 days. This is repeated every third day for a period of several months. Acetylene destroys the odor, materially decreases the discharge and hemorrhage, and in some cases is supposed to have produced a cure.

ACIDA.—Acids.

The term acid (from *acere*, to be sour) was given early in the history of chemistry to substances that had a sour taste. One of the earliest known of such substances was vinegar, the Latin name of which, *acetum*, indicates its sour property, as does also the word *acetic*, which is the name given to the acid in vinegar.

Another general property of acids is the power to change the color of certain dyes, as litmus, for example. Litmus is naturally blue, but when brought into a solution containing an acid it changes to red.

But neither of these properties is essential in order that a substance be classed as an acid, for there are some acids which are neither sour nor have the power to change the color of dyes. As a rule these acids are insoluble in water, and are termed *weak* acids. In general, acids which are soluble in water have a markedly sour taste and a reaction on dyes, such as litmus.

Another property which is strictly chemical and more important in determining whether a body is an acid, is the liberation of hydrogen gas when it is brought in contact with certain metals, as zinc, or more especially magnesium. Coördinate with this is also the power to combine with such substances as caustic soda or caustic potash, which are called *alkalies*. In both cases new and distinct compounds are formed, with properties quite different from those of the acid.

The liberation of hydrogen by magnesium leads to the general chemical definition of an acid, namely, An *acid* is a substance containing hydrogen, which it easily exchanges for a metal when treated with a metal itself, or with a compound of a metal, called a base or hydroxide.

A *base* or basic substance is a *metal* in combination with hydrogen and oxygen—that is, with the water residue (OH) known as *hydroxyl*. They are hence called hydroxides. The most striking and typical examples of bases are potassium and sodium hydroxides, KOH and NaOH, which bear the specific name *alkali*. (A few substances, chiefly ammonium hydroxide and its derivatives, have basic properties, but contain no metal.)

Bases are opposite in properties to acids, inasmuch as they in general restore the blue color of litmus that has been reddened by acids, and also destroy or *neutralize* the properties of acids.

The action of metals and bases on an acid is illustrated by the following equations: (1) $Zn + H_2SO_4 = ZnSO_4 + H_2$; (2) $Mg + H_2SO_4 = MgSO_4 + H_2$; (3) $Zn(OH)_2 + H_2SO_4 = ZnSO_4 + H_2O$; (4) $Mg(OH)_2 = H_2SO_4 = MgSO_4 + H_2O$; (5) $2KOH + H_2SO_4 = K_2SO_4 + H_2O$; (6) $NaOH + HCl = NaCl + H_2O$. Zinc and magnesium,

and their hydroxides, are represented in reaction with sulphuric acid, forming zinc and magnesium sulphates, with the liberation of hydrogen in the one case (metals) and water in the other. The metal has exchanged places with the hydrogen of the acid, forming a new body, which is called a *salt.* Salts are in general neutral compounds, possessing neither the properties of the metals nor of the acids which enter into them. A constant product in the formation of salts by neutralization of an acid by a base is water, as shown in equations 3, 4, 5, and 6.

Hydrogen is the acidifying element in all acids, but it was believed by Lavoisier and his followers, about the close of the eighteenth century, that oxygen caused the acid properties, which fact is indicated in the name Lavoisier gave to this element, namely, *oxygen,* which means acid-forming. This view arose from the fact that many oxides when dissolved in water gave acid solutions, and hence the oxides themselves were regarded as acids. Now such oxides are called *acidic oxides* or *acid anhydrides;* that is, acid minus water; thus, $SO_3 = H_2SO_4 - H_2O$. It has been proved that such oxides when perfectly free from water have no acid properties.

Custom perpetuates the error of the earlier chemists in the case of a few anhydrides which at the present day are called acids, and no doubt will continue thus to be designated for some time to come. Thus, CO_2, As_2O_3, CrO_3, SiO_2, SnO_2, OsO_4, are called, respectively, carbonic, arsenous, chromic, silicic, stannic, and osmic acid. The acids of these oxides are unstable, and cannot be obtained in the free state, but exist only in solution. Thus when we attempt to liberate carbonic acid from a carbonate by addition of sulphuric acid, we get the oxide CO_2, for the acid breaks up at once into water and the anhydride, $H_2CO_3 = H_2O + CO_2$.

While the great majority of acids contain oxygen, and are in reality a combination of the acid anhydrides with water, there are some well-marked acids which contain no oxygen; for example, the halogen acids, hydrobromic, hydrochloric, etc., HBr., HCl.

In the oxygen acids the replaceable hydrogen is in combination with oxygen as (OH), or hydroxyl, but the formulas usually employed, namely, the empirical or molecular, do not represent this fact. Thus we usually write for nitric acid HNO_3, but the more exact representation is NO_2OH.

Basicity of Acids.—According to the number of replaceable hydrogen atoms in acids, they are designated as *monobasic, dibasic, tribasic,* etc., acids. The terms refer to the number of molecules of a base containing a univalent metal that are required to neutralize fully an acid. Examples of monobasic acids are HCl, HBr, HI, HF, HNO_3, HPH_2O_2, $HC_2H_3O_2$, etc.; dibasic acids, H_2SO_4, H_2SO_3, H_2CO_3; tribasic acids, H_3PO_4, H_3BO_3, etc.

Some text-books distinguish between the replaceable and the non-replaceable hydrogen atoms by writing the former at the beginning of the formulas. Thus, hypophosphorous acid, HPH_2O_2; acetic acid, $HC_2H_3O_2$; tartaric acid, $H_2C_4H_4O_6$; citric acid, $H_3C_6H_5O_7$.

Acids containing more than one replaceable hydrogen atom can form more than one salt, according as one, two, three, etc., hydrogen atoms are replaced by metal. When all the acid hydrogen is replaced by metal the salt is termed *normal.*

Dibasic acids form two classes of salts, normal and *acid* or *bi-salts;* thus, Na_2SO_4, *acid* sodium sulphate or sodium *bi*sulphate.

Tribasic acids form three classes of salts, termed *mono-, di-,* and *tri-,* or *primary, secondary,* and *tertiary,* according as one, two, or three hydrogen atoms have been replaced by metal. The best illustration is offered by phosphoric acid, H_3PO_4:

H_2NaPO_4 = mono- or primary sodium phosphate.
HNa_2PO_4 = di- or secondary sodium phosphate.
Na_3PO_4 = tri- or tertiary (or normal) sodium phosphate.

The first two are also acid salts.

Bases which can neutralize more than one acid hydrogen atom give rise to several salts, designated *normal* and *basic.* The basic salts are those in which the base is not combined with all the acid it is capable of saturating. Thus, bismuth hydroxide, $Bi(OH)_3$, can form three nitrates, $Bi(OH)_2NO_3$, $Bi(OH)(NO_3)_2$, and $Bi(NO_3)_3$. The first two are basic salts.

Derived Acids.—Some acids are capable of splitting off water from one or more molecules by the aid of heat or otherwise, and forming related acids. This is well illustrated in the case of phosphoric and boric acids. When the former is gradually

heated to low red heat, the first change is the formation of pyrophosphoric acid by the elimination of 1 molecule of water between 2 molecules of acid; thus, $2H_3PO_4 = H_4P_2O_7$ (pyrophosphoric acid) $+ H_2O$. The next change is the formation of metaphosphoric acid by the further elimination of another molecule of water; thus, $H_4P_2O_7 = 2HPO_3$ (metaphosphoric acid) $+ H_2O$. Arsenic acid behaves in the same manner.

Boric acid when heated forms pyroboric and metaboric acids, $H_2B_4O_7$ and HBO_2. The most stable alkali borates are the salts of pyroboric or tetraboric acid.

Some acids, when heated sufficiently, lose all their hydrogen in the form of water, and leave behind the anhydrides; thus, arsenic acid leaves the pentoxide, As_2O_5, differing in this respect from phosphoric acid, which forms metaphosphoric acid as the last product.

INORGANIC ACIDS.

In this division are embraced all those acids which do not contain carbon, except carbonic acid, and perhaps hydrocyanic, HCN, cyanic, HOCN, sulphocyanic, HSCN, hydroferrocyanic, $H_4Fe(CN)_6$, and fulminic, acid, $H_2O_2C_2N_2$. The acids mentioned, although containing carbon, have properties so much like those of the other inorganic acids that they are grouped almost invariably with the latter. The great majority of inorganic acids are compounds of hydrogen, or of hydrogen and oxygen, with non-metallic elements. The exceptions to this statement are the acids of arsenic, antimony, chromium, molybdenum, manganese, and a few other metallic elements, and the acids mentioned above containing the group or radical (CN) cyanogen. The inorganic acids are gaseous, liquid, or solid. They are usually met with in commerce as dilute or concentrated aqueous solutions. Such non-official acids are described here as are considered to be of interest in one way or another, while the official acids will receive detailed treatment in alphabetical order farther on.

Acidum Arsenicum. *Arsenic acid. Acide arsénique*, Fr. Cod.; *Arsensäure*, G. $H_3AsO_4 + \frac{1}{2}H_2O$.—Obtained by oxidation of arsenous acid with nitric acid of specific gravity 1.38, evaporating to dryness to remove nitric acid, adding water, and evaporating again to dryness or to syrupy consistence. On neutralizing a sample with sodium hydroxide and adding a few drops of potassium dichromate solution, no green color should appear, showing the absence of arsenous acid. The acid is tribasic, crystallizing in plates or prisms. It occurs on the market as a white crumbly mass or coarse white powder which is hygroscopic. When strongly heated, it yields oxygen and arsenous acid. It is easily soluble in water, alcohol, and glycerin. With magnesia mixture and molybdate solution it acts like phosphoric acid (which see). For other tests, see under Arsenous Acid. The acid is not used medicinally, but the sodium salt is official. The acid is poisonous.

Acidum Cacodylicum. *Cacodylic acid, Dimethylarsenic acid*, E.; *Kakodylsäure*, G. $(CH_3)_2AsO.OH$.—This acid is related closely to arsenic acid, being a dimethyl derivative, as shown by the formula. When arsenous acid and potassium acetate are distilled together, an oil with a disgusting odor is obtained, which is known as Cadet's Liquid. This contains a little *cacodyl*. $As_2(CH_3)_4$, and much *cacodyl oxide*, $As_2(CH_3)_4O$, both oily liquids. The word cacodyl is derived from *κακώδης*, stinking. When treated with mercuric oxide, both oils are oxidized gradually to cacodylic acid. The acid forms odorless prisms, easily soluble in water. With lime-water the acid or its salts should yield no precipitate, proving the absence of oxalates, arsenites, and arsenate. Silver nitrate or magnesia mixture should give no precipitate. The acid is monobasic. The sodium and calcium salts have been introduced into medicine in the treatment of skin diseases and others. It is claimed that the acid and its salts are free from toxicity. Sodium cacodylate, $(CH_3)_2AsOONa$, a white soluble compound, is employed mostly, and is given hypodermically or internally in pills. Other cacodylates that have been experimented with are those of potassium, magnesium, lithium, quinine, iron, guaiacol, mercury. (E. Merck, *Annual Report*, 8, p. 51; *Pharm. Review*, 1901, xix. No. 8.)

Acidum Hydrofluoricum. *Hydrofluoric acid*, E.; *Acide fluorhydrique, Acide phtorique*, Fr.; *Fluorwasserstoffsäure, Flusssäure*, G. HF.—Fluorine exists in nature in combination with calcium as *fluor-spar*, also in *cryolite* (kryolite) and other minerals; small quantities of fluorine have been found in some mineral and potable waters, in bones, and in the ashes of various plants. The use of fluor-spar for etching on glass was known to Schwaukhard (1670), but hydrofluoric acid was discovered by Scheele (1771), and first prepared pure by Gay-Lussac and Thénard (1808). *Preparation.*—Powdered fluor-spar (or cryolite) which is free from silica is heated with sulphuric acid in a retort of platinum or lead, and the gas is conducted into distilled water contained in a well-cooled receiver of the same metal. Great caution is necessary to prevent contact with the vapors and to avoid inhaling them. *Properties.*—Pure hydrofluoric acid forms a thin colorless fuming liquid which is lighter than water, solidifies at —92.5° C. (—134.6° F.), boils at 19.4° C. (67° F.), and is freely soluble in water. The aqueous solution, which sometimes is called *fluoric acid, acide fluorique*, is heavier than water; a solution having the density 1.15 contains 35.37 per cent. of HF, and boils constantly at 120° C. (248° F.) (Bineau). Like

the pure acid, it is extremely caustic, and causes severe ulceration when applied to the skin. It corrodes glass and attacks most organic and inorganic compounds, but does not act upon paraffin; it is best preserved in bottles made of lead, gutta-percha, or hard paraffin. *Impurities.*—10 Cc. evaporated in a platinum dish should leave no residue. The acid diluted with water and acidified with hydrochloric acid should not give a precipitate with barium chloride solution (absence of sulphuric acid). Neither hydrogen sulphide nor ammonium sulphide, after neutralization, should give a precipitate (absence of arsenic, iron, lead, and zinc). The acid is purified by distillation from a platinum retort after standing some hours in contact with precipitated manganese dioxide. The strength of the acid may be determined by titration with normal alkali (phenolphtalein indicator) in beakers coated with paraffin. Each Cc. of alkali is equivalent to 0.02 Gm. of HF. While fluorine, chlorine, bromine, and iodine belong to the same natural family, the *halogens*, the fluorides differ in many respects from the chlorides, bromides, and iodides. For example, AgF is soluble in water, while AgCl, AgBr, and AgI are insoluble in water and acids. CaF_2 is quite insoluble in water, while $CaCl_2$, $CaBr_2$, and CaI_2 are deliquescent and very soluble. *Uses.*—Hydrofluoric acid in the gaseous state and its aqueous solution are used for etching on glass. *Ammonium fluoride* has a similar effect; it forms white or colorless scales or prisms, which are deliquescent and should be kept in a gutta-percha bottle. According to F. L. Slocum (1880), a mixture suitable for writing on glass, like that sold at one time as *diamond ink*, is made by mixing barium sulphate 3 parts, ammonium fluoride 1 part, and sulphuric acid sufficient to form a semifluid mixture; if kept in glass, this should be coated on the inside with paraffin, wax, or gutta-percha. The free acid, as well as the ammonium salt, is used to decompose silicates for analysis. The acid is added to the mash in the manufacture of spirits, to prevent lactic acid fermentation. The element fluorine was isolated by H. Moissan (1886) by electrolysis of anhydrous HF in platinum. It is a greenish-yellow gas, lighter in color than chlorine, with similar but more intense chemical activity. Of metals, only gold and platinum are not attacked by fluorine at ordinary temperature. It is the most active element. Oxygen, nitrogen, chlorine, and argon, however, are indifferent toward it. In 1900 Moissan observed that fluorine may be prepared in copper vessels at low temperatures, as the copper is soon coated with a film of insoluble fluoride, which protects it. *Action and Uses.*—Hydrofluoric acid is at present practically never used in medicine. In the strength of a 1 : 2500 solution in water it has been recommended for the prevention of putrefaction and fermentation changes in food-products. Inhalations of the acid largely diluted with air were at one time employed in the treatment of pulmonary tuberculosis, but at present are not in vogue. The fluorides are no longer used, because of the gastric disorder which they occasion.

Acidum Hydrosilicofluoricum. *Hydrofluosilicic acid*, E.; *Kieselfluorwasserstoffsäure, Kieselflusssäure*, G. H_2SiF_6.—Prepared by the action of gaseous silicon tetrafluoride on water: $3SiF_4 + 4H_2O = 2H_2SiF_6 + Si(OH)_4$. SiF_4 is formed by the action of sulphuric acid on a mixture of calcium fluoride and sand (SiO_2): $4HF + SiO_2 = SiF_4 + 2H_2O$. The aqueous solution of the acid is colorless, volatile without residue when heated in a platinum dish, and attacks glass only moderately. It is a strong dibasic acid, used in chemical analysis to precipitate and separate barium from strontium, the barium salt being insoluble.

Acidum Iodicum. *Iodic acid*, E.; *Iodsäure*, G. HIO_3.—Prepared by oxidation of iodine (10 parts) with nitric acid of specific gravity 1.5 (50 parts). Warm until the iodine disappears and red vapors cease to come off. Evaporate to dryness, and heat 1 hour at 200° C. (392° F.) to drive off all nitric acid. Dissolve in water and evaporate again on a water-bath. Iodic acid forms colorless rhombic crystals, soluble in 1 part of water, less soluble in alcohol. At 170° C. (338.9° F.) it breaks up into water and the anhydride I_2O_5, which decomposes at 300° C. (572° F.) into iodine and oxygen. Reducing agents liberate iodine from the acid. The acid and its salts find use as chemical reagents. It is used also in medicine as a substitute for potassium iodide. It is employed in chronic glandular enlargements and goitre as an injection in the dose of ½ drachm (2 Gm.) of a 2 per cent. solution. Various salts of the acid are in use.

Acidum Molybdicum. *Molybdic acid, Molybdenum trioxide, Molybdic anhydride*, E.; *Molybdänsäure*, G. MoO_3.—Molybdenum occurs in nature principally as the sulphide or molybdenite, MoS_2, and as lead molybdate or wulfenite, $PbMoO_4$, from which the acid (anhydride) MoO_3 is manufactured. Other oxides of the metal exist—for example, MoO, Mo_2O_3, MoO—but only the highest oxide, MoO_3, has acid properties, and is analogous to chromic acid, CrO_3. It is a whitish, crystalline, glistening powder, scarcely soluble in water, soluble in nitric or hydrochloric acid. In solution it is easily reduced, forming blue compounds. It is soluble in ammonia water and alkalies, forming molybdates, which are derived from the normal acid, H_2MoO_4, or poly-acids, as H_2MoO_4, $H_2Mo_3O_{10}$, etc. Molybdates of other metals are insoluble. The ammonium salt is the most important, and is used as a delicate test for phosphoric acid (see Acidum Phosporicum), also in alkaloidal testing. When this salt is treated with nitrohydrochloric acid, the ammonia is destroyed, and on evaporation free *phosphomolybdic* acid crystallizes out, $H_3PO_4.10MoO_3.12H_2O$, which is used in tests and for the separation of alkaloids.

Acidum Nitrosum. *Nitrous acid*, E.; *Salpetrige Säure*, G. HNO_2.—This acid does not exist in the free state, but occurs in combination in salts known as nitrites, some of which are official. The nitrites can be formed by reduction of nitrates; for example, when KNO_3 is heated with lead: $KNO_3 + Pb = KNO_2 + PbO$. When nitrates are treated with a strong acid,

as sulphuric, the nitrous acid liberated at once decomposes into its anhydride and water: $2HNO_2 = N_2O_3 + H_2O$. In this respect the acid behaves like carbonic acid. Nitrites find use in organic chemistry in forming diazo from amido compounds and in preparing the official ethyl and amyl nitrites.

Acidum Osmicum s. Perosmicum. *Osmic acid, Osmium tetroxide,* E.; *Osmiumsäure,* G. OsO_4.—The metal osmium belongs to the platinum group, and occurs alloyed with the members of this group in a few localities. It is obtained in the free state by complicated processes. When finely divided osmium is heated to 400° C. (752° F.) in the presence of oxygen, it burns to the tetroxide, which is volatile, and is caught in a well-cooled receiver. This is usually called osmic acid, though its acid properties are very weak. It occurs in lustrous, transparent yellow acicular crystals, very hygroscopic, and with an unbearable penetrating odor (the vapor is poisonous). Its boiling-point is about 100° C. (212° F.), and it forms with water a colorless solution which has an intensely acrid and burning taste, and upon addition of sulphurous acid is colored yellow, then red, green and finally blue. Osmic acid liberates iodine from iodides, is reduced from its solution by silver and other metals, and oxidizes organic compounds. It has been employed internally in doses of $\frac{1}{65}$ grain (0.001 Gm.), and subcutaneously in the form of a 1 per cent. solution (which should be freshly prepared) in cases of neuralgia, goitre, cancroid and scrofulous ulcers, and also epilepsy. (See also Potassium Osmate.)

Acidium Phosphorosum. *Phosphorous acid,* E.; *Phosphorige Säure,* G. H_3PO_3.—Obtained by action of phosphorus trichloride, PCl_3, on water: $PCl_3 + 3H_2O = P(OH)_3 + 3HCl$. The solution is evaporated and heated on a sand-bath to 180° C. (356° F.), to drive out HCl, and the residue then dissolved in water. It consists, when free from water, of a colorless crystalline mass, melting at 74° C. (165.2° F.) and decomposing above 180° C. (356° F.) into PH_3 and H_3PO_4: $4H_3PO_3 = PH_3 + 3H_3PO_4$. Phosphorous acid reduces many compounds, as potassium permanganate, silver, gold, and mercury salts. It is a dibasic acid; the salts are called *phosphites.* It is used in analysis to reduce mercuric to mercurous chloride for quantitative determination.

Acidum Selenicum. *Selenic acid,* E.; *Selensäure,* G. H_2SeO_4.—Prepared by oxidizing silver selenite suspended in water with bromine. It resembles sulphuric acid very much. Hydrogen selenide, H_2Se, like H_2S, is a gas, which affects the mucous membranes and is more poisonous than hydrogen sulphide. According to Otto Rosenheim (*Chem. News,* 83, p. 277), the presence of selenium interferes with the tests for arsenic by the Marsh's and other methods. Under certain conditions the arsenic mirror is inhibited completely. Selenium may be detected in the presence of arsenic by the Reinsch test, by using first silver- instead of copper-foil to precipitate the selenium, after which the arsenic may be deposited on copper-foil. Selenium compounds may be recognized by giving an odor of radishes upon heating, and by yielding a red amorphous precipitate of selenium with reducing agents, such as sulphur dioxide.

Acidum Selenosum. *Selenous acid,* E.; *Selenige Säure,* G. H_2SeO_3.—Selenium belongs to the sulphur group of elements. It resembles sulphur very closely in its compounds, but occurs in nature nowhere in large quantities. It is found combined with lead, copper, silver, and thallium, in the sulphur of Volcano Island, and in certain pyrites, which explains the occasional occurrence of selenium in sulphuric acid. Selenium, like sulphur, is a solid existing in several allotropic modifications. When selenium is heated in dry oxygen, it burns with a bluish-green flame, forming the dioxide, which, unlike sulphur dioxide, exists as white needles, volatile at 300° C. (572° F.) without melting. This dissolves in water, forming the acid H_2SeO_3, which is much more stable than sulphurous acid. Mecke finds a solution of selenous acid 0.5 Gm. in concentrated sulphuric acid 100 Gm. to be a sensitive reagent for alkaloids (*Apoth. Ztg.,* Sept. 6, 1899).

Acidum Silicotungsticum. *Silicotungstic acid,* E.; *Kieselwolframsäure,* G. $12WO_3.SiO_2.2H_2O$.—Tungstic acid forms interesting and complex acids with other acids, notably silicic acid. Salts of the above acid which can be crystallized are obtained by boiling alkali paratungstate, $Na_{10}W_{12}O_{41}$, with precipitated gelatinous silicic acid. The sodium salt is soluble in one-fifth its weight of water, the solution having the remarkably high specific gravity 3.05. Gabriel Bertrand (*Compt. rend.,* 128, 742) has found the alkali salts of the acid to be excellent reagents for alkaloids, forming well-defined permanent salts, white or yellow in color, nearly insoluble in cold water, with the general formula $12WO_3.SiO_2.2H_2O.4Alkaloid + nH_2O$. The alkaloids are set free from these precipitates by alkalies and ammonia water.

Acidum Telluricum. *Telluric acid,* E.; *Tellursäure,* G. H_2TeO_4.—Tellurium is a rare element, occurring combined with gold, silver, lead, and bismuth. It belongs to the sulphur group of elements, but has metallic properties. It forms a hydride, H_2Te, and a dioxide, TeO_2. H_2Te is a very poisonous, colorless, badly smelling gas. TeO_2 is colorless, sublimable, and melts at a red heat. Telluric acid, H_2TeO_4, is difficultly soluble; its solution heated to 40° C. (104° F.) precipitates TeO_2. Telluric acid crystallizes as the normal hydrate $Te(OH)_6$ in prisms, soluble in water. On drying the crystals in a warm place, H_2TeO_4 is formed, which at 160° C. (320° F.) gives orange-yellow TeO_3 and water. The salts of telluric acid have little analogy with those of sulphuric acid. Soluble and especially volatile compounds of tellurium, like those of osmium, have marked physiological activity, causing affections of the nervous system, and especially of the eyes. They give a repulsive odor to the perspiration and the breath.

Acidum Vanadicum. *Vanadic acid,* E.; *Vanadinsäure,* G. H_3VO_4.—This is the most important and best known of the compounds of vanadium. It is the final product of the oxidation of vanadium, and bears to this element the same relation that phosphoric, arsenic, and antimonic acids bear to phosphorus, arsenic, and antimony. Similarly there are ortho-, meta-,

and pyro-vanadates, though the most stable salts are the metavanadates, MVO_3. The free metavanadic acid is known. It is a beautiful golden-yellow compound, which may be used as a substitute for gold bronze. Vanadic acid and its sodium salt have been recommended in the treatment of tuberculosis and rheumatism.

ORGANIC ACIDS.

Organic acids may be defined as carbon compounds having the carboxyl group, COOH, as a characteristic constituent. They combine, on the one hand, some of the properties of the carbonyl group, CO, which is found in aldehydes and ketones, and, on the other hand, those of the hydroxyl group, OH, which is characteristic of the alcohols and phenols. While this definition applies to all typical organic acids, other carbon compounds, not containing carboxyl, should also be classified as organic acids, because they possess certain properties found only in members of this class, such as an acid reaction and the ability to neutralize bases and form salts. In place of carboxyl, such acids may contain either the sulphonic group, HSO_3, as in the case of the benzene-sulphonic acids, or the phenol group, OH, as in the case of picric acid, or others.

Organic acids are derived from hydrocarbons of both the fatty and aromatic series, and may be divided into fatty and aromatic acids. The former may again be subdivided into acids of the methane series, olefine or ethylene series, acetylene series, etc., according to the saturation of the underlying hydrocarbons.

Like inorganic acids, the organic may be monobasic, dibasic, tribasic, tetrabasic, etc., depending, as in the case of the former, upon the number of replaceable hydrogen atoms in the acidifying groups. The replacement may be by metals or hydrocarbon radicals; if by the former, the resulting compound is called a salt, as in the case of potassium acetate, CH_3COOK; if by an alcohol radical, the compound is termed an ester, as in the case of ethyl acetate, $CH_3COOC_2H_5$; and if the hydrogen is replaced by an acid radical, an anhydride is formed, as acetic anhydride, CH_3COOCH_3CO. Polybasic organic acids are capable of forming normal as well as acid salts; thus, mono- and dipotassium tartrate, corresponding to mono- and dipotassium sulphate; mono-, di,- and trisodium citrate, corresponding to mono-, di-, and trisodium phosphate, etc. A few organic acids are also capable of forming salts by replacement of hydrogen in some other group besides the acidic carboxyl, as in the case of the diatomic monobasic salicylic acid and the triatomic dibasic meconic acid; these acids contain a hydroxyl group in which the additional replacement occurs, and the resulting salts have been termed *basic salts* by some authors.

Some organic acids are liquid at ordinary temperature, others are solid, and of the latter a few crystallize with definite proportions of water. They occur in nature both in a free state and in combination. Some are freely soluble in water and alcohol, others only to a limited extent, while others are insoluble in water, and a few also in cold alcohol.

Of the very large number of organic acids known to chemists, comparatively few only are of interest to physicians and pharmacists; some of these have been treated under separate headings on account of their greater importance, and the others will follow here in alphabetical order, without regard to their chemical relationship.

Acidum Aconiticum. *Aconitic acid*, E.; *Akonitsäure*, G. $H_3C_6H_3O_6$ or $CH_2CCH(COOH)_3$. —This tribasic acid exists in monk's hood, *Aconitum Napellus*, and other plants, and may also be obtained by dehydrating citric acid by heat or with concentrated hydrochloric or sulphuric acid. It occurs in small laminæ, very soluble in water, alcohol, and ether. It melts at 186.5° C. (376.7° F.), and decomposes at a higher temperature into carbon dioxide and pyrocitric acids.

Acidum Angelicum. *Angelic acid*, E.; *Angelikasäure*, G. $HC_5H_7O_2$ or $CH_3CH.CH.COOH$.—It occurs in the free state in angelica and sumbul roots and as amyl and butyl esters in the oil of anthemis. The acid may be obtained by boiling angelica root with milk of lime and distilling the filtered solution with sulphuric acid; the oily distillate upon cooling yields angelic acid in the form of shining prisms or needles, which melt at 45° C. (113° F.). It is readily soluble in hot water and alcohol, and volatilizes with the vapor of water.

Acidum Anisicum. *Anisic acid, Paramethoxybenzoic acid*, E.; *Anissäure*, G. $HC_8H_7O_3$ or $C_6H_4(OCH_3)COOH$.—This acid does not pre-exist in oil of anise, but is readily obtained therefrom by adding the same to a warm mixture of potassium dichromate, water, and sulphuric acid, whereby the anethol present is oxidized, being converted first into anisic aldehyde and finally to anisic acid. The crude acid which separates is purified by solution in ammonia water, precipitation with hydrochloric acid, and recrystallization from hot water. It occurs in colorless odorless monoclinic prisms or needles, which melt at 184° C. (373° F.), and are readily soluble in boiling water, alcohol, and ether, but only very sparingly in cold water. Its aqueous solution is acid to test-paper, but fails to show a violet coloration upon addition of

ferric chloride solution (difference from salicylic acid). Both sodium and phenyl anisate have been used in medicine; the latter compound has been erroneously called *anisophenylic acid.*

Acidum Arachicum. *Arachic acid, Arachidic acid,* E.; *Arachinsäure,* G. $HC_{20}H_{39}O_2$ or $C_{19}H_{39}COOH$.—A fatty acid found in the oil of the ground (pea or earth) nut, *Arachis hypogœa.* It may be obtained by saponification of the oil with an alkali and subsequent decomposition of the soap with hydrochloric acid. It crystallizes in small shining scales melting at 75° C. (167° F.), which are sparingly soluble in cold alcohol, but readily in ether and boiling alcohol.

Acidum Asparticum. *Aspartic acid, Amido-succinic acid,* E.; *Asparaginsäure, Amidobernsteinsäure,* G. $H_2C_4H_5NO_4$ or $C_2H_3NH_2(COOH)_2$.—This acid occurs in beet-molasses, and is produced by various reactions from albuminous substances. It may be obtained by boiling asparagin, found in asparagus and other plants, with alkalies or acids, and crystallizes in small rhombic prisms, moderately soluble in water. It unites both with acids and bases, and with the latter forms both normal and acid salts. By treatment with nitrous acid it is converted into malic acid.

Acidum Butyricum. *Butyric acid,* E.; *Buttersäure,* G.—Of this acid two modifications are known, namely, normal and isobutyric acids. The former, called also propyl-formic acid and ethyl-acetic acid, $HC_4H_7O_2$ or C_3H_7COOH, occurs in tamarinds and other plants, both free and in combination, but is chiefly of interest because occurring as a glyceride in animal and vegetable fats, especially cows' butter. It may be obtained by fermentation of sugar in contact with putrid cheese at a temperature of about 35° C. (95° F.) and over. Normal butyric acid is a colorless viscid liquid having an unpleasant odor, solidifying at —12° C. (8.4° F.) and boiling at 163° C. (325.4° F.). It dissolves readily in water and in alcohol. Ethyl butyrate, $C_3H_7CO_2C_2H_5$, is used in artificial pineapple flavor.

Isobutyric acid, or dimethyl-acetic acid, $HC_4H_7O_2$ or $HC(CH_3)_2COOH$, is found as a glyceride in croton oil and in a free state in St. John's bread, the fruit of *Ceratonia siliqua.* It resembles the normal acid, but has a less disagreeable odor and is not miscible with water.

Acidum Caffeicum. *Caffeic acid,* E.; *Kaffeesäure,* G. $HC_9H_7O_4$ or $C_6H_3(OH)_2.CH{:}CH.COOH$.—When caffeotannic acid is boiled with a solution of potassium hydroxide, caffeic acid is formed, and may be obtained by decomposing the resulting potassium salt. It crystallizes in yellowish prisms, very soluble in hot water and alcohol. The aqueous solution reduces silver nitrate when heated; ferric chloride colors it green, changing to dark red on addition of sodium carbonate.

Acidum Capricum. *Capric acid, Rutic acid,* E.; *Caprinsäure,* G. $HC_{10}H_{19}O_2$ or $CH_3(CH_2)_8COOH$.—This acid exists as a glyceride in the butter of cows' and goats' milk (hence its name, from *capra,* a goat), and also in cocoanut oil. It occurs as a colorless crystalline body, having a characteristic odor, which becomes stronger upon heating, and melts at 31.4° C. (88.5° F.). It is readily soluble in cold alcohol and ether, and dissolves without change in strong nitric acid.

Acidum Carbamicum. *Carbamic acid, Amido-formic acid,* E.; *Carbaminsäure,* G. HNH_2CO_2 or NH_2COOH.—This acid has never been obtained in the free state, but is of interest on account of its ammonium salt, $NH_2CO_2NH_4$, which enters into the composition of commercial ammonium carbonate and appears to be formed by direct union of ammonia gas and carbon dioxide. Ethyl carbamate, $NH_2CO_2C_2H_5$, has been used as a hypnotic under the name of *urethane.*

Acidum Ceroticum. *Cerotic acid,* E.; *Cerotinsäure,* G. $HC_{28}H_{53}O_2$ or $C_{27}H_{53}COOH$.—Cerotic acid exists in a free state in bees' wax, and may be extracted from the same by means of boiling alcohol. It crystallizes in small grains which melt at 78° C. (172.4° F.) and may be distilled without alteration. Its ceryl ester, $C_{27}H_{55}CO_2C_{27}H_{55}$, forms the chief constituent of Chinese wax, which is produced on certain trees in China by the puncture of a species of *coccus.*

Acidum Cinnamicum. *Cinnamic acid, Phenylacrylic acid,* E.; *Zimmtsäure,* G. $HC_9H_7O_2$ or $C_6H_5CH{:}CH.COOH$.—This acid occurs in Peru and Tolu balsams, storax, and in some varieties of benzoin, in oil of cinnamon as the result of oxidation of the cinnamic aldehyde. It may be obtained by boiling storax or powdered Tolu balsam with milk of lime, filtering and decomposing the resulting calcium cinnamate, which crystallizes out, with hydrochloric acid. It crystallizes in slender needles from hot water and in thick prisms from alcohol, which are inodorous and melt at 133° C. (271.4° F.). This acid dissolves readily in alcohol, but requires 3500 parts of cold water for solution. It is recognized by the odor of oil of bitter almond, benzaldehyde, developed if the acid be warmed with a solution of potassium permangate. Its sodium salt is hypodermically used in tuberculosis in the dose of $\frac{1}{6}$ to $\frac{1}{4}$ grain (0.001–0.015 Gm.).

Acidum Hippuricum. *Hippuric acid, Benzamidoacetic acid, Benzoyl glycocoll,* E.; *Hippursäure,* G. $HC_9H_8NO_3$ or $CH_2(NH.C_7H_5O).COOH$.—Hippuric acid occurs in the urine of horses and cattle, and is the form in which benzoic and cinnamic acids, toluene, and other aromatic substances are excreted when taken into the human organism. It may be obtained by boiling fresh urine of horses with milk of lime, filtering, concentrating the filtrate, and precipitating with hydrochloric acid; the crude acid is purified by washing with chlorine water. It crystallizes in rhombic prisms, with acid reaction and slightly bitter taste, which melt at 187° C. (368.6° F.), and are soluble in 600 parts of cold water, readily soluble in hot water and alcohol.

Acidum Lauricum. *Lauric acid,* E.; *Laurinsäure,* G. $HC_{12}H_{23}O_2$ or $CH_{11}H_{23}COOH$.—This acid occurs as a glyceride chiefly in the fruit of the bay tree, *Laurus nobilis,* of the spice

bush, *Lindera Benzoin*, and in pichury beans. It is associated also with other fatty acids in the oil of the cocoanut and other fruits, and may be obtained by saponifying these fats with alkali and decomposing the resulting soap with tartaric or hydrochloric acid. Lauric acid is insoluble in water, but is readily soluble in alcohol and ether, and crystallizes from alcohol in shining white silky needles, which melt at 43.6° C. (110.5° F.). The laurates of the alkali metals are soluble in water.

Acidum Malicum. *Malic acid, Hydroxysuccinic acid*, E.; *Aepfelsäure*, G. $H_2C_4H_4O_5$ or $C_2H_3OH(COOH)_2$.—Malic acid occurs both in the free and combined state in numerous fruits—hence its name from *malum*, apple—as well as the juice of garden rhubarb and of the berries of the mountain-ash, *Sorbus acuparia*. It is obtained by treating the neutralized expressed juice with lead acetate after removal of any oxalic acid present by calcium acetate, and collecting the resulting lead malate on a filter, washing, diffusing in water, and decomposing with hydrogen sulphide. The liquid is filtered, concentrated to a syrupy consistence, and left in a dry atmosphere until it becomes converted into a solid mass of malic acid. It crystallizes in groups of colorless prisms, somewhat deliquescent and readily soluble in water and in alcohol. If heated to 100° C. (212° F.), the acid melts, and at 140° C. (284° F.) it loses water and is converted into fumaric and maleic acids.

Acidum Mandelicum. *Acidum amygdalicum. Mandelic acid, Phenylglycollic acid*, E.; *Mandelsäure, Amygdalinsäure*, G. $HC_8H_7O_3$ or $C_6H_5.CHOH.COOH$.—This acid is of interest as forming with antipyrine a salt, antipyrine mandelate, known also as *tussol*, which is used to some extent in medicine. It may be prepared by heating the glucoside amygdalin with hydrochloric acid or by boiling oil of bitter almond (benzaldehyde) for 30 hours with hydrocyanic and hydrochloric acids; in the latter case benzyl oxycyanide, $C_6H_5CH(OH)CN$, is formed, which, taking up the elements of water, produces mandelic acid and ammonia. It crystallizes in prisms or plates, readily soluble in water, alcohol, and ether.

Acidum Meconicum. *Meconic acid, Oxychelidonic acid*, E.; *Mekonsäure*, G. $H_2C_7H_2O_7$ or $C_5HO_2(OH)(COOH)_2$.—Meconic acid occurs in opium, in which it was discovered first in 1805, and may be obtained by treating an infusion of opium with calcium chloride and chalk. The calcium meconate thus obtained is decomposed by hydrochloric acid, and the resulting crude meconic acid treated repeatedly with hydrochloric acid. It crystallizes in plates or prisms containing 3 molecules of water, readily soluble in alcohol and in hot water, but only sparingly in cold water. Ferric chloride added to solutions of meconic acid causes a blood-red color, due to formation of ferric meconate and closely resembling the color of ferric acetate and sulphocyanate, from which it can be distinguished, however, by its indifference to dilute hydrochloric acid (color of ferric acetate is discharged), and to auric and mercuric chlorides, which destroy the color of ferric sulphocyanate. This reaction may be used to determine the presence of opium in many liquids. Although meconic acid contains but two carboxyl groups, it contains three replaceable hydrogen atoms, of which one is derived from the hydroxyl group present, and is capable of forming acid, normal, and basic salts; the basic salts of the metals always have a yellow color. It was for a long time considered a tribasic acid, as announced by Liebig, but it has since been shown that only two carboxyl groups are present, and that hence it is only dibasic.

Acidum Myristicum. *Myristic acid*, E. *Myristinsäure*, G. $HC_{14}H_{27}O_2$ or $C_{13}H_{27}COOH$. —It occurs as glyceryl trimyristate in the fat of nutmegs, better known as nutmeg butter, and is found also in cocoanut oil and other fats. When pure it crystallizes in white shining laminæ which melt at 54° C. (129.2° F.), and are readily soluble in ether and in hot alcohol. The alkali myristates are soluble in water without decomposition—difference from the stearates.

Acidum Myronicum. *Myronic acid*, E.; *Myronsäure*, G. $HC_{10}H_{18}NS_2O_{10}$.—This acid occurs in black mustard seed as potassium myronate, a glucoside better known as *sinigrin*, upon which depends the production of volatile oil of mustard by reaction with an albuminous ferment called *myrosin*.

Acidum Opianicum. *Opianic acid, Aldehydodimethylprotocatechuic acid*, E.; *Opiansäure*, G. $HC_{10}H_9O_5$ or $C_6H_2(OCH_3)_2CHOCOOH$.—Opianic acid is of interest in pharmacy chiefly as a by-product in the manufacture of hydrastinine, by treating hydrastine with oxidizing agents. It is obtained also together with cotarnine when narcotine is subjected to oxidation. It occurs in slender colorless prisms, slightly soluble in cold water and melting at 140° C. (285° F.).

Acidum Palmiticum. *Palmitic acid, Hexadecylic acid*, E.; *Palmitinsäure*, G. $HC_{16}H_{31}O_2$ or $CH_3(CH_2)_{14}COOH$.—Palmitic acid occurs in nature in a free state and in combination. Solid animal fats are composed chiefly of the glyceryl esters of palmitic and stearic acids. Palm oil, Chinese tallow, and Japan wax consist chiefly of the glyceride of palmitic acid. Spermaceti is cetyl palmitate, and the chief constituent of bees' wax is myricyl palmitate. The acid may be obtained by saponifying palm oil with caustic potash, decomposing the resulting soap with sulphuric acid, washing the precipitated acid with water, and recrystallizing from hot alcohol until a product is obtained having a constant melting-point. When pure it crystallizes in colorless odorless tasteless needles, melting at 62° C. (143.6° F.), and congeals to a mass of shining nacreous laminæ. It is soluble in boiling alcohol, the solution when concentrated solidifying on cooling. The alkali palmitates are important constituents of soaps: they separate in a gelatinous condition from water and alcohol.

Acidum Phtalicum. *Phtalic acid, Benzenedicarboxylic acid*, E.; *Phtalsäure*, G. $H_2C_8H_4O_2$ or $C_6H_4(COOH)_2$.—This acid is of interest to pharmacists chiefly in connection with morphine

phthalate, introduced into medicine, and phenolphthalein, a valuable indicator in alkalimetry. It is obtained by the action of nitric acid and other oxidizing agents on naphtalene; chromic acid mixture, however, cannot be used in its preparation, as it is easily oxidized thereby to carbon dioxide. Phtalic acid crystallizes in short prisms or laminæ, slightly soluble in cold water, and readily soluble in hot water, alcohol, and ether. It melts at 185° C. (365° F.), and at a higher temperature is resolved into its anhydride, $C_6H_4(CO)_2O$, and water. *Phenolphtalein* is made by heating phenol, phtalic anhydride, and sulphuric acid together at 120° C. (248 ° F.) for 8 or 10 hours, leaching the mixture with boiling water, and dissolving the residue in solution of sodium hydroxide. After filtration phenolphtalein is precipitated by acetic acid, dissolved in alcohol, decolorized with animal charcoal, and precipitated by addition of water.

Acidum Succinicum. *Succinic acid, Ethylene dicarboxylic acid*, E.; *Bernsteinsäure*, G. $H_2C_4H_4O_4$ or $(CH_2)_2(COOH)_2$.—The formation of a crystalline sublimate during the distillation of amber was observed first during the sixteenth century, but not until 1675 was its acid nature determined. Succinic acid, which derives its name from the Latin *succinum*, amber, is widely distributed in both the animal and vegetable kingdoms. When prepared by destructive distillation of amber it is generally contaminated with oil of amber, and may be purified by treatment with nitric acid and subsequent recrystallization. By this method about 5 per cent. may be obtained, while if powdered amber be treated with solution of potassium hydroxide the yield may be increased to 8 per cent. It occurs in colorless odorless prismatic crystals, which melt at 184° C. (363.2° F.) and are soluble in 20 parts of cold and 2.2 parts of boiling water; also soluble in 10 parts of 90 per cent. alcohol and in 80 parts of ether. The commercial acid frequently has a yellowish color and the odor of oil of amber. Succinic acid is rarely employed in medicine in this country. It has been recommended in rheumatism, bronchitis, and hysteria, but its administration is probably attended with little or no result. Solution of succinate of ammonium may be employed in hysterical affections, delirium tremens, and low fevers. The dose of the acid is stated to be from 5 to 15 grains (0.3–1 Gm.); of the solution of succinate of ammonium, from 10 to 30 minims (0.6–2 Cc.).

ACIDUM ACETICUM, *U. S., Br., P. G.*—Acetic Acid.

Acide acétique, Fr.; *Essigsäure*, G.; *Acido acetico*, It., Sp.

Formula, $HC_2H_3O_2$ or CH_3COOH. Molecular weight, 59.58.

History.—The substance known as vinegar, meaning sharp or sour wine, was known during antiquity. Its purification by means of distillation was taught by Geber (eighth century). The preparation of more concentrated acids by distillation of acetates, especially of copper and lead acetates, was known first to Basil Valentine (fifteenth century) and other alchemists. Wood vinegar was known to Glauber in 1648, but was examined only toward the close of the eighteenth century. The crystallization of pure acetic acid was observed by Lauraguais (1759). The preparation and properties of glacial acetic acid were, however, described in detail by Westendorf (1772) and by Löwitz (1789–1793).

Occurrence.—Acetic acid occurs extensively, though in small quantity, partly free, partly as salts (potassium and calcium acetates) or esters, both in the vegetable and the animal kingdoms. The hexyl ester has been found in *Heraclium sphondylium*, the octyl ester in *H. sphondylium* and *H. giganteum*, the menthyl ester in *Mentha piperita*, the bornyl ester in a number of coniferous (*Fichtennadel Oel*) and other oils, the terpinyl ester also, etc. The glyceride occurs in croton oil and other fatty oils.

Preparation.—Almost all of the acetic acid used in the arts and industries is obtained indirectly from wood. That used for culinary purposes (vinegar) is made principally by the acetous fermentation of dilute alcoholic liquids obtained by the vinous fermentation of grain (see Acetum).

Formerly much acetic acid was obtained in the form of wood vinegar or pyroligneous acid, by destructive distillation of oakwood in iron retorts kept at a temperature of 205° C. (401° F.). This crude acid liquid, of slightly yellowish color, was neutralized with soda-ash or sodium carbonate and evaporated, the resulting sodium acetate being then roasted to destroy empyreumatic products and to drive off water and other volatile matter. Upon finally treating the sodium acetate in suitable stills with sulphuric acid, purified acetic acid was obtained. This plan has, however, been abandoned by manufacturers, who now prefer to procure the acetic acid in the form of calcium acetate from charcoal-burners, and then bring this into solution and decompose it with sodium sulphate, whereby calcium sulphate is precipitated and sodium acetate remains in solution, which is then filtered and further treated as above explained.

If wood is distilled at a temperature above 230° C. (446° F.), as in the manufacture of charcoal, the resulting wood vinegar is more or less highly colored and possesses a strongly empyreumatic odor. It requires a tedious process of purification by means of milk of lime, whereby soluble calcium acetate is formed and many impurities are precipitated as insoluble calcium compounds.

Acetic acid may also be obtained direct from crude calcium acetate, and in order to avoid reaction of the strong sulphuric acid with the tarry impurities present, resulting in volatile products likely to contaminate the acid, it has been suggested to use polysulphates in place of the sulphuric acid. The liberation of acetic acid would occur as follows: $3Ca(C_2H_3O_2)_2 + 2NaH_3(SO_4)_2 = 6HC_2H_3O_2 + 3CaSO_4 + Na_2SO_4$.

Chemically, acetic acid may be looked upon as methane or marsh-gas (CH_4), in which an atom of hydrogen has been replaced by the carboxyl group, COOH, forming a monobasic acid; thus, $CH_3COOH = HC_2H_3O_2$. It is a remarkably stable acid, and, although rich in oxygen, is not decomposed at moderately high temperatures, nor is it readily affected by oxidizing or reducing agents.

Specific gravity is of no value in the examination of acetic acid, since the maximum density is reached in an 80 per cent. solution; beyond this point the specific gravity again decreases until absolute acetic acid is reached, having a density of 1.053. Official glacial acetic acid and an acid of 46 per cent. have the same specific gravity, 1.058 at 15° C. (59° F.), and, if diluted with water, the density of the weaker acid only will fall, that of the stronger acid increasing; between 72 and 84 per cent. acetic acid the specific gravity is almost stationary, the rise between these two points amounting to not more than 0.0008. Titration with normal alkali solution, as directed in the Pharmacopœia, is the only correct means of ascertaining the strength of acetic acid solutions, each Cc. of normal KOH solution corresponding to 0.05958 Gm. of absolute $HC_2H_3O_2$, as shown by the equation $KOH + HC_2H_3O_2 = KC_2H_3O_2 + H_2O$.

The following table, adopted by the U. S. P., shows the specific gravity at 15° C. and at 25° C. for acetic acid of different percentage strengths, and also the quantity of normal alkali required by 1 Cc. of these acids:

Per cent. absolute acetic acid.	Specific gravity— 25° C. / 25° C.	Specific gravity— 15° C. / 15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
1	1.0015	1.0015	0.00017	0.067	0.17	0.059
2	1.0030	1.0030	0.00018	0.071	0.34	0.059
3	1.0044	1.0045	0.00019	0.067	0.51	0.063
4	1.0059	1.0060	0.00020	0.071	0.67	0.059
5	1.0073	1.0075	0.00021	0.071	0.84	0.059
6	**1.0087**	**1.0090**	**0.00022**	**0.071**	**1.01**	**0.059**
7	1.0101	1.0105	0.00023	0.077	1.18	0.059
8	1.0114	1.0120	0.00024	0.071	1.35	0.056
9	1.0128	1.0135	0.00025	0.071	1.53	0.059
10	1.0142	1.0150	0.00026	0.071	1.70	0.059
11	1.0156	1.0165	0.00027	0.071	1.87	0.059
12	1.0169	1.0179	0.00028	0.077	2.04	0.056
13	1.0183	1.0193	0.00028	0.071	2.22	0.059
14	1.0197	1.0208	0.00029	0.077	2.39	0.059
15	1.0210	1.0222	0.00030	0.077	2.56	0.056
16	1.0223	1.0236	0.00031	0.077	2.74	0.059
17	1.0236	1.0250	0.00032	0.077	2.91	0.056
18	1.0249	1.0264	0.00033	0.077	3.09	0.059
19	1.0262	1.0278	0.00034	0.077	3.26	0.056
20	1.0275	1.0292	0.00035	0.083	3.44	0.056
21	1.0287	1.0306	0.00037	0.083	3.62	0.059
22	1.0299	1.0319	0.00038	0.083	3.79	0.056
23	1.0311	1.0332	0.00039	0.083	3.97	0.056
24	1.0323	1.0345	0.00041	0.091	4.15	0.059
25	1.0334	1.0358	0.00042	0.083	4.32	0.056
26	1.0346	1.0371	0.00044	0.091	4.50	0.056
27	1.0357	1.0384	0.00045	0.100	4.68	0.056
28	1.0367	1.0396	0.00047	0.091	4.86	0.056
29	1.0378	1.0408	0.00048	0.100	5.04	0.056
30	1.0388	1.0420	0.00050	0.100	5.22	0.056
31	1.0398	1.0432	0.00051	0.100	5.40	0.056
32	1.0408	1.0444	0.00053	0.100	5.58	0.056
33	1.0418	1.0455	0.00055	0.100	5.76	0.056
34	1.0428	1.0467	0.00057	0.111	5.94	0.056
35	1.0437	1.0478	0.00059	0.100	6.12	0.056
36	**1.0447**	**1.0489**	**0.00060**	**0.111**	**6.30**	**0.056**
37	1.0456	1.0500	0.00062	0.125	6.48	0.056
38	1.0464	1.0510	0.00064	0.111	6.66	0.056

[1] Add if the temperature is above, subtract if the temperature is below, 25° C.
[2] Corresponding with a difference in specific gravity of 0.0001.

Per cent. absolute acetic acid.	Specific gravity— $\frac{25°\text{ C.}}{25°\text{ C.}}$	Specific gravity— $\frac{15°\text{ C.}}{15°\text{ C.}}$	Correction of specific gravity for 1° C.	Fractional per cent.	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
39	31.047	1.0521	0.00066	0.111	6.84	0.056
40	1.0481	1.0531	0.00068	0.111	7.02	0.056
41	1.0490	1.0541	0.00069	0.125	7.20	0.056
42	1.0498	1.0551	0.00070	0.111	7.38	0.056
43	1.0507	1.0560	0.00071	0.111	7.56	0.056
44	1.0516	1.0570	0.00072	0.125	7.74	0.053
45	1.0524	1.0579	0.00073	0.125	7.93	0.056
46	1.0532	1.0588	0.00074	0.125	8.11	0.056
47	1.0540	1.0597	0.00074	0.111	8.29	0.056
48	1.0549	1.0606	0.00075	0.125	8.47	0.053
49	1.0557	1.0615	0.00076	0.143	8.66	0.056
50	1.0564	1.0623	0.00077	0.125	8.84	0.056
51	1.0572	1.0631	0.00078	0.143	9.02	0.056
52	1.0579	1.0639	0.00078	0.143	9.20	0.053
53	1.0586	1.0646	0.00079	0.143	9.39	0.056
54	1.0593	1.0654	0.00080	0.167	9.57	0.053
55	1.0599	1.0661	0.00081	0.167	9.76	0.056
56	1.0605	1.0668	0.00081	0.167	9.94	0.056
57	1.0611	1.0674	0.00082	0.167	10.12	0.053
58	1.0617	1.0681	0.00083	0.167	10.31	0.056
59	1.0623	1.0687	0.00083	0.200	10.49	0.056
60	1.0628	1.0693	0.00084	0.200	10.67	0.053
61	1.0633	1.0699	0.00084	0.200	10.86	0.056
62	1.0638	1.0705	0.00085	0.200	11.04	0.056
63	1.0643	1.0710	0.00086	0.250	11.22	0.056
64	1.0647	1.0715	0.00087	0.250	11.40	0.053
65	1.0651	1.0720	0.00088	0.250	11.59	0.056
66	1.0655	1.0725	0.00088	0.250	11.77	0.056
67	1.0659	1.0729	0.00089	0.333	11.95	0.056
68	1.0662	1.0733	0.00090	0.250	12.13	0.053
69	1.0666	1.0737	0.00090	0.333	12.32	0.056
70	1.0669	1.0741	0.00091	0.333	12.50	0.056
71	1.0672	1.0745	0.00091	0.500	12.68	0.056
72	1.0674	1.0748	0.00092	0.500	12.86	0.056
73	1.0676	1.0750	0.00093	1.000	13.04	0.056
74	1.0677	1.0752	0.00093	1.000	13.22	0.056
75	1.0678	1.0754	0.00094	. .	13.40	0.056
76	1.0679	1.0755	0.00095	. .	13.58	0.056
77	1.0679	1.0756	0.00095	. .	13.76	0.056
78	1.0679 [1]	1.0756	0.00096	. .	13.94	0.056
79	1.0678	1.0756	0.00096	. .	14.12	0.056
80	1.0678	1.0756	0.00097	1.000	14.30	0.056
81	1.0677	1.0755	0.00097	0.500	14.48	0.056
82	1.0675	1.0754	0.00098	0.333	14.66	0.059
83	1.0672	1.0752	0.00099	0.333	14.83	0.059
84	1.0669	1.0750	0.00099	0.333	15.00	0.059
85	1.0666	1.0747	0.00100	0.250	15.17	0.059
86	1.0662	1.0744	0.00100	0.200	15.34	0.059
87	1.0657	1.0739	0.00101	0.200	15.51	0.059
88	1.0652	1.0734	0.00101	0.143	15.68	0.059
89	1.0645	1.0728	0.00102	0.143	15.85	0.059
90	1.0638	1.0721	0.00102	0.111	16.02	0.059
91	1.0629	1.0713	0.00103	0.091	16.19	0.063
92	1.0620	1.0704	0.00103	0.091	16.35	0.063
93	1.0609	1.0694	0.00104	0.077	16.51	0.063
94	1.0596	1.0682	0.00104	0.071	16.67	0.067
95	1.0582	1.0668	0.00105	0.059	16.82	0.067
96	1.0565	1.0652	0.00105	0.050	16.97	0.067
97	1.0545	1.0633	0.00106	0.045	17.12	0.071
98	1.0523	1.0612	0.00106	0.042	17.26	0.077
99	1.0499	1.0588	0.00107	0.037	17.39	0.077
100	1.0472	1.0562	0.00108	. .	17.52	

Note.—If the specific gravity $\left(\frac{25°\text{ C.}}{25°\text{ C.}}\right)$ of the acid be greater than 1.045, mix with some of the acid an equal weight of water before taking the specific gravity, and multiply the percentage taken from the table by two.

To find the weight in grammes of absolute acetic acid in 100 Cc., multiply the specific gravity by the per cent. of absolute acid.

To find the volume per cent. of official Acetic Acid, multiply the "normality" by 15.87. For the volume per cent. of Glacial Acetic Acid, multiply the "normality" by 5.71. For the volume per cent. of official diluted Acetic Acid, multiply the "normality" by 99.

[1] Below this point the specific gravity diminishes as the strength of the acid increases.

The U. S. Pharmacopœia recognizes three grades of acetic acid, which are designated officially as glacial acetic acid, acetic acid, and diluted acetic acid, and contain, respectively, 99, 36, and 6 per cent. of absolute $HC_2H_3O_2$. The three acids, recognized by the same names in the British Pharmacopœia, correspond very closely in strength to the above, containing 99, 33, and 4.27 per cent. of absolute acetic acid, respectively; but in the German Pharmacopœia the term acetic acid is used to designate a solution containing 96 per cent. of absolute acid, while the German diluted acetic acid contains 30 per cent.

I. **Acidum Aceticum**, U. S., Br.; *Acetic acid*, E.; *Acide acétique*, Fr.; *Essigsäure*, G.

Preparation.—The manufacture of acetic acid in general has been explained above. In all probability manufacturers and dealers prepare the official acid by simply diluting a stronger acid with the required quantity of water and standardizing the mixture with volumetric alkali solution. Acetic acid of 60 and 80 per cent. strength can be purchased from reliable manufacturers at relatively lower prices than the official acid. These can be diluted to suit any requirement by the following simple rule: Multiply the desired quantity (in grammes or avoirdupois ounces) by the required percentage and divide the product by the percentage of the stronger acid; the quotient will represent the quantity of stronger acid necessary to yield the desired quantity of weaker acid. Thus, if 1000 Gm. (or 100 ounces) of official acetic acid (36 per cent.) are to be made from 80 per cent. acid, it would be necessary to mix 450 Gm. (or 45 ounces) of the strong acid with 550 Gm. (or 55 ounces) of water; for 1000 (or 100) $\times$ 36 = 36,000 (or 3600), and 36,000 (or 3600) $\div$ 80 = 450 (or 45), then 1000 (or 100) — 450 (or 45) = 550 (or 55).

Properties.—Acetic acid occurs as a colorless, clear liquid of strongly acid reaction, vinegar-like odor, and pure acid taste. It is volatilized completely when heated, and mixes in all proportions with alcohol and water. If ferric chloride test-solution be added to acetic acid previously neutralized with ammonia water, a blood-red color, due to formation of ferric acetate, is produced, which is discharged by strongly acidulating with sulphuric acid.

The official acid has a specific gravity of 1.045 at 25° C. (77° F.), U. S., and 1.044 at 15.59° C. (60° F.), Br., which indicates a percentage of absolute acid amounting to 36 U. S. and 33 Br. *Acidum aceticum* of the P. G. and *Acide acétique du commerce* of the French Codex differ considerably from the above, the former being of 1.064 specific gravity and containing 96 per cent. of absolute acid, while the latter has a specific gravity of 1.060 and contains 49 per cent. of absolute acid.

Tests.—The transparency of the acid is not disturbed on diluting it with distilled water or alcohol; and on evaporating it on a water-bath no residue should be left (saline impurities). Calcium salts if present will produce a white precipitate upon addition of ammonium oxalate solution. Iron is detected best by the blue color or precipitate occasioned with potassium ferrocyanide; zinc, by the white precipitate; and the other metals, like copper, lead, or tin, by the brown or black color or precipitate formed on the addition of hydrogen sulphide after previous dilution with water. Empyreumatic products, if present in considerable proportion, may be detected by the odor after the acid has been diluted largely with water or neutralized with an alkali; smaller quantities are indicated by adding a minute quantity of solution of potassium permanganate, the color of which will disappear readily; pure acetic acid, containing less than 50 per cent. of absolute acid, is not affected by this test (Hager, Merck).

The U. S. P. directs proving the absence of copper by excess of ammonia (blue color); lead and other metals, by hydrogen sulphide (coloration or precipitate); sulphuric and hydrochloric acids, by barium chloride and silver nitrate (turbidity or precipitate); and formic or sulphurous acid, by neutralizing with ammonia and warming with silver nitrate (dark color and precipitate). The limit of empyreumatic substances is ascertained by diluting 2 Cc. of the acid with 10 Cc. of distilled water in a clear glass-stoppered vial, and adding 5 drops of decinormal potassium permanganate solution; the tint of the mixture should not change at once from pink to brown, and in half a minute should not be entirely free from pinkish brown. 5.96 Gm. of the acid should require 36 Cc., U. S. (1 Gm.—3.3 Cc., Br.), of normal potassium or sodium hydroxide solution for complete neutralization, using methyl orange as indicator.

II. **Acidum Aceticum Dilutum**, U. S., Br.; *Acetum purum s. destillatum.—Diluted acetic acid*, E.; *Acide acétique dilué*, Fr.; *Verdünnte Essigsäure, Reiner Essig*, G.

Preparation.—Diluted acetic acid is prepared by mixing 100 Gm. of acetic acid

with 500 Gm. of distilled water, U. S., or 1 part of acid with 5 parts of water (by weight). The Br. directs 1 volume of acetic acid to be mixed with 7 volumes of distilled water.

The diluted acetic acid of the P. G. is a much stronger preparation, containing 30 per cent. of absolute acid, and corresponds more nearly to the official acetic acid of this country and England.

Properties.—Diluted acetic acid has a specific gravity of 1.009 at 25° C. (77° F.), U. S. (1.006 at 15.59° C. (60° F.), Br.), corresponding to 6 per cent. (4.27 per cent., Br.) of absolute acid; therefore 23.8 Gm. of the acid require for neutralization 24 Cc., U. S. (10 Gm.—7.12 Cc., Br.), of volumetric solution of potassium hydroxide. The purity of diluted acetic acid is ascertained by the same tests mentioned for the stronger acid.

III. **Acidum Aceticum Glaciale,** U. S., Br.; *Glacial acetic acid,* E.; *Acide acétique crystallizable,* Fr. Cod.; *Esprit de vinaigre, Vinaigre glacial,* Fr.; *Eisesssig,* G.; *Acido acetico-concentrato,* It.

Preparation.—Glacial acetic acid is obtained by distilling anhydrous sodium acetate with concentrated sulphuric acid and exposing the resulting liquid to a temperature below 10° C. (50° F.); after crystallization has taken place the remaining liquid may be drained off and again exposed to cold, to secure a farther yield of crystals. It may also be prepared by distilling an intimate mixture of anhydrous sodium acetate and fused potassium sulphate, as suggested by Hirsch. Glacial acetic acid of official strength retains its crystalline form until a temperature of at least 15° C. (59° F.) is reached, when it slowly begins to liquefy; much of the so-called glacial acetic acid of commerce is simply a strong solution, containing from 75 to 85 per cent. of absolute acid, and does not solidify at a temperature of 5° C. (41° F.), or even lower.

Properties.—Glacial acetic acid forms colorless flat rhombic crystals, which melt on the application of heat to a colorless liquid, and this retains the fluid condition frequently on being cooled to 10° C. (50° F.), unless brought in contact with a crystal. At the mean temperature of the air it forms a colorless liquid with a strong acetous odor and very pungent, acid taste. It boils at 117°–118° C. (242.6°–244.4° F.), the vapor evolved burning with a blue flame.

The U. S. and Br. Pharmacopœias require glacial acetic acid to contain 99 per cent. of absolute $C_4H_2O_2$; but the melting-point is given at about 15° C. (59° F.), U. S., and above 15.5° C. (60° F.), Br., and the specific gravity as not above 1.049 at 25° C. (77° F.), U. S., and 1.058 at 15.5° C. (60° F.), Br., 1.063, Fr. Cod. An acid of the strength indicated is miscible in all proportions with alcohol, ether, and chloroform, and dissolves an equal weight of fresh oil of lemon, but less of the resinified oil. The oil is also far less soluble in weaker acetic acid, requiring about 10 parts of the latter if of 96 per cent. A more reliable test for the absence of water is carbon disulphide; equal parts of it and glacial acetic acid form, according to Flückiger, a clear solution at and above 20° C. (68° F.), but an opalescent or turbid liquid below that temperature. On neutralizing the acid 1.49 Gm. of it should require not less than 24.75 Cc. (1 Gm. 16.6 Cc., Br.) of normal potassium hydroxide solution (U. S.). The German Pharmacopœia recognizes glacial acetic acid under the simple name *Acidum Aceticum,* which is apt to give rise to confusion with the weaker acids of the same name used in other countries. It requires that the acid shall contain at least 96 per cent. of absolute $HC_2H_3O_2$. If this acid be mixed with 9 parts of water, 5 Cc. of the mixture will require not less than 8 Cc. of normal alkali solution for neutralization. The absence of arsenic is determined by mixing 1 Cc. of the acid with 3 Cc. of stannous chloride solution; the mixture should not acquire a brown or black color within 1 hour.

Glacial acetic acid absorbs moisture from the atmosphere, whereby its melting-point is lowered and its density increased to a certain degree. It must therefore be preserved in tightly stoppered bottles. For the detection of impurities, this acid is to be diluted with distilled water, and then tested as stated under Acidum Aceticum. It should respond to the same tests of purity; but the tint produced by the addition of 2 drops of decinormal potassium permanganate solution to 2 Cc. of the acid diluted with 10 Cc. of water, should not be changed to brown within 2 hours (U. S.).

Action and Uses.—Pure acetic acid is not used in medicine except in its dilute form (for action, uses, and dose, see Acetum).

Glacial acetic acid is used externally as a caustic in the removal of warts, corns, and vegetations about the external genitals. It may be employed as a vesicant when a very rapid action is desired, but should be applied with caution, because of its tendency to spread and involve too great an area.

ACIDUM AGARICUM.—Agaric Acid.

Agaricinum, P. G.—*Agaricin, Agaricic acid*, E.; *Acide agarique*, Fr.; *Agaricinsäure, Agaricussäure*, G.

Formula, $C_{16}H_{30}O_5 + H_2O$ or $C_{14}H_{27}(OH)(COOH)_2H_2O$. Molecular weight, 319.28.

Occurrence and Preparation.—Agaric acid occurs in the resinous principles of the larch agaric, and may be obtained as follows: Powdered agaric is exhausted with alcohol and the resulting solution concentrated by evaporation. Upon cooling, three white resins separate, while a red-colored resin remains in solution. By treating the white resins with warm 60 per cent. alcohol, impure agaric acid is extracted, which may be farther purified by dissolving in hot alcohol and adding an alcoholic solution of potassium hydroxide, whereby it is split up into alpha, beta, and gamma resins, the first two forming respectively soluble and insoluble potassium salts, while the last named does not combine with alkali. After filtering, the residue is treated with water and again filtered, whereby the gamma resin is removed. Upon addition of barium chloride to the filtrate, the barium salt of agaric acid is precipitated, which, after solution in boiling 30 per cent. alcohol, is decomposed with dilute sulphuric acid and filtered. Pure agaric acid crystallizes out from the filtrate while cooling.

Properties.—Agaric acid forms either a white amorphous or crystalliue powder; the microscope shows the latter to be made up of quadrangular plates. It fuses near 140° C. (284° F.) to a yellow liquid, which, when heated to a higher temperature, gives off white fumes and chars with a caramel-like odor; lastly, it burns, leaving no or only a trace of residue. It is soluble in 130 parts of cold and 10 parts of hot alcohol, more soluble in hot acetic acid and hot oil of turpentine, and only slightly soluble in ether, chloroform, benzene, and cold water; in hot water it swells, and when boiled dissolves, forming a clear and strongly foaming solution, which shows an acid reaction with litmus-paper, and on cooling becomes turbid. Agaric acid is a dibasic acid, crystallizing with 1 molecule of water, which it loses at 80° C. (176° F.); at higher temperatures the anhydride, $C_{16}H_{28}O_4$, is formed. Ammonia and potassium hydroxide solution should dissolve it. 0.1 Gm. of agaric acid dissolved in 15 Cc. of absolute alcohol yields with alcoholic potassium hydroxide solution a white precipitate which should be soluble in water. If 0.1 Gm. of agaric acid be boiled with 10 Cc. of diluted sulphuric acid, a turbid liquid results, which upon standing on a hot water-bath deposits oily globules, becoming crystalline on cooling.—P. G.

For uses, see Agaric.

ACIDUM ARSENOSUM.—Arsenous Acid.

See Arseni Trioxidum, page 243.

ACIDUM BENZOICUM, *U. S., Br., P. G.*—Benzoic Acid.

Acidum Benzoicum sublimatum, Flores benzoes.—Flowers of benzoin, E.; *Acide benzoique, Fleurs de benjoin*, Fr.; *Benzoesäure, Benzoeblumen*, G.; *Acido benzico*, It., Sp.

Formula, $HC_7H_5O_2$ or C_6H_5COOH. Molecular weight, 121.13.

Origin.—Benzoic acid is contained in benzoin, Tolu balsam, Peru balsam, storax, Botany Bay resin, in several other resinous exudations, and in certain plants. It was described by Vigenere (1608) as one of the products of the dry distillation of benzoin, and was recognized by Lemery (1675) and Scheele (1775) as an acid. Liebig (1836) found it among the products of the dry distillation of hippuric acid, and Dessaignes (1847) obtained it from the latter by the action of the acids and alkalies. Its artificial preparation is described below.

Preparation.—Benzoic acid may be obtained by subjecting benzoin in coarse powder, after removal of adhering moisture by careful warming or exposure over burnt

lime, to dry distillation in shallow iron pans. The pan is covered with a porous diaphragm, preferably of cloth, and then provided with a suitable condenser consisting either of a cap of thick, well-sized paper or a pasteboard hood or box suitably lined with glazed paper. The application of sand-bath heat should carefully be regulated, as the acid begins to sublime at 100° C. (212° F.), and at 140°–145° C. (284°–293° F.) is volatilized very freely. As the temperature is allowed to rise to 200° C. (392° F.) and over, the acid will be contaminated with other products, partly the result of decomposition, such as guaiacol, pyrocatechin, benzylbenzoate, vanillin, etc. The sublimed acid obtained from the cooled apparatus is used, but is never chemically pure; if made from good benzoin, the yield may reach 8 or 10 per cent., leaving often a still larger proportion in the fused resin, from which it may be obtained by the wet process, to be described presently, or the resinous mass may be broken again into small pieces and subjected to another sublimation.

The *wet process* for obtaining benzoic acid is carried on usually as follows: 4 or 5 parts of powdered benzoin and 1 part of lime are mixed with 10 parts of water, and the mixture allowed to stand in a warm place for some hours, replacing the water lost by evaporation; 50 parts of water are now added, the mixture boiled down to 30 parts, and filtered while hot. The residue is boiled again with water, and the mixed filtrates are supersaturated with hydrochloric acid. In this process, which is essentially that of Scheele (1775), the benzoic acid, together with a little resin, is rendered more freely soluble in water through the formation of calcium benzoate. This salt is decomposed in the filtrate by the hydrochloric acid, with the production of freely soluble calcium chloride and crystallizing benzoic acid, the latter being contaminated with some resin and coloring-matter, from which it may be freed by dissolving it in 20 times its weight of boiling water, adding some animal charcoal, filtering while hot, and crystallizing. In order to impart to the acid obtained by this method the peculiar aroma characteristic of the sublimed benzoic acid, it has been suggested to subject it to sublimation in the presence of benzoin, and possibly this plan is followed by some manufacturers.

Although sodium benzoate is about fifteen times more soluble in water than the calcium salt, and hence the acid might be prepared from it with smaller quantities of liquid, yet the use of sodium carbonate in the place of lime is not to be recommended, as the resulting acid will be found mixed with larger proportions of resin than that obtained by the lime process.

Hippuric acid, obtained from the urine of cattle or horses, consists of benzoyl glycocoll, and, if boiled with strong hydrochloric acid, absorbs water and is split up into benzoic acid and glycocoll (amidoacetic acid); thus, $C_6H_5CONH.CH_2COOH + H_2O = C_6H_5COOH + CH_2(NH_2)COOH$. Benzoic acid thus prepared has a fetid odor, and must be purified by recrystallization and sublimation with benzoin.

At present benzoic acid is manufactured extensively from toluene (toluol), $C_6H_5CH_3$, and probably the bulk of artificial acid is made now by this method. If chlorine gas be conducted into boiling toluene until an increase of weight is no longer perceptible, the latter body is converted into benzo-trichloride (trichlormethyl-benzene or phenyl chloroform), $C_6H_5CCl_3$. This liquid, when treated with water under pressure, yields benzoic and hydrochloric acids; thus, $C_6H_5CCl_3 + 2H_2O = C_6H_5COOH + 3HCl$. It is important that the chlorine gas be passed into the boiling toluene in diffused sunlight, since other products are formed when light is excluded.

The U. S. P. and Br. P. recognize the natural as well as the artificial benzoic acid, whereas the German Pharmacopœia specifies the acid obtained by sublimation from benzoin.

Benzoic acid occurs both in white and in yellowish-white feathery flexible crystalline flakes and needles, having, in case of the sublimed acid, an agreeable, aromatic odor, due to the presence of small quantities of volatile oil. It has a warm acidulous taste, and becomes darker in color when exposed to light. It is soluble in 400 parts (Br.), 370 parts (P. G.) of water, and in 2 parts of alcohol at 15° C. (59° F.); in 281 parts of water or 1.8 parts of alcohol at 25° C. (77° F.) (U. S.); in 15 parts (U. S.), 17 parts (Br.), of boiling water; and in 1 part of boiling alcohol. Also soluble in 3 parts of ether, 7 parts of chloroform, and readily soluble in carbon disulphide, benzene, fixed and volatile oils, but sparingly soluble in benzin. Its solubility in water is increased materially by sodium borate, sodium phosphate, and other salts. Benzoic acid begins to sublime at 100° C. (212° F.), melts at 121.4° C. (250.5° F.), and boils at 249° C. (480.2° F.) without decomposition. It volatilizes freely with the vapors of water.

The acid sublimed from benzoin has a lower melting-point and dissolves more freely in water than that obtained by other methods. On heating benzoic acid gradually with 3 parts of freshly slaked lime in a dry test-tube, benzene is evolved.

A solution of benzoic acid in strong sulphuric acid is colorless, and when gently warmed brownish, and on adding it to water benzoic acid again is precipitated; but the solution in fuming sulphuric acid, on being heated, gradually forms sulphobenzoic acid, $C_6H_4SO_3H.COOH$, which is deliquescent. Boiling nitric acid does not affect benzoic acid, but fuming nitric acid produces substitution compounds. Nascent hydrogen causes deoxidation, with the formation of benzaldehyde (oil of bitter almond) and benzalcohol, and the production of crystalline hydrobenzoic acid, $C_7H_{10}O_2$.

The salts of benzoic acid are more or less soluble in water, and many of them also in alcohol; those with the alkalies dissolve very freely in water. Solutions of the salts yield with neutral or basic ferric salts pale brownish-red, and with lead acetate and silver nitrate white precipitates, which are sparingly soluble in water.

Tests.—Benzoic acid should evaporate completely from platinum-foil. If much charcoal be left behind, the presence of other organic substances would be indicated, of which sugar manifests itself by the odor of caramel, and hippuric acid by the odor of hydrocyanic acid, during the application of heat, while mineral substances will be left as a fixed residue. Since some varieties of benzoin, notably the Sumatra, contain cinnamic acid, this should always be tested for before benzoic acid is prepared. The U. S., Br., and G. pharmacopœias have adopted a test indicating the limit of chlorine compounds that may be present, by igniting in a crucible a dried mixture of 0.5 Gm. of the acid, 0.8 Gm. of calcium carbonate, and a little water; the residue is dissolved in water and nitric acid to 20 Cc. of filtrate, in which the addition of decinormal silver nitrate solution should not produce more than a faint opalescence at the utmost. Cinnamic acid is detected readily by the odor of oil of bitter almond developed if 0.5 Gm. of benzoic acid, 0.5 Gm. of potassium permanganate, and 5 Cc. of water be warmed in a loosely stoppered test-tube to about 45° C. (113° F.) on a water-bath, and then tightly stoppering the tube and cooling with cold water.

Pure benzoic acid does not decolorize a solution of potassium permanganate, but the odorous compounds present in the sublimed acid rapidly deoxidize it, both in acid and alkaline solution. This test has been perfected by C. Schacht and others, and is applied by mixing 0.1 Gm. of the acid, and 5 drops of permanganate solution (1 : 200) with 5 Cc. of distilled water or with 3 Cc. each of potassium hydroxide solution, specific gravity 1.18, and distilled water, and heating the mixture just to boiling, when complete decoloration will be effected at once without the previous production of a green color. Benzoic acid, when prepared artificially or by the wet process, will either not reduce the permanganate or will effect it more slowly than the sublimed acid. For this reason C. Schneider has increased the test-liquid to 16 drops, which, when the mixture has been set aside for 8 hours, will be decolorized only by the sublimed acid, but not by the other kinds, even if resublimed with benzoin. In the presence of cinnamic acid reduction will likewise take place, but at the same time the odor of oil of bitter almond will be observed.

Pharmaceutical Preparation.—Lozenges of Benzoic Acid, Br.

Action and Uses.—Benzoic acid is strongly antiseptic, and in concentrated form irritates mucous membranes. Ordinary doses cause a sense of warmth over the entire body, which feeling increases with the amount ingested, large quantities causing severe burning pain. It may produce nausea and vomiting. It is said to be somewhat sedative to the central nervous system, and at times causes diaphoresis and increased expectoration. The drug increases the acidity of the urine, as it is eliminated by the kidneys as hippuric acid.

Senator recommends benzoic acid in the daily dose of 2 or 3 ounces (60–90 Gm.) in the treatment of rheumatic fever. It is stated, however, that while the drug may relieve the pain as well as salicylic acid, and is free from the untoward effects produced by the latter, yet it fails to reduce the temperature or quiet the pulse.

It may be given with benefit in phosphaturia, in incontinence of urine, and in cystitis due to alkalinity.

Benzoic acid is given in the dose of from 10 to 30 grains (0.60–2 Gm.). Being sparingly soluble in water, it is frequently combined with 4 parts of sodium phosphate or 1½ parts of sodium borate to aid in its solution.

ACIDUM BORICUM, *U. S.*, *Br.*, *P. G.*—Boric Acid.

Acidum boracicum.—*Boracic acid*, E.; *Acide borique crystallisé*, Fr. Cod.; *Borsäure*, G.; *Acido borico*, F. It.

Formula, H_3BO_3 or $B(OH)_3$. Molecular weight, 61.54.

Origin and Preparation.—This acid was obtained by Homberg (1702) by heating borax with copperas, and subsequently from sulphuric acid and borax. It was known as *Sal sedativum Hombergi* until Gay-Lussac and Thénard (1804) proved it to be an oxygen compound of boron. It is a constituent of several minerals, especially in the niter-regions of Chili and Peru, as *borocalcite*. It is present, mostly in minute quantities, in various plants, mineral waters, and sea water, and in somewhat larger proportion in several of the hot springs in Western North America. It has been found in large quantity as a constituent of borax in Borax Lake, California, and it also occurs in the same form as *tincal* in the dried-up saline lagoons or lake-beds of Thibet. The major part of the boric acid consumed in the United States is now derived from California, while the greater part of the world is supplied from Tuscany, Italy, and the Liparian island of Volcano, north of Sicily. The crater of Volcano contains a deposit of boric acid mixed with sulphur, known as *sassoline*, and the same acid is found in the vapors which issue from fissures in the volcanic rocks of Tuscany. These fissures, called *soffioni*, are either natural or made artificially by drilling, sometimes to the depth of 150 to 200 feet. Surrounding one or more of the *soffioni* a series of basins or *lagoons* are constructed on the side of the mountain, either by excavation or masonry, and are then filled with water from a mountain-stream; the hot vapors in passing through the water yield to it boric acid and heat the water at the same time. The solution of boric acid thus obtained is passed from one basin to another lower one, and when sufficiently saturated into a reservoir; thence it is conducted into evaporating-pans, and finally into vats, where the acid is deposited. This crude product is used in the preparation of borax (see Sodii Boras), and from this salt boric acid is again prepared for medicinal use. The American production of refined borax, including boric acid, was 21,422,300 pounds in 1897.

10 parts of borax are dissolved in 24 parts of boiling water; the solution is filtered while hot, mixed with 6 parts of hydrochloric acid, and the liquid set aside for a day in a cool place. The crystals are collected either in a funnel or upon a strainer, and are drained and washed with a little cold water, after which they are redissolved in 5 times their weight of boiling distilled water. After a day or two the crystals are collected as before, washed with cold water to remove the last traces of adhering hydrochloric acid, and dried in a moderately warm place. The yield is between 5½ and 6 parts. The reaction which takes place is explained by the equation: $Na_2B_4O_7.10H_2O + 2HCl = 4H_3BO_3 + 2NaCl + 5H_2O$. Sulphuric acid may be employed in the place of hydrochloric acid, but will adhere more persistently to the boric acid, necessitating two or three recrystallizations.

Properties.—Boric acid crystallizes in white translucent six-sided scales, which have a slight pearly luster, are somewhat unctuous to the touch, inodorous, and of an acidulous and slightly acrid taste. It is soluble at 25° C. (77° F.) in 18 parts of water, 15.3 parts of alcohol, or 4.6 parts of glycerin; also soluble in 3 parts of boiling water and in 4.3 parts of boiling alcohol (U. S.). Addition of hydrochloric acid increases its solubility in water. The P. G. says boric acid is slowly soluble in 25 parts of cold water, 3 parts of boiling water, and 15 parts of alcohol. According to the Br. P., the acid is soluble in 30 parts of cold water, 3 parts of boiling water, 30 parts of alcohol (90 per cent.), and 4 parts of glycerin. The taste of the solutions is somewhat astringent and sweetish, and in the presence of salicylic acid quite bitter. When heated, it melts, disengaging vapors of water, which contain some of the acid; between 80° and 100° C. (176° and 212° F.) it is converted into *metaboric acid*, HBO_2; between 140° and 160° C. (284° and 320° F.) it yields tetraboric or *pyroboric acid*, $H_2B_4O_7$; and at a red heat all the water is expelled, *boric anhydride*, B_2O_3, being left in the form of a transparent, very hard but brittle glass, and weighing about 56 per cent. or less of the boric acid used. Boric acid volatilizes appreciably with water at and above 60° C. (140° F.), and with the vapors of boiling alcohol; its solution in the latter burns with a green flame. It is nearly insoluble in ether, soluble in volatile oils. The aqueous solutions impart a red color to blue litmus-paper and a brownish-red color to turmeric-paper upon drying the latter. The last-named reaction is produced also in the presence of diluted

mineral acids, which distinguishes boric acid from alkalies. On touching the brown part with ammonia-water it changes to blackish blue (a delicate and characteristic test).

Boric acid, mixed with the salts of mineral acids and ignited, decomposes all those containing volatile acids; in aqueous solution it decomposes the carbonates only, forming borates, of which those with an alkaline base are readily soluble in water, while most others are slightly soluble or nearly insoluble. On ignition they melt to a glass-like mass; and when mixed with sulphuric acid and alcohol, on igniting the latter the green flame of free boric acid is observed.

Tests.—In addition to its fusibility, and its complete solubility in water and alcohol, boric acid, dissolved in 50 parts of distilled water acidulated with nitric acid, should yield no precipitate with the nitrates of silver and of barium (absence of hydrochloric and sulphuric acids), and no dark color with hydrogen sulphide either before or after neutralization with ammonia (metals). The solution of 1 Gm. of the acid in a mixture of 1 Cc. of hydrochloric acid and 49 Cc. of distilled water should not at once assume a blue color on the addition of 0.5 Cc. of potassium ferrocyanide solution (limit of *iron*); nor should it, when heated on a clean platinum wire, impart to a non-luminous flame a persistent yellow color (absence of *sodium*). The absence of earths is determined by testing a 2 per cent. aqueous solution of boric acid with ammonium oxalate for calcium, and with sodium phosphate and ammonia water for magnesium, which reagents should yield no precipitates (U. S.). If mixed with an excess of sulphuric acid, the addition of a crystal of ferrous sulphate should not cause the appearance of a dark-brown color (absence of nitrates). 5 Cc. of a saturated aqueous solution of boric acid should not respond to the modified Gutzeit's test for arsenic (U. S.); see ARSENI TRIOXIDUM, page 243.

Free boric acid may be determined quantitatively either gravimetrically or volumetrically.

a. Gravimetrically.—If only boric acid is present in the solution, add a weighed and sufficient quantity of ignited sodium carbonate, evaporate to dryness and ignite the residue. The acid drives out an equivalent amount of CO_2. The remaining CO_2 is then determined, and the difference between this and the total weight of carbon dioxide in the carbonate taken gives the weight of the same displaced by the boric acid, from which the boric acid is calculated, using the equation: $2B(OH)_3 + nNa_2CO_3 = 2Na_3BO_3 + 3H_2O + 3CO_2 + (n-3)Na_2CO_3$ (Fresenius, *Quant. Anal.*, I. and II.).

b. Volumetrically.—The U. S. P. demands not less than 99.8 per cent. purity for boric acid, to be determined as follows: 1 Gm. of boric acid, when dissolved in 50 Cc. of warm distilled water, after addition of 50 Cc. of glycerin, should require not less than 16.28 Cc. of normal sodium hydroxide solution for neutralization, phenolphthalein test-solution being used as indicator.

Estimation in Surgical Dressings.—5 Gm. of borated cotton or gauze are cut up and extracted in a 500 Cc. flask by repeated shaking with a mixture composed of 1 part of glycerin and 19 parts of water. The flask is then filled to the mark with more of the mixture. 100 Cc. are removed with a pipette, mixed with 40 Cc. of glycerin, and titrated with decinomal NaOH (free from CO_2). The boric acid is calculated from the number of Cc. of alkali used (1 Cc. = 0.006154 Gm. of $B(OH)_3$), and this will be the weight in 1 Gm. of material. Addition of more glycerin should not remove the phenolphthalein red color at the end of the operation. If it does, a new titration must be made, using more glycerin (Hager's *Handbuch*, 1899).

Glycerin, like manna, has the property of increasing the acidity of boric acid, so that it may be neutralized fully by alkalies. Ordinarily, on adding alkalies to boric acid solution the neutral point is reached before the boric acid has been converted fully into borate.

Louis Cleveland Jones (*Am. Jr. Sc.*, 1899 (4), vii.) describes a method for determining boric acid, free or in combination, volumetrically, by the use of mannite to increase the acidity of the acid. For details of the operation, consult the original article, of which a reprint is given in *Chem. News*, Aug. 11, 1899.

Pharmaceutical Preparations.—GLYCERITE OF BOROGLYCERIN, U. S.; OINTMENT OF BORIC ACID, Br.

Action and Uses.—Boric acid has been employed as a mild antiseptic and detergent, but it does not possess germicidal properties. It is absorbed so rapidly that it is of

no value as an intestinal antiseptic. The drug is eliminated principally by the kidneys, and its administration increases the acidity of the urine. It has little effect upon the animal organism unless taken in enormous amounts or given for a long time, when it may produce a scarlatiniform rash, eczema of the skin of the joints, with local swellings and œdema. Such doses may cause gastro-intestinal inflammation, with nausea, vomiting, and diarrhœa. Not uncommonly emaciation, great muscular weakness, and insomnia follow its prolonged use.

Internally boric acid is useful in the treatment of cystitis due to alkalinity of the urine, and it has been largely used in epilepsy. As a lotion it has been employed with some success in erysipelas and in the treatment of burns and scalds; in the latter conditions, however, this remedy has been supplanted largely by the solution of hydrogen dioxide.

Because of its mild antiseptic and non-irritative properties boric acid is widely used in inflammatory conditions of the eye, ear, nose, and throat. It is especially useful as an eye wash, and has been highly recommended in chronic otitis media, in which condition the drug may be used either in solution or in powder by insufflation.

The dose of boric acid is from 5 to 10 grains (0.30–0.60 Gm.) 4 times daily. The strength of the solution for local application to the conjunctiva is from 5 grains to the ounce up to saturation.

Boric acid ointment may be prepared by incorporating 4 parts of hot boroglycerin in a mixture of 1 part of spermaceti and white wax and 6 parts of petrolatum. Lister's boric acid ointment contains 1 part each of boric acid and white wax, and 2 parts each of the oil of sweet almond and paraffin.

Combinations of Boric Acid.—Boralid, a mixture of equal parts of boric acid and acetanilid: in eczema.

Boricin, a mixture of borax and boric acid.

Borocitric acid, a combination of the two acids; a white soluble powder, used as solvent for phosphates and urates in calculi, gout, etc.

Boroformol, Boroformalin, made by solution of aluminum hydroxide in a mixture of 2 parts of formic acid and 1 part of boric acid, and evaporating to dryness. Soluble white scales; antiseptic, deodorant.

Borol, borosulphate of sodium or potassium, $SO_2(OBO)(OK)$. A powerful antiseptic in infectious diseases.

Borophenylic acid, phenyl-boric acid, $C_6H_5B(OH)_2$. Obtained by condensation of phenol and boric acid by means of phosphorus oxychloride. Difficultly soluble white powder of mild taste. Antiseptic, preservative, 1:5000.

Borosalicyl, an antiseptic, containing 32 parts of sodium salicylate to 25 parts of boric acid.

Borosalicylic acid, solution of 4 per cent. each of boric and salicylic acids. Antiseptic.

Glacialin, which has been recommended as an antiseptic and for the preservation of articles of food, is a mixture of boric acid 6 parts, borax 3 parts, sugar 3 parts, and glycerin 2 parts.

Glybolid, a paste of 2 parts of glycerin, 1 part of boric acid, and 1 part of acetanilid. For pustules, abscesses, etc.

Wickersheimer's Preserving Fluid.—50 Gm. of boric acid, 20 Gm. of sodium chloride, 7.5 Gm. of salicylic acid, 250 Gm. of glycerin, and water sufficient to make 500 Cc.

ACIDUM CAMPHORICUM, *U. S.*, *P. G.*—Camphoric Acid.

Acide camphorique, Fr.; *Kamphorsäure*, *Kamphersäure*, *Kamphylsäure*, G.

Formula, $H_2C_{10}H_{14}O_4$ or $C_8H_{14}(COOH)_2$. Molecular weight, 198.62.

Preparation.—Camphoric acid is obtained by heating on a boiling water-bath a mixture of 150 Gm. of camphor and 2000 Cc. of nitric acid, specific gravity 1.37, in a long-neck flask, provided with a reflux condenser consisting of a long straight glass tube, until colored vapors are no longer given off. The operation should be conducted in the open air or in a fume chamber, and may be hastened by gently boiling the mixture over a direct flame. When cool, the liquid is filtered through asbestos or glass-wool for the purpose of collecting the crystals of camphoric acid which have separated; the filtrate is reduced by evaporation to about one-fifth of its volume, and an additional crop of crystals thus obtained. The crystals are next dissolved in 5 parts of water with the aid of sodium carbonate, and the slightly alkaline solution of sodium camphorate filtered and allowed to crystallize; after solution in 10 parts of water the sodium camphorate is decomposed by an excess of hydrochloric acid. The liberated camphoric acid will crystallize out, and may further be purified by redissolving in

hot water, treating with animal charcoal, and recrystallizing. The acid mother-liquid from which the crude camphoric acid was first obtained contains *camphoronic acid*, $C_6H_{11}(COOH)_3$, a tribasic acid, melting at 136° C. (276.8° F.).

Properties.—Camphoric acid occurs in acicular scales free from color and odor. It is soluble in about 150 parts of water at 15° C. (59° F.), 125 parts at 25° C. (77° F.) (U. S.), 8 parts of boiling water, readily soluble in alcohol and ether, but less so in chloroform; its solutions redden blue litmus-paper. The acid melts at 187° C. (368.6° F.), and at higher temperatures it loses water and is volatilized completely in the form of white vapors of pungent odor, consisting of camphoric anhydride. It is a dibasic acid, and forms readily soluble and crystallizable salts with the alkalies, calcium, barium, and magnesium. Camphoric acid is dextrorotatory, showing in 10 per cent. alcoholic solution the value $(\alpha)_D = +47.8°$ (U. S.).

Tests.—A cold saturated aqueous solution of camphoric acid should not be affected by test-solutions of barium chloride and silver nitrate, showing absence of sulphuric and hydrochloric acids. If 2 Cc. of a saturated aqueous solution of camphoric acid be mixed with 2 Cc. of sulphuric acid in a test-tube, and 1 Cc. of a solution made by dissolving 1 Gm. of ferrous sulphate in 2 Cc. of diluted sulphuric acid be poured carefully upon it, no dark-colored zone should develop at the line of contact (absence of *nitric acid*) (U. S.). 1 Gm. of camphoric acid previously dried requires for complete neutralization 10 Cc. of normal alkali solution, using phenolphthalein as indicator (P. G.).

Action and Uses.—Camphoric acid is quite largely employed to combat the night-sweats of phthisis, for which condition it should be given upon retiring; or if the sweats occur in the morning, it should be taken about the middle of the night. 1 per cent. solutions of the drug may be employed successfully in the treatment of pharyngitis and laryngitis; and in chronic cystitis, irrigation of the bladder with a solution of the same strength will often prove of service. Camphoric acid has also been recommended internally in pulmonary tuberculosis, cystitis, pyelitis, chronic gonorrhœa, and in diarrhœa resulting from intestinal fermentation.

The dose for internal administration is from 10 to 30 grains (0.60–2 Gm.), usually in powder or capsule. In combating colliquative sweats, it is well to give full doses.

ACIDUM CARBOLICUM, *Br., P. G.*—Carbolic Acid.

Phenol, U. S.; *Phénol, Acide carbolique, Acide phénique*, Fr. Cod.; *Karbolsäure*, G.
For full description, see PHENOL, page 1158.

ACIDUM CARBOLICUM LIQUEFACTUM, *Br., P. G.*—Liquefied Carbolic Acid.

Phenol liquefactum, U. S.; *Phénol liquefiée*, Fr.; *Verflüssigte Karbolsäure*, G.
For full description, see PHENOL LIQUEFACTUM, page 1163.

ACIDUM CARBONICUM.—Carbonic Acid.

Carbonic acid, Carbonic anhydride, Carbon dioxide, E.; *Acide carbonique*, Fr.; *Kohlensäure*, G.

Formula, CO_2. Molecular weight, 43.67.

Occurrence and Preparation.—Carbonic acid gas, as it exists in certain mineral waters, was regarded by Libavius (1597) as a very volatile spirit. In the following century Van Helmont distinguished it and other irrespirable gases from atmospheric air as "spiritus sylvestris" or "gas sylvestre." In the beginning of the eighteenth century F. Hoffmann recognized the acid character of carbonic acid in mineral waters, and called it "spiritus mineralis." Joseph Black (1755) observed that this "fixed air" combined with alkalies and earths and increased their weight. Lavoisier (1775) proved this gas to be composed of carbon and oxygen.

Carbon dioxide gas is a regular constituent of the atmosphere, in which it is present to the extent of 0.03 per cent. by volume or about 0.05 per cent. by weight. In certain localities it issues from fissures in considerable quantity; at Brohl, Germany, about 660 pounds (300 Kgm.) of the gas escape from the earth in 24 hours. It is a product of respiration

of animal life (exhaled air containing 4–5 per cent. of CO_2) and of alcoholic fermentation, exists in combination in many minerals, and is formed on the complete combustion of carbon or organic compounds in the presence of an excess of oxygen; diamond and graphite require a high heat for their combustion. The best sources for preparing carbon dioxide in a pure state are whiting, marble-dust, or similar native carbonates, which are decomposed by dilute sulphuric acid in an apparatus provided with a stirrer to prevent the calcium sulphate formed from enveloping the undecomposed carbonate. On a small scale, and for obtaining a uniform current of carbon dioxide gas, fragments of marble and diluted hydrochloric acid are used, whereby calcium chloride is formed, together with some water, and remains in solution: $CaCO_3 + 2HCl$ yields $CaCl_2 + H_2O + CO_2$. Should the gas possess a disagreeable odor, it may be deprived of it, according to Stenhouse, by passing it over granular charcoal, or, according to Hager (1868), by conducting it successively through solutions of ferric sulphate, sodium carbonate, potassium permanganate, and water, by which treatment it is freed from hydrogen sulphide and hydrocarbons.

A cheap source of carbon dioxide is sodium bicarbonate, which yields about half its weight of the gas, and when decomposed by sulphuric acid gradually added will, in addition, produce 15 parts of crystallized sodium sulphate for every 4 parts of the bicarbonate used: $2NaHCO_3 + H_2SO_4 = Na_2SO_4 + 2H_2O + 2CO_2$.

Properties.—Carbonic acid—or, more properly, carbon dioxide—is a colorless, uninflammable gas, which has a slight pungent odor and pricking, acidulous taste, colors moist litmus-paper transiently red, and does not support combustion. It is heavier than atmospheric air, its specific gravity at 0° C. (32° F.) being 1.529 as compared with atmospheric air, and 1 liter of it weighing 1.9781 Gm. at 0° C. (32° F.) and 760 Mm. pressure. By pressure it is converted into a very mobile colorless liquid, which is lighter than water, and on removal of the pressure boils rapidly and is partly converted into white flakes of solid carbonic anhydride. At 0° C. (32°F.) the pressure required is 36 atmospheres, at 20° C. (68° F.) about 59 atmospheres, at 30° C. (86° F.) 73 atmospheres. The temperature of liquid carbonic acid, boiling freely at atmospheric pressure, falls to —78° C. (—108.4° F.). The gas dissolves at 15° C. (59° F.) in an equal volume of water, and is more soluble in alcohol, absolute alcohol at 15° C. (59° F) dissolving 3 volumes of the gas, which is partly expelled on dilution with water. It unites with most of the basic hydroxides, forming salts which, with the exception of the alkali carbonates, are insoluble in water, but dissolve to a slight extent in carbonic acid water and are decomposed by all mineral and most organic acids. Carbonic acid is dibasic; all the acid carbonates (bicarbonates) are decomposed by heat, carbon dioxide being evolved.

Technical.—Carbon dioxide is used extensively for various purposes; for example, the production of low temperature, sparkling waters, high pressures, etc., in consequence of which it is prepared now on the large scale and stored in strong steel cylinders in liquid form. Many industrial operations give rise to immense quantities of the gas, such as beer, wine, and spirit fermentation, reduction processes in metallurgy, lime-burning, besides issuing from vents in the earth in certain localities (volcanic). It is collected from these vents in large gasometers and liquefied by pressure. In the case of impure gases, the carbon dioxide is separated from other gases by absorption in sodium carbonate solution, which forms bicarbonate, from which the carbon dioxide is driven out again by heating, collected, and liquefied by pressure.

In 1899 there were in Germany about 80 factories engaged in making liquid carbon dioxide. At Bernhardshall alone 600 tons are produced yearly. In 1897 the total production in Germany was 11,000 tons.

The Pabst Brewing Co., at Milwaukee, was the first to introduce a system of carbon dioxide gas collection; in 1897 more than 1,500,000 pounds were liquefied, and double this quantity in 1898. This plant could furnish 10,000,000 pounds of the gas annually from the 1,000,000 barrels of beer brewed.

Pharmaceutical Uses.—In pharmacy carbon dioxide is employed almost exclusively in the preparation of carbonic acid water.

Aqua Acidi Carbonici, U. S. 1870; *Aqua acidula simplicior*, Fr. Cod.; *Aqua carbonica. Carbonic acid water*, E.; *Eau gazeuse simple*, Fr.; *Kohlensäure-Wasser, Brausewasser*, G.—This water is prepared very extensively in the United States and sold under the names of *soda water* and *mineral water*. Several apparatus have been constructed and patented for the convenient preparation of carbon dioxide and for charging water with this gas under

pressure. They consist of a generator, a strong copper vessel, into which the powdered marble, whiting, or sodium bicarbonate is introduced with some water, and which connects with another copper vessel containing the sulphuric acid, which is admitted in small quantities. The gas is passed first through a vessel containing water, to deprive it of impurities, and then to the bottom of the fountain, as the receiving vessel is called, containing the requisite quantity of water. The fountains are made either of cast iron, well protected on the inside by enamel, or of copper lined with block-tin; or stoneware fountains, secured by iron bands, are employed. The water, which usually is charged with from 8 to 10 times its volume of carbon dioxide, is drawn off through block-tin pipes, which pass through a chamber containing ice. Carbonic acid water has an agreeable acidulous and refreshing taste, and effervesces strongly. It produces white precipitates with lime and baryta water, and acts upon iron, lead, and copper, which metals are dissolved gradually; tin and silver are affected less; hence the importance of preventing the water from coming in contact with other metals except the two last mentioned. It should not be discolored by hydrogen sulphide nor ammonia, and should yield no precipitate with sodium sulphate or with potassium ferrocyanide.

Action and Uses.—Inhalations of pure carbonic acid produce asphyxia and death. Small quantities largely diluted with air first stimulate and later depress the nervous, respiratory, and circulatory systems; the reflexes are decreased, the pulse becomes slow and weak, and the respirations very shallow. Locally applied, it acts as a stimulant to both the skin and mucous membranes, producing a sensation of tingling and causing considerable redness. Carbonic acid is absorbed by the skin and mucous membranes and eliminated by the lungs. Very large amounts are said to cause the blood to become overcharged.

Internally in the form of carbonated waters small amounts increase digestion. These waters have been employed as diuretics, but when given in large quantities are apt to derange digestion. Inhalations of the diluted gas have been recommended in pulmonary tuberculosis, but are of doubtful efficacy. Carbonated waters relieve thirst more readily than plain water, and are grateful in feverish conditions (see Carbonated Waters).

ACIDUM CHROMICUM, *Br., P. G.*—Chromic Acid.

Chromii trioxidum, U. S.; *Acide chromique cristallisé*, Fr. Cod.; *Chromsäure*, G.
For full description, see CHROMII TRIOXIDUM, page 416.

ACIDUM CHRYSOPHANICUM.—Chrysophanic Acid.

Chrysophansäure, Rhein, Rheïnsäure, Rhabarbergelb, Parietinsäure, G.; *Dioxymethylanthraquinone.*

Formula, $C_{15}H_{10}O_4$ or $C_6H_2(CH_3)(OH)\begin{<}{l}CO\\CO\end{>}C_6H_3.OH$. Molecular weight, 252.17.

This acid is a constituent of rhubarb, also of *Rumex obtusifolius* and senna leaves, but is not found in the yellow lichen, *Parmelia parietina*, from which Rochleder and Heldt thought they had isolated it. Chrysophanic acid formerly was regarded identical with chrysarobin.

Preparation.—Remove extractives from rhubarb cut in small pieces as completely as possible by exhausting with water, then extract the residue with dilute alkali, filter the liquid, and acidify with acetic acid, whereupon chrysophanic acid is thrown down. Wash the precipitate with water, dry, and recrystallize from hot ligroïn or benzene.

A second method consists in mixing chrysarobin powder with a large volume of dilute alkali in a wide flask, passing air into the liquid, and shaking until all chrysarobin has been dissolved and a uniform red solution obtained. The filtered solution is acidified with dilute hydrochloric acid and the precipitate treated as above. In this process chrysarobin is oxidized to chrysophanic acid; thus, $C_{30}H_{26}O_7 + O_4 = 2C_{15}H_{10}O_4 + 3H_2O$.

Properties.—Chrysophanic acid forms golden-yellow, tasteless, clinorhombic prisms, insoluble in water, soluble in 224 parts of boiling alcohol (81 per cent.), in acetic acid, chloroform, benzene, and benzin. It dissolves in caustic alkalies with a red color, and in concentrated sulphuric acid with a deep-red color (contrast to chrysarobin, which gives a yellow color with sulphuric acid). Fused with potassium hydroxide, it gives a blue, chrysarobin, a yellow mass. It melts at 162° C. (323.6° F.). No residue is left on incinerating the acid.

Action and Uses.—Chrysophanic acid is occasionally employed locally in the treatment of skin diseases, for example, psoriasis and chronic eczema, but is not so commonly used as chrysarobin, a substance closely allied to it. (For action and uses, see Chrysarobinum.)

ACIDUM CITRICUM, *U. S., Br., P. G.*—Citric Acid.

Acidum citri, s. limonum, s. limonorum.—Acide citrique, A. du citron, Fr.; *Citronensäure,* G.; *Acido citrico,* It., Sp.

Formula, $H_3C_6H_5O_7 + H_2O$ or $C_3H_4(OH)(COOH)_3 + H_2O$. Molecular weight, 208.5.

History.—The activity of lemon-juice was known to the ancients, but it was not until 1776 that Retzius distinguished it from tartaric and other vegetable acids. Scheele in 1784 obtained it in the crystalline form. Its synthesis was accomplished by Grimaux and Adam (1880) by the hydrolysis of the dicyanide from s-dichlor-hydroxyisobutyric acid, $(CH_2Cl)_2.C(OH).COOH$, with hydrochloric acid. Inasmuch as the s-dichlor-hydroxyisobutyric acid can be obtained through the cyanhydrin reaction from s-dichlor acetone, the synthesis of citric acid can be referred back to acetone and farther. A more direct synthesis is from acetone dicarbonic acid, $CO(CH_2COOH)_2$, by means of the HCN reaction.

Occurrence.—Citric acid occurs widely distributed in nature, in the free state and as salts, also associated with tartaric and malic acids. It occurs free and with little or no malic acid in the fruits of *Vaccinium vitis idæa, V. oxycoccus, Prunus padus;* and especially pure and abundant in the not quite mature fruits of the orange family (lemon, bergamot, etc.). Associated with other acids, it is found in cherries, raspberries, gooseberries, strawberries, tamarinds, etc.; also in the roots, leaves, and bark of various plants.

Preparation.—Citric acid is manufactured in this country and in Europe on a large scale from lemon- and lime-juice. The juice is employed either in its natural condition or considerably concentrated by evaporation, or else in the form of a crystalline powder as calcium or magnesium citrate. The juice is clarified by ebullition, or, if obtained from unsound fruits, by allowing it to undergo the vinous fermentation. After decantation and straining, an excess of chalk is added, and finally some milk of lime. The calcium citrate, $Ca_3(C_6H_5O_7)_2.4H_2O$, thus formed being less soluble in hot than in cold water, the mixture is heated to boiling, and while hot the clear liquid is drawn off from the precipitated calcium citrate, which is washed with boiling water for the purpose of removing all the extractive matter. The calcium citrate is now decomposed by diluted sulphuric acid in such a proportion as to form calcium sulphate, and to leave a little sulphuric acid in excess: 10 parts of calcium citrate require about 9 parts of sulphuric acid diluted with from 50 to 60 parts of water. The solution of citric acid is drawn off from the precipitated calcium sulphate, and the latter washed with very cold or with boiling water, in which gypsum is less soluble than in water of a medium temperature. The liquid, with the washings, is evaporated by steam heat to a syrupy consistence, and then allowed to crystallize in suitable tanks lined with lead. The presence of a little sulphuric acid appears to favor crystallization, which is prevented or considerably retarded by acid calcium citrate. The crystals are redissolved in a small quantity of water, and the solution is treated with animal charcoal and then evaporated to crystallize. Citric acid may be prepared by this process from the juice of other acidulous fruits; Græger (1873) described the manipulations necessary to obtain it advantageously from whortleberries.

During the past few years citric acid has been prepared from dextrose (grape-sugar) by the action of certain fungi, known as citromyces. The yield amounts to about 55 per cent. of the weight of dextrose used, and the resulting citric acid is in every respect identical with the natural acid. The manufacture of artificial or synthetic citric acid is said to be already in progress on a commercial scale.

Properties.—Citric acid crystallizes in colorless rhombic prisms which have an agreeable acid taste. The solubility is variously stated as follows: U. S. Pharmacopœia, at 25° C. (77° F.), 1 part of acid in 0.54 part of water, 1.08 parts of alcohol, and in 18 parts of ether; also soluble in 0.4 part of boiling water and in 1.43 parts of boiling alcohol. British Pharmacopœia, temperature not specified, but 15.5° C. (59° F.) gen-

erally understood, 1 part of acid soluble in 0.75 part of water, less soluble in alcohol of 0.835 specific gravity, and insoluble in ether; also soluble in 0.5 part of boiling water. German Pharmacopœia, at 15° C. (59° F.), 1 part of acid soluble in 0.54 part of water, 1 part of alcohol, and in 50 parts of ether. It is also soluble in methyl and amyl alcohols and glycerin, and is freely soluble in hot creosote, but insoluble in chloroform and in hydrocarbons, except in the presence of alcohol. When a solution is made by dissolving 40 grains of the crystals in 1 ounce of water, it resembles lemon-juice in strength and in the nature of its acid properties, and, like lemon-juice, it undergoes decomposition, acetic acid being among the products, and becomes mouldy by keeping. The crystals are permanent in dry air, but at a somewhat elevated temperature, beginning at 35°–40° C. (95°–104° F.), slowly part with their water of crystallization, and in a damp atmosphere they become moist and gradually deliquesce. The anhydrous acid fuses between 152° and 153° C. (305.6° and 307.4° F.). When slowly ignited, it is decomposed gradually without emitting the odor of burning sugar (difference from tartaric acid), and is consumed finally without leaving more than 0.05 per cent. of residue (U. S.).

Citric acid is a tribasic acid, having the formula $H_3C_6H_5O_7$, or, as met with in the crystallized condition, $H_3C_6H_5O_7 + H_2O$. The water of crystallization, amounting to 8.6 per cent., is expelled at 135° C. (275° F.), and at 155° C. (311° F.) another molecule of water is given off, *aconitic acid*, $H_3C_6H_3O_6$, remaining behind, which is identical with the acids that have been isolated from aconite, yarrow, and other plants. Like citric acid, it forms three series of salts, either 1, 2, or 3 atoms of hydrogen being replaceable by a basylous radical.

The citrates of the alkalies are all soluble in water; the neutral citrates of the heavy metals are mostly insoluble in water, but dissolve in nitric, and many also in citric acid. Ferric and aluminum citrates are not precipitated by alkalies. That the calcium citrate is soluble in cold and insoluble in hot water has been mentioned. If lime water is not completely neutralized by solution of citric acid, no precipitate will occur until the liquid is heated to boiling. 3.5 Gm. of citric acid dissolved in distilled water are neutralized by 50 Cc. of normal alkali solution.

Tests.—The impurities which may be present in citric acid in consequence of carelessness in its manufacture may be sulphuric acid, calcium, iron, lead, and copper. Minute fragments of metallic lead occasionally are observed adhering to some of the crystals. Sulphuric acid is detected readily in the aqueous solution of citric acid by the white precipitate occurring with barium chloride; iron, by the blue color occasioned by potassium ferrocyanide; and lead and copper, by the black coloration or precipitate resulting from hydrogen sulphide. For the detection of calcium, it is advisable to neutralize the citric acid solution with ammonia, then to acidulate with acetic acid, and add ammonium oxalate, when a white precipitate of calcium oxalate will appear. 5 Cc. of a 10 per cent. solution of the acid neutralized with ammonia should remain clear on the addition of 1 Cc. of ammonium oxalate test-solution (absence of calcium, U. S.). The U. S. P. demands not less than 99.5 per cent. purity, as shown by the following test: If 5 Gm. of citric acid be dissolved in sufficient water to measure 100 Cc., then 34.75 Cc. of this solution should require not less than 24.87 Cc. of normal potassium hydroxide solution (each Cc. corresponding to 4 per cent. of pure citric acid), phenolphthalein being used as an indicator. Mineral impurities may also be tested for in the ash after dissolving it in a little dilute nitric acid.

Tartaric acid is used occasionally as an adulteration, and oxalic acid and various crystallized salts are said to have been employed for the same purpose. Such frauds are accomplished usually by mixing the foreign compounds in a crystalline form with the acid, and it is therefore necessary to employ a larger quantity (say several ounces) of the large and small crystals, to be triturated in a mortar into powder. Many of the salts will be found to be insoluble in alcohol, and may thus be detected, or by the residue left on incinerating a portion of the powder upon platinum-foil. The aqueous solution of the powder is neutralized with ammonia, and then acidulated with acetic acid. Upon adding calcium chloride, oxalic acid, if present, will be precipitated as white calcium oxalate. The clear filtrate, neutralized with ammonia, will deposit in the cold white calcium tartrate if tartaric acid be present, and the filtrate from it will, on boiling, throw down calcium citrate. On dissolving some of the powder in diluted alcohol and adding a concentrated solution of potassium acetate, tartaric acid will yield a white crystalline

precipitate of acid potassium tartrate. Oxalic acid, if present in sufficient quantity, will likewise cause a precipitate with this test. Or a number of crystals of different sizes are placed upon a glass plate in a little potassium hydroxide solution, or preferably a strong solution of potassium acetate: the crystals of citric acid will remain transparent, while the crystals of tartaric acid will become opaque, in consequence of the formation of acid potassium tartrate. The British Pharmacopœia determines the absence of tartaric acid by the following tests: One drop of a solution of ferrous sulphate, then a few drops of hydrogen peroxide solution, and finally an excess of solution of potassium hydroxide, added to an aqueous solution of the acid, no purple or even light violet coloration should result; or 1 Gm. of acid placed in a test-tube with 5 Cc. of solution of ammonium molybdate, 2 or 3 drops of hydrogen peroxide solution being added, should not afford a bluish coloration after the tube has been shaken and placed in boiling water for 10 minutes. (In the latter test, the presence of metallic particles gives rise to a similar coloration.)

Action and Uses.—Citric acid in large quantities produces gastric disorder and diarrhœa. It increases the acidity of the urine and the coagulability of the blood, especially in scurvy, in which disease it is the best remedy we possess for prophylactic and curative treatment. It has been recommended in rheumatic fever, in which condition it may be given in the form of lemon-juice in daily doses of 1 or 2 fluidounces (30–60 Cc.). Lemon-juice has also been employed in catarrhal jaundice. Lemon-juice, in the form of lemonade, is used as a refreshing drink in fevered states. Solutions of citric acid may be employed in the same conditions, but are inferior to the juice obtained from the lemon or lime.

ACIDUM FORMICICUM, *P. G.*—Formic Acid.

Acidum formicarum, Acidum formicum.—Acide formique, Fr.; *Ameisensäure, Formylsäure*, G.

Formula, $CH_2O_2 = HCOOH$. Molecular weight, 45.67.

Historical.—As early as the sixteenth century Brunfels called attention to the acid nature of the vapors from an ant-pile. According to some, J. Wray (1670), according to others, S. Fischer (1670), first showed that the free acid can be obtained by distillation of ants with water vapor. Marggraf (in 1749) distinguished between it and acetic acid.

Occurrence.—Free formic acid occurs in ants, especially in *Formica rufa*, whence its name; also in a number of other insects (*e. g., Bombyx processionea*), and in animal secretions (perspiration, urine). It is found in the leaf-hairs of the nettles, in pine-needles, several volatile oils, and as glyceride in croton oil. It is obtained frequently in small quantity upon distillation of vegetable and animal matter with water vapor. However, it does not always exist as such, but frequently is obtained as a product of decomposition. It has also been found in peat and in several mineral waters (Brueckenau, Prinzhofen, Weilbach).

Formation.—It is obtained by the oxidation of methyl alcohol, by the hydrolysis of hydrocyanic acid, by the saponification of chloroform, by the direct union of CO with KOH at 100° C. (212° F.), etc.

Like all derivatives of methane, formic acid is unique as an acid. It contains both the CHO and COOH groups, and therefore acts both as an aldehyde and an acid. This accounts for its property of precipitating metallic silver from a hot neutral solution of silver nitrate, and calomel from a solution of mercuric chloride, the acid being oxidized to carbonic acid.

Preparation.—Place in a distilling bulb of 150 Cc. capacity 50 Gm. of glycerin and 50 Gm. of crystallized oxalic acid. Immerse a thermometer in the liquid, connect the bulb with a condenser, and heat with a low flame till the thermometer rises slowly to 105° C. (221° F.). Allow to cool to about 50° C. (122° F.), add 50 Gm. more of oxalic acid, and distil again, always over a low flame and slowly, to a temperature of 115° C. (239° F.). The process may be repeated almost indefinitely; the acid coming over in the later distillations is stronger than that in the first. The residue may be used for the preparation of allyl alcohol (Noyes).

Anhydrous acid can be obtained by converting the acid into the lead salt and decomposing this with hydrogen sulphide, or by combining the water of the dilute acid with

anhydrous oxalic acid, allowing the oxalic acid to crystallize, pouring off the formic acid, and distilling. In order to obtain the official acid, the crude acid is rectified by distillation and diluted to the proper strength.

Oxalic acid, when heated by itself, decomposes principally into CO_2, CO, and H_2O, but little formic acid being formed. In glycerin solution, however, formic acid may be obtained in larger amount. The glycerin does not act merely as a physical solvent or regulator of heat, but unites chemically with the oxalic acid: $H_2C_2O_4$ (oxalic acid) + $C_3H_5(OH)_3$ (glycerin) = $C_3H_5(OH)_2COOH$ (glyceryl monoformate) + CO_2 + H_2O. The water formed then saponifies the ester, regenerating glycerin: $C_3H_5(OH)_2COOH$ (glyceryl monoformate) + H_2O = $C_3H_5(OH)_3$ (glycerin) + HCOOH (formic acid). Theoretically, therefore, a small amount of glycerin will suffice to convert an indefinite amount of oxalic acid into formic acid. Practically, the process is limited, owing to secondary changes of the glycerin.

Properties.—A clear colorless volatile liquid with a pungent but not empyreumatic odor and a strongly sour taste. It contains 24 to 25 per cent. of pure acid and has a specific gravity of 1.060 to 1.063 at 15° C. (59° F.). Mixed with solution of basic lead acetate, formic acid yields a white crystalline precipitate of lead formate. Diluted with water (1 : 6) and saturated with yellow mercuric oxide, a clear solution results, which upon heating gradually deposits metallic mercury, indicating the aldehyde character of the acid.

Tests.—When neutralized with potassium hydroxide solution, formic acid should develop neither a pungent nor an empyreumatic odor, showing the absence of acrolein and allyl alcohol. A solution of formic acid (1 : 6) should not be altered by silver nitrate solution (absence of chlorides), nor, after neutralization with ammonia, by calcium chloride solution (absence of oxalic acid), nor by hydrogen sulphide solution (absence of heavy metals).

A solution of 1 Cc. of formic acid in 5 Cc. of water should yield a neutral filtrate after it has been heated on a water-bath with 1.5 Gm. of yellow mercuric oxide, shaking repeatedly, until evolution of gas ceases to take place (absence of other acids). 5 Cc. of official formic acid require for complete neutralization 28–29 Cc. of normal alkali solution, using phenolphthalein as indicator.

Pharmaceutical Preparations.—Spiritus Formicarum, P. G.; *Spiritus formicæ.*—*Spirit of ants*, E.; *Esprit de fourmis*, Fr.; *Ameisengeist, Ameisenspiritus*, G.—A clear colorless liquid, prepared by mixing 2 parts of formic acid, 35 parts of alcohol, and 13 parts of water, all by weight. It has a specific gravity of 0.894–0.898, and if heated with silver nitrate solution the latter assumes a dark color. Owing to the continuous reaction between the formic acid and alcohol, producing ethyl formate, $C_2H_5CHO_2$, this preparation gradually grows weaker in acid. If spirit of ants be shaken with solution of lead subacetate, crystalline lead formate, $Pb(HCO_2)_2$, will separate.

Action and Uses.—Locally applied, formic acid is irritant and rubefacient. If its application is sufficiently prolonged, it vesicates and produces sloughing. When diluted with an equal quantity of water, it is stated to be of advantage in the treatment of neuralgia and rheumatic pains. It may be employed to prevent bedsores, especially in the early stages of paralysis, as it irritates the skin and so increases circulation. It was formerly employed internally, like ammonia, as a rapidly acting diffusible stimulant, and the Spiritus formicarum (P. G.) may be given in the dose of from 20 to 60 minims (1.3–4 Cc.).

ACIDUM GALLICUM, *U. S., Br.*—Gallic Acid.

Trioxybenzoic acid, Dioxysalicylic acid.—Acide gallique, Fr.; *Gallussäure*, G.; *Acido gallico*, It., Sp.

Formula, $HC_7H_5O_5 + H_2O$ or $C_6H_2(OH)_3COOH + H_2O$. Molecular weight, 186.65

Origin.—Gallic acid is found in nutgalls, sumach, uva ursi, and in a number of other astringent plants. It was for a time confounded with tannin, but its distinction from this was recognized by Scheele (1785), who obtained it in a pure state.

Preparation.—Boil 1 part of tannic acid (or 2 parts of coarsely powdered nutgall) with 1 part of sulphuric acid and 5 parts of water, for 15 minutes; strain the mixture while hot, and set the liquid aside so that crystals may form, which are then deprived of

color by re-solution in hot water and filtration through animal charcoal. The filtrate is set aside again to crystallize, and if necessary the treatment with charcoal is repeated.

The above method is indicated in the British Pharmacopœia, and probably is used now altogether, being more expeditious than the following older method: Nutgall, in fine powder, is made into a thin paste with water and exposed to the air in shallow glass or porcelain vessels for a month, occasionally stirring and adding water from time to time to preserve the semifluid consistence. The mixture is then expressed, the liquid rejected, and the residue boiled for a few minutes in distilled water and filtered while hot through animal charcoal. The filtrate is set aside so that crystals may form, which are then dried.

In both cases contact with iron should be avoided, which would impart to the acid a color difficult to remove.

The conversion of the whole amount of tannin into gallic acid is proved readily by testing a small portion of the filtered liquid with solution of isinglass, which should cause no turbidity. The change takes place slowly at a low temperature, and the yield necessarily varies with the amount of tannin present in the galls.

Formation.—The conversion of tannin into gallic acid has been the subject of much controversy, involving numerous researches. It was supposed at first that gallic acid existed ready formed in galls, but the experiments of Pelouze (1833) proved that most of it is formed from the tannin contained therein. The relation of the two compounds to each other appears to have been settled finally by the researches of H. Schiff, Sac and J. Löwe (1871 and 1872), and Etti (1884), according to which, pure tannin is *digallic acid*, an anhydride of gallic acid, the conversion of the former into the latter occurring as follows: $C_{14}H_{10}O_9 + H_2O = 2C_7H_6O_5$; and the sugar observed in the preparation of gallic acid is referable to the glucose which naturally exists in galls, perhaps in combination with digallic acid, and from which tannin is purified with difficulty. Löwe prepared pure tannin from galls, and Schiff succeeded in converting gallic acid into tannin absolutely free from glucose.

Properties.—Gallic acid occurs in fine white or pale fawn-colored silky needles or circular prisms, which have a slightly acid and faint astringent taste, and are inodorous. It is soluble at 15° C. (59° F.) in 100 parts of water and in 5 parts of alcohol; at 25° C. (77° F.) in 83.7 parts of water and in 4.14 parts of alcohol (U. S.); in 3 parts of boiling water and 1 part of boiling alcohol. Also soluble in 40 parts of ether and in 12 parts of glycerin. Very slightly soluble in chloroform, benzene, and benzin. The solution has an acid reaction and gives no precipitate with ferrous sulphate. With ferric salts a bluish-black precipitate is obtained which is easily soluble in acetic acid, and disappears on boiling. Gallic acid dissolves permanently in a solution of potassium citrate to such an extent that, according to F. Long (1881), 15 grains (1 Gm.) of it, with 20 grains (1.3 Gm.) of the citrate, will yield a clear solution in 1 ounce (30 Gm.) of water. At 100° C. (212° F.) it loses 9.5 per cent. of water of crystallization. Heated to between 200° and 215° C. (392° and 419° F.), or, according to Schiff (1879), to about 240° C. (464° F.), it melts, and then yields carbon dioxide gas and a sublimate of pyrogallol, $C_6H_3(OH)_3$, without leaving any residue.

Alkalies added to a solution of gallic acid rapidly color the liquid, which in the presence of very little potassium or sodium hydroxide gradually becomes green, but with an excess is at once yellow, and turns red and brown; little ammonia causes a yellow, and an excess a reddish and red-brown color. Alkali carbonates produce similar colorations, but act less energetically; on the subsequent addition of hydrochloric acid the color is changed to red. If added to a solution of potassium cyanide, gallic acid causes a red coloration (Young's test). Most of its salts, those with the alkalies excepted, are insoluble in water. When perfectly dry they keep unaltered; but in the presence of water, and particularly of alkaline liquids, they speedily are decomposed, becoming brown and black. Solutions of salts of silver, gold, platinum, and the allied metals are reduced gradually by gallic acid and its salts at the ordinary temperature.

Tests.—Resinous substances would be insoluble in boiling water; sugar and dextrin would remain undissolved on treatment with spirit of ether; and mineral admixtures would remain behind upon heating the acid to redness.

Gallic acid may be distinguished from tannic acid as follows: On adding to a cold saturated solution of the acid a little lime water a bluish-white precipitate will form where the test-solution is temporarily in excess, and will disappear on shaking. When the test-

solution has been added in excess, the precipitate no longer dissolves, and the liquid acquires a tint which is blue by reflected and green by transmitted light, or becomes pink on the addition of a large excess of the lime water (U. S.). Gallic acid solutions do not precipitate solutions of the alkaloids, gelatin, tartar emetic, albumin, and starch. Fehling's Solution is not reduced by gallic acid.

Action and Uses.—When locally applied, gallic acid acts as a mild astringent, but does not cause coagulation of the blood, for which reason it is not used locally in the control of hemorrhage. When administered internally, the drug is rapidly absorbed and eliminated by the kidneys as gallic acid. It is stated that it decreases the secretion of sweat and of urine, and that it does not cause constipation.

When taken internally, gallic acid produces constriction of the bloodvessels, and in this manner lends itself to the control of capillary and arteriole hemorrhage.

Gallic acid has been used with asserted benefit in hæmaturia, purpura, hæmoptysis, and menorrhagia. It has been employed successfully in local sweating of the hands and feet, in the night-sweats of phthisis, and when combined with opium is of value in diabetes insipidus and mellitus. It may do good in pyrosis, bronchitis with profuse expectoration, epistaxis, and in intestinal and other forms of hemorrhage. In both acute and chronic Bright's disease the drug causes a material decrease in the albumin in the urine.

Locally applied in the form of an ointment, it has been used in the treatment of external hemorrhoids and in chronic ulcers and sores. It has also met with favor in the treatment of psoriasis and alopecia.

The dose for internal use is from 5 to 20 grains (0.30–1.30) Gm.), repeated several times daily according to the urgency of the case.

ACIDUM GLYCEROPHOSPHORICUM.—Glycerophosphoric Acid.

Acidum glycerinophosphoricum.—Glycerinophosphoric acid, Phosphoglyceric acid, Glycerin acid phosphate, E.; *Glycerinphosphorsäure, Saurer Phosphorsäureglycerinester,* G.

Formula, $C_3H_5(OH)_2H_2PO_4$ or $C_3H_5(OH)_2O.PO(OH)_2$. Molecular weight, 170.78.

Occurrence.—Glycerophosphoric acid is met with in blood, flesh, the brain, and the nerves. It also occurs together with cholin as a result of the splitting up of lecithin.

Preparation.—Absolute glycerophosphoric acid is very unstable, and all efforts to produce a concentrated solution of the same have resulted in decomposition of the acid into glycerin and phosphoric acid. The commercial article sold as glycerophosphoric acid is a 20 per cent. aqueous solution of the ester. It may be obtained as follows: Glacial phosphoric acid (metaphosphoric acid) is dissolved gradually in an equal weight of 95 per cent. glycerin with aid of a moderate heat, and the solution then heated to 110° C. (230° F.) on a paraffin-bath for several hours. Water is split off and the following reaction takes place: $C_3H_5(OH)_3 + HPO_3 = C_3H_5(OH)_2H_2PO_4$. A tenacious mass results, which is dissolved, while still warm, in cold water and an excess of milk of lime or solution of barium hydroxide added. The mixture is filtered, the excess of calcium or barium hydroxide removed by a current of carbon dioxide, and again filtered. The filtrate is concentrated in a vacuum apparatus and precipitated by addition of alcohol or evaporated to dryness. The glycerophosphate thus obtained is freed from adhering glycerin by washing with alcohol, redissolved in water, and decomposed by addition of a previously calculated quantity of diluted sulphuric acid, the precipitated calcium or barium sulphate being removed by filtration and the acid liquid evaporated to the proper density.

Properties.—When freshly prepared, glycerophosphoric acid is a clear colorless liquid having the specific gravity 1.125; on keeping, it gradually assumes a yellow color and decomposes slowly in the cold, more rapidly when heated, into glycerin and ordinary phosphoric acid. It has a decided acid taste and reaction, and is readily miscible with water and alcohol. Being a dibasic acid, it is capable of forming both normal and acid salts; the former are soluble in water, insoluble in alcohol, and generally have an alkaline reaction. If lead acetate be added to an aqueous solution of the glycerophosphates, the corresponding lead salt is precipitated, which is readily soluble in nitric acid, but with difficulty in acetic acid. The usual reagents for phosphoric acid, such as ammonium molybdate, uranium acetate, and magnesia mixture, do not affect a solution of glycerophosphates in the cold. If glycerophosphates be boiled with mineral acids, the liberated

acid breaks up into glycerin and ordinary phosphoric acid. When heated to redness they are converted into pyrophosphates.

The glycerophosphates of calcium, potassium, sodium, lithium, iron, and quinine have been introduced into medicine. They are discussed under the respective bases.

Action and Uses.—Glycerophosphoric acid is not employed in medicine as such; but its salts, especially that of sodium, have been used quite largely in the treatment of certain constitutional conditions. (For action and uses, see CALCII GLYCEROPHOSPHAS.)

ACIDUM HYDRIODICUM DILUTUM, *U. S.*—Diluted Hydriodic Acid.

Acid hydroiodique dilué, Fr.; *Verdünnte Jodwasserstoffsäure*, G.

Formula, HI. Molecular weight, 126.9.

A solution of hydriodic acid, containing not less than 10 per cent. of the absolute acid and about 90 per cent. of water. It should be kept in amber-colored glass-stoppered bottles, protected from light.—U. S.

Preparation.—Potassium iodide, 135 Gm.; potassium hypophosphite, 10 Gm.; tartaric acid, 136.5 Gm.; distilled water, diluted alcohol, of each a sufficient quantity to make 1000 Gm. Dissolve the potassium salts in 250 Cc. of distilled water with the aid of heat, and the tartaric acid in 400 Cc. of diluted alcohol. Having poured the solution of tartaric acid into a bottle of about 1000 Cc. capacity, add the solution of the potassium salts and shake the mixture briskly. Set the bottle into a bath of ice-water for several hours and, having placed a pledget of cotton tightly in the throat of a funnel, transfer the contents of the bottle to the funnel. When all the liquid has passed through, wash the bottle and crystalline precipitate with diluted alcohol in successive small portions until 1000 Gm. of clear filtrate have been obtained. Evaporate the liquid at a moderate temperature, on a water-bath, until all of the alcohol has been dissipated, and add sufficient distilled water to make the product weigh 1000 Gm.—U. S.

In the above process the potassium iodide and hypophosphite are decomposed by the tartaric acid, liberating hydriodic and hypophosphorous acids, acid potassium tartrate being formed at the same time, which is precipitated, thus: $KI + KPH_2O_2 + 2H_2C_4H_4O_6 = HI + HPH_2O_2 + 2KHC_4H_4O_6$. The presence of alcohol aids in the removal of the acid potassium tartrate, as does also the application of cold. Upon evaporation of the filtrate for removal of the alcohol, it assumes a yellowish color when concentrated, but no iodine is liberated, and the liquid again becomes colorless when diluted with distilled water.

Properties.—Diluted hydriodic acid is a clear colorless liquid without odor and having an acid taste. It has a specific gravity of about 1.106 at 25° C. (77° F.), and is miscible in all proportions with water and alcohol. To blue litmus-paper it shows a strong acid reaction. On distilling diluted hydriodic acid, water with some weak acid first passes over; at the temperature of 127° C. (260.6° F.) an acid of 57.5 per cent. distils over unchanged. Silver nitrate test-solution causes a yellow, curdy precipitate, insoluble in nitric acid, almost insoluble in ammonia-water, but soluble in solutions of sodium thiosulphate and potassium cyanide. If a few drops of ferric chloride test-solution or chlorine-water be added to the acid, diluted with twice its volume of water, iodine will be liberated and impart to the solution a reddish-brown color. On agitating the mixture with a few drops of chloroform, the latter will acquire a violet color.—U. S.

Tests.—Diluted hydriodic acid should not become colored on keeping. Barium chloride test-solution should not produce a turbidity or precipitate (absence of sulphuric acid). The acid should not be rendered turbid by addition of potassium sulphate test-solution (absence of barium). Diluted hydriodic acid, when evaporated to dryness on a water-bath of boiling water and then heated to 115° C. (239° F.), should not leave more than 1 per cent. of residue. 10 Cc. of the diluted acid warmed to about 50° C. (122° F.) should not be colored or rendered turbid by the addition of an equal volume of fresh hydrogen sulphide test-solution after standing stoppered at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals). If 5 Cc. of diluted hydriodic acid be measured into a beaker containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water, and then evaporated to dryness on a bath of boiling water, the residue should not respond to the modified Gutzeit's test for arsenic (see under ARSENI TRIOXIDUM). Into a flask provided with a well-fitting stopper introduce 2.54 Gm. of diluted hydriodic acid, diluted with

50 Cc. of distilled water, followed by 25 Cc. of tenth-normal silver nitrate solution, 5 Cc. of ferric ammonium sulphate test-solution, and 3 or 4 Cc. of nitric acid (free from nitrous compounds), then securely stopper the flask and shake it well. Not more than 5 Cc. of tenth-normal potassium sulphocyanate solution should then be required to produce a permanent reddish-brown tint (each Cc. of tenth-normal silver nitrate solution consumed by the diluted hydriodic acid corresponding to 0.5 per cent. of absolute hydriodic acid).—U. S.

Hydriodic acid was first recognized by Clement and Desormes in 1813 and investigated the same year by Gay-Lussac. The absolute acid may be prepared by the action of iodine on phosphorus in the presence of water, used in the proportions of 15, 1, and 4 respectively. The flask containing the mixture is connected with a condenser and a receiving flask partly filled with water. Upon heating, the following reactions occur: $P + I_3 = PI_3$; $PI_3 + 3H_2O = 3HI + H_3PO_3$; the gaseous acid being absorbed by the water in the flask. Solutions of hydriodic acid decompose readily, especially when exposed to light, which may be prevented by the presence of free hypophosphorous acid. The official diluted acid (containing about 0.63 per cent. of absolute hypophosphorous acid) has been found to keep perfectly for over 6 months in diffused light.

Absolute hydriodic acid is a colorless, irrespirable, and uninflammable gas of 4.44 specific gravity, and having an odor resembling hydrochloric acid. The most concentrated solution obtainable by distillation contains 57.75 per cent. of HI, has a specific gravity of 1.708, and boils at 127° C. (260.6° F.).

Action and Uses.—This preparation contains about ten times the amount of hydriodic acid as does the Syrupus Acidi Hydriodici. It produces less disorder of the stomach than the iodides, and like them is employed for the alterative effect of the iodine present. If discolored by the presence of free iodine it should not be administered, as it may produce severe gastric irritation. It is considered of especial value in scrofulosis in children. The dose is from 5 to 40 minims (0.30–2.6 Cc.).

ACIDUM HYDROBROMICUM DILUTUM, *U. S., Br.*—Diluted Hydrobromic Acid.

Acidum Hydrobromicum, P. G.; *Acide hydrobromique dilué*, Fr.; *Verdünnte Bromwasserstoffsäure, V. Hydrobromsäure*, G.

Formula, HBr. Molecular weight, 80.36.

A liquid composed of 10 per cent. of absolute hydrobromic acid and about 90 per cent. of water. It should be preserved in amber-colored glass-stoppered bottles and protected from light.—U. S.

Origin.—Hydrobromic acid was discovered by Balard (1826). It is formed by the direct union of its elements at a red heat, by the decomposition of hydrogen sulphide and other hydrogen compounds by bromine, by the action of bromine in the presence of water upon the lower oxides of sulphur, phosphorus, arsenic, and other elements, and by the action of water upon the sulphur, phosphorus, and other compounds of bromine.

Preparation.—Markoe (1875) recommended the following procedure: 1 pound of phosphorus is spread over the bottom of a 1-gallon jar, covered with water, and the jar half-filled with ice, after which a large funnel is inserted into the throat of the jar, a funnel-tube adjusted so as to reach a short distance above the phosphorus, and the jar surrounded with ice. 3 or 4 pounds of bromine may now be added very slowly through the funnel-tube, care being taken to prevent accumulation in the jar of uncombined bromine, which would give rise to an explosion when reacting with the phosphorus. The two elements unite to form phosphorus pentabromide, PBr_5; and this, reacting with water, forms phosphoric and hydrobromic acids; $PBr_5 + 4H_2O$ yields $H_3PO_4 + 5HBr$. After the reaction is completed, the excess of phosphorus is removed, and the aqueous liquid distilled until hydrobromic acid ceases to come over. The syrupy residue left in the retort, when properly diluted, is utilized as phosphoric acid.

Fothergill's formula is an adaptation of that of D. C. Wade (1875). An acid of the strength required by the U. S. Pharmacopœia, but containing small quantities of potassium bitartrate and bromide, may be prepared extemporaneously by dissolving 8 parts of potassium bromide and 10 parts of tartaric acid, each in 25 parts of distilled water, mixing the solutions, cooling the mixture, and stirring it well; after the potassium bitartrate has precipitated, the whole is thrown upon a small filter, and the vessel and precipitate are washed with 10 parts of ice-cold water. The potassium bitartrate may be

removed more completely by adding double the volume of strong alcohol to the mixture, and letting it stand some time, filtering, and recovering the alcohol by distillation.

Hydrobromic acid, like hydriodic acid, cannot be made by distilling bromides with strong sulphuric acid, owing to decomposition of the acid into free bromine. This difficulty has been overcome in a method proposed by Dr. Squibb (1878), as follows: 7 parts by weight of sulphuric acid, specific gravity 1.838 at 15.6° C. (60° F.), are added to 1 part of water, and the mixture allowed to cool, when it is slowly, and with constant stirring, added to a hot solution of 6 parts of potassium bromide in 6 parts of water. A decomposition into hydrobromic acid and potassium sulphate will take place; $2KBr + H_2SO_4$ yields $2HBr + K_2SO_4$. On setting the mixture aside for 24 hours, the salt crystallizes, the liquid is poured off into a retort, and the crystalline mass broken up, transferred to a funnel, and washed with 2 parts of cold water to recover adhering hydrobromic acid. The washings likewise are poured into the retort, which is placed upon a sand-bath or set upon wire gauze, and the whole then is distilled nearly to dryness. The distillate, which weighs about 10 parts, is assayed with normal sodium hydroxide solution, and then diluted with distilled water so as to contain 34 per cent. of HBr. When of this strength, the acid represents one-half the bromine strength of an equal weight of potassium bromide, and should be dispensed only as *acidum hydrobromicum concentratum.*

The following other methods may be employed to prepare hydrobromic acid solutions: Exact precipitation of barium bromide in solution with sulphuric acid and distillation of the filtrate: $(BaBr_2 + 2H_2O) + H_2SO_4 = BaSO_4 + 2HBr + 2H_2O$. Distillation of potassium bromide with phosphoric acid, specific gravity 1.304 (W. Grüning, 1883): $KBr + H_3PO_4 = HBr + KH_2PO_4$. Decomposition of hydrogen sulphide by bromine, as in case of hydriodic acid, and subsequent distillation: $H_2S + Br_2 = 2HBr + S$. By action of bromine on organic bodies, such as benzene, for example: $C_6H_6 + 2Br_2 = C_6H_4Br_2 + 2HBr$. Large quantities of the gaseous HBr are obtained in this manner in the chemical industries as a by-product. The acid is converted into barium bromide, from which an aqueous solution is obtained in the manner given above.

Properties.—Diluted hydrobromic acid has the specific gravity 1.076 at 25° C. (77° F.) (U. S.) and contains 10 per cent. of HBr (U. S., Br.). The hydrobromic acid of the German Pharmacopœia is $2\frac{1}{2}$ times as strong as the preceding and is not officially designated as diluted acid. Pure hydrobromic acid is a colorless gas of a pungent and irritating odor, and produces dense white fumes in a moist atmosphere. The specific gravity of the gas is 2.797 (air = 1), and 1 liter at 0° C. (32° F.) and 760 Mm. weighs 3.6167 Gm. Its aqueous solutions are colorless, odorless, limpid liquids of a strongly acid taste, which remain colorless on exposure to air when dilute, but strong solutions turn yellow. Dr. Squibb determined the acid of the strength suggested by him to have the specific gravity 1.274 at 15.6° C. (60° F.), and to contain 34 per cent. of HBr. When heated, water and a weak acid distil over, and when the temperature reaches 126° C. (258.8° F.) an acid remains which has the specific gravity 1.490 and contains 47.8 per cent. of HBr. This strong acid may be distilled unchanged.

Hydrobromic acid liberates bromine on the cautious addition of chlorine water or of nitric acid, the bromine being soluble, with a yellow or orange-red color, in chloroform, ether, and carbon disulphide; and such a solution, agitated with starch paste, imparts to the latter a yellow color; excess of chlorine water will destroy the color.

The density of aqueous hydrobromic acid at 15° C. (59° F.), according to Biel (1881), is as follows:

Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.
1	1.0082	11	1.085	21	1.172	31	1.270	41	1.388
2	1.0155	12	1.093	22	1.181	32	1.281	42	1.401
3	1.0230	13	1.102	23	1.190	33	1.292	43	1.415
4	1.0305	14	1.110	24	1.200	34	1.303	44	1.429
5	1.0380	15	1.119	25	1.209	35	1.314	45	1.444
6	1.0460	16	1.127	26	1.219	36	1.326	46	1.459
7	1.0530	17	1.136	27	1.229	37	1.338	47	1.474
8	1.0610	18	1.145	28	1.239	38	1.350	48	1.490
9	1.0690	19	1.154	29	1.249	39	1.362	49	1.496
10	1.0770	20	1.163	30	1.260	40	1.375	50	1.513

Tests.—The acid should not become colored on keeping. If copper sulphate test-solution be added to the acid, a deep-red color is produced upon the addition of sulphuric acid. It yields a yellowish-white precipitate with silver nitrate solution, which is nearly insoluble in *dilute* ammonia-water; silver chloride, however, is readily soluble in the latter. If 10 Cc. of the acid be evaporated and heated to 110° C. (230° F.), no appreciable residue should remain (limit of non-volatile impurities). Barium chloride solution should not produce a precipitate or turbidity (absence of sulphuric acid). 10 Cc. of the acid should not be rendered turbid by 1 Cc. of potassium sulphate test-solution (absence of barium). 10 Cc. of the acid warmed to 50° C. (122° F.) should not be colored or rendered turbid by the addition of an equal volume of fresh hydrogen sulphide test-solution after standing stoppered at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals). 2 Cc. of chloroform shaken with 10 Cc. of the acid should remain colorless (absence of free bromine), and by subsequent addition of chlorine-water previously diluted with an equal volume of water, drop by drop, with shaking, the chloroform should be colored orange, with no trace of violet (absence of iodine). 5 Cc. of the acid should not respond to the modified Gutzeit's test for arsenic (see under ARSENI TRIOXIDUM). If 0.5 Cc. of the acid, 10 Cc. of water, 8 Cc. of silver nitrate solution, and 6 Cc. of ammonium carbonate test-solution be mixed and digested for 10 minutes on a boiling water-bath, then cooled and filtered, the filtrate, acidified with nitric acid, should not become more than slightly opalescent (limit of hydrochloric acid and chlorides). If 10 Gm. of the acid be diluted with water to 100 Cc., and if to 8.04 Cc. of this solution, after exact neutralization with dilute ammonia-water (litmus as indicator), there be added 3 drops of potassium chromate test-solution, not less than 10 Cc. of decinormal silver nitrate should be required to produce a permanent red color in the liquid (each Cc. representing 1 per cent. of absolute acid). 0.804 Gm. of the acid are used in the titration, and 1 Cc. of the silver solution precipitates 0.00804 Gm. of HBr, which is 1 per cent. of the weight taken for titration. The reaction is $HBr + AgNO_3 = AgBr + HNO_3$. The solution is made neutral in order that the chromate indicator may be used to show when just enough silver solution has been added. In the Br. P. 4 Gm. of the acid should require 49.8 Cc. of the volumetric silver solution. 5 Cc. of the official German acid should require 18.7 Cc. of normal alkali for neutralization.

Action and Uses.—In concentrated form, hydrobromic acid is a caustic poison, producing symptoms resembling those caused by poisoning by hydrochloric acid. Internally, in its dilute form, the drug may be employed with some benefit in those conditions which usually are relieved by the bromides (see Potassii Bromidum). Because of its irritating properties, it cannot, as a rule, be given in quantities sufficiently large to produce any marked result. It is stated that it possesses the peculiar property of preventing and relieving tinnitus aurium, and for this purpose has been exhibited with quinine and the salicylates. As these drugs themselves frequently cause gastric distress, its combination with them at times may prove of decided disadvantage.

Diluted hydrobromic acid is usually given in the dose of from 1 to 2 fluidrachms (4–8 Cc.) well diluted with sweetened water.

ACIDUM HYDROCHLORICUM, *U. S., Br., P. G.*—Hydrochloric Acid.

Acidum muriaticum s. hydrochloratum s. chlorhydricum.—*Muriatic acid*, E.; *Acide chlorhydrique s. muriatique*, Fr.; *Salzsäure, Chlorwasserstoffsäure*, G.; *Acido cloridico*, F. It., Sp.

Formula, HCl. Molecular weight, 36.18.

The acid of the U. S. Pharmacopœia, of 1.158 specific gravity at 25° C. (77° F.) and containing 31.9 per cent. of HCl, is practically identical with that of the British, which contains 31.79 per cent. of HCl.

Origin.—Hydrochloric acid occurs in the uncombined state among the gases emitted by active volcanoes, and in combination its radical, chlorine, is found in numerous minerals, prominent among which is sodium chloride, or common salt, which is also one of the most important constituents of sea water and the source of nearly all the hydrochloric acid of commerce. The acid was obtained in the fifteenth century by Basilius Valentinus, and was described as *spirit of salt*, a name which is used occasionally even at the present time. The correct composition of hydrochloric acid was proved by Humphry Davy (1810).

Preparation.—The acid is made by the action of concentrated sulphuric acid on sodium chloride: $2NaCl + H_2SO_4 = Na_2SO_4 + 2HCl$. It escapes as a gas from the retort, and is caught in pure water in a cooled receiver. Enormous quantities of the

acid are produced in the Le Blanc soda factories, where common salt and sulphuric acid are heated in large horizontal cylinders in order to obtain sodium sulphate or "salt cake," which is the first step in the manufacture of sodium carbonate. Formerly the acid was allowed to escape into the air, but a law was passed prohibiting this, so that now the acid is caught in water and furnishes practically all the crude acid of commerce The acid is a source of revenue to the soda industries, and offers the anomalous instance of an evil thing being turned to great profit by the very law which was directed against it. The acid from the soda works usually has a lighter or darker yellow color, due to a small quantity of ferric chloride. It finds application in cases where great purity is not essential. Pure acid is prepared on a large scale by distilling pure salt and sulphuric acid from a glass retort and catching the acid in pure water.

To prepare the acid in the laboratory, it is better to choose quantities so that acid sodium sulphate is formed—thus, $NaCl + H_2SO_4 = NaHSO_4 + HCl$—because a lower temperature is required. 3 parts of dry salt require a trifle over 5 parts of concentrated sulphuric acid. The acid should be diluted with about ½ its weight of water. The crude acid may also be purified by distillation.

Dry gaseous hydrochloric acid may be prepared by dropping concentrated sulphuric acid from a dropping funnel into a flask containing fuming hydrochloric acid, fitted with a tube leading to a wash-bottle filled with concentrated sulphuric acid. The gas may also be led into distilled water to form a solution of pure acid.

Arsenic-free Hydrochloric Acid.—Almost every specimen of hydrochloric acid on the market, unless very carefully purified, contains small quantities of arsenic. This is particularly true in the case of the acid made by using European sulphuric acid, which is made from iron pyrites, and this usually contains arsenic. The American sulphuric acid is made chiefly from sulphur, and is much purer and freer from arsenic.

For toxicological purposes, hydrochloric acid absolutely free from arsenic is required. It may be prepared thus: In a glass-stoppered retort place 1000 Cc. of "pure" fuming hydrochloric acid and 30 Gm. of ferrous chloride (dry); heat until fumes cease to come off and a watery distillate begins to come over. Collect this distillate until about 150 Cc. remain in the retort. The acid is about 20 per cent. strong, and contains only a trace of ferric chloride, which does not interfere in tests for arsenic. The arsenic impurity is removed at the beginning as volatile arsenous chloride. Arsenic-free acid should not be kept a long time in glass vessels, since glass usually contains arsenic, which will recontaminate the acid (Hager's *Handbuch*, 1899). Traces of arsenic may also be removed from strong hydrochloric acid by precipitating it with stannous chloride and redistilling the clear solution (Bettendorff, *Zeit. für Chem.*, (2) 5, p. 492).

Fuming Hydrochloric Acid.—The acid known in commerce by this name has a specific gravity of 1.195 and contains 38.2 per cent. of HCl; fumes strongly in air and is colorless. It is used in analytical and synthetical processes and for preparing arsenic-free and gaseous hydrochloric acid.

Crude Hydrochloric Acid.—This is the yellowish impure fuming acid of commerce, obtained as a by-product in large chemical industries, chiefly in the Le Blanc soda process; specific gravity 1.16–1.17, strength 30–33 per cent. The impurities are iron, alumina, sulphuric and sulphurous acids, chlorine, arsenic.

Properties.—1. Hydrochloric Acid Gas.—It is colorless, has a pungent, acid, suffocating odor, and when inhaled is highly irritating, though less so than chlorine. Its specific gravity is 1.2844 (Thomson). The weight of 1 liter at 0° C. (32° F.) and 760 Mm. pressure is 1.6352 Gm. It strongly reddens blue litmus-paper, does not support combustion, and in contact with the atmosphere produces grayish-white fumes by condensing the moisture of the air. It may be condensed into a colorless liquid by a pressure of 1 atmosphere and a refrigerating mixture of solid carbon dioxide and ether. This liquid does not congeal at —110° C. (—166° F.), and at 10° C. (50° F.) exerts a pressure equal to 40 atmospheres. Its composition is HCl, or equal volumes of hydrogen and chlorine united without condensation.

2. Official Hydrochloric Acid.—It is a colorless liquid, having the specific gravity 1.158 at 25° C. (77° F.), U. S., 1.160, Br., 1.124, P. G., and emitting white vapors in contact with the air. It gives with silver nitrate a white curdy precipitate, which is soluble in ammonia and insoluble in nitric acid. The strength of the acid is determined by diluting 10 Gm. with water to 100 Cc. and titrating 36.2 Cc. (36.18 Cc.) of this solution (representing 3.62 Gm. of the acid) with normal alkali solution, using phenolphthalein as indicator. 31.9 Cc. of the normal alkali should be required, each

Cc. corresponding to 1 per cent. of absolute acid. 1 Gm. diluted with water should require 8.7 Cc. normal alkali (Br.). 0.1 Gm. should require, for complete precipitation, 8.7 Cc. of decinormal solution of silver nitrate (Br.). Pure hydrochloric acid of the German Pharmacopœia is required to have the density 1.124 and to contain 25 per cent. of HCl; and 5 Cc. of the acid will therefore require 38.5 Cc. of normal alkali solution.

Water absorbs at 0° C. (32° F.), the barometer being 760 Mm., 503 volumes, at 20° C. (68° F.) 460 volumes, of hydrochloric acid gas. The concentrated acid, on being heated, loses gas, becoming weaker on boiling until, at the barometric pressure given before, it has reached the specific gravity 1.098 at 25° C. (77° F.), contains 20.13 per cent. of HCl, and distils at 110° C. (230° F.) unchanged, leaving no residue if the acid was perfectly pure. On boiling a weaker acid it becomes stronger, the final density depending on the atmospheric pressure.

Hydrochloric acid of the specific gravity 1.01 at 25° C. (77° F.) contains, according to E. Davy, 2.02 per cent. of gas, and for every additional 2.02 per cent. increases in density at the ratio of 0.01, so that an acid of 1.10 specific gravity contains 20.20 per cent., and if of specific gravity 1.19 contains 38.38 per cent. of gas. These figures differ little from those ascertained by A. Ure.

The following table, which is incorporated in the U. S. Pharmacopœia, refers only to chemically pure acids. The percentage of real acid in the commercial acids, particularly when they are concentrated, is always less than that given in the table:

Per cent. hydrochloric acid.	Specific gravity — 25° C. / 25° C.	Specific gravity — 15° C. / 15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
1	1.0051	1.0051	0.00017	0.020	0.28	0.036
2	1.0101	1.0102	0.00018	0.020	0.56	0.036
3	1.0151	1.0152	0.00018	0.020	0.84	0.034
4	1.0201	1.0202	0.00019	0.020	1.13	0.036
5	1.0250	1.0253	0.00020	0.020	1.41	0.034
6	1.0299	1.0303	0.00021	0.020	1.70	0.033
7	1.0348	1.0353	0.00023	0.021	2.00	0.034
8	1.0396	1.0402	0.00024	0.021	2.29	0.033
9	1.0444	1.0452	0.00026	0.021	2.59	0.033
10	**1.0492**	**1.0502**	**0.00027**	**0.020**	**2.89**	**0.032**
11	1.0541	1.0552	0.00029	0.021	3.20	0.033
12	1.0589	1.0602	0.00031	0.020	3.50	0.032
13	1.0638	1.0652	0.00033	0.021	3.81	0.032
14	1.0686	1.0702	0.00035	0.021	4.12	0.031
15	1.0734	1.0752	0.00037	0.020	4.44	0.032
16	1.0783	1.0803	0.00039	0.020	4.75	0.031
17	1.0832	1.0853	0.00041	0.020	5.07	0.030
18	1.0881	1.0904	0.00043	0.021	5.40	0.031
19	1.0929	1.0954	0.00044	0.020	5.72	0.030
20	1.0978	1.1005	0.00046	0.020	6.05	0.030
21	1.1029	1.1058	0.00048	0.019	6.38	0.029
22	1.1081	1.1111	0.00050	0.020	6.72	0.029
23	1.1132	1.1164	0.00052	0.020	7.06	0.029
24	1.1183	1.1217	0.00054	0.020	7.40	0.029
25	1.1234	1.1270	0.00056	0.020	7.74	0.029
26	1.1284	1.1322	0.00058	0.020	8.09	0.029
27	1.1335	1.1375	0.00059	0.020	8.44	0.029
28	1.1386	1.1427	0.00061	0.020	8.79	0.029
29	1.1437	1.1480	0.00063	0.020	9.14	0.028
30	1.1487	1.1532	0.00065	0.020	9.50	0.028
31	1.1537	1.1583	0.00067	0.020	9.86	0.028
31.9	**1.1581**	**1.1629**	**0.00068**	**0.020**	**10.18**	**0.028**
32	1.1586	1.1634	0.00068	0.020	10.22	0.028
33	1.1636	1.1685	0.00070	0.020	10.58	0.027
34	1.1687	1.1737	0.00071	0.020	10.95	0.027
35	1.1736	1.1789	0.00073	0.020	11.32	0.027
36	1.1787	1.1842	0.00074	0.019	11.69	0.026
37	1.1839	1.1894	0.00076	0.019	12.07	0.026
38	1.1891	1.1947	0.00077	0.019	12.45	0.026
39	1.1943	1.2000	0.00078	0.019	12.83	0.026
40	1.1995	1.2053	0.00079	. .	13.22	

Note.—To find the per cent. of chlorine, multiply the per cent. of HCl by 0.9724.

To find the weight in grammes of HCl in 100 Cc., multiply the specific gravity by the per cent. of HCl.

To find the volume per cent. of official Hydrochloric Acid, multiply the "normality" by 9.823. For the volume per cent. of official diluted Hydrochloric Acid, multiply the "normality" by 34.60.

[1] Add if the temperature is above, subtract if the temperature is below, 25° C.

[2] Corresponding with a difference in specific gravity of 0.0001.

Impurities and Tests.—By evaporating 10 Cc. of the acid and drying at 110° C. (230° F.), no appreciable residue should remain (limit of non-volatile matter). If to 5 Cc. of the acid, diluted with an equal volume of water, 1 Cc. of chloroform be added, and if chlorine-water previously diluted with an equal volume of water be then added, a drop at a time, with constant agitation, the chloroform should remain free from any yellow, orange, or violet color (absence of bromine or iodine). On agitating a mixture of 1 Cc. of the acid, 5 Cc. of water, 1 Cc. of potassium iodide test-solution, and 1 Cc. of chloroform, the chloroform should be free from any violet coloration (absence of free chlorine or bromine). 5 Cc. of the diluted acid (1 in 10) should not respond to the modified Gutzeit's test for arsenic (see under ARSENI TRIOXIDUM). If 1 Cc. of the acid be diluted with 5 Cc. of water, and a few drops of barium chloride test-solution be added, no precipitate or turbidity should appear within one hour (absence of sulphuric acid or sulphates), nor should a few drops of tenth-normal iodine solution produce a turbidity in this mixture (absence of sulphurous acid). 10 Cc. of the diluted acid (1 in 20), warmed to about 50° C. (122° F.), should not be colored or rendered turbid by the addition of an equal volume of fresh hydrogen sulphide test-solution after standing stoppered at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals).

Acidum Hydrochloricum Dilutum, U. S., Br., P. G.—*Acidum muriaticum dilutum.—Diluted hydrochloric acid, Diluted muriatic acid,* E.; *Acide chlorhydrique dilué,* Fr.; *Verdünnte Salzsäure,* G.

Preparation.—Diluted hydrochloric acid is prepared by mixing 100 Gm. of hydrochloric acid with 219 Gm. of distilled water (U. S.). Or 10 parts of the acid may be mixed with 21.9 parts of water, all by weight. The British Pharmacopœia directs that to 350.1 Gm. (or 3063 grains) of hydrochloric acid sufficient distilled water be added, so that the mixture after shaking shall measure 1000 Cc. (or 1 Imperial pint) at 15.5° C. (60° F.). The German diluted hydrochloric acid is made by mixing equal parts by weight of 25 per cent. hydrochloric acid and water.

Properties.—The diluted acid has the same properties as the strong acid, except that it does not fume and is without odor. It contains 10 per cent. of absolute HCl (U. S.), 10.58 per cent. (Br.), 12.5 per cent. (P. G.), and has the specific gravity 1.049 at 25° C. (77° F.) (U. S.), 1.052 (Br.), 1.061 (P. G.). The amount of normal sodium hydroxide solution required for neutralization is 10 Cc. for 3.62 Gm. of the diluted acid (U. S.), and 2.9 Cc. for 1 Gm. of the latter (Br.). The diluted acid should conform to all the reactions and tests of the strong acid.

Action and Uses.—When applied to the skin in concentrated form, hydrochloric acid produces a blister, and if allowed to remain sufficiently long destroys the tissue. It first whitens mucous membranes, but finally produces necrosis with sloughing.

When taken internally in diluted form, the drug is said to increase the peristaltic action of the stomach and to prevent lactic acid fermentation. It acts as a gastric antiseptic and exists in the normal gastric juice in the strength of 0.2 per cent., aiding in the conversion of pepsinogen into pepsin and of proteids into peptones. Hydrochloric acid may do good in certain forms of indigestion, especially in those conditions in which it is absent from the gastric juice, as in the low fevers. It will be found of great service in many cases of enteric fever. In chronic gastric catarrh with atony of the tubules and in gastric cancer it may be administered with success. It has been recommended in syphilis, phosphaturia, and in intestinal indigestion with diarrhœa. As a caustic, concentrated hydrochloric acid may be employed in the removal of small epithelial growths.

Poisonous doses of hydrochloric acid produce a whitening of the mucous membrane of the mouth, violent pain in the œsophagus, stomach, and intestines, corrosion or perforation of the wall of the stomach, with consequent peritonitis. The patient becomes restless, complains of thirst, and attempts to vomit. There may be collapse, the temperature becoming subnormal and the pulse running and thready. Large quantities of mild alkalies, such as magnesia, soap, or wall-plaster, should promptly be given. Mucilaginous drinks, eggs, milk or bland oils, and opium may be used for relief of the pain. The application of external heat to maintain the bodily temperature and the free use of stimulants are indicated should collapse occur.

Hydrochloric acid may be given in the dose of from 5 to 10 minims (0.3–0.6 Cc.)

largely diluted with water and taken through a glass tube. Immediately after its ingestion the mouth should be rinsed with a solution of sodium bicarbonate. It is usually given in the form of the dilute acid, in the dose of 5 to 30 minims (0.30–2 Cc.).

ACIDUM HYDROCYANICUM DILUTUM, *U. S.*, *Br.* — Diluted Hydrocyanic Acid.

Acidum hydrocyanatum s. borussicum.—Prussic acid, E.; *Acide cyanhydrique s. hydrocyanique,* Fr.; *Cyanwasserstoffsäure, Blausäure,* G.; *Acido cianhidrico,* Sp.

Formula, HCN, old style HCy. Molecular weight, 26.84.

The official diluted acid of the U. S. and Br. pharmacopœias contains 2 per cent. of absolute hydrocyanic acid; the French preparation contains only 1 per cent., while the Spanish contains 10 per cent. Hydrocyanic acid is not recognized at all in the German Pharmacopœia.

Origin.—Hydrocyanic acid was discovered by Scheele (1782); Berthollet (1803) ascertained it to be a compound of hydrogen, carbon, and nitrogen; and Gay-Lussac (1815) succeeded in analyzing it and in isolating the radical *cyanogen,* CN, or, more correctly, $(CN)_2$. The acid has been found in the root of *Jatropha Manihot,* and in the bark, leaves, flowers, and seeds of many shrubs and trees belonging to the suborders *Amygdaleæ* and *Pomeæ* of the order *Rosaceæ.* It occurs in the free state only in some of the more juicy parts of these plants, but a larger quantity is formed on macerating the parts indicated in cold water, when the amygdalin contained therein is split by the action of emulsin or a similar ferment into sugar, oil of bitter almond, and hydrocyanic acid; $C_{20}H_{27}NO_{11}$ (amygdalin) $+ 2H_2O$ yields $2C_6H_{12}O_6$ (glucose) $+ C_7H_6O$ (oil of bitter almond) $+$ HCN (hydrocyanic acid). It is found likewise among the products of the reaction of nitric and nitrous acids upon many organic compounds, and of gaseous ammonia upon incandescent charcoal. For medicinal purposes it is prepared mostly by the decomposition of potassium ferrocyanide by means of sulphuric acid. It may also be prepared extemporaneously by the following process:

Preparation.—Silver cyanide, 6 Gm.; diluted hydrochloric acid, 15.54 Cc.; distilled water, 44.10 Cc. Mix the diluted hydrochloric acid with the water, add the silver cyanide, and shake the whole together in a glass-stoppered bottle. When the precipitate has subsided, pour off the clear liquid.—U. S. 50 grains of silver cyanide may be added to a mixture of 138 grains of diluted hydrochloric acid and 355 grains of distilled water, and the resulting solution, after filtration, will correspond to the official acid. The hydrochloric acid decomposes the silver cyanide, forming hydrocyanic acid and insoluble silver chloride, thus: $AgCN + HCl = HCN + AgCl$. 1 grain (1 Gm.) of silver cyanide will yield 0.2019 grain (0.2019 Gm.) of absolute hydrocyanic acid. The Br. P. does not give a process for making the official acid, but states that it may be made by the interaction of diluted sulphuric acid and potassium ferrocyanide.

On mixing diluted sulphuric acid with a solution of potassium ferrocyanide in the cold, only one-half of the latter salt is decomposed, with the formation of potassium sulphate and hydroferrocyanic acid; thus, $K_4Fe(CN)_6$ (potassium ferrocyanide) $+ 2H_2SO_4$ yields $2K_2SO_4 + H_4Fe(CN)_6$ (hydroferrocyanic acid). This last compound may be obtained by adding ether to the mixture, when the acid will be separated as a whitish powder or pearly scales. On the application of heat to the mixture, this acid reacts with the remaining potassium ferrocyanide and sulphuric acid, yielding hydrocyanic acid, which distils over, potassium sulphate, which remains in solution, and ferrocyanide of iron and potassium (Everitt's salt), which precipitates as a white powder, rapidly turning green, and finally blue, in the presence of oxygen. The reaction may be explained as follows: $H_4Fe(CN)_6 + K_4Fe(CN)_6 + H_2SO_4 = 6HCN$ (hydrocyanic acid) $+ K_2SO_4 + K_2Fe(FeC_6N_6)$ (Everitt's salt).

Properties.—Anhydrous hydrocyanic acid is a colorless mobile liquid which congeals at —15° C. (5° F.) to feathery crystals, has the density 0.697 at 18° C. (64.4° F.), boils at 26.5° C. (79.7° F.), and when ignited burns with a slightly luminous flame to carbonic anhydride and nitrogen. It has a strong odor, resembling that of oil of bitter almond, and is extremely poisonous. It is the hydride of the radical cyanogen, and its composition is expressed by the formula HCN. It reddens litmus-paper slightly and transiently, and with alkalies yields crystallizable salts having a strongly alkaline reaction. It is an extremely weak acid, being liberated from most of its salts, for example,

KCN, by so weak an acid as carbonic. For this reason potassium cyanide always has the odor of the free acid. The free acid produces no precipitate with a mixture of a ferrous and ferric salt. On adding now caustic alkali, a dirty precipitate is formed, which goes into solution with excess of hydrochloric acid and forms immediately or after a few moments a precipitate of Prussian blue. Most of its salts, on being treated with diluted mineral or many organic acids, yield hydrocyanic acid, and are decomposed by strong nitric acid, with the evolution of nitrogen and other gases; silver cyanide dissolves in boiling nitric acid, the solution containing silver nitrate. A solution of an alkali cyanide mixed with a solution of picric acid and heated to about 60° C. (140° F.) acquires a deep-red color, from the production of a salt of *isopurpuric* or *picrocyanic acid*, $C_8H_5N_5O_6$ (Hlasiwetz, 1859).

Hydrocyanic acid is soluble in water, alcohol, and ether in all proportions. The official acid contains 2 per cent. of anhydrous acid; the aqueous solution of this strength has the specific gravity 0.997 (Br.). It is a colorless liquid, having a characteristic odor resembling that of oil of bitter almonds, and yields, when neutralized, the reactions characteristic of cyanides. Minute quantities of hydrocyanic acid may be detected by Schönbein's (see Guaiacum) or by Liebig's test (1847); the latter is applied by adding a little ammonium sulphide, a drop of dilute alkali, evaporating at a moderate heat to dryness, and adding to the residue, dissolved in water and slightly acidulated with hydrochloric acid, a drop of diluted ferric chloride, when the blood-red color of ferric sulphocyanate will appear.

Under various circumstances hydrocyanic acid is decomposed on keeping, evolving ammonium formate, cyanic acid, and carbon dioxide, and depositing a brown substance containing paracyanogen, C_3N_3 or C_6N_6. The causes of these changes have not been fully explained: it is, however, well known that the presence of alkalies and exposure to the light favor decomposition; and since, by heating hydrocyanic acid in the presence of free mineral acids, ammonium formate is apt to be produced, it will be seen that even recently prepared dilute hydrocyanic acid may be prone to change, and that, if altered, the decomposition cannot be arrested by distillation except after the previous addition of sufficient sulphuric acid. The addition of a minute quantity of hydrochloric acid, and of alcohol in place of a portion of the water, to the recently prepared acid, appears to retard that change, but does not altogether prevent it. The stronger the hydrocyanic acid is, the more liable it is to decomposition. The acid known as Scheele's acid, which contains 5 per cent. of HCN, is therefore not adapted for medicinal use.

Another difficulty in preserving the strength of hydrocyanic acid must be attributed to its volatility and the loss suffered by the medicinal acid on the frequent opening of the vial containing it. J. Williams states that an addition of 20 per cent. of glycerin will preserve acid up to the strength of about 5 per cent.; and J. U. Lloyd (1878) observed that alcoholic hydrocyanic acid could be kept in partially filled bottles unaltered and without material loss of acid for three years. Careful observations made by large manufacturers have thus far failed to suggest a desirable remedy for the well-known instability of hydrocyanic acid. The use of diluted alcohol as prescribed by the U. S. Pharmacopœia of 1880 gave no better results than the present method. Weaker solutions of hydrocyanic acid are known to keep better, but even these are not stable. The U. S. and Br. directions to keep the acid in a cool dark place should always be observed.

Tests.—Diluted hydrocyanic acid is completely volatilized by heat, and 10 Cc., when evaporated to dryness, should not leave a weighable residue. If 5 Gm. of diluted hydrocyanic acid be diluted with distilled water to measure 50 Cc., then 26.9 Cc. of this solution, after addition of 5 Cc. of ammonia-water and 3 drops of potassium iodide test-solution, should require for the production of a slight permanent precipitate the addition of not less than 10 Cc. of tenth-normal silver nitrate solution (U. S.). The Br. P. demands that each Gm. of the dilute acid made alkaline by the addition of sodium hydroxide solution shall require 3.7 Cc. of tenth-normal silver nitrate solution before a permanent precipitate appears.

The two last-named tests are practically identical. This process is known as Liebig's method, depending upon the formation of a double salt (alkali silver cyanide), which is not decomposed by an excess of alkali. The permanent turbidity occurs when all the hydrocyanic acid present is in combination as the double cyanide, and the further addition of silver nitrate solution then causes decomposition, insoluble silver cyanide sep-

arating. In the U. S. P. test the potassium iodide is added as an indicator, and will show the yellow color of silver iodide formed by interaction of silver cyanide and potassium iodide.

Impurities.—On adding a few drops of a solution of corrosive sublimate, and heating to boiling, a reduction of the mercuric salt to calomel or to mercury will indicate the presence of formic acid. Sulphuric acid is recognized by the white precipitate produced on the addition of barium chloride. Hydrochloric and phosphoric acids are detected by adding solution of borax, evaporating to dryness, and dissolving the residue in diluted nitric acid; a white precipitate with silver nitrate will indicate the former, and a yellow precipitate with ammonium molybdate the latter, impurity.

Action and Uses.—Hydrocyanic acid is probably the most rapidly acting drug we possess. In overdose it is a depressing protoplasmic poison, which is very rapidly absorbed and eliminated. Some of the drug is destroyed in the body, and a part of it may be found in the urine. Small doses stimulate respiration and the nervous system, but slow the circulation by stimulation of the vagi and depression of the heart muscle. Lethal amounts paralyze the respiratory center and the heart muscle, death, as a rule, being due to failure of respiration with almost simultaneous cessation of the action of the heart. Death may, however, result from syncope. Local applications of dilute solutions act as sedatives to the peripheral sensory nerves.

Hydrocyanic acid may be used with benefit in gastralgia, enteralgia, and in vomiting. It has been employed as a palliative in the cough of pulmonary tuberculosis. The drug has been recommended in whooping-cough, asthma, angina pectoris, and in the pain of gastric ulcer and gastric cancer. Its topical use often relieves the itching of many forms of skin disease.

When given in full medicinal doses the drug produces dizziness, roaring in the ears, staggering, headache, and salivation. The patient may experience a sense of tightness of the chest, laryngeal irritation, and irregular cardiac action. Muscular relaxation and mental hebetude may sometimes occur. Very large doses produce immediate death. As soon as the drug is ingested the patient utters a cry, falls to the floor, and immediately expires. In other cases where the dose is not so large the symptoms may be divided into three stages: The first is characterized by difficulty in breathing, a very slow heart action, and disturbance of the central nervous system. This occupies a very brief period, and immediately is followed by wild outcries, vomiting, convulsions of a clonic character (during which the tongue is bitten, causing the lips to become covered with a bloody froth), dilatation of the pupils, unconsciousness, involuntary urination, defecation, and ejaculation of semen. In the third stage death is preceded by asphyxia, paralysis, and collapse. After death the eyes are bulging and staring and the pupils widely dilated; the teeth are clinched and covered with bloody froth, and the face is cyanosed. Unless death has occurred instantly, the blood will be found dark and venous looking. As a rule the patient dies before treatment can be instituted. Applications of cold to the chest and spine, the internal administration of chlorine water and aromatic spirit of ammonia, with inhalations of ammonia gas, have been employed with some success. Atropine has been recommended, but probably is not sufficiently rapid in its action to be of benefit. The application of faradic electricity is also said to be of service.

Dilute hydrocyanic acid is given in the dose of from 2 to 3 minims (0.10–0.20 Cc.), repeated at frequent intervals. It is usually given with other remedies, and should be dispensed in a bottle which excludes the light. A lotion made by adding from 30 minims to a fluidrachm (2–4 Cc.) to 1 fluidounce (30 Cc.) of water, may be applied to the unbroken skin to control the itching and other distressing local symptoms of jaundice and urticaria.

ACIDUM HYPOPHOSPHOROSUM, *U. S.*—Hypophosphorous Acid.

Acide hypophosphoreux, Fr.; *Unterphosphorigesäure*, G.

Formula, HPH_2O_2 or $PO.H_2(OH)$. Molecular weight, 65.53.

A liquid composed of 30 per cent. by weight of absolute hypophosphorous acid and 70 per cent. of water. It should be kept in glass-stoppered bottles.—U. S.

Hypophosphorous acid was discovered by Dulong in 1816, and more fully investigated by H. Rose in 1826.

Preparation.—The U. S. P. does not give a process for manufacturing hypophosphorous acid. It may be prepared by decomposing potassium hypophosphite in solution by means of tartaric acid, and adding alcohol to the mixture to facilitate separation of the newly formed acid potassium tartrate, 208 parts of the hypophosphite requiring 300 parts of the acid. Another good plan is to decompose calcium hypophosphite in boiling solution by means of oxalic acid.

To prepare the official 30 per cent. acid, 138 Gm. of calcium hypophosphite are dissolved in 900 Cc. of boiling water, and to the solution is added a solution of 103 Gm. of pure oxalic acid in 400 Cc. of boiling water. The mixture is boiled for half an hour and, after cooling, filtered through cotton, and the precipitated calcium oxalate washed with cold water until it is free from all adhering acid. The filtrate is finally evaporated to 358 Gm. The reaction occurring is shown by the following equation: $Ca(PH_2O_2)_2 + H_2C_2O_4 = 2HPH_2O_2 + CaC_2O_4$.

Properties.—Hypophosphorous acid is a colorless liquid, without odor, and having an acid taste. It has a specific gravity of about 1.130 at 25° C. (77° F.), and is miscible with water in all proportions. Even when largely diluted with water, it has an acid reaction upon blue litmus-paper. When heated in a porcelain dish, water evaporates and the acid becomes more concentrated. On further heating, between 130° and 140° C. (266° and 284° F.), it decomposes, forming hydrogen phosphide, which ignites, and phosphorous acid: the latter, between 160° and 170° C. (320° and 338° F.), decomposes into hydrogen phosphide and phosphoric acid; the pasty residue finally reddens, ignites, and the last portions of unoxidized phosphorus burn out at a higher temperature. The addition of silver nitrate test-solution to hypophosphorous acid, diluted with an equal volume of water, produces a black precipitate of metallic silver; the addition of mercuric chloride test-solution, a white precipitate of mercurous chloride. When the acid is gently heated with copper sulphate test-solution, a yellow precipitate of copper hydride forms, which rapidly assumes a reddish-brown color.—U. S.

Hypophosphorous acid is a strong reducing agent, and as such is used to protect otherwise unstable solutions like those of ferrous iodide, hydriodic acid, etc.

Tests.—Neither platinic chloride test-solution nor sodium cobaltic nitrite test-solution should produce more than a slight yellow turbidity in hypophosphorous acid when diluted with water (limit of potassium). If some of the acid be neutralized with ammonia-water, a clear liquid should result, and a portion of this liquid should not become turbid upon the addition of potassium sulphate test-solution (absence of barium); nor should more than a slight turbidity be produced in another portion by barium chloride test-solution (limit of sulphuric, oxalic, and tartaric acids). 10 Cc. of the acid, warmed to about 50° C. (122° F.), should not be colored or rendered turbid by the addition of an equal volume of fresh hydrogen sulphide test-solution after standing stoppered at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals). If 2 Cc. of hypophosphorous acid be measured into a beaker containing 3 Cc. of nitric acid, which has been previously diluted with about 10 Cc. of water, and the whole evaporated to dryness on a bath of boiling water, the residue should not respond to the modified Gutzeit's test for arsenic (see under Arseni Trioxidum). If 10 Gm. of hypophosphorous acid be diluted with distilled water to measure 100 Cc., then 65.5 Cc. of this solution should require not less than 30 Cc. of normal potassium hydroxide solution for neutralization, methyl orange being used as indicator, each Cc. corresponding to 1 per cent. of absolute hypophosphorous acid.—U. S.

Action and Uses.—This acid is used for making the Acidum Hypophosphorosum Dilutum.

Acidum Hypophosphorosum Dilutum, U. S.—*Diluted Hypophosphorous Acid,* E.; *Acide hypophosphoreux dilué,* Fr.; *Verdünnte Unterphosphorigesäure,* G.—Mix hypophosphorous acid, 200 Gm., with distilled water, 400 Gm.—U. S. Diluted hypophosphorous acid contains 10 per cent. of the absolute acid, and has a specific gravity of about 1.042 at 25° C. (77° F.). It corresponds in chemical properties with hypophosphorous acid, and should conform to the same reactions and tests. If 10 Gm. of diluted hypophosphorous acid be diluted with distilled water to measure 100 Cc., then 65.5 Cc. of this solution should require not less than 10 Cc. of normal potassium hydroxide solution for neutralization, phenolphthalein being used as indicator, each Cc. corresponding to 1 per cent. of absolute hypophosphorous acid.

Action and Uses.—Dilute hypophosphorous acid is rarely employed except in the form of its salts, the hypophosphites (see CALCII HYPOPHOSPHIS). It was at one time used as a tonic to the nervous system. The dose is from 10 to 30 minims (0.60–2 Cc.), given well diluted with water.

ACIDUM LACTICUM, *U. S., Br., P. G.*—Lactic Acid.

Isolactic, Ethyledene-lactic, or Oxypropionic acid, E.; *Acide lactique*, Fr.; *Milchsäure*, G.; *Acido lactico*, Sp.

Formula, $HC_3H_5O_3$ or $CH_3.CHOH.COOH$. Molecular weight, 89.37.

Official lactic acid contains 75 per cent. of the absolute acid.

Origin.—Lactic acid was discovered by Scheele (1780) in sour milk, in which it results from the spontaneous fermentation of the sugar of milk under the influence of the casein. This transformation of the former into the latter is called the *lactic fermentation*. A similar change is produced in dextrin, glucose, cane-sugar, etc., by the action of casein and other protein compounds: lactic acid is therefore met with in many vegetable products which have turned sour. T. and H. Smith's *thebolactic acid* of opium is identical with the lactic acid of milk; but the sarcolactic acid of meat-juice, discovered by Berzelius (1807), and recognized by Liebig as differing in several respects from the lactic acid of milk, consists of two acids, one of which, known as *paralactic acid*, has the composition given above, but is dextrogyre, and the solutions of its salts have a levogyre action. The second lactic acid of flesh is like that of milk, optically inactive, but is *ethylenelactic acid*, having the composition $CH_2OH.CH_2.COOH$, and its zinc salt is soluble in absolute alcohol. Strecker (1858) observed that by heating sarcolactic acid for some time at 130° or 140° C. (266° or 284° F.) the anhydride is produced, which, dissolved in boiling water, yields ordinary lactic acid. During lactic fermentation, alcohol, several acids, a peculiar gum, and mannite are formed in variable proportions, more particularly if the temperature be allowed to vary much from about 45° C. (113° F.).

Preparation.—Lactic acid may be obtained in several ways. If a mixture of sugar, water, fresh cheese, and chalk be set aside for several weeks in a sunny place, calcium lactate will crystallize out, which may then be decomposed by a calculated quantity of sulphuric acid, and the resulting solution of lactic acid concentrated by evaporation. Milk-sugar and inverted sugar may be used for fermentation, and zinc oxide may be substituted for the chalk. In the latter case zinc lactate will be obtained, from which the zinc is removed by hydrogen sulphide.

A more rapid method is that of Kiliani (1882), in which 500 Gm. of cane-sugar, dissolved in 200 Gm. of water, are converted into inverted sugar by boiling with 10 Cc. of sulphuric acid; 450 Cc. of a solution made of equal parts of caustic soda and water, are added gradually, and the mixture is heated to 60° or 70° C. (140°–158° F.) until it ceases to react for sugar with Fehling's Solution. The liquid is allowed to cool and neutralized with sulphuric acid, the sodium sulphate allowed to crystallize, and the remainder precipitated by addition of alcohol; one-half of the clear alcoholic liquid containing the lactic acid is heated, neutralized with zinc carbonate, mixed with the other half, and cooled, when zinc lactate will crystallize, from which the acid may be obtained in the usual way.

Recently (1899) a process has been patented in Germany for recovering the lactic acid produced in the manufacture of the so-called "sour-krout." This consists in neutralizing the liquors of the sour-krout factories with lime, filtering the solution, evaporating, and crystallizing. The crystals of calcium lactate are freed from sodium chloride by washing with water, recrystallized if necessary and decomposed by means of sulphuric acid.

Two commercial varieties of lactic acid are met with, designated respectively as concentrated and dilute lactic acid; as neither specific gravity nor percentage strength is indicated, these terms are meaningless, and sure to lead to confusion.

Absolute lactic acid cannot be prepared under ordinary conditions of evaporation, water being split off and insoluble lactic anhydride, $C_6H_8O_4$, resulting. If repeatedly rectified under reduced pressure, 12 millimeters, the pure acid is obtained in the form of a crystalline mass melting at 18° C. (64.4° F.).

Properties.—Official lactic acid is a syrupy colorless liquid, having no odor, a very sour taste, and the specific gravity 1.213 at 15° C. (59° F.), 1.206 at 25° C.

(77° F.) (U. S.); it absorbs moisture when exposed to damp air; the pure acid is colorless, inodorous, and has the specific gravity, according to Mendelejeff, 1.2485 at 15° C. (59° F.). It is miscible in all proportions with water, alcohol, and ether, but is insoluble in chloroform, carbon disulphide, and benzin. On warming the acid with potassium permanganate the odor of aldehyde is given off. Lactic acid is not vaporized by a heat below 160° C. (320° F.). At a higher temperature it emits inflammable vapors and is finally dissipated; 5 Gm., after combination, should not leave more than 0.05 Gm. of fixed residue (U. S.). It coagulates milk and albumin, and displaces carbonic and acetic acids from their compounds, yielding salts which are soluble in water, and mostly also in alcohol. Lactic acid, on being oxidized by nitric acid, yields oxalic acid, and by treatment with chromic acid formic and acetic acids are produced. 90 grains of the official acid are neutralized by 75 grains of potassium bicarbonate, or 4.5 Gm. of the acid by 37.5 Cc. of volumetric solution of sodium hydroxide, indicating 75 per cent. of $HC_3H_5O_3$, phenolphthalein being used as indicator.

Tests.—Treated with a hot solution of potassium hydroxide, lactic acid is not materially colored; if it readily becomes brown, extractive matters are present. Dissolved in strong alcohol, gum and some mineral salts are left behind. Glycerin, glucose, mannite, tartaric acid, and most salts remain undissolved by ether. Acetic and butyric acids are recognized by their odor, which becomes more apparent on warming. For detecting other organic and mineral acids, their special tests may be applied. In the diluted acid calcium salts are indicated by ammonium oxalate; lead, by hydrogen sulphide; zinc, after neutralization with ammonia, by ammonium sulphide; sulphuric acid, by barium chloride; sarcolactic acid, by copper sulphate; hydrochloric acid, by silver nitrate; and oxalic acid, by calcium chloride, after previously diluting the acid with 20 times its quantity of water and neutralizing with ammonia. On saturating the acid with zinc carbonate, drying at 100° C. (212° F.), and treating with absolute alcohol, zinc sarcolactate will be dissolved: also glycerin and mannite, if present, imparting a sweet taste to the alcohol.

Adding 1 Cc. of lactic acid, drop by drop, to 2 Cc. of ether, no turbidity, either transient or permanent, should be observed (P. G.); this is intended to prove the absence of glycerin, sugar, mannite, etc. The absence of sugars is determined also by the failure of the acid to produce red cuprous oxide on being added to hot Fehling's Solution. Solution of copper sulphate should have no effect upon a 10 per cent. solution of lactic acid (absence of sarcolactic acid). The limits of allowable impurities are determined as follows: "10 Cc. of a 1 per cent. aqueous solution of the acid should not be rendered opalescent by the addition of 1 Cc. of decinormal silver nitrate solution (limit of chloride). On mixing equal volumes of lactic and colorless sulphuric acid in a clean test-tube and keeping the temperature at or below 15° C. (59° F.), no dark-colored zone should develop at the line of contact upon standing for 15 minutes (absence of more than traces of organic impurities). If 5 Gm. of lactic acid be diluted with water to measure 50 Cc., then 44.7 Cc. of this solution should require for complete neutralization not less than 37.5 Cc. of normal potassium hydroxide solution, phenolphthalein being used as indicator, each Cc. corresponding to 2 per cent. of absolute lactic acid."—U. S.

Action and Uses.—It is stated that lactic acid is a normal constituent of the gastric juice, and in combination with pepsin it has been proposed in the treatment of atonic dyspepsia. The drug has been employed as a curative application in laryngeal tuberculosis and in infantile diarrhœas. Uric acid diathesis, phosphaturia, and oxaluria depending upon improper assimilation are frequently benefited by its use. It has also been recommended in chronic cystitis due to ammoniacal decomposition of urine. Lactic acid has been employed with varying success in the treatment of diabetes, but the remedy is now rarely prescribed. As a hypnotic it is valueless, and is no longer used. The drug dissolves false membrane, and a solution of 1 part of the acid in 6 parts of water may be employed with advantage in the local treatment of diphtheria and croup. Local applications of the pure acid are successful in arresting the growth of venereal warts, and are recommended in the treatment of tuberculous ulcers, lupus, and epithelioma.

Lactic acid may be given in the dose of 15 to 30 minims (1–2 Cc.) 3 times daily. It is usually prescribed before or during the meal, and should be largely diluted and sweetened to suit the taste. After its administration the mouth should be rinsed with a solution of sodium bicarbonate.

ACIDUM NITRICUM, *U. S., Br., P. G.*—Nitric Acid.

Acidum nitri s. azoticum, Spiritus nitri acidus.—Acide azotique s. nitrique, Fr.; *Salpetersäure,* G.; *Acido nitrico,* It., Sp.

Formula, $HNO_3 = NO_2.OH$. Molecular weight, 62.57.

The official nitric acid of the different pharmacopœias varies in strength; thus while the U. S. requires 68 per cent. of absolute acid, the Br. demands 70 per cent. and the P. G. only 25 per cent. Specific gravity about 1.403 at 25° C. (77° F.) and boiling-point 120.5° C. (248.9° F.).—U. S.

Origin.—Nitric acid occurs occasionally in the free state, but more usually as the ammonium salt, in very small quantity in the air, rain water and spring water. Its presence in the air is due to electric discharges, by which nitrogen and oxygen combine. Nitrates of sodium, potassium, ammonium, magnesium, and calcium are distributed very widely as a normal constituent of the humus of soil. Their presence is due to the oxidation to nitric acid of ammonia and other nitrogen products which result from the putrefaction of vegetable and animal matter. This oxidation is facilitated by bacteria, which act as a nitrifying ferment. The nitrates thus formed accumulate in beds in regions where water is scarce, for example, the large sodium nitrate beds in rainless districts of Peru (province of Tarapaca and the desert of Atacama), and Chilian Bolivia. Smaller beds are formed in Spain, the trans-Caspian district, and India.

A process for preparing this acid was made public first by Geber in the eighth century, and its composition was determined by Cavendish (1785) and Davy (1816). For medicinal and technical purposes nitric acid is made by decomposing sodium or potassium nitrate by sulphuric acid.

Preparation.—1. Acidum Nitricum.—It is prepared on the large scale in apparatus constructed similar to that used in the manufacture of hydrochloric acid. Formerly all nitric acid, whether on the large or small scale, was prepared from the more expensive but easily purified potassium nitrate, but now, since processes have been devised for obtaining the cheaper sodium nitrate or Chili saltpeter pure, the latter is used almost exclusively in the manufacture of the acid. The heat required is less than in the case of potassium nitrate, and the following reaction takes place: $H_2SO_4 + 2NaNO_3 = 2HNO_3 + Na_2SO_4$. When potassium nitrate is used, such proportions of it and sulphuric acid are taken as correspond to this reaction: $KNO_3 + H_2SO_4 = KHSO_4 + HNO_3$. The heat required to carry out the complete exchange between the nitrate and acid—thus, $2KNO_3 + H_2SO_4 = K_2SO_4 + 2HNO_3$—is so high as to decompose some of the nitric acid into water, oxygen, and red oxides of nitrogen. The red fumes dissolve in the nitric acid which condenses in the receiver, thus giving it a reddish-brown color. Hence the process is carried out according to the first reaction unless it is desired to make colored acid, which is known as *red fuming nitric acid.*

Nitric acid which is colored from the presence of oxides of nitrogen may be decolorized by applying a moderate heat or by passing a current of dry carbon dioxide through it.

Impure acid containing chlorine or iodine, derived from impure niter or Chili saltpeter, or sulphuric acid, may be purified by distillation over lead nitrate, and discarding the first distillate until silver nitrate gives no precipitate.

Approximately 100 per cent. acid can be obtained by mixing very concentrated acid with absolute sulphuric acid and carefully distilling at a greatly reduced pressure.

2. Acidum Nitricum Fumans, P. G.; *Acidum nitroso-nitricum, Spiritus nitri fumans.—Fuming nitric acid, Nitroso-nitric acid,* E.; *Acide azotique fumante,* Fr.; *Rauchende Salpetersäure,* G.—A clear reddish-brown acid giving off suffocating yellowish-red fumes; strength, 86 per cent. or more of absolute nitric acid; specific gravity, 1.486–1.50 at 15° C. (59° F.).

3. Acidum Nitricum Crudum, P. G.; *Crude nitric acid,* E.; *Rohe Salpetersäure,* G.—A clear colorless or faintly yellow liquid, when heated volatile without residue, and containing 61 per cent. of absolute HNO_3. Its specific gravity is 1.38–1.40. at 15° C. (59° F.).

Properties.—1. Nitric Anhydride, Nitrogen Pentoxide.—This was discovered by St. Clair Deville (1849) in decomposing pure crystallized silver nitrate by absolutely dry chlorine gas. It forms colorless shining prisms, which readily decompose into nitrogen tetroxide and oxygen, fuse at about 30° C. (86° F.) into a liquid boiling near 50° C. (122° F.), and deliquesce rapidly when in contact with moist air. Its composition is N_2O_5, molecular weight, 107.82; combining with 1 molecule of water, H_2O, it forms 2 molecules of nitric acid, $2HNO_3$.

2. Crude Nitric Acid.—As met with in commerce, it is either colorless or of a pale yellowish color, and contains the impurities mentioned above, together with a little iron. It is often called *aqua fortis;* the weaker kind is of about 1.21 specific gravity, being known as single aqua fortis, and the stronger, of specific gravity 1.37, as double aqua fortis. Crude nitric acid is extensively used in many chemical processes.

3. Pure Nitric Acid.—It is a colorless fuming liquid, wholly volatilized by heat. It colors animal tissue yellow (xanthoproteic reaction) and causes deep and slowly healing sores. It decolorizes a solution of indigo when heated with it, and has an intense acid reaction even in very dilute solution. The strength is determined by diluting the acid with water and neutralizing with normal sodium hydroxide solution, of which 3.13 Gm. of the acid require 34 Cc. (U. S.), or 1 Gm. requires 11.1 Cc. (Br.), indicating respectively 68 and 70 per cent. of HNO_3, or 58.29 and 60 per cent. of N_2O_5, each Cc. of alkali representing 0.0626 Gm. of HNO_3. Nitric acid, P. G., is much weaker, having the specific gravity 1.153 and containing 25 per cent. of HNO_3, as stated above.

Nitric acid is a powerful oxidizing agent, converting most metals into oxides or nitrates, and decomposing most organic compounds. Orange-red vapors are given off during the action. It decomposes in direct or diffused sunlight into brown oxides of nitrogen, which color the acid reddish. All nitrates are soluble in water; a few so-called subnitrates are insoluble in water—*e. g.*, bismuth subnitrate. The concentrated acid, corresponding in composition to the formula HNO_3, has at 0° C. (32° F.) the specific gravity 1.559. When exposed to the light or heated to near its boiling-point, 86° C. (186.8° F.), it is decomposed partly into water and nitrogen tetroxide, so that its boiling-point is not constant. Nor is the boiling-point of weaker acids constant. Those below and those above the specific gravity 1.42 boil at a constantly rising temperature, until the acid in the retort has been raised or lowered in strength to correspond to the formula $2HNO_3.3H_2O$, when its boiling-point will be stationary at 121° C. (249.8° F.), and it will have at 15.5° C. (60° F.) the specific gravity 1.42 (Graham). This strength of nitric acid has been adopted as the official standard in the British Pharmacopœia. According to Roscoe, nitric acid containing between 65 and 70 per cent. of hydrogen nitrate yields, after continued boiling, a liquid the boiling-point of which is 120.5° C. (248.9° F.) at a barometer pressure of 735 Mm., and the specific gravity of which is 1.414 at 15.5° C. (60° F.). This is the acid recognized in the United States Pharmacopœia, and contains 68 per cent. of hydrogen nitrate, while Graham's acid should contain 69.96 per cent. The existence of a definite hydrate having a constant boiling-point appears, therefore, somewhat doubtful.

The following table, incorporated in the Pharmacopœia, shows the specific gravity of nitric acid as compared with water at 15° and 25° C. (59° and 77° F.), and also the quantity of normal KOH solution required to neutralize 1 Cc. of acid of different strengths:

Per cent. nitric acid.	Specific gravity— 25° C. / 25° C.	Specific gravity— 15° C. / 15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc normal KOH.
1	1.0056	1.0057	0.00018	0.018	0.16	0.063
2	1.0112	1.0114	0.00020	0.019	0.32	0.059
3	1.0166	1.0170	0.00023	0.019	0.49	0.063
4	1.0219	1.0226	0.00025	0.019	0.65	0.059
5	1.0272	1.0282	0.00028	0.019	0.82	0.059
6	1.0325	1.0338	0.00030	0.019	0.99	0.059
7	1.0378	1.0394	0.00033	0.018	1.16	0.059
8	1.0433	1.0452	0.00036	0.018	1.33	0.059
9	1.0488	1.0510	0.00040	0.018	1.50	0.056
10	**1.0544**	**1.0569**	**0.00043**	**0.018**	**1.68**	**0.056**
11	1.0601	1.0629	0.00047	0.018	1.86	0.056
12	1.0658	1.0689	0.00050	0.017	2.04	0.056
13	1.0716	1.0751	0.00054	0.017	2.22	0.056
14	1.0776	1.0814	0.00058	0.017	2.40	0.053
15	1.0835	1.0877	0.00061	0.017	2.59	0.053
16	1.0895	1.0940	0.00065	0.016	2.78	0.053

Note.—To find the per cent. of N_2O_5, multiply the per cent. of HNO_3 by 0.85712. To find the per cent. of NO_3, multiply the per cent. of HNO_3 by 0.98402. To find the weight in grammes of HNO_3 in 100 Cc., multiply the specific gravity by the per cent. of HNO_3. To find the volume per cent. of official Nitric Acid, multiply the "normality" by 6.579. For the volume per cent. of official diluted Nitric Acid, multiply the "normality" by 59.52.

[1] Add if the temperature is above, subtract if the temperature is below, 25° C.
[2] Corresponding with a difference in specific gravity of 0.0001.

Per cent. nitric acid.	Specific gravity— 25° C. / 25° C.	Specific gravity— 15° C. / 15° C.	Correction of specific gravity for 1° C.	Fractional per cent.	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
17	1.0956	1.1004	0.00068	0.017	2.97	0.053
18	1.1016	1.1068	0.00072	0.016	3.16	0.053
19	1.1077	1.1132	0.00075	0.016	3.35	0.050
20	1.1138	1.1196	0.00078	0.016	3.55	0.050
21	1.1200	1.1261	0.00080	0.016	3.75	0.050
22	1.1263	1.1326	0.00083	0.016	3.95	0.050
23	1.1326	1.1391	0.00085	0.016	4.15	0.048
24	1.1390	1.1457	0.00087	0.016	4.36	0.050
25	1.1453	1.1522	0.00089	0.016	4.56	0.048
26	1.1517	1.1588	0.00090	0.015	4.77	0.048
27	1.1582	1.1654	0.00092	0.015	4.98	0.045
28	1.1647	1.1720	0.00094	0.015	5.20	0.048
29	1.1712	1.1787	0.00096	0.015	5.41	0.045
30	1.1778	1.1854	0.00097	0.015	5.63	0.045
31	1.1844	1.1921	0.00099	0.015	5.85	0.045
32	1.1910	1.1988	0.00100	0.015	6.07	0.043
33	1.1977	1.2057	0.00101	0.015	6.30	0.045
34	1.2044	1.2125	0.00102	0.015	6.52	0.043
35	1.2112	1.2194	0.00103	0.015	6.75	0.043
36	1.2178	1.2261	0.00104	0.015	6.98	0.042
37	1.2244	1.2328	0.00105	0.015	7.22	0.043
38	1.2310	1.2394	0.00106	0.015	7.45	0.042
39	1.2375	1.2460	0.00107	0.015	7.69	0.042
40	1.2440	1.2526	0.00108	0.016	7.93	0.042
41	1.2504	1.2591	0.00109	0.015	8.17	0.042
42	1.2559	1.2657	0.00110	0.015	8.41	0.040
43	1.2634	1.2722	0.00110	0.016	8.66	0.042
44	1.2698	1.2787	0.00111	0.015	8.90	0.040
45	1.2763	1.2853	0.00112	0.015	9.15	0.040
46	1.2828	1.2918	0.00113	0.016	9.40	0.040
47	1.2891	1.2982	0.00113	0.016	9.65	0.038
48	1.2954	1.3046	0.00114	0.016	9.91	0.040
49	1.3017	1.3110	0.00115	0.016	10.16	0.038
50	1.3079	1.3172	0.00116	0.017	10.42	0.038
51	1.3139	1.3233	0.00117	0.017	10.68	0.038
52	1.3199	1.3294	0.00118	0.017	10.94	0.038
53	1.3258	1.3353	0.00119	0.017	11.20	0.038
54	1.3316	1.3412	0.00120	0.018	11.46	0.038
55	1.3373	1.3470	0.00121	0.018	11.72	0.038
56	1.3429	1.3527	0.00122	0.018	11.98	0.037
57	1.3485	1.3584	0.00123	0.018	12.25	0.038
58	1.3540	1.3640	0.00124	0.019	12.51	0.037
59	1.3594	1.3695	0.00125	0.019	12.78	0.037
60	1.3648	1.3750	0.00126	0.020	13.05	0.038
61	1.3699	1.3802	0.00127	0.020	13.31	0.037
62	1.3750	1.3854	0.00128	0.020	13.58	0.037
63	1.3800	1.3905	0.00129	0.021	13.85	0.037
64	1.3848	1.3954	0.00130	0.022	14.12	0.037
65	1.3894	1.4002	0.00132	0.022	14.39	0.037
66	1.3939	1.4049	0.00132	0.023	14.66	0.037
67	1.3983	1.4094	0.00134	0.023	14.93	0.037
68	**1.4027**	**1.4139**	**0.00136**	**0.023**	**15.20**	**0.037**
69	1.4070	1.4183	0.00137	0.024	15.47	0.037
70	1.4112	1.4226	0.00139	0.025	15.74	0.037
71	1.4152	1.4268	0.00141	0.026	16.01	0.037
72	1.4191	1.4310	0.00144	0.026	16.28	0.037
73	1.4230	1.4351	0.00146	0.026	16.55	0.037
74	1.4268	1.4391	0.00148	0.027	16.82	0.037
75	1.4305	1.4430	0.00151	0.028	17.09	0.036
76	1.4341	1.4468	0.00153	0.027	17.37	0.037
77	1.4378	1.4506	0.00154	0.027	17.64	0.037
78	1.4415	1.4544	0.00156	0.028	17.91	0.036
79	1.4451	1.4582	0.00157	0.029	18.19	0.037
80	1.4486	1.4619	0.00159	0.029	18.46	0.036
81	1.4520	1.4654	0.00160	0.030	18.74	0.037
82	1.4553	1.4688	0.00161	0.030	19.01	0.036
83	1.4586	1.4721	0.00162	0.031	19.29	0.037
84	1.4618	1.4754	0.00163	0.032	19.56	0.036
85	1.4649	1.4786	0.00163	0.033	19.84	0.037
86	1.4679	1.4817	0.00164	0.034	20.11	0.037
87	1.4707	1.4846	0.00165	0.036	20.38	0.036

Per cent. nitric acid.	Specific gravity— 25° C. / 25° C.	Specific gravity— 15° C. / 15° C.	Correction of specific gravity for 1° C.	Fractional per cent.	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
88	1.4735	1.4875	0.00166	0.037	20.66	0.037
89	1.4762	1.4903	0.00167	0.040	20.93	0.037
90	1.4787	1.4929	0.00168	0.045	21.20	0.037
91	1.4809	1.4953	0.00169	0.045	21.47	0.038
92	1.4831	1.4976	0.00170	0.048	21.73	0.037
93	1.4852	1.4997	0.00172	0.056	22.00	0.037
94	1.4870	1.5017	0.00173	0.056	22.27	0.038
95	1.4888	1.5037	0.00175	0.050	22.53	0.037
96	1.4908	1.5059	0.00177	0.042	22.80	0.037
97	1.4932	1.5085	0.00179	0.037	23.07	0.036
98	1.4959	1.5115	0.00182	0.021	23.35	0.033
99	1.5007	1.5165	0.00184	0.012	23.67	0.027
100	1.5088	1.5249	0.00187	. .	24.04	

The density of pure nitric acid varies with its strength. In taking its specific gravity the absence of notable quantities of nitrogen tetroxide should be ascertained, since they increase the density.

4. Fuming Nitric Acid has a brown-red color, and when in contact with the air emits vapors of the same color, which have a suffocating odor. It requires to be kept in a cool place, and caution should be exercised in removing the stopper, lest a portion of the liquid should be ejected violently with the escaping vapors. The German Pharmacopœia requires for this preparation a specific gravity of from 1.486 to 1.50 The so-called *nitrous acid* of commerce is a similar but weaker article, consisting of nitric acid which is colored red by variable quantities of nitrogen tetroxide.

Impurities.—Such as are likely to be present have been mentioned above. Mineral impurities are left as a fixed residue on evaporation, and may then be recognized by appropriate tests.

Tests.—5 Cc. of diluted nitric acid (1 in 10) should not respond to the modified Gutzeit's test for arsenic (see under Arseni Trioxidum). Other portions of this dilution should not yield a precipitate with barium chloride test-solution (absence of sulphuric acid), or with silver nitrate test-solution (absence of hydrochloric acid). 10 Cc. of the diluted acid (1 in 20) warmed to 50° C. (122° F.) should not be colored or rendered turbid by an equal volume of fresh hydrogen sulphide test-solution after standing corked at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals). If the diluted acid (1 in 3) be shaken with a few drops of chloroform, the latter should remain colorless (absence of iodine or bromine) even after the introduction of a small piece of zinc (absence of iodic or bromic acid). The latter acids would be reduced by zinc to hydriodic or hydrobromic acid, which with nitric acid would decompose, giving free iodine or bromine.

Acidum Nitricum Dilutum, U. S., Br.—*Diluted nitric acid*, E.; *Acide azotique dilué*, Fr.; *Verdünnte Salpetersäure*, G.

Preparation.—Diluted nitric acid is prepared by mixing 10 Gm. of nitric acid with 58 Gm. of distilled water (U. S.). Or 1 part of nitric acid may be mixed with 5.8 parts of water, all by weight. The British Pharmacopœia directs that to 274.3 Gm. (or 2400 grains) of nitric acid shall be added sufficient distilled water to bring the volume of the mixture up to 1000 Cc. (or 1 Imperial pint) at 15.5° C. (60° F.).

Properties.—Diluted nitric acid is a colorless odorless liquid of decided acid taste and reaction. It contains 10 per cent. of absolute nitric acid (U. S.) or 17.44 per cent. (Br.), and has the specific gravity 1.054 at 25° C. (77° F.) (U. S.) or 1.101 (Br.). 6.26 Gm. of the liquid require 10 Cc. (U. S.) or 16.90 Cc. (Br.) of normal sodium hydroxide solution for neutralization, using phenolphthalein as indicator. In its other properties and tests it conforms to those given for nitric acid.

Action and Uses.—Concentrated nitric acid acts as a powerful escharotic upon the tissues of the body and causes them to assume a lemon-yellow color. Local applications of the diluted acid are irritating and astringent.

In small doses the drug stimulates the secretory glands of the stomach and intestines.

Poisonous doses of the concentrated acid cause violent gastro-enteritis, with burning pain in the mouth and œsophagus; hæmaturia occasionally occurs and bloody stools are common. The pain and inflammation are very violent; the patient passes into collapse

and frequently dies. Should recovery from the acute symptoms occur, death may result later from stricture of the œsophagus or destruction of the peptic tubules. Mild alkaline solutions or whitewash from the surface of walls are the best antidotes. The administration of bland oils and opium, to relieve irritation, and the maintenance of bodily heat are measures which should be instituted at the earliest opportunity.

Nitric acid may be employed with success in the treatment of gastric and intestinal indigestion, in enteric diarrhœa, and in infantile diarrhœa when the stools are of a green color. It has been employed with benefit in oxaluria and phosphaturia. The drug has also been recommended in diabetes, syphilis, syphilitic jaundice, chronic impetigo, and intermittent fever, but at present is rarely employed in these conditions.

Lotions of nitric acid in the proportion of ½ to 1 drachm (2–4 Gm.) to a pint (480 Cc.) of water have been employed to arrest hemorrhage from bleeding hemorrhoids, and the pure acid when touched to one or two points of a hemorrhoid sometimes produces a cure. It may be employed locally as a caustic for the bites of rabid animals, poisonous serpents, and insects, and in its dilute form is an excellent application for syphilitic and other sores of the mouth.

Nitric acid is often used as a test for albumin in the urine. If the acid be placed first in a tube and the suspected urine be allowed to flow down gently and overlay it, a zone of coagulated albumin will appear at the line of contact if albumin is present.

The dose of nitric acid is from 5 to 10 minims (0.3–0.6 Cc.) 3 times daily, largely diluted, and taken through a glass tube.

ACIDUM NITROHYDROCHLORICUM, *U. S.*—Nitrohydrochloric Acid.

Acidum chloro-nitrosum, Acidum nitromuriaticum, Aqua regia, Aqua regis.—Nitromuriatic acid, E.; *Acide chloro-azotique s. chloro-nitreux, Eau régale*, Fr.; *Salpetersalzsäure, Königswasser*, G.

Preparation.—Take of nitric acid, 180 Cc.; hydrochloric acid, 820 Cc. Mix the acids in a capacious glass vessel, and when effervescence has ceased pour the product into glass-stoppered bottles, which should not be more than half-filled, and keep them in a cool dark place.—*U. S.* (If 4½ fluidrachms of nitric acid and 20½ fluidrachms of hydrochloric acid be mixed, the official proportions will remain undisturbed.) The French Codex directs 80 parts of nitric acid, specific gravity 1.39, 20 parts of water, and 300 parts of hydrochloric acid, specific gravity 1.17.

This preparation should never be made extemporaneously, as time must be allowed for complete reaction, which is ascertained by cessation of effervescence; moreover, the vessel containing the acids should be kept in a cool place in the open air, as the fumes arising from the mixture are extremely annoying. As soon as reaction has ceased, the liquid should be poured into bottles as directed, and kept in a cool dark place, so that the chlorine and nitrosyl chloride may remain as such. At a low temperature this mixture may be kept without evolution of gas, but at ordinary or a somewhat elevated temperature a variable mixture of gas is given off; hence the necessity of not dispensing this preparation until after effervescence has ceased, and of keeping it in vials not quite filled.

On mixing nitric with hydrochloric acid a decomposition takes place, resulting in the liberation of chlorine and the formation of water and a chlorinated oxide of nitrogen, NOCl. This preparation has received the name of *aqua regia* from its property of dissolving gold, which is due to the presence of free chlorine; for the same reason are dissolved platinum, calomel, and all other metals and compounds which yield soluble chlorides. Its activity therefore depends upon the amount of free chlorine contained in it. The change taking place on mixing the acids is expressed thus, $HNO_3 + 3HCl = Cl_2 + NOCl + 2H_2O$. The *nitrosyl chloride*, NOCl, is a yellowish gas, which becomes a red liquid at −5° C. (23° F.).

Properties.—Nitrohydrochloric acid is a liquid having a deep golden-yellow color and the odor of chlorine. It readily dissolves gold-leaf, liberates iodine and bromine from their salts, and is volatilized wholly by heat. It should be kept in a cool and dark place, and dispensed in dark- or yellow-colored bottles; and the patient should be cautioned against exposing the vial to light and heat, so as to avoid accidents. It should not be kept on hand for a long time.

Action and Uses.—This acid, like those that compose it, is an intense irritant and caustic when in concentrated form. Taken in full dose, it may irritate the stomach, and

it attacks the enamel of the teeth in its passage through the mouth unless taken through a tube. When placed in the warm water of a bath, it is absorbed by the skin and causes the urine to be acid. Taken internally, its effect on the bowels is laxative and it is stimulant to the flow of bile.

The dilute acid soon loses its peculiar properties, and the freshly prepared strong acid, which is of an orange color, should be used.

Overdoses of the strong acid destroy the mucous membranes of the mouth, pharynx, and œsophagus, causing severe, burning pain, and very violent gastro-enteritis. The inflammation frequently extends to the other abdominal viscera. Perforation of the stomach or intestines, causing peritonitis, may occur. Vomiting and bloody stools are not uncommon. Early collapse followed by death frequently ensues. Patients recovering from the acute symptoms usually die at a later period from stricture of the œsophagus or intestines, or from destruction of the peptic tubules. The poisoning is treated best by the administration of mild alkalies, such as lime water, magnesia, chalk, or whitewash from walls. Opium and bland oils may be employed to relieve pain and irritation. External heat to maintain bodily temperature and stimulants when indicated, should be resorted to.

Nitrohydrochloric acid has been employed in hepatic torpor, chronic hepatitis, hepatic cirrhosis, and in chronic dysentery. It may also be used in gastric and intestinal indigestion, and has been recommended in phosphaturia, oxaluria, and the various conditions depending upon the uric acid diathesis. A certain amount of success has been derived from its administration in full doses in the treatment of hypochondriasis and melancholia. Baths containing 5 per cent. of the acid may be employed as adjuncts in the treatment of the above conditions.

Concentrated nitrohydrochloric acid may be applied locally to venereal sores and phagedenic ulcers, but great care should be taken to prevent it from destroying healthy tissue as well.

The dose of the stronger acid is 3 to 6 minims (0.20–0.40 Cc.), well diluted, and of the diluted form 15 to 30 minims (1–2 Cc.), largely diluted and taken through a glass tube. Because of its destructive action upon the teeth, the mouth should be washed thoroughly with a solution of sodium bicarbonate immediately after its ingestion.

ACIDUM NITROHYDROCHLORICUM DILUTUM, *U. S.*, *Br.*—Diluted Nitrohydrochloric Acid.

Acidum nitromuriaticum dilutum.—Diluted nitromuriatic acid, E.; *Acide chlorazotique dilué*, Fr.; *Verdünnte Salpetersalzsäure*, G.

Preparation.—Take of nitric acid, 40 Cc.; hydrochloric acid, 180 Cc.; distilled water, 780 Cc. Mix the acids in a capacious open glass vessel, and when effervescence has ceased add the distilled water. Keep the product in dark amber-colored glass-stoppered bottles in a cool place.—U. S. (By mixing 2 fluidrachms of nitric acid with 9 fluidrachms of hydrochloric acid, and finally adding 39 fluidrachms of distilled water, the official strength will be preserved.)

It is imperative that the reaction between the strong acids be completed before the water is added. When the mixture is diluted with water, NOCl is decomposed thus, $NOCl + H_2O = HCl + HNO_2$, giving hydrochloric and nitrous acids. It is evident therefore that the diluted nitrohydrochloric acid does not contain the same products as the original undiluted mixture. This subject has been investigated by Tilden, and also by Redwood, of England (*Pharm. Jour. and Trans.*, x. 508), who found that diluted nitrohydrochloric acid contains hydrochloric, nitric, and a little nitrous acids.

The British Pharmacopœia merely directs that 3 fluidounces of nitric acid and 4 fluidounces of hydrochloric acid be added to 25 fluidounces of distilled water, the mixture to be kept in a glass-stoppered bottle for 14 days before it is used. The dilute acid must have a specific gravity of 1.07, and 4 Gm. require for neutralization about 10 Cc. of normal solution of sodium hydroxide.

Properties.—Diluted nitrohydrochloric acid is a colorless liquid having a faint odor of chlorine when freshly made and a very acid taste. Like the strong acid, it is completely volatilized by heat and liberates iodine and bromine from their salts. It contains nearly one-fourth as much acid as the stronger preparation, but, as already explained, has an entirely different composition.

For uses and dose of the diluted acid, see the preceding article.

ACIDUM OLEICUM, *U. S., Br.*—Oleic Acid.

Acidum oleinicum, Acidum elainicum.—Elaic acid, E.; *Acide oléique,* Fr.; *Oelsäure, Oleinsäure, Elainsäure,* G.

Formula, $HC_{18}H_{33}O_2$ or $C_{17}H_{33}COOH$ or $CH_3(CH_2)_7CH.CH(CH_2)_7COOH$. Molecular weight, 280.14.

History and Occurrence.—The earliest references to oleic acid were made by Chevreul in 1823. It was prepared first in a pure state by Gottlieb in 1846. It occurs as a glyceryl ester, triolein, in greater or less amount in almost all fats. Especially rich are the non-drying fatty oils, such as almond oil, olive oil, etc.

Preparation.—Large quantities of crude oleic acid are obtained as a by-product in the manufacture of stearic acid for stearin candles. It contains variable amounts of stearic and palmitic acids, frequently also fatty acids with a lower number of carbon atoms. The two first mentioned impurities can be in large part removed by exposing the impure acid to a low temperature.

For the preparation of a pure oleic acid, the fatty acids of almond oil are converted into their lead salts by digesting with lead oxide in the presence of water. When dried, the oleate of lead can be separated from the other salts by solution in ether. From the ethereal solution the lead is precipitated as chloride with hydrochloric acid, and the filtered ethereal solution of oleic acid evaporated. This product can be purified further, if desired, by dissolving it in ammonia, precipitating the barium salt by the addition of barium chloride, repeated recrystallization from alcohol, and final liberation of the oleic acid with tartaric acid with exclusion of air.

Properties.—The official acid has a specific gravity of 0.900 at 15° C. (59° F.), about 0.895 at 25° C. (77° F.) (U. S.), and its solution in alcohol has a feebly acid reaction upon litmus-paper; it is prepared from a good quality of commercial acid (usually known as "Red Oil") by cooling the latter to 5° C. (41° F.), and separating the liquid portion from palmitic and other acids. When cooled to 4° C. (39.2° F.), oleic acid becomes semisolid, and on further cooling congeals to a whitish solid mass.—U. S.

Pure oleic acid is a colorless, inodorous, and tasteless oily liquid, of neutral reaction, having at 19° C. (66.2° F.) the density 0.898 (Chevreul), congealing to a white crystalline mass at 4° C. (39.2° F.), and crystallizing from alcohol in dazzling white needles melting at 14° C. (57.2° F.) (Gottlieb). The solid acid is but little affected by exposure to air, but in the liquid state it rapidly absorbs oxygen on exposure, becoming yellow and brown, and acquiring a rancid odor, lower congealing-point, and an acid reaction. The official oleic acid has a yellowish or brownish-yellow color, and a peculiar, lard-like odor and taste. When heated to a temperature of about 95° C. (203° F.), decomposition commences, and acrid vapors are produced; at a higher temperature it is completely dissipated (U. S.). It may be distilled *in vacuo* without decomposition, but if distilled in contact with air yields carbon dioxide, hydrocarbons, and an oily distillate containing *sebatic acid*, $C_{10}H_{18}O_4$. With melted potassium hydroxide it is decomposed into palmitic and acetic acids. It is a solvent for fats and fatty acids, is insoluble in water, and dissolves in all proportions of alcohol, ether, chloroform, benzin, and other hydrocarbons, volatile and fixed oils. It unites with bases, and when heated slowly decomposes the alkali and earthy carbonates, forming soaps. Many of the oleates are soluble in alcohol, several also in ether; the normal lead oleate is white, melts at 80° C. (176° F.), and dissolves in ether and benzin. Oleic acid left in contact with nitrous acid is converted into the isomeric *elaidic acid*, which crystallizes in pearly plates and melts at 44° C. (111.2° F.). When oxidized by nitric acid, succinic and several other acids are obtained.

Tests.—A solution of oleic acid in an equal volume of alcohol at ordinary temperature should be perfectly transparent and not separate a layer of fixed oil, and at 7.2° C. (45° F.) should not yield a crystalline deposit of stearic or palmitic acid. To show the absence of notable quantities of stearic and palmitic acids, the U. S. Pharmacopœia requires oleic acid to stand the following test: 1 Gm. of the acid is heated with 20 Cc. of alcohol, and after the addition of two drops of phenolphthalein solution sodium hydroxide solution (1 to 4) is dropped into the liquid until it has acquired a permanent red tint; acetic acid is then added to the liquid until the red color is just discharged, and the liquid filtered. 10 Cc. of the filtrate, mixed with 10 Cc. of ether, should not be rendered more than slightly turbid by 1 Cc. of lead acetate test-solution.

Commercial oleic acid is said to be adulterated frequently with linoleic acid, which admixture can be detected even to the extent of 1 per cent. by treating with potassium permanganate, whereby oleic acid is converted into azaleinic acid, soluble in ether, whereas linoleic acid yields sativic acid insoluble in ether (*Proc. Amer. Pharm. Assoc.*, 1890).

Action and Uses.—Oleic acid is employed in medicine only in combination. It is used in the preparation of oleates, which are considered by some more elegant preparations than ointments, as they do not deteriorate and are less irritating to the skin.

Derivative.—SULPHOLEIC ACID. $C_{17}H_{32}(SO_3H)COOH$.—When almond, castor, or olive oil is treated for 8 or 10 hours with 30 or 40 times its weight of concentrated sulphuric acid at a temperature not exceeding 50° C. (122° F.), the reaction being controlled by cooling with ice if necessary, decomposition results, sulpholeic acid and glyceryl-sulphuric acid being formed; the latter together with the diluted sulphuric acid is decanted and the residue washed with water. The crude acid is neutralized with alkali carbonates or hydroxides, to be subsequently decomposed with sulphuric acid and the purified sulpholeic acid extracted with benzin or ether, which yields the acid in anhydrous condition upon evaporation. If castor oil be used, the resulting acid is designated more specifically as sulphoricinoleic acid. Sulpholeic acid forms neutral salts with the alkalies, which are soap-like compounds readily soluble in water, and possess the property of taking up large quantities of substances otherwise immiscible with water. The alkali sulpholeates have at different times been placed on the market under such names as *oleite, solvine, polysolve*, etc.

ACIDUM OXALICUM.—Oxalic Acid.

Acide oxalique, Fr.; *Oxalsäure, Kleesäure, Sauerkleesäure*, G.

Formula, $H_2C_2O_4.2H_2O$ or $COOH.COOH + 2H_2O$. Molecular weight, 125.10.

Oxalic acid is officially recognized in the French and Italian Pharmacopœias.

History and Occurrence.—The acid potassium salt of oxalic acid was prepared as early as the middle of the seventeenth century by Angelus Sala from *Rumex acetosa*. It was examined later by Marggraf (1740), and by Savary (1773). The free acid was prepared first by Scheele (1776) by the oxidation of sugar; later (1784) he demonstrated the identity of this acid with that previously found as potassium salt in nature. Although free oxalic acid is of rare occurrence in the vegetable kingdom (*Boletus sulfureus, B. ignarius, Cicer arietinum*, etc.), its salts are distributed very widely. The potassium salt is found in various species of *Oxalis*, hence the name (the German for *Oxalis acetosella* is *Sauerklee*, hence *Sauerkleesäure* and *Kleesäure*); and of *Rumex* also in *Geranium acetosum, Spinacea oleracea, Phytolacca decandra, Rheum palmatum, Atropa Belladonna*, etc. The sodium salt occurs in most species of *Salsola* and *Salicornia*, the ammonium salt in guano. Especially common is the occurrence of calcium oxalate, either in solution or deposited as crystals in cells. In the animal kingdom also oxalic acid is found, especially as calcium salt, *e. g., as sediment in urine*, etc. It occurs in the form of ferrous oxalate in the mineral kingdom, as oxalite or humboldtite, etc.

Preparation.—(1) From sugar: 1 part of granulated sugar is heated with 8 parts of crude nitric acid, first gently, then to boiling. After the evolution of gases has ceased, the solution is evaporated to one-sixth of the original volume and allowed to cool. The crystals, when formed, are collected on a filter, washed with cold water and purified by recrystallization. Oxalic acid thus prepared can readily be obtained chemically pure.

(2) From cellulose: Sodium oxalate, obtained by heating sawdust with soda and potassa (60:40) lye (specific gravity 1.35) to 240°–250° C. (464°–482° F.) until dry, lixiviating and crystallizing the sodium salt, is precipitated as calcium oxalate, and the oxalic acid freed by means of sulphuric acid. The acid is purified by crystallization. By this process sawdust yields about half its weight of oxalic acid. Anhydrous oxalic acid can be obtained in crystals by dissolving oxalic acid, which has been deprived of its water of crystallization by heating to 100° C. (212° F.), in $2\frac{1}{2}$ parts of hot glacial acetic acid and allowing to cool. It melts at 186°–187° C. (366.8°–367.6° F.).

(3) From sodium formate: If this salt be heated to over 400° C. (752° F.), air being excluded as much as possible, it is converted into sodium oxalate, from which the acid can then be liberated as in the preceding method. The yield of acid amounts to 50 per cent. and more of the weight of sodium formate used. Sodium formate is produced readily by heating sodium hydroxide with carbon monoxide to 100° C. (212° F.); thus, $NaOH + CO = NaHCO_2$.

Purification.—For the purpose of volumetric analysis the U. S. Pharmacopœia directs oxalic acid which leaves a residue on ignition, or on solution in water, to be puri-

fied as follows: To 1 part of the acid add 10 parts of cold water, and shake until the latter is saturated.

Properties.—Oxalic acid crystallizes from its aqueous solution in flat, oblique, rhombic prisms, which are colorless, transparent, inodorous, of a strongly acid taste and reaction, effloresce when warmed, and are soluble in about 10 parts of water at ordinary temperature, and in nearly all proportions of boiling water. Nitric acid increases their solubility in cold water. They dissolve in $2\frac{1}{2}$ parts of cold and 1.8 parts of boiling strong alcohol, and are but little soluble in ether. Oxalic acid fuses at 98° C. (208.4° F.), and at about 160° C. (320° F.) sublimes partly unaltered, and is partly decomposed into carbonic anhydride and carbon monoxide without residue. The same decomposition takes place when oxalic acid is heated with strong sulphuric acid, but when dissolved in the latter at a moderate heat large oblique octahedra of anhydrous oxalic acid are deposited gradually. The commercial acid usually leaves upon platinum-foil a little charcoal, which finally is consumed, a small residue of alkali carbonate often remaining. Heated with glycerin to a little above the temperature of boiling water, it is decomposed into carbonic and formic acids. In chemical affinity it is one of the strongest acids, yielding normal and acid salts, which, with the exception of the normal alkali oxalates, are mostly insoluble or slightly soluble in water, but which dissolve in diluted nitric acid. Oxalic acid yields with lime-water, and the soluble oxalates with all soluble calcium salts, a white precipitate which is insoluble in oxalic and acetic acids. The acid potassium oxalates are popularly called *salt of sorrel*, also *salt of lemon*, and are employed for removing iron stains from paper, linen, leather, etc.; but at present oxalic acid is usually substituted for this purpose.

Tests.—Mineral impurities are left behind on incinerating oxalic acid upon platinum-foil; organic impurities will blacken concentrated sulphuric acid on boiling. Sulphuric acid, if present, will produce with barium nitrate a white precipitate which is insoluble in diluted nitric acid.

Action and Uses.—Oxalic acid is practically never employed in medicine. It has been recommended for asthma, chronic bronchitis, amenorrhœa, and cystitis, but is rarely given in these conditions on account of its poisonous properties. The drug is a good antiseptic, and is used by many surgeons to disinfect the hands. Oxalic acid has been frequently dispensed in error for magnesium sulphate, but may be easily distinguished from the latter by its sour taste.

In overdose, especially when given in concentrated solution, it occasions violent gastro-enteritis. There is a sensation of constriction and burning pain in the throat and stomach. Vomiting usually occurs, the ejected matter being dark colored and at times containing blood. The severe pain usually causes collapse, which passes into drowsiness, stupor, and death. When given in dilute solution it produces death by depressing the heart and central nervous system. It produces little pain or irritation, but softens the tissue with which it comes in contact. Death may occur within half an hour or the patient may live a number of days. The urine, after a poisonous dose has been taken, frequently abounds in oxalates, and glycosuria may be present. Very large doses may cause early emesis, and under these circumstances recovery is not uncommon. It is stated that 1 drachm (4 Gm.) is the minimum fatal dose. The antidote to oxalic acid is chalk or magnesia mixed with water. Potassa and soda are not antidotes because they are soluble oxalates and equally as poisonous as the acid. Unless prompt treatment is instituted the patient usually dies. The use of a stomach-tube is advantageous. If seen early, emetics may be employed. Should collapse occur, the maintenance of a prone position, the application of external heat, and the administration of circulatory and respiratory stimulants are essential.

The dose of oxalic acid is stated to be from $\frac{1}{4}$ to $\frac{3}{4}$ of a grain (0.015–0.045 Gm.). It should be well diluted with water, and may be repeated every three or four hours.

ACIDUM PHOSPHORICUM, *U. S.*, *P. G.*—Phosphoric Acid.

Acidum phosphoricum concentratum.—*Concentrated Phosphoric Acid*, Br.—*Acide phosphorique*, Fr.; *Phosphorsäure*, G.; *Acido phosphorico*, It., Sp.

Formula, $H_3PO_4 = PO.(OH)_3$. Molecular weight, 97.29.

Official phosphoric acid of the different pharmacopœias is not of uniform strength, that of the U. S. P. has the specific gravity 1.707, and contains 85 per cent. of absolute

H_3PO_4; that of the Br. P. the specific gravity 1.5, and contains 66.3 per cent. of H_3PO_4, and that of the G. P. contains only 25 per cent. of the absolute acid and has the specific gravity 1.154.

History and Origin.—This is the principal acid of the element phosphorus, and was discovered by Marggraf in 1757. Phosphorus occurs in nature almost exclusively in the form of phosphates, principally of calcium (phosphorite, opatite, etc.), aluminum, and iron. The greatest beds of phosphate rock (essentially calcium phosphate) are in Florida. Phosphates are an essential constituent of fertile soils, and are indispensable for the development of seeds. They occur abundantly in urine, blood, and bones. Bone-ash is almost wholly calcium phosphate. During the last twenty years the slags from iron and steel furnaces have become a source of phosphates and phosphoric acid.

Preparation.—For pharmaceutical purposes the acid should always be made from phosphorus. Several methods may be employed:

Phosphorus heated with nitric acid of sufficient strength is oxidized rapidly to phosphoric acid; thus, $5HNO_3 + 3P + 2H_2O = 3H_3PO_4 + 5NO$. Care should be taken to control the reaction and to insure full oxidation of the phosphorus, and removal of all nitric acid and decomposition-products in the final product. 1 part of phosphorus requires about 3½ parts of concentrated nitric acid. The phosphorus and a portion of the acid diluted with an equal weight of water are introduced into the tubulated retort, which is heated on a water-bath. The nitric acid that distils over is caught in a cooled receiver and returned to the retort. As the first reaction grows weaker, more nitric acid is added in small quantities. Finally the contents of the retort are evaporated in a porcelain dish up to a temperature of 190° C. (374° F.) to drive out nitric acid, a portion is diluted and tested with potassium permanganate for phosphorous acid. The color should not disappear within a minute, otherwise more nitric acid must be added and the liquid heated again.

Markoe (*Proc. Am. Pharm. Assoc.*, 1875) proposed a process which is used on a large scale. 540 parts of distilled water are placed in a large jar which is surrounded by ice, 90 parts of phosphorus and 1 part of iodine are added and stirred to bring both in thorough contact. 6 parts of bromine are now run in from a stoppered separatory funnel, *drop by drop*, and in such manner that each drop comes in contact with phosphorus, so that no accumulation of bromine may occur. After the reaction is over, 540 parts of nitric acid (specific gravity 1.42) are added and the vessel covered with a plate. The action goes on slowly for 24 hours or so, and needs no care. After the phosphorus has disappeared the liquid is treated as in the above process. While the iodine assists the chemical change somehow, the essential reactions occur between phosphorus, bromine, and nitric acid; thus, (1) $P + 5Br = PBr_5$. (2) $PBr_5 + 4H_2O = H_3PO_4 + 5HBr$. (3) $3HBr + HNO_3 = 3Br + 2H_2O + NO$. The reactions are cyclic, and bromine acts merely as a medium for carrying oxygen from the nitric acid to the phosphorus.

Phosphoric acid prepared from phosphorus nearly always contains arsenic; this should be removed by diluting and warming the acid, saturating it with hydrogen sulphide, and letting it stand corked in a warm place for 24 hours. Arsenic sulphide is filtered off and the acid concentrated by heat again.

For use in the arts and in the manufacture of phosphates, where a chemically pure acid is not required, the acid is made from bone-ash by treatment with sulphuric acid, by which insoluble calcium sulphate is formed and phosphoric acid; thus, $Ca_3(PO_4)_2 + 3H_2SO_4 = 3CaSO_4 + 2H_3PO_4$. After filtering off and washing the sulphate the filtrate is evaporated to a small volume, any additional sediment of calcium sulphate filtered off, and the liquid then heated to 320° C. (608° F.) until any sulphuric acid present is volatilized.

Another method is to treat the filtrate from calcium sulphate with sodium carbonate, to form sodium phosphate, which is then precipitated as barium phosphate. The latter is treated with a calculated quantity of sulphuric acid, when phosphoric acid is set free; thus, $Ba_3(PO_4)_2 + 3H_2SO_4 = 3BaSO_4 + 2H_3PO_4$. The barium sulphate is quite insoluble.

Bone-ash phosphoric acid is always contaminated with calcium salts and often with sulphates, and hence is unsuitable for medicinal purposes.

The following table, incorporated in the U. S. P., shows the specific gravity of phosphoric acid at 15° and 25° C. (59° and 77° F.), and also the quantity of normal KOH solution required to neutralize 1 Cc. of the acid of different strengths:

Per cent. phosphoric acid.	Specific gravity— $\frac{25°\ C.}{25°\ C.}$	Specific gravity— $\frac{15°\ C.}{15°\ C.}$	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
1	1.0056	1.0056	0.00017	0.018	0.21	0.048
2	1.0113	1.0113	0.00017	0.018	0.42	0.048
3	1.0169	1.0170	0.00018	0.018	0.63	0.048
4	1.0225	1.0226	0.00019	0.018	0.84	0.048
5	1.0281	1.0283	0.00020	0.018	1.05	0.045
6	1.0338	1.0340	0.00020	0.018	1.27	0.045
7	1.0395	1.0398	0.00021	0.017	1.49	0.045
8	1.0453	1.0457	0.00022	0.017	1.71	0.045
9	1.0512	1.0517	0.00022	0.017	1.94	0.043
10	1.0572	1.0577	0.00023	0.017	2.17	0.043
11	1.0632	1.0637	0.00024	0.017	2.40	0.043
12	1.0692	1.0698	0.00025	0.016	2.63	0.043
13	1.0753	1.0759	0.00025	0.016	2.86	0.042
14	1.0814	1.0821	0.00026	0.016	3.10	0.042
15	1.0875	1.0883	0.00027	0.016	3.34	0.042
16	1.0937	1.0945	0.00028	0.016	3.58	0.040
17	1.0999	1.1008	0.00029	0.016	3.83	0.040
18	1.1062	1.1072	0.00030	0.016	4.08	0.040
19	1.1125	1.1136	0.00031	0.016	4.33	0.038
20	1.1189	1.1201	0.00032	0.015	4.59	0.040
21	1.1254	1.1266	0.00033	0.015	4.84	0.038
22	1.1319	1.1332	0.00034	0.015	5.10	0.037
23	1.1385	1.1399	0.00034	0.015	5.37	0.038
24	1.1452	1.1467	0.00035	0.015	5.63	0.037
25	1.1519	1.1535	0.00036	0.014	5.90	0.037
26	1.1588	1.1604	0.00037	0.014	6.17	0.035
27	1.1657	1.1674	0.00037	0.014	6.45	0.035
28	1.1727	1.1745	0.00038	0.014	6.73	0.035
29	1.1799	1.1817	0.00039	0.014	7.01	0.034
30	1.1871	1.1889	0.00040	0.014	7.30	0.034
31	1.1943	1.1962	0.00040	0.014	7.59	0.034
32	1.2015	1.2035	0.00041	0.014	7.88	0.033
33	1.2088	1.2109	0.00042	0.014	8.18	0.033
34	1.2162	1.2184	0.00042	0.013	8.48	0.033
35	1.2237	1.2260	0.00043	0.013	8.78	0.033
36	1.2313	1.2336	0.00044	0.013	9.08	0.032
37	1.2389	1.2412	0.00044	0.013	9.39	0.031
38	1.2465	1.2489	0.00045	0.013	9.61	0.032
39	1.2542	1.2567	0.00046	0.013	10.02	0.031
40	1.2620	1.2645	0.00047	0.013	10.34	0.030
41	1.2698	1.2724	0.00047	0.013	10.67	0.030
42	1.2778	1.2804	0.00048	0.013	11.00	0.030
43	1.2858	1.2885	0.00049	0.012	11.33	0.029
44	1.2940	1.2967	0.00049	0.012	11.67	0.029
45	1.3023	1.3050	0.00050	0.012	12.01	0.029
46	1.3106	1.3134	0.00051	0.012	12.35	0.029
47	1.3190	1.3219	0.00052	0.012	12.70	0.028
48	1.3276	1.3305	0.00052	0.012	13.06	0.028
49	1.3362	1.3392	0.00053	0.011	13.42	0.028
50	1.3449	1.3479	0.00054	0.011	13.78	0.027
51	1.3537	1.3568	0.00055	0.011	14.15	0.027
52	1.3626	1.3658	0.00055	0.011	14.52	0 026
53	1.3716	1.3748	0.00056	0.011	14.90	0.026
54	1.3807	1.3840	0.00057	0.011	15.28	0.026
55	1.3898	1.3932	0.00058	0.011	15.66	0.025
56	1.3991	1.4026	0.00058	0.011	16.06	0.026
57	1.4085	1.4120	0.00059	0.011	16.45	0.025
58	1.4180	1.4215	0.00060	0.010	16.85	0.024
59	1.4276	1.4312	0.00060	0.010	17.26	0.024
60	1.4373	1.4409	0.00061	0.010	17.67	0.024
61	1.4471	1.4508	0.00062	0.010	18.09	0.024

Note.—To find the per cent. of P_2O_5, multiply the per cent. of H_3PO_4 by 0.7243. To find the per cent. of PO_4, multiply the per cent. of H_3PO_4 by 0.96916.

To find the weight in grammes of H_3PO_4 in 100 Cc., multiply the specific gravity by the per cent. of H_3PO_4.

To find the volume per cent. of official Phosphoric Acid, multiply the "normality" by 3.365. For the volume per cent. of official Diluted Phosphoric Acid, multiply the "normality" by 46.08.

[1] Add if the temperature is above, subtract if the temperature is below, 25° C.
[2] Corresponding with a difference in specific gravity of 0.0001.

Per cent. phosphoric acid.	Specific gravity— 25° C. / 25° C.	Specific gravity— 15° C. / 15° C.	Correction of specific gravity for 1° C.	Fractional per cent.	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
62	1.4570	1.4607	0.00063	0.010	18.51	0.023
63	1.4669	1.4706	0.00064	0.010	18.94	0.023
64	1.4768	1.4807	0.00065	0.010	19.37	0.023
65	1.4868	1.4908	0.00066	0.010	19.80	0.023
66	1.4970	1.5010	0.00067	0.010	20.24	0.022
67	1.5072	1.5113	0.00067	0.010	20.69	0.022
68	1.5175	1.5217	0.00068	0.010	21.14	0.022
69	1.5280	1.5322	0.00069	0.009	21.60	0.021
70	1.5386	1.5429	0.00070	0.009	22.07	0.021
71	1.5493	1.5536	0.00071	0.009	22.54	0.021
72	1.5600	1.5644	0.00072	0.009	23.01	0.021
73	1.5708	1.5753	0.00072	0.009	23.49	0.021
74	1.5817	1.5862	0.00073	0.009	23.98	0.021
75	1.5927	1.5972	0.00074	0.009	24.47	0.020
76	1.6038	1.6083	0.00073	0.009	24.97	0.020
77	1.6149	1.6193	0.00072	0.009	25.48	0.020
78	1.6261	1.6304	0.00072	0.009	25.99	0.020
79	1.6374	1.6416	0.00071	0.009	26.50	0.019
80	1.6488	1.6529	0.00070	0.009	27.02	0.019
81	1.6602	1.6642	0.00070	0.009	27.55	0.019
82	1.6717	1.6756	0.00069	0.009	28.09	0.019
83	1.6832	1.6871	0.00069	0.009	28.62	0.018
84	1.6948	1.6986	0.00068	0.009	29.17	0.018
85	1.7065	1.7102	0.00068	. .	29.72	

Phosphoric acid may also be made by burning phosphorus in air in a suitable apparatus, dissolving the resulting pentoxide in water or in very dilute nitric acid and heating for a long time: $2P + 5O = P_2O_5$; $P_2O_5 + 3H_2O = 2H_3PO_4$.

Properties.—Phosphoric acid, U. S. P., is a colorless inodorous strongly acid liquid, miscible with water and alcohol in all proportions. If evaporated at a temperature not exceeding 160° C. (320° F.), a syrupy liquid is obtained, which gradually on standing, more rapidly on the addition of a crystal of phosphoric acid, yields colorless, flattish, hexagonal prisms, melting at about 40° C. (104° F.), deliquescing in a damp atmosphere and completely soluble in alcohol and in water. The syrupy acid does not act on animal and vegetable matter like sulphuric or other mineral acids. At 200° C. (392° F.) it begins to change to pyrophosphoric acid. At a still higher temperature it is converted into metaphosphoric acid, which volatilizes in dense fumes, or, on cooling, forms a transparent mass of glacial phosphoric acid.

The salts of orthophosphoric acid, with the exception of those of the alkalies, are mostly insoluble in water; the insoluble ones dissolve in nitric acid, likewise in acetic acid, with the exception of the phosphates of lead, iron (ferric), uranium, and aluminum. The solution of an orthophosphate rendered alkaline by ammonia yields a white precipitate with a mixture of magnesium and ammonium salts. This precipitate is insoluble in ammonia, sparingly soluble in water, freely soluble in acids, and at a red heat is converted into magnesium pyrophosphate; this reaction is used often for the gravimetric estimation of phosphoric acid. For its volumetric estimation the U. S. Pharmacopœia prescribes titration with normal alkali solution, using phenolphthalein as an indicator, as follows: 10 Gm. of the acid are diluted to 100 Cc. 9.73 Cc. of the diluted acid (containing 0.973 Gm. of H_3PO_4), when mixed with 10 Cc. of a cold saturated solution of potassium chloride, should require for neutralization not less than 17 Cc. of normal potassium hydroxide solution. Phosphoric acid, being tribasic, is capable of forming three classes of salts with the alkalies—namely, primary, secondary, and tertiary—the first having a distinctly acid reaction; the second, neutral or only slightly alkaline; and the last, a strongly alkaline reaction. Complete neutralization, therefore, can not be aimed at, as the normal phosphate itself would affect the indicator; and since different indicators show different behavior with the primary and secondary phosphates, it is important to know at which point the end-reaction occurs. With phenolphthalein the point of neutrality is observed as soon as two-thirds of the acid present have combined to form dipotassium-hydrogen phosphate, K_2HPO_4, while with methyl-orange and Congo-red the change occurs when one-third of the acid has combined, forming monopotassium-hydrogen phosphate, KH_2PO_4. This peculiar behavior necessitates different calculations as the respective color indicators

are used; with phenolphthalein each Cc. of normal KOH solution represents 0.04865 Gm. of H_3PO_4, whereas with methyl-orange the value of each Cc. is increased to 0.0973. The number of cubic centimeters of normal KOH solution, added in either case to produce the first permanent alkaline reaction, when multiplied by the respective factors, will indicate the total amount of orthophosphoric acid present in the weighed sample, and from this the percentage is readily calculated. In the above assay, each Cc. of alkali represents 5 per cent. of H_3PO_4.

The strength of medicinal phosphoric acid, which has been proved to be free from other acids and from salts, may be conveniently ascertained by combining with lead, using an excess of the pure oxide, evaporating to dryness, and igniting, when the increase of weight indicates the amount of phosphoric anhydride (Br.).

Acidum Phosphoricum Dilutum, U. S., Br.—*Diluted phosphoric acid,* E.; *Acide phosphorique médicinal,* Fr.; *Verdünnte Phosphorsäure,* G.—Mix phosphoric acid, 10 Gm., with distilled water, 75 Gm.—U. S. Or 1 part of acid may be mixed with 7.5 parts of water, all by weight. Mix concentrated phosphoric acid, 3 fluidounces, with distilled water, sufficient to make 20 fluidounces.—Br.

Diluted phosphoric acid corresponds in all respects to the preceding, except that it contains only 10 per cent. of H_3PO_4 (U. S.), 13.8 per cent. (Br.), and has the density of 1.057 (U. S.) or 1.08 (Br.). When 4.87 Gm. of this acid are diluted with 5 Cc. of a cold saturated solution of potassium chloride and titrated with normal alkali solution, 10 Cc. of the latter should be required before the alkaline end-reaction occurs, using phenolphthalein as an indicator, each Cc. corresponding to 1 per cent. of H_3PO_4 (U. S.). The British Pharmacopœia requires 1 Gm. of this acid to yield with 0.5 Gm. of oxide of lead a residue weighing 0.6 Gm. after heating to dull redness; 6 fluidrachms (Br.) of this acid correspond to 35.5 grains of P_2O_5 or 49 grains of H_3PO_4.

Fungous growths may appear in dilute phosphoric acid after a long time; a trace of hydrochloric acid will prevent this.

Impurities.—Pure glacial phosphoric acid dissolves completely in distilled water, and this solution is not precipitated on standing for 2 days, after having been saturated with hydrogen sulphide (arsenic, lead). When boiled for some time and then supersaturated with ammonia, no precipitate is produced, with the exception of a slight turbidity (calcium, magnesium), and the further addition of ammonium sulphide causes no change (iron and similar metals). With potassium hydroxide in excess ammonia is not evolved. If completely precipitated by lead acetate, the filtrate, after the excess of lead has been removed by hydrogen sulphide, leaves, on evaporation, only a very minute residue (potassium sodium). Official phosphoric acid must stand the following U. S. P. requirements: No dark-brown color should appear around a crystal of ferrous sulphate when dropped into a cooled mixture of 1 Cc. each of the acid and sulphuric acid (absence of nitric acid). 1 Cc. of the acid diluted with 5 Cc. of water and gently warmed should not be blackened by a few drops of silver nitrate test-solution, or rendered turbid by mercuric chloride test-solution (absence of phosphorous acid). After dilution with water (1 in 10), 5 Cc. should not respond to the modified Gutzeit's test for arsenic (see under Arseni Trioxidum). If phosphorous acid be present, the same preliminary treatment should be applied as is described under Acidum Hypophosphorosum. No turbidity should appear upon mixing 1 Cc. of the acid, 3 Cc. of alcohol, and 1 Cc. of ether (absence of phosphates). 10 Cc. of the acid diluted with water (1 in 20), when acidulated with 1 Cc. of diluted hydrochloric acid, should not be colored or rendered turbid by the addition of an equal volume of fresh hydrogen sulphide test-solution, after being corked at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals). The acid diluted with 5 volumes of water, tested in separate portions, should not yield a precipitate with barium chloride test-solution (absence of sulphuric acid), or with silver nitrate test-solution (absence of hydrochloric acid), or when dropped into albumin test-solution (absence of metaphosphoric acid), or by the addition of an equal volume of official tincture of ferric chloride, even after several hours (absence of pyrophosphoric and metaphosphoric acids). The official diluted acid should conform to the reactions and tests given above for phosphoric acid.

Action and Uses.—Dilute phosphoric acid is very generally employed in medicine. It is a tonic and stimulant to the gastric mucous membranes, acts as a synergist to pepsin,

and aids in the formation of peptones. It does not act as phosphorus; and the animal tissues cannot produce phosphorus compounds either from the acid or the inorganic phosphates. It may be given with advantage in nervous exhaustion and in certain forms of dyspepsia. Phosphoric acid is recommended in melancholia, hysteria, diabetes, the low fevers, and in jaundice, but it is probable that hydrochloric or nitric acid may be given to better advantage. It has been used to control the night-sweats of phthisis, but other more valuable remedies have largely replaced it. The dose of the pure acid is stated to be from 2 to 8 minims (0.10–0.50 Cc.), largely diluted with water; of the dilute acid, from 20 minims to 1 drachm (1.30–4 Cc.), in water, are usually given at a dose.

Related Acids.—1. ACIDUM METAPHOSPHORICUM.—*Metaphosphoric acid, Glacial phosphoric acid*, E.; *Acide phosphorique glaciale*, Fr.; *Metaphosphorsäure, Glasige Phosphorsäure*, G. HPO_3.—Thomas Graham, 1833, showed that the relation between meta-, pyro-, and orthophosphoric acids was one involving different degrees of hydration of P_2O_5, as shown in the equations: $P_2O_5 + H_2O = 2HPO_3$, metaphosphoric acid; $P_2O_5 + 2H_2O = H_4P_2O_7$, pyrophosphoric acid; $P_2O_5 + 3H_2O = 2H_3PO_4$, orthophosphoric acid. By dissolving P_2O_5 in cold water, the meta acid is formed, which, on boiling a long time, or heating with a small quantity of nitric acid, changes to the ortho acid by addition of water. Conversely, by heating the ortho acid above 300° C. (572° F.) it passes to the meta acid by loss of water. The meta acid is also formed by heating ammonium orthophosphate, $(NH_4)_2HPO_4 = 2NH_3 + H_2O + HPO_3$. Pure metaphosphoric acid is a white sticky mass. The commercial "glacial" phosphoric acid is a hard white transparent substance which contains an admixture of sodium metaphosphate to give it hardness and transparency. The glacial acid occurs in sticks or glassy lumps, the latter, as a rule, being purer than the sticks. Besides the sodium salt, it also contains varying quantities of the pyro acid. The acid is easily soluble in water, gradually changing into phosphoric acid. It is hygroscopic. The method of preparation is as follows: About equal parts of bones burned to whiteness, and sulphuric acid diluted with 15 parts of water, are digested until the insoluble part has been converted into white smooth calcium sulphate; the liquid, containing sulphuric and phosphoric acids and holding calcium and magnesium phosphates in solution, is removed by filtration and washing with water, neutralized with ammonia or ammonium carbonate, separated from the precipitated phosphates, and evaporated to dryness. The ammonium phosphate is then heated in a platinum crucible to redness until the ammonia has been completely driven off. Porcelain capsules are corroded in this last operation. The fused acid is poured upon polished iron plates, and, when cool, put into bottles. Thus prepared, phosphoric acid contains a little sodium (from the bone ash), to free it from which Neustadtl proposed to neutralize the acid with ammonia, precipitate with barium chloride, and decompose the resulting barium phosphate after it has been thoroughly washed, with sulphuric acid; the acid filtrate is then evaporated and heated to redness.

2. ACIDUM METAPHOSPHORICUM DILUTUM, N. F.—*Diluted glacial or metaphosphoric acid.*—Glacial phosphoric acid, 100 Gm.; distilled water, sufficient to make 1000 Cc.; dissolve without the aid of heat. When prepared from pure glacial acid this preparation contains about 10 per cent. of metaphosphoric acid. It should be kept in a cool and dark place, and not too large quantities should be prepared. Whenever iron pyrophosphate (U. S. P.) forms one of the ingredients of a mixture containing diluted phosphoric acid, the official acid is unsuitable, as it produces with the salt a gelatinous precipitate. If a clear mixture is required, the above preparation is to be used in place of the official. The same is true of phosphate of iron (U. S. P.), though here, under certain conditions, no precipitate may occur with phosphoric acid (N. F.).

3. ACIDUM PYROPHOSPHORICUM.—*Pyrophosphoric acid*, E.; *Acide pyrophosphorique*, Fr.; *Pyrophosphorsäure*, G. $H_4P_2O_7$.—Obtained by heating syrupy phosphoric acid in a platinum dish to 230°–250° C. (446°–482° F.) until a portion, neutralized with ammonia water, gives a pure white precipitate with silver nitrate. It is a white, hygroscopic, glassy mass, or indistinct opaque crystals. An aqueous solution is permanent for about a year; heating it converts the pyro acid into ortho acid. The insoluble salts of meta- and pyrophosphoric acids are mostly soluble in dilute acids. Ferrous and ferric, mercurous, copper, zinc, lead, and silver pyrophosphates dissolve also in a solution of sodium pyrophosphate.

The following tests will serve to distinguish the three varieties of phosphoric acid from each other:

Acid.	Egg-albumen (free acid).	Silver nitrate (acid neutralized with ammonia).	Magnesia mixture (acid neutralized with ammonia).
HPO_3.	Coagulation.	White precipitate.	No precipitate.
$H_4P_2O_7$.	No coagulation.	White precipitate.	No precipitate.
H_3PO_4.	No coagulation.	Yellow precipitate.	White precipitate.

ACIDUM PICRICUM.—Picric Acid.

Acidum carbazoticum.—*Carbazotic* or *Nitrophenisic acid, Trinitrophenol*, E.; *Acide picrique, carbazotique, nitroxanthique*; *Jaune-amer*, Fr.; *Pikrinsäure, Trinitrocarbolsäure, Welter'sches Bitter*, G.; *Acido picrico*, Sp.

Formula, $C_6H_2(NO_2)_3OH$. Molecular weight, 227.41.

Origin and Preparation.—A solution of this compound, as obtained from indigo, was recognized as a dyeing material by Woulfe (1771). Hausmann (1788) prepared picric acid from the same material as a bitter mass; Welter (1799) obtained it in crystals from silk, and subsequently its composition was investigated by Liebig, Dumas, and others. It can be obtained by the action of nitric acid upon salicin and its derivatives, phloridzin, indigo, aloes, benzoin, silk, and other substances, and may be prepared on a large scale by mixing equal parts of phenol and sulphuric acid of 1.84 specific gravity, and, after the formation of phenolsulphonic acid has been completed, adding nitric acid of 1.34 specific gravity in a thin stream and with constant stirring of the mixture as long as nitrous fumes are given off. The mixture having cooled and congealed to a crystalline mass, is freed from adhering acid in a centrifuge and dissolved in solution of sodium hydroxide. After filtration the solution of sodium picrate is decomposed by means of hydrochloric acid and the precipitated picric acid is purified by recrystallization from hot water. The reactions involved in the preparation of the acid may be expressed thus: $C_6H_5OH + H_2SO_4 = C_6H_4(SO_3H)OH$ (phenolsulphonic acid) $+ H_2O$ and $C_6H_4(SO_3H)OH + 3HNO_3 = C_6H_2(NO_2)_3OH$ (picric acid) $+ H_2SO_4 + 2H_2O$.

Picric acid is officially recognized in the French Pharmacopœia.

Properties.—Picric acid crystallizes in bright-yellow, inodorous needles or scales, which melt at 122.5° C. (252.5° F.), and when cautiously heated sublime without decomposition, forming yellow suffocating vapors which condense again to crystals; but on being rapidly and strongly heated in a test-tube picric acid is decomposed with detonation, while upon platinum-foil it burns with a sooty flame, without residue. It has an acid and extremely bitter taste, dissolves at 5° C. (41° F.) in 160 parts, at 15° C. (59° F.) in 86 parts of water, and in 25 parts of boiling water, forming a bright-yellow solution, and is readily soluble in alcohol, ether, chloroform, benzene, and petroleum benzin. Its solutions stain the skin and other organic matter permanently yellow; hence its use in dyeing. The aqueous solution precipitates gelatin. It unites with bases, forming salts which are mostly yellow, crystallizable, have a bitter taste, and are explosive by percussion or when heated. Ammonium picrate, $C_6H_2(NO_2)_3ONH_4$, occurs in yellow needle-shaped crystals, readily soluble in cold water.

Tests.—The above-described properties are sufficient for recognizing the acid. Its purity is shown by the complete solubility in the solvents mentioned before. On heating an aqueous solution of picric acid with chlorinated lime, very pungent and irritating vapors of the so-called *chloropicrin* are given off—a compound more properly known as *nitrochloroform* and *nitrotrichlormethane*, $C(NO_2)Cl_3$.

Pharmaceutical Uses.—A solution of 1 part of picric acid in 100 parts of water forms a convenient test for alkaloids, nearly all of which are precipitated from their diluted acidulated solutions, except aconitine, caffeine, cocaine, coniine, hyoscyamine, morphine, and theobromine.

Picric acid is much employed for dyeing wool and silk yellow, also for staining wood.

Action and Uses.—Picric acid is given with apparently little advantage in medicine, and for this reason is rarely used. It is claimed that the drug is an antiseptic and analgesic, and solutions of varying strength, locally applied, have been recommended in fungous endometritis after the employment of the curette and as a lotion in the treatment of erysipelas, lymphangitis, and fissured nipples. Picric acid is a very useful application for burns. It should be used by soaking lint in a solution containing $1\frac{1}{2}$ drachms of the acid, 2 ounces of alcohol, and 2 pints of water. Ammonium picrate was formerly employed in trichiniasis and in intermittent fevers, but experience has shown it to be of little or no value in either condition. Large amounts of the acid or its salt are irritant, causing gastro-intestinal inflammation, nausea, vomiting, and purging, followed by collapse, convulsions, and death. It imparts a yellow color to all the tissues of the body and to the urine. The red blood-cells are partly dissolved, the white ones are increased in number and are said to contain numerous motile nuclei.

The dose of picric acid is from $\frac{1}{2}$ to 2 grains (0.025–0.10 Gm.); that of the ammonium salt $\frac{1}{2}$ a grain (0.025 Gm.) three times daily.

ACIDUM SALICYLICUM, *U. S., Br., P. G.*—Salicylic Acid.

Acidum Spiricum.—*Ortho-oxybenzoic acid*, E.; *Acide salicylique*, Fr.; *Salicylsäure, Spirsäure, Spiroylsäure, Salicoylsäure*, G.; *Acido salicilico*, It., Sp.

Formula, $HC_7H_5O_3$ or $C_6H_4.OH.COOH$. Molecular weight, 137.01.

Origin and Formation.—Salicylic acid occurs in the free state in the flowers of *Spirwa Ulmaria*, and as methyl salicylic acid ester in the leaves of *Gaultheria procumbens* and *Andromeda Leschenaultii*, and is formed from salicin, indigo, and some other organic matters by adding them to potassium hydroxide heated to fusion. It was discovered by Piria (1838) as a derivative of salicin; its presence in oil of wintergreen was proved by Procter (1848), and in several species of *viola* by Mandelin (1881).

Preparation.—It is extensively prepared from phenol, according to a method first suggested by Kolbe in 1874. As the first step, dry sodium carbolate is prepared, which is introduced into a retort; dry carbon dioxide is passed through it while heat is applied, gradually increased from 100° to 220° C. (212°–428° F.), and not over 250° C. (464° F.). By this operation carbon dioxide is made to enter into the molecule of phenol, producing disodium salicylate, while one-half of the phenol distils over: $2C_6H_5ONa + CO_2 = C_6H_4ONaCOONa + C_6H_5OH$. The residue in the retort is now dissolved in boiling water, filtered if necessary, and decomposed by hydrochloric acid, when, on cooling, impure salicylic acid, having a brown or reddish-brown color, is precipitated in the form of a crystalline powder; this reaction occurs as follows: $Na_2C_7H_4O_3 + 2HCl = 2NaCl + C_6H_4OHCOOH$ (salicylic acid), sodium chloride remaining in solution. The impure acid thus obtained is further purified by converting it into calcium salicylate by neutralizing with calcium carbonate, and decomposing the newly formed salt again with hydrochloric acid. Impure salicylic acid may also be purified by sublimation in a current of superheated steam or by dialysis of a hydro-alcoholic solution.

C. Schmitt (1885) showed that dry sodium carbolate treated under pressure in the cold with CO_2 yields sodium phenylcarbonate, $C_6H_5ONaCO_2$, which when heated to 120°–140° C. (248°–284° F.) is changed to monosodium salicylate, $C_6H_4OHCO_2Na$, by molecular rearrangement, without loss of phenol. From this salt salicylic acid may then be obtained by the usual methods of decomposition and purification. This process has been patented and is probably now used in place of the original synthetic method for economical reasons. Contact with iron or with materials containing iron is to be avoided, since a reddish color is thereby imparted.

Salicylic acid is obtained on a limited scale, commercially, direct from oil of wintergreen, by boiling the latter with potassium hydroxide solution, whereby potassium salicylate is formed, methyl alcohol being liberated; thus, $C_6H_4OHCOOCH_3 + KOH = C_6H_4OHCOOK + CH_3OH$. The alcohol may be recovered by distillation, and the potassium salicylate decomposed in solution by hydrochloric acid, the liberated salicylic acid being washed with cold water and recrystallized from hot solution. Such acid is sold as natural salicylic acid, and commands a much higher price than the synthetic acid.

Properties.—Thus obtained, salicylic acid is in small acicular crystals, white, inodorous, of a sweetish, acidulous, somewhat acrid taste, and of the specific gravity 1.45. The commercial article occasionally has a yellowish or brownish tinge and a slight odor. It fuses at 156°–157° C. (312.8°–314.6° F.), and if carefully heated sublimes unaltered, without boiling, and without leaving more than 0.6 per cent. of fixed residue, at about 200° C. (392° F.). When rapidly heated to between 220° and 230° C. (428° and 446° F.), it is decomposed into carbon dioxide and phenol: $C_6H_4OHCOOH$ yields $CO_2 + C_6H_5OH$. It is soluble in 450 parts (500 parts, Br. and P. G.) of water at 15° C. (59° F.), 308 parts at 25° C. (77° F.), U. S., and in 14 parts, U. S. (15 parts, Br. and P. G.), of boiling water. The hot solution when slowly cooled yields long, slender needles. The solubility in water is considerably increased by the addition of phosphates, citrates, and acetates of the alkalies, and of borax, the solution made with the latter gradually acquiring a bitter taste. It dissolves freely at ordinary temperatures in wood spirit, in 2 parts of absolute and 2.4 parts of 90 per cent. alcohol, in 3.5 parts of amyl alcohol, in 2 parts of ether, in 80 parts of chloroform, in 80 parts of benzene, in 60 parts of fixed oils, and in 20 parts of glycerin. Its solution in 5 parts of boiling oil of turpentine congeals on cooling. C. Becker (1875) observed that 1 part of salicylic acid and 2 parts of olive oil, heated together, formed a homogeneous mixture. On adding to a small portion of salicylic acid, in a test-tube, about 1 Cc. of concentrated sulphuric

acid, and then cautiously about 1 Cc. of methyl alcohol in drops, on heating the mixture to boiling the odor of oil of gaultheria will be evolved. With borax a crystallizable union is obtained, $NaC_7H_5O_3 + C_7H_5(BO)O_3$, of acid reaction (Prescott). With half its weight of borax and two and a half times its weight of glycerin, a 25 per cent. solution of salicylic acid may be obtained. The alcoholic solution, evaporated spontaneously, yields the acid in large oblique, quadrangular prisms. The aqueous or alcoholic solutions acquire a deep-violet color with ferric chloride, provided alkalies, alkaline salts, and most acids are absent. The aqueous solution yields with bromine water a crystalline precipitate sparingly soluble in water, and when boiled with Millon's reagent of mercuric nitrate gives a red color. A blood-red color, changing to brown and black, is produced by adding an excess of sulphuric acid to a mixture of salicylic acid and sugar, and applying a gentle heat. Sulphate of copper produces an emerald-green color in very dilute solutions of normal salicylates or salicylic acid. Potassium chlorate and hydrochloric acid convert it, like phenol, quinone, and allied compounds, into *chloranil* or tetrachloroquinone, $C_6Cl_4O_2$, which forms yellow crystals soluble in ammonia with a deep-red color. Salicylic acid effervesces with carbonates, behaving as a monobasic acid ; but under certain circumstances a second hydrogen atom may be replaced by metals, as in the case of disodium salicylate mentioned above. Combined with alkalies, the solution of salicylic acid turns brown in contact with the air. On dry distillation the salicylates are decomposed, yielding carbon dioxide and phenol.

Tests.—Salicylic acid should be absolutely free from the odor of phenol, the presence of which lowers its melting-point. If 0.5 Gm. of the acid be dissolved in 10 Cc. of a 10 per cent. sodium carbonate solution, the liquid shaken with an equal volume of ether, and the ethereal solution allowed to evaporate spontaneously, the residue, if any, should be free from the odor of phenol. A 5 per cent. alcoholic solution of the acid, acidified with nitric acid, should not be affected upon addition of silver nitrate test-solution, showing the absence of hydrochloric acid. Heated upon platinum-foil, salicylic acid should evaporate without residue (mineral impurities). It should dissolve in cold concentrated sulphuric acid without imparting any or only a faint-yellow color (organic impurities). Kolbe (1876) has given the following practical test: It should be completely soluble in absolute alcohol, and the solution, if allowed to evaporate spontaneously in a glass or porcelain dish in a place protected from dust, should yield a white residue of aggregated crystals, the points of which are colorless and transparent. In the presence of iron the ends will be reddish or purplish, and with organic coloring-matter will appear yellowish or brown.

Two other oxybenzoic acids are known, which melt at 200° and 210° C. (392° and 410° F.) and do not give a violet-red color with ferric chloride. The para-acid is more freely soluble than the others, and is obtained in Kolbe's process for salicylic acid by using potassium instead of sodium carbolate and increasing the heat to above 150° C. (302° F.).

Action and Uses.—When locally applied to mucous membranes in concentrated form, salicylic acid acts as a decided irritant. When taken internally it is capable of causing ulceration of the buccal mucous membrane and nausea and vomiting, and if continuously applied to the skin, it may cause slight corrosion of this tissue also. Solutions of the acid or its salts usually have a less harmful effect, and do not cause to so marked a degree the irritation which follows the employment of the powdered drug.

Solutions of salicylic acid are germicidal, and may be employed interchangeably with those of carbolic acid ; the consensus of opinion, however, is that the latter drug is more efficacious. The drug is also antifermentative, and impedes not only the digestive ferments and those of putrefaction, but also carbonic and acetic acid formation.

In moderate amounts salicylic acid decreases reflex action, causes roaring in the ears, vertigo, and occasionally headache. In overdose these symptoms are exaggerated ; profuse sweating, partial or complete blindness, ptosis or complete paralysis, and deafness or impairment of hearing may also occur. Medicinal quantities exert no powerful influence upon the circulation, but may be considered depressant rather than stimulant. It is thought by some that a primary increase in blood-pressure occurs, but that this is soon followed by dilatation of the peripheral capillaries. See below.

Salicylic acid materially lowers the temperature in fevered states, but has only a slight influence upon the normal bodily heat. This may be due in part to the profuse sweats which follow its use, but in the author's opinion the fall is chiefly caused also by its effect upon the centers governing the heat mechanism of the body.

It is generally conceded that the drug is rapidly absorbed as a salicylate, and that its elimination begins in from fifteen to thirty minutes. The urine becomes olive green when poisonous doses are taken, due to the presence of indican and pyrocatechin. Salicylic acid increases the percentage of urea in the urine, and it is eliminated by the kidneys as salicyluric acid.

Ordinary doses of the drug increase the depth and rapidity of respiration. This is probably due to stimulation of the respiratory center and the peripheral pulmonary vagi. Poisonous doses produce death by respiratory paralysis.

The drug is considered by some as an hepatic stimulant, but it is practically never employed for this purpose.

Salicylic acid was first employed in medicine as an antiperiodic and antipyretic, but as it is much inferior to quinine and the coal-tar derivatives it is rarely used when these drugs are indicated. It is of more benefit in the treatment of rheumatic fever than any other drug, as it reduces the temperature, relieves the pain, and frequently shortens the course of the disease. It prevents the cardiac and joint complications only by shortening the duration of the disease, and not by any specific action upon these parts. The drug may be employed with benefit in quinsy occurring in persons with a rheumatic diathesis and for the nervous irritability which sometimes occurs in gouty or lithæmic patients. Lumbago and sciatica sometimes succumb to its administration, and migraine, especially in gouty persons, is frequently cured by its use. It has been recommended in gastric dilatation when sarcinæ are present, in paroxysmal gastralgia, and for the removal of round worms.

A dusting-powder containing an equal amount of starch is beneficial in bromidrosis A 20 per cent. ointment sometimes relieves pruritus ani and vulvæ. In the treatment of corns a saturated solution applied upon lint is very serviceable, or 30 grains (2 Gm.) of the acid and 5 grains (0.3 Gm.) of extract of cannabis indica may be dissolved in ½ fluidounce (16 Cc.) of collodion and painted over the corn with a camel's hair brush.

The dose of the drug is from 5 to 20 grains (0.30–1.3 Gm.) every 4 hours until its physiological effects are observed.

Allied Compounds and Derivatives.—ACETYLSALICYLIC ACID. *Aspirin.* $C_6H_4COOHCO_2CH_3$.—A compound obtained by heating salicylic acid with acetyl chloride or acetic anhydride to 150° C. (302° F.) in a flask provided with a reflux condenser. It occurs in colorless crystals, of acidulous taste and melting at 135° C. (275° F.), not very soluble in cold water, but readily in alcohol, ether, and chloroform. Aspirin may be distinguished from salicylic acid by adding ferric chloride to an aqueous or alcoholic solution; no violet color should appear. It should not be confounded with salicyloacetic acid, occurring in glassy scales and used as an antiseptic. Aspirin may be employed as a substitute for salicylic acid in the treatment of rheumatic fever. It is stated that the drug is less likely to produce tinnitus than the latter remedy. It has also been recommended as an intestinal antiseptic. The dose is from 10 to 15 grains (0.60–1 Gm.) 3 times daily.

HOMOSALICYLIC ACID. *Cresotic acid, Oxytoluic acid.* $C_6H_3CH_3OHCOOH$.—Three varieties of this acid occur—ortho-, meta-, and paracresotic acid, homologous with the three oxybenzoic acids. They may be prepared from the isomeric cresols by a process similar to that for synthetic salicylic acid. The acids occur in long, prismatic crystals, dissolve readily in alcohol, ether, and chloroform, but less so in hot water, and only with difficulty in cold water. The paracresotic acid is the only one that has met with much favor among physicians; its melting-point is at 151° C. (304.8° F.); it has been used as a sodium salt in the form of a finely crystalline powder, soluble in 24 parts of warm water, and possessing a bitter but not repulsive taste. Cresotic acid is never employed in medicine alone, but its sodium salt is said to possess antipyretic properties, and may be prescribed in doses of 30 to 60 grains (2–4 Gm.).

PHENYLSALICYLIC ACID. *Oxydiphenylcarbonic acid.* $C_6H_5.C_6H_3.OH.COOH$.—A white powder, freely soluble in alcohol, ether, and glycerin, but sparingly in water, and obtained by dry distillation of a mixture of calcium benzoate and salicylate, the resulting oxydiphenylketone being fused with potassium hydroxide. Phenylsalicylic acid has been recommended as an antiseptic dusting-powder.

SALICYLOUS ACID. *Salicylaldehyde, Oxybenzaldehyde, Oil of spiræa.* $C_6H_4OH.CHO$.—Occurs naturally as a constituent of various species of *Spiræa*, notably *Spiræa ulmaria*, meadow sweet. It is prepared synthetically by boiling a solution of sodium carbolate with chloroform for some time, acidulating with sulphuric acid and distilling. From the distillate the salicylaldehyde is removed by acid sodium sulphite, washed with alcohol, treated with diluted sulphuric acid, and redistilled. It is a colorless liquid, of agreeable odor, pungent taste, and slight acid reaction, having the specific gravity 1.1725 and boiling at 196° C. (384.8° F.). Sparingly soluble in water, but readily in alcohol or ether. It is capable of forming salt-like compounds with the metals. Salicylaldehyde is said to possess diuretic and antiseptic properties. It is given in doses of 2 to 10 minims (0.10–0.60 Cc.) several times daily.

SALICYLURIC ACID. *Salicoylglycocoll.* $CH_2NH(C_7H_5O_2)COOH$.—When salicylic acid is taken into the system a part is excreted in the form of the above combination. If the urine be slightly acidulated with phosphoric acid and shaken with ether, the ethereal solution evaporated, and the residue heated to 150° C. (302° F.) in a current of air, salicyluric acid will be obtained. It forms colorless needle-shaped crystals, difficultly soluble in water.

SULPHOSALICYLIC ACID. *Salicyl-sulphonic acid.* $C_6H_3SO_3H.OH.COOH$.—Occurs as colorless acicular crystals, freely soluble in water and in alcohol. It is obtained by the action of sulphuric anhydride on salicylic acid, or by treating salicylic acid with strong sulphuric acid. Its chief use is as a delicate test for proteids of all kinds, albumin, peptones, globulins, and fibrin. 1 part of egg-albumin in 12,500 parts of water can be detected by this reagent. A dense, bulky white precipitate, which is not redissolved on boiling, is formed in all cases except albumoses and peptones, and in these the precipitate, which dissolves on boiling, reappears on cooling. Sulphosalicylic acid has been employed in the treatment of rheumatic fever, and it may be tried in the various other conditions in which *salicylic acid* is useful. The dose is said to be from 5 to 10 grains (0.30–0.60 Gm.).

SALITANNOL. $C_{14}H_{10}O_7$.—A condensation-product of salicylic and gallic acids, formed by the action of phosphorus oxychloride. It occurs as a white amorphous powder insoluble in water, ether, and chloroform, but soluble in solutions of caustic alkalies; also slightly soluble in alcohol. Salitannol, because of its non-poisonous properties, has been employed as a safe surgical antiseptic.

ACIDUM STEARICUM, *U. S.*—Stearic Acid.

Aeidum stearinicum.—Acide stéarique, Fr.; *Stearinsäure, Talgsäure,* G.

Formula, $HC_{18}H_{35}O_2$ or $CH_3(CH_2)_{16}COOH$. Molecular weight, 282.14.

Origin.—Stearic acid occurs widely diffused throughout the animal kingdom, combined with glycerin in the form of stearin (glyceryl tristearate), and constitutes the bulk of the more solid fats, such as suet and tallow. It is also found in many vegetable fats, notably in palm oil.

Preparation.—When tallow and similar fats are saponified by boiling with soda-lye, the stearin is decomposed, sodium stearate being formed with liberation of glycerin; thus, $C_3H_5(C_{18}H_{35}O_2)_3 + 3NaOH = C_3H_5(OH)_3 + 3NaC_{18}H_{35}O_2$. The soap formed is decomposed by heating with water and sulphuric or hydrochloric acid; by this means the fatty acids are set free, and will float on the aqueous liquid, whence they are removed. Upon cooling, the solid acid mixture is subjected to strong pressure, whereby the fluid acids, oleic, etc., are removed. The residue may be still further purified by dissolving in hot alcohol, when upon cooling the solid acids separate, the liquid acids remaining in solution. Stearic acid is also obtained on a large scale by decomposing tallow or suet with sulphuric acid or superheated steam under pressure, as in the manufacture of glycerin; the fats are readily split up, the glycerin going into solution in the condensed water and the fatty acids floating on top. They may then be removed and purified as explained above.

Properties.—Pure stearic acid occurs in white glistening needles or leaflets, is odorless and tasteless, and does not appear greasy to the touch. It dissolves in all proportions in boiling alcohol and ether, from which it separates on cooling. It melts at 69.2° C. (156.5° F.) to a colorless oil, which on cooling solidifies to a white crystalline mass. The commercial acid, which is contaminated with palmitic, oxystearic, and other solid fatty acids, should have a melting-point not lower than 56° C. (132.8° F.), and on cooling should congeal at 54° C. (129.2° F.). It is soluble in 45 parts of alcohol at 15° C. (59° F.), or 16.6 parts at 25° C. (77° F.), U. S. The presence of undecomposed fat is ascertained by boiling 1 Gm. of the acid with 0.5 Gm. of monohydrated sodium carbonate in 30 Cc. of water; the resulting solution while hot should not be more than faintly opalescent.

Pharmaceutical Uses.—Stearic acid is used in the manufacture of glycerin suppositories, in which it is combined with sodium carbonate, forming sodium stearate, which gives body to the mass.

ACIDUM SULPHANILICUM.—Sulphanilic Acid.

Para-amido-benzene-sulphonic acid, E.; *Acide Sulfanilique,* Fr.; *Sulfanilsäure,* G.

Formula, $C_6H_4.NH_2.SO_3H + H_2O$. Molecular weight, 189.74.

Preparation.—To 75 Gm. of concentrated sulphuric acid (specific gravity 1.836) in a 250 Cc. flask add in small portions and with agitation 25 Gm. of colorless aniline; then heat the mixture on an oil-bath to 180°–190° C. (356°–374° F.) about 3 hours, or until no more aniline is noticed, by its odor or cloudiness, when a little of the liquid

is poured into caustic soda solution. When this point is reached, pour the brown syrupy liquid into 500 Cc. of cold water, in which sulphanilic acid is precipitated as a gray crystalline powder. Filter and dry on porous plates. Purify by repeated recrystallization from hot water, and if necessary with the aid of animal charcoal.

The acid is a substitution-product of benzene in which the sulphuric acid residue replaces an atom of hydrogen in the benzene molecule, in the para position to the amido group, NH_2, as shown by the equation $C_6H_5NH_2 + H_2SO_4 = C_6H_4\begin{cases}NH_2\\SO_3H\end{cases} + H_2O$.

Properties.—Sulphanilic acid forms rhombic crystals which effloresce in dry air and become opaque. It is soluble in 115 parts of water at 15° C. (59° F.), more easily in hot water; insoluble in alcohol and ether. The aqueous solution of the acid has an acid reaction; ammonia and caustic alkalies form easily soluble salts. Nitrous acid in cold solution forms with sulphanilic acid diazo-benzene-sulphonic acid: $C_6H_4\begin{cases}NH_2\\SO_3H\end{cases} + NOOH = H_2O + C_6H_4\begin{cases}N=N-OH\\SO_3H\end{cases}$. The latter forms dyes (azo-dyes) with numerous phenolic bodies, for example, alpha-amidonaphthol (applied in water analysis as a delicate test for nitrites). This diazo reaction is of practical importance in the uses of sulphanilic acid.

Tests.—The crystals should be colorless and burn on platinum-foil without leaving a residue. An aqueous solution should not be changed by hydrogen sulphide or barium chloride.

Ehrlich's Diazo-reagent.—I. Sulphanilic acid, 5 Gm.; hydrochloric acid (25 per cent.), 50 Gm.; distilled water, 1000 Cc. II. Sodium nitrite, 0.5 Gm.; distilled water, 100 Cc. For use, mix 50 Cc. of I. with 5 Cc. of II. Diazo-benzene-sulphonic acid is formed in solution in the mixture. This reagent has diagnostic value in certain febrile diseases when applied in testing the urine. The test is known as

Ehrlich's Diazo-reaction.—10 Cc. of urine are shaken with 10 Cc. of the diazo-reagent and 2.5 Cc. of ammonia water (10 per cent.). A yellowish-red to red color may be produced, which is best seen in the foam of the urine. The colors are designated as egg-yellow, orange, orange-red, carmine, scarlet.

ACIDUM SULPHURICUM, *U. S.*, *Br.*—Sulphuric Acid.

Acidum Sulfuricum, P. A., P. G.—*Oil of vitriol*, E.; *Acide sulfurique, Huile de vitriol*, Fr.; *Schwefelsäure, Vitriolöl*, G.; *Acido solforico*, It.; *Acido sulfurico*, Sp.

Formula, H_2SO_4. Molecular weight, 97.35.

Sulphuric acid as recognized in the different pharmacopœias varies somewhat in strength, as follows: Not less than 92.5 per cent. of absolute H_2SO_4 and a specific gravity not below 1.826 at 25° C. (77° F.), U. S.; 98 per cent. of absolute acid and the specific gravity 1.843, Br.; 94–98 per cent. absolute acid and a specific gravity of 1.836–1.84, P. G.

History and Occurrence.—The acid was known at an early date to the alchemists, but its preparation by heating to a high temperature anhydrous "vitriol" (ferrous sulphate) was first described by Basil Valentine about 1440, who named it *oil of vitriol*. Lavoisier (1777) showed that it contained sulphur and oxygen; and Richter (1795) determined the percentage composition nearly correctly. Sulphuric acid occurs widely distributed in combination with metals, chiefly as calcium, magnesium, and barium salts. It sometimes, though rarely, occurs in the free state in volcanic waters. It also occurs free in salivary glands of some mollusks.

Preparation.—It cannot be prepared from its salts, but must be made from sulphur dioxide, SO_2. It is best prepared on the large scale, and is manufactured in enormous quantities, the greatest portions being made in England and the United States. Sulphur dioxide, nitric acid, air, and steam are passed into large leaden chambers. The sulphur dioxide is oxidized to sulphuric acid, with formation of a lower oxide of nitrogen. This oxide acts as a medium for carrying oxygen of the air to sulphur dioxide. The probable changes taking place in the chambers are these: (1) $SO_2 + 2HNO_3 = H_2SO_4 + 2NO_2$. (2) $4NO_2 + H_2O = N_2O_3 + 2HNO_3$. (3) $SO_2 + N_2O_3 + H_2O = H_2SO_4 + 2NO$. (4) $2NO + O = NO_2$ Since the oxide of nitrogen is always set free and is available again for further work, theoretically a small quantity would be sufficient to convert an

infinitely large quantity of SO_2 into H_2SO_4. But there is always some loss, which must be made good from time to time. If the supply of steam falls short, crystals appear, the formation of which may be represented thus, $2SO_2 + N_2O_3 + O_2 + H_2O = 2SO_2 \begin{cases} OH \\ NO_2 \end{cases}$. These are known as "lead chamber crystals." In presence of sufficient steam they dissolve, forming sulphuric acid and oxide of nitrogen; thus, $2SO_2 \begin{cases} OH \\ NO_2 \end{cases} + H_2O = 2H_2SO_4 + N_2O_3$. When the acid in the chamber has reached a specific gravity of 1.55–1.60 (64 per cent.) it is drawn off and evaporated in leaden pans to the specific gravity of 1.75 (78 per cent.). It then attacks the lead, and is transferred to iron, glass, or platinum vessels, and further evaporated until it contains 93–94 per cent. of H_2SO_4. To prevent any loss of oxide of nitrogen from the exit of the chamber, the escaping gases are made to pass up a tall tower (Gay-Lussac) filled with coke or pumice stone over which concentrated sulphuric acid is allowed to trickle. The oxide is dissolved in the strong acid. To regain the oxide of nitrogen, the acid from this tower is made to trickle down a second one, called the Glover tower, into which weak sulphuric acid is also introduced from above, for the purpose of diluting the concentrated acid. Under these conditions the oxide of nitrogen escapes. The sulphur dioxide from the generating furnace is made to pass up the Glover tower and thus sweeps along the liberated oxide of nitrogen into the chambers. At the same time the high temperature of the dioxide serves to concentrate the acid by evaporating the water.

In England and on the continent, SO_2 is generated by roasting iron pyrites, chiefly from Spain; also zinc sulphide. As these are impure, the sulphuric acid usually contains arsenic and other substances. In this country Sicilian sulphur is burned, and to some extent American pyrites, which yield a much purer acid than the English acid, since the raw materials are practically free from arsenic.

Purification.—To remove arsenic, the chamber acid is treated with H_2S and the precipitated arsenous sulphide filtered off. Another method is to warm the chamber acid to 70°–80° C. (158°–176° F.) and add a quantity of sodium thiosulphate equivalent to the content of arsenic, when arsenous sulphide is precipitated; thus, $As_2O_3 + 3Na_2S_2O_3 = As_2S_3 + 3Na_2SO_4$. The acid which has been concentrated in lead pans can be purified and further concentrated by cooling, whereby crystals of the composition $H_2SO_4.H_2O$ separate. By repeating the process, a pure acid is obtained. To remove any nitrogen trioxide, the acid is heated with ammonium sulphate: $(NH_4)_2SO_4 + N_2O_3 = H_2SO_4 + 3H_2O + 2N_2$. The final purification is by distillation from glass retorts. This is a more or less dangerous operation, which can be conducted successfully best on the large scale.

Commercial Sulphuric Acid. *Acidum Sulfuricum Crudum*, P. G.—It forms a colorless or brownish, inodorous, oily liquid, intensely acid and corrosive, having a specific gravity of not less than 1.830, and containing not less than 91 per cent. of absolute H_2SO_4 (P. G.). It holds a small quantity of lead sulphate in solution, which, however, does not render it unfit for pharmaceutical purposes if it is otherwise pure, more particularly free from arsenic, since the lead salt is precipitated when the acid is diluted with water or alcohol. It is also liable to contain small quantities of nitric, hydrochloric, and sulphurous acids, iron and other metals, lime, ammonia, and other alkalies.

Sulphuric acid is manufactured by the millions of tons, the largest proportion being produced in the United States and England, each country yielding upward of a million tons annually. It is used more than any other acid and for all varieties of purposes; for example, liberating many other acids, in preparing soda from salt, in refining petroleum, in the manufacture of fertilizers, and also phosphorus and phosphoric acid, in bleaching and dyeing industries, etc.

Fuming Sulphuric Acid, Pyrosulphuric Acid, Nordhausen Oil of Vitriol. —The acid received its name from the place where it was first prepared, in Saxony. In fact, the method for making it is the oldest of all, and consists in heating anhydrous ferrous sulphate in earthenware retorts to red heat: $2FeSO_4 = Fe_2O_3 + SO_2 + SO_3$. The anhydride SO_3 is caught in a small quantity of water or sulphuric acid; SO_2 escapes as a gas, and the red oxide of iron, Fe_2O_3, remaining in the retort is sold as polisher under the name *colcothar* or *rouge*. The acid is essentially a solution of SO_3 in H_2SO_4. It is a heavy, thick, oily liquid, usually colored from organic impurities, fumes strongly

in air, and when cooled forms crystals of the composition $H_2SO_4.SO_3$ or $H_2S_2O_7$. The acid is made principally in Bohemia and England. In Bohemia the green vitriol is first roasted to oxidize it to a basic ferric sulphate before heating in retorts, since then there is no loss due to sulphur dioxide. In recent years the method has been perfected for making SO_3 by passing SO_2 and air over finely divided platinum, when combination takes place. It is now made in large quantities in the largest factory in Germany, and it seems that the method will ultimately displace the process of producing concentrated sulphuric acid from chamber acid by evaporation, since it is much more economical and gives a much stronger acid. It cannot displace the present chamber process, however, for making the less concentrated acid, as the latter is more economical for this purpose.

Fuming sulphuric acid finds application in some chemical industries but not in pharmacy.

Sulphuric Anhydride or Sulphur Trioxide.—This distils first when Nordhausen oil of vitriol is heated. At a low temperature it forms long, colorless prisms having in quantity somewhat the aspect of asbestos. It fuses at about 16° C. (68° F.) to a colorless liquid, boils at 46° C. (114.8° F.), and dissolves in all proportions of oil of vitriol. When kept at a temperature below 25° C. (87° F.) it is gradually converted into a modification which is slightly soluble in oil of vitriol, and melts slowly above 50° C. (122° F.), at the same time passing into the former kind. Both kinds attract moisture with great avidity, forming sulphuric acid, and in contact with the air give off white fumes. Its composition is SO_3. It is now made in any desired quantity by the method given under fuming sulphuric acid above.

Persulphuric Acid, $H_2S_2O_8$, is obtained in solution by passing a current of 2 ampères through sulphuric acid of 1.4 specific gravity: $2H_2SO_4 = H_2 + H_2S_2O_8$. The salts of this acid are of more importance than the acid, and are finding application in various ways as oxidizing agents.

Properties.—Pure sulphuric acid is a clear, colorless, odorless, oily, strongly corrosive and hygroscopic liquid. When an acid containing not more than 2 per cent. of water is cooled, crystals of pure H_2SO_4 form, which melt at 10.5° C. (50.9° F.). The absolute acid has a specific gravity of 1.8384 at 15° C. (59° F.) (water at 4° C. (39.2°F.) = 1). On heating the absolute acid it begins to fume at 30° C. (86° F.), sulphur trioxide escaping. This continues until 338° C. (640° F.) is reached, when a liquid of constant composition distils, containing 98.5 per cent. of H_2SO_4, specific gravity 1.842 at 15° C. (59° F.). If a dilute acid is heated, water is given off until 338° C. (640° F.) is reached, when the above acid distils over. The affinity of concentrated sulphuric acid for water is so great that organic compounds left in contact with it are charred, while the acid at the same time acquires a brown color.

Pure sulphuric acid mixes with water and alcohol in all proportions, forming transparent liquids; a white turbidity indicates lead sulphate, which becomes black with hydrogen sulphide. The acid should contain not less than 92.5 per cent. of H_2SO_4; if 1 Gm. be diluted with water to 50 Cc., then 24.34 Cc. of this solution (= 0.4868 Gm. of the acid) should require not less than 9.25 Cc. of normal alkali for neutralization, using phenolphthalein as indicator. Each Cc. of alkali represents 0.04868 Gm. of H_2SO_4, or 10 per cent. The British Pharmacopœia requires that each Gm. of acid shall neutralize 20.1 Cc. of normal alkali solution, which corresponds to 98 per cent. of H_2SO_4, equal to 80 per cent. of SO_3.

Sulphuric acid is one of the strongest of acids. It is dibasic, and forms normal and acid salts, which are generally crystallizable and soluble in water. The barium and lead sulphates are entirely insoluble in water and diluted acids; hence their soluble salts furnish the best reagents for sulphuric acid in its uncombined and combined state.

The following table, adopted by the Pharmacopœia, gives the specific gravity of sulphuric acid of different percentage strengths, both at 15° and 25° C. (59° and 77° F.):

Per cent. sulphuric acid.	Specific gravity— 25° C. / 25° C.	Specific gravity— 15° C. / 15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
1	1.0067	1.0070	0.00021	0.015	0.21	0.048
2	1.0132	1.0137	0.00023	0.015	0.42	0.048
3	1.0197	1.0204	0.00025	0.015	0.63	0.048
4	1.0263	1.0272	0.00027	0.015	0.84	0.045
5	1.0329	1.0340	0.00029	0.015	1.06	0.045
6	1.0395	1.0408	0.00031	0.015	1.28	0.045
7	1.0462	1.0477	0.00034	0.015	1.50	0.043
8	1.0529	1.0547	0.00036	0.015	1.73	0.045
9	1.0598	1.0617	0.00038	0.015	1.95	0.042
10	1.0667	1.0688	0.00040	0.014	2.19	0.043
11	1.0737	1.0760	0.00042	0.014	2.42	0.042
12	1.0808	1.0832	0.00044	0.014	2.66	0.042
13	1.0879	1.0905	0.00046	0.014	2.90	0.042
14	1.0950	1.0978	0.00047	0.014	3.14	0.040
15	1.1023	1.1052	0.00049	0.014	3.39	0.040
16	1.1096	1.1127	0.00050	0.014	3.64	0.040
17	1.1170	1.1202	0.00052	0.014	3.89	0.038
18	1.1244	1.1277	0.00053	0.013	4.15	0.038
19	1.1319	1.1354	0.00054	0.013	4.41	0.038
20	1.1394	1.1430	0.00056	0.013	4.67	0.038
21	1.1471	1.1508	0.00057	0.013	4.93	0.037
22	1.1547	1.1586	0.00058	0.013	5.20	0.036
23	1.1625	1.1664	0.00060	0.013	5.48	0.037
24	1.1703	1.1743	0.00061	0.013	5.75	0.036
25	1.1781	1.1823	0.00062	0.013	6.03	0.034
26	1.1860	1.1903	0.00063	0.013	6.32	0.036
27	1.1939	1.1983	0.00065	0.013	6.60	0.033
28	1.2019	1.2064	0.00066	0.013	6.90	0.034
29	1.2100	1.2145	0.00066	0.013	7.19	0.032
30	1.2181	1.2226	0.00067	0.013	7.48	0.032
31	1.2262	1.2308	0.00068	0.012	7.79	0.033
32	1.2344	1.2391	0.00068	0.012	8.09	0.032
33	1.2427	1.2474	0.00069	0.012	8.40	0.032
34	1.2511	1.2558	0.00069	0.012	8.71	0.031
35	1.2594	1.2642	0.00070	0.012	9.03	0.031
36	1.2679	1.2727	0.00070	0.012	9.35	0.031
37	1.2764	1.2812	0.00071	0.012	9.67	0.030
38	1.2849	1.2898	0.00071	0.012	10.00	0.030
39	1.2936	1.2985	0.00071	0.012	10.33	0.030
40	1.3023	1.3072	0.00072	0.011	10.67	0.029
41	1.3111	1.3160	0.00072	0.011	11.01	0.029
42	1.3200	1.3249	0.00072	0.011	11.35	0.029
43	1.3289	1.3339	0.00072	0.011	11.70	0.028
44	1.3380	1.3429	0.00072	0.011	12.06	0.028
45	1.3471	1.3521	0.00073	0.011	12.42	0.028
46	1.3563	1.3613	0.00073	0.011	12.78	0.027
47	1.3657	1.3707	0.00074	0.011	13.15	0.027
48	1.3751	1.3802	0.00074	0.010	13.52	0.026
49	1.3847	1.3897	0.00075	0.010	13.90	0.026
50	1.3943	1.3994	0.00075	0.010	14.28	0.026
51	1.4041	1.4092	0.00076	0.010	14.67	0.026
52	1.4140	1.4191	0.00076	0.010	15.06	0.025
53	1.4239	1.4292	0.00077	0.010	15.46	0.025
54	1.4340	1.4393	0.00077	0.010	15.86	0.024
55	1.4442	1.4495	0.00078	0.010	16.27	0.024
56	1.4546	1.4599	0.00079	0.010	16.68	0.024
57	1.4650	1.4703	0.00079	0.010	17.10	0.023
58	1.4755	1.4809	0.00079	0.009	17.53	0.023
59	1.4862	1.4916	0.00080	0.009	17.96	0.023
60	1.4969	1.5025	0.00081	0.009	18.39	0.022
61	1.5078	1.5134	0.00082	0.009	18.84	0.023
62	1.5188	1.5244	0.00083	0.009	19.28	0.022

Note.—To find the per cent. of SO_3, multiply the per cent. of H_2SO_4 by 0.81633; to find the per cent. of SO_4, multiply the per cent. of H_2SO_4 by 0.97946 = 5.5.

To find the weight in grammes of H_2SO_4 in 100 Cc., multiply the specific gravity by the per cent. of H_2SO_4.

To find the volume per cent. of official Sulphuric Acid, multiply the "normality" by 2.891. For the volume per cent. of official diluted Sulphuric Acid, multiply the "normality" by 45.76.

[1] Add if the temperature is above, subtract if the temperature is below, 25° C.

[2] Corresponding with a difference in specific gravity of 0.0001.

Per cent. sulphuric acid.	Specific gravity— 25° C. / 25° C.	Specific gravity— 15° C. / 15° C.	Correction of specific gravity for 1° C.	Fractional per cent.	Normality 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
63	1.5299	1.5355	0.00083	0.009	19.74	0.022
64	1.5411	1.5467	0.00083	0.009	20.20	0.022
65	1.5523	1.5580	0.00084	0.009	20.66	0.021
66	1.5637	1.5694	0.00085	0.009	21.13	0.021
67	1.5751	1.5809	0.00085	0.009	21.61	0.021
68	1.5866	1.5924	0.00086	0.009	22.09	0.020
69	1.5981	1.6040	0.00087	0.009	22.58	0.020
70	1.6097	1.6156	0.00087	0.009	23.07	0.020
71	1.6214	1.6273	0.00088	0.009	23.57	0.020
72	1.6331	1.6391	0.00089	0.009	24.08	0.020
73	1.6448	1.6509	0.00090	0.009	24.59	0.020
74	1.6565	1.6627	0.00091	0.009	25.10	0.019
75	1.6682	1.6746	0.00092	0.008	25.62	0.019
76	1.6800	1.6864	0.00093	0.009	26.14	0.019
77	1.6916	1.6981	0.00094	0.009	26.67	0.019
78	1.7032	1.7097	0.00095	0.009	27.20	0.019
79	1.7146	1.7213	0.00096	0.009	27.73	0.019
80	1.7260	1.7328	0.00098	0.009	28.27	0.019
81	1.7370	1.7440	0.00100	0.009	28.81	0.019
82	1.7477	1.7548	0.00102	0.010	29.34	0.019
83	1.7579	1.7652	0.00103	0.010	29.88	0.019
84	1.7678	1.7752	0.00104	0.011	30.41	0.019
85	1.7771	1.7845	0.00105	0.012	30.93	0.019
86	1.7858	1.7934	0.00106	0.013	31.45	0.020
87	1.7938	1.8013	0.00105	0.014	31.96	0.020
88	1.8012	1.8086	0.00105	0.015	32.46	0.020
89	1.8080	1.8153	0.00103	0.016	32.95	0.021
90	1.8141	1.8212	0.00102	0.019	33.43	0.021
91	1.8195	1.8265	0.00101	0.020	33.90	0.022
92	1.8243	1.8311	0.00099	0.024	34.36	0.022
93	1.8284	1.8351	0.00098	0.029	34.82	0.023
94	1.8319	1.8384	0.00097	0.037	35.26	0.023
95	1.8346	1.8411	0.00097	0.050	35.69	0.024
96	1.8366	1.8430	0.00096	0.091	36.10	0.025
97	1.8377	1.8441	0.00096	. .	36.50	0.026
97.5	1.8379[1]	1.8442	0.00095	. .	36.69	0.028
98	1.8377	1.8441	0.00096	0.077	36.87	0.029
99	1.8364	1.8427	0.00095	0.029	37.22	0.032
100	1.8330	1.8394	0.00096	0.029	37.53	0.032

Impurities.—The most important impurities are arsenic, lead, and nitrogen oxides. Saline additions made to increase the specific gravity of weaker acids are recognized by the fixed residue left on evaporating a small quantity from a platinum dish or crucible. Sulphurous and nitrous acids rapidly decolorize potassium permanganate. Arsenic is found principally in sulphuric acid manufactured from pyrites, more rarely if made from sulphur; for this reason the sulphuric acid manufactured in the United States is often free from this contamination. The purity of sulphuric acid is determined as follows: 1 volume of acid diluted with 5 volumes of alcohol must remain clear and free from precipitate after one hour (absence of lead sulphate, or other salts). The mixture of 1 Cc. of sulphuric acid and 5 Cc. of water should not at once discharge the color of 0.1 Cc. decinormal potassium permanganate solution (absence of sulphurous or nitrous acid). 2 Cc. of the acid, upon which a layer of ferrous sulphate solution has been carefully poured, should not cause a brown or reddish color at the zone of contact (absence of *nitric* or *nitrous acid*). In sulphuric acid diluted with 20 volumes of water no precipitate should be formed by the addition of silver nitrate solution (absence of hydrochloric acid); nor should 10 Cc. of the diluted acid be colored or rendered turbid by an equal volume of fresh hydrogen sulphide test-solution after being stoppered at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals); nor after supersaturation with ammonia-water should the acid leave any fixed residue on evaporation and ignition (absence of non-volatile impurities). 5 Cc. of the acid diluted with water (1 in 10) should not respond to the modified

[1] Note that the specific gravity diminishes in acids of more than 97.5 per cent. strength as the percentage increases.

it's test for arsenic (see under ARSENI TRIOXIDUM). On carefully pouring a on of a small fragment of sodium sulphite in 2 Cc. of hydrochloric acid upon 2 f sulphuric acid, the zone of contact should not acquire a reddish color, nor should, on warming, a red compound be separated, showing the absence of selenium. These tests are nearly identical with those adopted by the German Pharmacopœia.

Acidum Sulphuricum Dilutum, U. S., Br. *Diluted sulphuric acid,* E.; *Acide sulfurique dilué,* Fr.; *Verdünnte Schwefelsäure,* G.—Take of sulphuric acid, 100 Gm.; distilled water, 825 Gm. Pour the acid gradually, with constant stirring, into the distilled water.—U. S. Mix 1333 grains of sulphuric acid 98 per cent. with sufficient distilled water until the mixture at 15.5° C. (60° F.) measures 1 Imperial pint.—Br. Mix sulphuric acid 1 part and water 5 parts.—P. G.

In place of using metric weights, 1 ounce (av. or troy) of sulphuric acid may be carefully mixed with $8\frac{1}{4}$ ounces (av. or troy) of distilled water, and when cool sufficient distilled water should be added to bring the weight of the diluted acid up to $9\frac{1}{4}$ ounces (av. or troy).

The direction of the Pharmacopœias to add *the acid to the water* must be observed in all cases, and more particularly if large quantities of acid are to be diluted. During the mixing of the two liquids, which is performed best in a porcelain dish or beaker-glass a considerable elevation of temperature takes place, causing a portion of the water to evaporate; the weight of the cooled mixture should therefore be made up to the required weight by the addition of distilled water. Filtration through paper or decantation is necessary only when pure sulphuric acid has not been used, to remove the lead sulphate, which is deposited from the commercial acid on diluting with water. It has the general properties of the strong acid, but is not of an oily consistence, and is less caustic. The diluted acid of the U. S. P. contains 10 per cent. of absolute H_2SO_4, and 4.868 Gm. of it are neutralized by 10 Cc. of normal potassium hydroxide solution. The British Pharmacopœia requires the diluted acid to contain 13.65 per cent. of H_2SO_4; 1 Gm. to be neutralized by 2.8 Cc. of normal solution of sodium hydroxide. Other authorities direct 15.6–16.3 (P. G.), 10 (Fr. Cod.), 16.66 (P. A.), and 18.8 (F. It.) per cent. of H_2SO_4. The specific gravity of the official acid is about 1.067 at 25° C. (77° F.).

Action and Uses.—As an escharotic this acid may be employed in the treatment of indolent ulcers, gangrene, warts, and venereal sores. Michel's paste, consisting of 3 parts of sulphuric acid and 1 part of finely powdered asbestos thoroughly triturated together, has been recommended for the extirpation of skin cancers. An ointment containing 10 per cent. of the acid may be used in tinea capitis. In all of the above conditions the acid is rarely used, because of its powerful action and tendency to extend and involve healthy tissue. Internally it is tonic, astringent, and refrigerant, and may be given with excellent results in serous diarrhœa resulting from a relaxed condition of the bloodvessels of the intestines. It is employed both as a prophylactic and a cure in epidemic cholera. The drug acts favorably during convalescence from prolonged fevers, by increasing the appetite and promoting digestion. It is a chemical antidote in acute lead-poisoning, and when employed for this condition, or as a prophylactic in cholera, should be given in the strength of 5 minims (0.3 Cc.) of the acid to a wineglassful of water. Sulphuric acid is recommended in the treatment of phosphaturia, and when combined with belladonna may be given with advantage in the night-sweats of phthisis, or in those resulting from any other depraved condition of the system. Weak solutions may also be employed as a lotion for this purpose.

Concentrated sulphuric acid abstracts water from the tissues so rapidly that they become carbonized. Overdoses destroy the tissues with which they come in contact, and produce a violent gastro-enteritis with severe burning pain in the mouth, œsophagus, and stomach. Collapse followed by death may occur in a few moments; or if the dose has not been sufficient to cause perforation, a lingering death may follow. Should the patient survive several days, inflammation of the parotid gland, due to occlusion of Steno's duct, may occur. Acute nephritis with hæmaturia is sometimes observed. If recovery from the acute condition takes place, the patient frequently dies later from inanition, resulting either from stricture of the œsophagus or destruction of the gastric tubules. The treatment of poisoning consists in the administration of mild alkaline drinks, demulcents, and opium for the relief of pain. Bodily temperature should be maintained and stimulation given as needed.

The dose of the pure acid is from 2 to 3 minims (0.10–0.20 Cc.), largely diluted and taken through a glass tube or quill. The mouth should afterward be rinsed with a mild alkaline solution. The dose of dilute sulphuric acid is from 10 to 30 minims (0.60–2 Cc.), largely diluted and taken through a tube (see ACIDUM SULPHURICUM AROMATICUM).

ACIDUM SULPHURICUM AROMATICUM, *U. S.*, *Br.*—Aromatic Sulphuric Acid.

Tinctura aromatica acida, Elixir vitrioli Mynsichti.—Elixir of vitriol, E.; *Elixir vitriolique, Teinture (Alcoolé) aromatique sulfurique*, Fr.; *Saure aromatische Tinktur*, G.

Preparation.—Add gradually sulphuric acid 111 Cc. to alcohol 700 Cc., and allow the mixture to cool. Then add to it tincture of ginger 50 Cc., oil of cinnamon 1 Cc., and sufficient alcohol to make the product measure 1000 Cc.—U. S.

In the absence of metric measures the following proportions will yield a preparation of official strength: Sulphuric acid (92.5 per cent.) 11 fluidrachms, tincture of ginger 5 fluidrachms, oil of cinnamon 5 drops, alcohol sufficient to make 12½ fluidounces. Aromatic sulphuric acid is a light-colored liquid, of about 0.933 specific gravity at 25° C. (77° F.), and contains, when freshly made, about 11 per cent. by volume of official sulphuric acid, or nearly 20 per cent. by weight of absolute acid. Upon standing, chemical action ensues, and a part of the sulphuric acid is gradually converted into ethylsulphuric (sulphovinic) acid, according to the equation: $H_2SO_4 + C_2H_5OH = C_2H_5HSO_4 + H_2O$. The newly formed compound is soluble in water and alcohol, but is not precipitated by barium chloride; by boiling its aqueous solution it is split up into sulphuric acid and alcohol. To determine the acid strength of aromatic sulphuric acid, 10 Gm. of the latter should be diluted with 30 Cc. of water, the mixture boiled for a few minutes, and when cool titrated with normal alkali solution, using phenolphtalein as indicator. Each Cc. of the alkali solution required corresponds to 0.04867 Gm. of absolute sulphuric acid.

The aromatic sulphuric acid of the present Pharmacopœia differs considerably from the preparation of the same name of the 1870 Pharmacopœia, formerly often prescribed under the name of Elixir of Vitriol. The latter preparation was of a brownish-red color, and very prone to precipitation; it was made by percolating 1 troyounce of ginger and 1½ troyounces of cinnamon with 1 pint of alcohol, and adding this to a previously prepared and cooled mixture of 1 pint of alcohol and 6 troyounces of sulphuric acid.

The British Pharmacopœia recognizes a preparation slightly weaker than that of the United States. It is a mixture of sulphuric acid (98 per cent.) 3 fluidounces, spirit of cinnamon ½ fluidounce, tincture of ginger 10 fluidounces, and alcohol (90 per cent.) 29½ fluidounces. It has a specific gravity of 0.922–0.926, and 100 Gm. should correspond in neutralizing power to 13.8 Gm. of absolute sulphuric acid.

Action and Uses.—This preparation is preferable to any other form of this acid. It possesses tonic and astringent properties, and is employed in all conditions for which the dilute acid is adapted. It is especially useful in the night-sweats of phthisis, other hectic conditions, and gastro-intestinal disorders attended with colliquative serous stools.

The dose is from 10 to 30 minims (0.60–2 Cc.), largely diluted, two or three times daily. The mouth should afterward be rinsed with a mild alkaline solution, to prevent injury to the teeth.

ACIDUM SULPHUROSUM, *U. S.*, *Br.*—Sulphurous Acid.

Acide sulfureux, Fr.; *Schweflige Säure*, G.

An aqueous solution of sulphurous acid containing not less than 6.4 per cent. of SO_2 (U. S.) or 5 per cent. (Br.) and having the specific gravity 1.028 (U. S.) or 1.025 (Br.).

The term sulphurous acid is commonly, though erroneously, given to SO_2, which chemically is sulphurous anhydride or sulphur dioxide. Sulphurous acid, H_2SO_3, does not exist in the free state, but undoubtedly is present in solution when SO_2 is passed into water.

History and Production.—Sulphurous acid was first distinguished from sulphuric acid by Stahl (1697); its properties in the gaseous state were studied by Priestley (1775), and Lavoisier (1777) showed that it contained less oxygen than sulphuric acid. It is met with in the exhalations of active volcanoes, and is produced on the burning of

sulphur, by roasting sulphides, and when concentrated sulphuric acid is heated with charcoal or with organic matters, with copper, mercury, or other metals. The official process is as follows:

Preparation.—Take of sulphuric acid, 60 Cc.; charcoal, in coarse powder, 20 Gm.; distilled water, 500 Cc. Pour the acid upon the charcoal previously introduced into a glass flask, and mix the two well together. By means of a glass tube and well-fitting corks connect the flask with a 200-Cc. wash-bottle, which is one-third filled with water and fitted with a rubber stopper having three perforations. Into one of these perforations insert a safety-tube, which should reach nearly to the bottom of the bottle; into the remaining perforation fit a glass tube and connect it with a bottle provided with a doubly perforated rubber stopper, having a capacity of about 1000 Cc., and containing 500 Cc. of well cooled distilled water This tube should dip about 1 inch (25 Mm.) below the surface of the water. By means of a second tube connect this bottle with another containing water, the end of the tube extending 2 inches (5 Cm.) below the surface. Having ascertained that all the connections are air-tight, apply a moderate heat to the flask until the evolution of gas has nearly ceased, and during the passage of the gas keep the bottle containing the distilled water at or below 10° C. (50° F.) by surrounding it with cold water or ice. Assay a small portion of the sulphurous acid by the method given below. Then add to the remainder sufficient distilled water to bring the product to the strength of 6.4 per cent. of sulphurous acid gas. Finally, pour the sulphurous acid into dark amber-colored, glass-stoppered bottles, which should be completely filled, and kept in a cool place, protected from light. Owing to its rapid deterioration, sulphurous acid should be frequently assayed, and none should be dispensed if it fails to conform to the assay given below.—U. S. If a safety-tube be inserted in the apparatus, the delivery-tube may be allowed to reach to near the bottom of the distilled water.

The charcoal acts as a reducing agent upon the sulphuric acid, generating carbon dioxide and sulphurous anhydride and water; thus, $C + 2H_2SO_4 = CO_2 + 2SO_2 + 2H_2O$. The gas is therefore contaminated with carbon dioxide, which will likewise be retained by the distilled water to a slight extent. A purer acid is obtained by heating copper clippings with concentrated sulphuric acid, when copper sulphate and sulphur dioxide will be produced: $Cu + 2H_2SO_4 = CuSO_2 + SO_2 + 2H_2O$. Double the quantity of sulphuric acid will be necessary to produce the same amount of sulphurous acid as is produced by the official process.

Properties and Tests.—Sulphur dioxide is a colorless, irrespirable, pungent, and suffocating gas, and condenses to a liquid at —10° C. (14° F.) or under a pressure of 4 or 5 atmospheres, which boils at —8° C. (17.6° F.) and solidifies at —76° C. (—104.8° F.); this liquid boils briskly on coming into contact with ice.

The density of sulphur dioxide gas is 2.211. 1 volume of water dissolves

	At 0°. C. (32° F.).	At 15° C. (59° F.).	At 20° C. (68° F.).	At 40° C. (104° F.)
Volumes of SO_2	80	43.5	39.4	18.8

The solution contains sulphurous acid, $H_2SO_3 = (HSO_2(OH))$, and when saturated at ordinary temperature has, according to Anthon (1860), the density 1.046 and contains 9.54 per cent. of SO_2. 1 volume of alcohol at 15° C. (59° F.) dissolves 115.8 volumes of SO_2; camphor and glacial acetic acid dissolve 308 and 318 volumes of SO_2, respectively.

The aqueous solution of sulphurous acid in contact with air is oxidized to sulphuric acid, and when exposed to light it acquires the property of precipitating silver sulphide from silver nitrate. The gas remains with the water when the solution freezes, and at the boiling temperature some time elapses before it is entirely expelled.

Sulphurous acid is a powerful deoxidizing agent, abstracting oxygen from permanganic, chromic, iodic, arsenic, nitric, and other acids, from ferric, mercuric, argentic, and other salts, and from most vegetable colors, thereby bleaching the latter. It yields hydrogen sulphide and water when in contact with nascent hydrogen. It displaces carbon dioxide from carbonates, and yields salts which generally are sparingly soluble in water, except the alkali sulphites; they are inodorous, have a somewhat acrid taste, and on ignition are converted into sulphate and sulphide, or sulphur dioxide is given off, the metallic oxide remaining.

Official sulphurous acid is a colorless liquid, having the characteristic odor of burning

sulphur and an acid sulphurous taste. Its specific gravity is not less than 1.028 at 25° C. (77° F.), U. S., 1.025 at 15.5° C. (60° F.), Br., and when evaporated it leaves no residue. Blue litmus-paper moistened with the acid is first reddened and afterward bleached. On gently heating a few Cc. of the acid in a test-tube, the gas evolved will blacken a strip of paper moistened with mercurous nitrate test-solution, but will not affect one moistened with lead acetate test-solution. On mixing in a test-tube 1 Cc. of sulphurous acid with 5 Cc. of diluted hydrochloric acid, and adding a small piece of pure zinc, hydrogen sulphide gas will be evolved, which will blacken a strip of paper moistened with lead acetate test-solution.—U. S. It gives but a slight precipitate with solution of barium chloride (absence of sulphates), but a copious precipitate if solution of chlorine also be added (Br.). If to 10 Cc. of sulphurous acid there be added 1 Cc. of diluted hydrochloric acid and afterward 1 Cc. of barium chloride test-solution, not more than a slight turbidity should be at once produced (limit of sulphuric acid).—U. S. Mixed with 100 times its volume of recently boiled and cooled water and a little mucilage of starch it should not acquire a permanent blue color with volumetric solution of iodine until, for each gramme of the acid, 15.7 Cc. of the iodine solution have been added.—Br.

Assay of Sulphurous Acid.—Dilute 10 Gm. of the sulphurous acid to be assayed with enough distilled water to measure 100 Cc. To 15.9 (15.898) Cc. of this solution add 35 Cc. of tenth-normal iodine solution, and allow it to stand for 5 minutes, then add tenth-normal sodium thiosulphate solution until it is just decolorized. Subtract the number of Cc. of tenth-normal sodium thiosulphate solution used from the number of Cc. of tenth-normal iodine solution taken, and multiply the remainder by 0.2, which will give the percentage of sulphurous acid gas in the liquid, each Cc. of the tenth-normal iodine solution consumed corresponding to 0.2 per cent. of sulphur dioxide. Dilute the sulphurous acid with distilled water, as directed in the process above, so that it shall have the strength of 6.4 per cent. of sulphurous acid gas. Finally, test the finished product, when 15.9 (15.898) Cc. of the acid, diluted as above, should, after adding 35 Cc. of tenth-normal iodine solution, and allowing it to stand for 5 minutes, require not more than 5.3 Cc. of tenth-normal sodium thiosulphate solution for decolorization. —U. S.

Practical Uses.—Sulphurous acid is employed in the preparation of sodium, calcium, and other sulphites, and of calomel by the wet process, and serves as a powerful reducing agent. In pharmacy and the arts it is used for bleaching sponges, bones, straw, and other organic matters, for removing fruit-stains, and for arresting or preventing fermentation and putrefaction. Liquid SO_2 is sold in iron containers.

Action and Uses.—Sulphurous acid possesses germicidal and disinfectant properties. It arrests fermentation and putrefaction by destroying the germs which produce them. The fumes of burning sulphur, which contain large quantities of the acid, have been largely replaced by formaldehyde for disinfecting purposes, as the latter is more powerful and does not possess the bleaching property of the former. In the strength of 1 per cent. by volume it destroys most micro-organisms, but does not kill the spores.

The drug is rarely employed in medicine, but may be used with advantage in the treatment of parasitic skin diseases. Inhalations have been recommended for whooping-cough, and a solution of the acid is considered valuable in gangrenous pharyngitis as a gargle. Internally it may be employed in the treatment of urticaria and flatulent dyspepsia.

The dose is stated to be from ½ to 2 drachms (2–8 Cc.), largely diluted.

ACIDUM TANNICUM, *U. S., Br., P. G.*—Tannic Acid.

Acidum gallotannicum, Tanninum.—Gallotannic acid, Digallic acid, Tannin, E.; *Acide tannique, Tannin*, Fr.; *Gerbsäure, Gallusgerbsäure, Tannin*, G.; *Acido tannico*, It., Sp.

Formula, $C_{14}H_{10}O_9 = (C_6H_2)_2.(OH)_3.OCO.COOH$. Molecular weight, 319.66.

Origin and Varieties.—The generic name tannin is employed to designate compounds widely diffused in the vegetable kingdom, which are characterized by an astringent taste and the property of precipitating gelatin and albumin from their solutions, and also of producing dark-colored solutions or precipitates with salts of iron. The tannin or tannic acid employed in medicine is more specifically known as gallotannic acid, from its source, nutgall, and was first obtained by Deyeux and Seguin toward the close of the eighteenth century; it has also been met with in the leaves of tea and

sumach. Trimble divided all tannins into two main groups, designated as the gallo-tannic-acid group and the oak-tannin group. To the first group belong, besides nutgall tannin, the tannins found in chestnut wood, chestnut bark, pomegranate bark, and sumach; while the second comprises the tannins of the different species of oak, of kino, catechu, krameria, tormentil, mangrove, and canaigre. They are distinguished from each other by their behavior toward lime water, bromine water, and ferric salts, as explained below.

Preparation.—Two methods are extensively employed at the present time for the manufacture of tannic acid on a commercial scale.

1. Moderately finely powdered galls are treated with water heated to 40° or 60° C. (104°–140° F.) until the powder is exhausted and a concentrated solution obtained; this is allowed to settle, and is then filtered into a churn-like vessel provided with numerous paddles. To the liquor is now added about ¼ of its volume of ether (specific gravity 0.750), and the mixture thoroughly agitated; when the resulting emulsion is allowed to stand for several days it separates into two distinct layers, the upper ethereal layer being a solution of resin, fat, gallic acid, and coloring-matter, while the lower aqueous layer contains the tannin with some few impurities. After separation the tannin solution is concentrated, under reduced pressure, in a still to a syrupy consistence, and then spread on plates of sheet tin, which are warmed, so that the tannin may be obtained as dry, spongy masses; the syrupy liquid may also be spread on glass plates, which are then heated in drying ovens to 110° C. (230° F.).

2. Nutgall in moderately fine powder is exhausted in stoneware or glass vessels with a mixture of 4 parts of ether and 1 part of 90 per cent. alcohol by repeated maceration with fresh portions of solvent. The united liquids are repeatedly shaken with water, which takes up the tannic acid, and having been treated, if necessary, with animal charcoal, the aqueous solution is concentrated and further treated as above stated.

Two other varieties, less pure, are met with, known as alcohol-tannin and water-tannin; the former is made by extracting nutgall with 50 per cent. alcohol, carefully filtering, and concentrating the solution, which is finally evaporated in a vacuum. Water-tannin is extracted similarly to ether-tannin, but, instead of adding ether, the solution, after filtration, is concentrated to dryness in a vacuum apparatus. Pure tannic acid has been obtained by Gartenmeister by exhausting powdered galls with acetic ether, and a patent has been granted for the process in Germany. The acetic ether solution is concentrated, and thoroughly agitated with water, which forms an emulsion, from which the impurities are removed by centrifugal action and admixture of charcoal or pumice-stone. Finally, the aqueous solution, almost free from color, is evaporated to dryness by appropriate means. It is scarcely necessary to state that in all these methods contact with metal, especially iron, must be avoided to prevent discoloration of the final product. The so-called crystallized tannic acid is simply finely spun tannin obtained in thin threads by forcing a concentrated solution through finely perforated sieves, and allowing the mass to fall from a height of 15 feet or more on to rapidly revolving wood cylinders.

Properties.—Tannic acid has a yellowish-white color, frequently of a slight greenish tint. It is odorless or has a faint characteristic odor, a strongly astringent taste, and is soluble in about 0.336 part of water or 0.224 part of alcohol at 25° C. (77° F.). Very soluble in boiling water, boiling alcohol, and in diluted alcohol, also in 1 part of glycerin moderately heated; but remains pulverulent when in contact with anhydrous ether which is free from alcohol, and is likewise insoluble, or nearly so, in absolute alcohol, chloroform, petroleum benzin, benzene, carbon disulphide, and in most fixed and volatile oils. The solutions have an acid reaction. Tannic acid being less soluble in acidulated water and in solutions of certain salts than in pure water, its aqueous solution is precipitated by mineral and certain organic acids, by the chlorides and several other salts of the alkalies, these precipitates being again soluble in water. Tannin renders iodine soluble in water, and prevents the reaction of the latter upon starch; this behavior has been recommended by F. Jean for the estimation of tannin. It yields precipitates with the alkaloids and many so-called neutral principles, with lime water, most metallic salts, with starch, albumin, and gelatin. The latter precipitate is soluble in solutions of gelatin and of tannin, but insoluble in water and aqueous solutions of certain salts (see Gelatina); this tannate of gelatin is formed in the tanning of hides, and is an important constituent of leather. With solutions of pure ferrous salts no change takes place in the absence of oxygen, but ferric salts give at once in diluted solutions a deep-blue color, and in more concen-

trated solutions a bluish-black precipitate, with a reduction to ferrous compounds. In the presence of alkalies and in contact with air solutions of tannin rapidly assume a brown color.

Composition.—The impossibility of obtaining tannic acid in the crystallized state has rendered the determination of its composition difficult. It has been the subject of frequent investigations, and not until Schiff (1871) and Etti (1884) announced the result of their work was the true chemical character of tannic acid understood. Owing to the fact that it is generally contaminated with variable proportions of glucose in weak combination, the view that tannic acid is a glucoside prevailed for a long time. From this it can be completely freed, however, as suggested by Trimble, by treatment with lead acetate and hydrogen sulphide and subsequent extraction with acetic ether. Tannic acid, when pure, is now looked upon as digallic acid or an anhydride of gallic acid. This relation is seen from the following equation: $2(C_6H_2(OH)_3.COOH)$ (gallic acid) $- H_2O = (C_6H_2)_2.(OH)_5.OCO.COOH$ (tannic acid) $= C_{14}H_{10}O_9$.

Tests.—Tannic acid should burn from platinum-foil without leaving more than 0.2 per cent. of ash, and be completely soluble in 5 parts of alcohol (dextrin insoluble) and the same proportion of warm water (resin insoluble), both solutions being nearly transparent. The latter solution should not be precipitated on mixing it with twice its volume of alcohol.

If a small quantity of lime water be added to a 1 per cent. aqueous solution of tannic acid, a pale bluish-white precipitate is produced, which is not dissolved on shaking (difference from gallic acid), and which deepens in color and increases by addition of a moderate excess of lime water; a large excess of lime water gives to the solution a pale pinkish tint.

The following reactions serve to distinguish between the members of the gallotannic acid group and those of the oak-tannin group: Gallotannic acid causes a blue precipitate with lime water, while with oak-tannins a pink or red precipitate is obtained. It is not affected by bromine water, whereas oak-tannins produce a yellow precipitate. Ferric chloride and ammonium hydroxide cause a green precipitate with oak-tannins and a blue precipitate with gallotannic acid; the blue color sometimes observed in the case of oak-tannins with ferric salts is due to the presence of a foreign substance, and is never caused by the pure article (Trimble).

Estimation.—The estimation of tannin and the valuation of the various tanning materials are conducted with considerable difficulty, and often require to be modified according to the nature of other organic compounds present.

Von Schröder's modification of Löwenthal's method, although by no means free from defect, is looked upon as the most reliable for technical analysis; it was adopted by a committee of German chemists in 1885. The method combines Hammer's suggestion for the use of hide-powder with Löwenthal's for potassium permanganate in presence of indigo; the value of the permanganate solution for a known quantity of pure tannin before and after treatment with hide-powder must first be established, solution of sodium sulphindigotate being used as indicator; it is assumed that when the color of the indigo solution changes to a pure golden-yellow (evidence of complete oxidation) all the tannin present will also have been oxidized by the permanganate. The necessary reagents are (1) a solution of pure potassium permanganate of the strength of 10 Gm. to 6000 Cc. of distilled water; (2) a solution of 30 Gm. of pure sodium sulphindigotate in 3000 Cc. of dilute sulphuric acid (1 volume of acid, 5 volumes of water)—after filtration 3000 Cc. more of water are added; (3) white woolly hide-powder, which yields to distilled water nothing capable of reducing the permanganate solution; (4) strictly pure tannin. The indigo solution should be tested separately, and 20 Cc. of the same, when diluted with 750 Cc. of water, should require about 10.7 Cc. of the permanganate solution for oxidation.

To standardize the tannin value of the permanganate solution, 10 Cc. of a solution of pure tannin (2 Gm. to 1000 Cc.) are added to 20 Cc. of indigo solution and 750 Cc. of water; the $KMnO_4$ solution is cautiously added until the color changes to pure yellow. 50 Cc. of tannin solution are now macerated with 3 Gm. of hide-powder, previously well moistened and expressed, for 18 or 20 hours with frequent agitation, filtered, and 10 Cc. of the filtrate added to 20 Cc. of indigo solution and 750 Cc. of water; the mixture is titrated with $KMnO_4$ solution as before, the difference between the first and second titrations representing the tannin or oxidizable matter removed by the hide. From these data the tannin value per Cc. of permanganate solution is readily calculated. For subsequent estimation of tannin in infusions or otherwise, the same reagents must be employed, and

the liquid to be tested should contain a quantity of tannic acid corresponding to not less than 4 nor more than 10 Cc. of permanganate solution.

Pharmaceutical Preparations.—Glycerite of Tannic Acid, Styptic Collodion, Troches of Tannic Acid, Ointment of Tannic Acid, U. S. P.

Action and Uses.—Tannic acid possesses considerable astringent and slight irritating properties. When locally applied to the tissues, it constricts the bloodvessels present and temporarily decreases the vascularity of the part. Taken internally, it lessens secretion and produces constipation. If mixed with blood or injected into the circulation, it causes coagulation of the albumin, thus forming a clot. Tannic acid is rapidly absorbed as gallic acid. It is mostly oxidized in the body, but portions of it are eliminated by the kidneys as gallic acid.

Tannic acid acts as such only before it is absorbed, and can be employed only in those conditions which permit of its direct application. It has been used largely to control hemorrhages; as, for example, epistaxis, the various forms of uterine hemorrhage, hæmatemesis, and, in the form of a spray, in hæmoptysis. It may be employed as an astringent to relaxed mucous membranes, and, as such, is of use in the treatment of serous diarrhœa. Solutions of tannic acid are useful in the treatment of aphthous stomatitis, spongy gums, ptyalism, and chronic pharyngitis with relaxation of the uvula. Vaginal leucorrhœa has been cured by the application of a saturated solution upon cotton, and bleeding hemorrhoids are frequently benefited by the insertion of a suppository containing 2 to 5 grains (0.10–0.30 Gm.) of the acid. Its application in the treatment of chronic inflammation of the conjunctiva, especially pannus, is also attended with good results.

Internally the dose of tannic acid is from 3 to 10 grains (0.20–0.60 Gm.), repeated as often as is deemed essential. For local application, a solution containing from 3 to 10 grains (0.20–0.60 Gm.) of the acid in 1 fluidounce (30 Cc.) of water may be employed. Should a more powerful solution be desired, the glycerite may be used (see Glyceritum Acidi Tannici).

Derivatives.—Tannalbinum.—*Tannalbin.*—A compound of tannin and albumin, obtained by mixing 10 parts of a 10 per cent. solution of egg-albumin with 6.5 parts of a 10 per cent. solution of tannin in water, collecting the resulting precipitate, and washing the same with water until the filtrate scarcely reacts with ferric chloride. After drying on porous tiles it is powdered and heated for 6 hours to 120° C. (248° F.). It occurs as a brownish, odorless, and tasteless powder, containing about 50 per cent. of tannin, and is sparingly soluble in water and alcohol. Tannalbin is employed internally in cases of serous diarrhœa as an astringent. It is not dissolved by the gastric juices, but is decomposed by the alkaline secretions of the intestines, and its dose is from ½ to 2 drachms (2–8 Gm.).

Tannigenum.—*Tannigen, Diacetyl-tannin.* $C_{14}H_8(CH_3CO)_2O_9$.—An odorless and tasteless compound, obtained by heating tannic acid with acetic anhydride and glacial acetic acid in a flask provided with a reflux condenser. The resulting product is added to water, and the precipitate which is formed is then washed with warm water, dried, and powdered. It occurs as a yellowish-gray powder, insoluble in water and dilute acids, but readily soluble in alcohol and in alkaline solutions, such as sodium phosphate, sodium carbonate, and borax. Tannigen has been highly recommended by some practitioners in the treatment of chronic diarrhœa, as it is an intestinal astringent, and which because of its insolubility escapes through the stomach into the intestines, where the alkaline secretions of the small intestine break it up into its constituent parts. Its dose is 4 to 8 grains (0.2–0.5 Gm.).

Tannoformum.—*Tannoform, Methylene-ditannin.* $CH_2(C_{14}H_9O_9)_2$.—A condensation-product of tannin and formaldehyde, prepared by mixing a solution of 5 parts of tannin in 15 parts of hot water with 3 parts of a 30 per cent. solution of formaldehyde, and then adding strong hydrochloric acid as long as precipitation continues. The precipitate is washed with water and dried with moderate heat. It is a pale-reddish light powder, without odor or taste, insoluble in water, but soluble in alcohol and in alkaline liquids. Tannoform has been used locally as a dusting-powder for burns and excessive sweating, and as an astringent agent in ozæna, pruritus, and hemorrhoids. Internally it is given in chronic intestinal catarrh. When used as a dusting-powder, it should be mixed with from 2 to 4 parts of starch. Internally its dose is from 4 to 8 grains (0.25–0.5 Gm.).

ACIDUM TARTARICUM, *U. S., Br., P. G.*—Tartaric Acid.

Dextrotartaric acid, Di(hydr)oxy succinic acid, E.; *Acide tartrique, Acide dextero racémique, Acide du tartre,* Fr.; *Weinsäure, Weinsteinsäure,* G.; *Acido tartarico,* It., Sp.

Formula, $H_2C_4H_4O_6$ or $[CH(OH)]_2(COOH)_2$. Molecular weight, 148.92.

History.—Dextrotartaric acid was isolated first by Scheele in 1768, and obtained in

the crystalline form by Retzius in 1770, who designated it *Sal essentiale tartari*. Its composition and salts were studied by Gay-Lussac, Berzelius, and others; its optical properties especially by Biot (1815) and Pasteur (1841).

Occurrence.—Dextrotartaric acid, commonly designated merely as tartaric acid, is one of the most widely distributed vegetable acids. It occurs partly free, partly combined with potassium and calcium in numerous fruits (grapes, tamarinds, mountain ash berries); occasionally also in roots, leaves, and flowers.

Formation and Preparation.—It results upon the oxidation with nitric acid of starch, gum, cane-sugar, milk-sugar, grape-sugar, sorbin, saccharic acid, and other substances.

It is prepared from crude tartar, which consists principally of acid potassium tartrate and some calcium, magnesium, iron, and aluminum salts. The salts are dissolved in water at 140°–170° C. (284°–338° F.) under pressure and the clear solution rendered almost neutral by addition of chalk: $2KHC_4H_4O_6 + CaCO_3 = CaC_4H_4O_6 + K_2C_4H_4O_6 + CO_2 + H_2O$. Complete neutralization should be avoided in order to retain in solution the magnesium, iron, and aluminum salts. In order to convert the normal potassium tartrate resulting according to the above equation and remaining in solution, into insoluble calcium tartrate, calcium chloride is added to the hot mixture: $K_2C_4H_4O_6 + CaCl_2 = CaC_4H_4O_6 + 2KCl$. The normal calcium tartrate resulting in accordance with both equations is sparingly soluble even in hot water. After being washed well with water it is decomposed with little more than the theoretic amount of dilute sulphuric acid at a temperature of 70°–75° C. (158°–167° F.). The solution of the free acid is evaporated in lead vacuum pans and the concentrated liquid allowed to crystallize in lead-lined vats. The resulting acid is redissolved, decolorized by means of animal charcoal, and recrystallized. In order to obtain well-developed, transparent crystals for the arts, tartaric acid is recrystallized from a solution to which some sulphuric acid has been added.

Properties.—Tartaric acid occurs in colorless translucent monoclinic prisms, or crystalline crusts, or a white powder, odorless, having a strongly acid, not disagreeable, taste, and permanent in the air. It is soluble at 25° C. (77° F.) in about 0.71 part of water and in 1.67 parts of alcohol, in about 0.5 part of boiling water, and in about 0.2 part of boiling alcohol; also in 250 parts of ether (50 parts, P. G.); nearly insoluble in chloroform, benzene, or benzin. When heated for some time at 100° C. (212° F.) the powdered crystals do not suffer a sensible loss of weight. At 135° C. (275° F.) the acid melts, and above 180° C. (356° F.) it is gradually decomposed into pyrouvic, pyrotartaric, and pyrotartrillic acids, carbon dioxide, etc., and emits the odor of burning sugar; it is finally consumed without leaving more than 0.05 per cent. of ash. Tartaric acid has an acid reaction upon litmus-paper. If an aqueous solution (1 : 2) of the acid be mixed with a strong solution (1 : 3) of potassium acetate, a white crystalline precipitate of potassium acid tartrate will be formed, which is insoluble in acetic acid, but soluble in mineral acids and solutions of the alkalies.—U. S.

Tartaric acid is a strong dibasic acid, forming normal and acid salts, most of which are readily obtained in crystals; all are blackened by heat and evolve an odor similar to that of burning sugar.

Tests.—The absence of sulphuric acid, as required by the Pharmacopœia, may be shown by adding to a 10 per cent. solution of tartaric acid a few drops of hydrochloric acid and then some barium chloride test-solution; the liquid should remain clear. Calcium sulphate test-solution should not cause a precipitate in a 10 per cent solution of the acid nearly, but not entirely, neutralized by addition of ammonia water, showing the absence of oxalic and uvic acids, which would form insoluble calcium salts. Neither ammonium oxalate nor hydrogen sulphide test-solutions should affect a solution of the acid supersaturated with ammonia, thus showing the absence of calcium salts and of heavy metals, as iron, lead, copper, etc. The Pharmacopœia requires that 3.73 Gm. of tartaric acid shall require not less than 49.75 Cc. of normal potassium hydroxide solution for neutralization, using phenolphthalein as indicator, thus demanding not less than 99.5 per cent. of purity.

Action and Uses.—Tartaric acid is rarely prescribed alone, but is given in combination with alkalies or alkaline carbonates. It is frequently employed in place of citric acid and lemon-juice in the preparation of acidulous drinks and effervescing draughts. In its action it resembles citric acid, but is more irritating, and poisonous amounts cause

gastro-enteritis, great pain, collapse, and death. The drug is usually given in the dose of from 10 to 30 grains (0.60–2 Gm.), dissolved in water and sweetened to suit the taste. If a small amount of spirit of lemon be added to this solution, it may be used as a substitute for lemonade.

ACIDUM TRICHLORACETICUM, *U. S.*, *P. G.*—Trichloracetic Acid.

Acide trichloracétique, Fr.; *Trichloressigsäure*, G.

Formula, $HC_2Cl_3O_2$ or CCl_3COOH. Molecular weight, 162.12.

Preparation.—Trichloracetic acid was first prepared by Dumas by the action of chlorine on acetic acid under the influence of sunlight, mono- ($CH_2ClCOOH$) and dichlor-acetic acid ($CHCl_2COOH$) resulting as intermediate products, the former being solid and the latter a liquid compound. It is more readily prepared from chloral, CCl_3CHO, by oxidation with nitric acid, as follows: To 165.5 Gm. of chloral hydrate, previously fused at 58° C. (136.4° F.) are added 63 Gm. of fuming nitric acid and the mixture set aside for an hour or until red vapors cease to be formed. It is then carefully distilled, that portion coming over above 190° C. (374° F.), and consisting of pure trichloracetic acid, being collected separately.

Properties.—Colorless rhombic crystals, which readily deliquesce, possessing a weak pungent odor and a strongly acid reaction, soluble in water, alcohol, and ether. The aqueous solution on boiling is decomposed with the formation of chloroform and carbon dioxide. It melts at about 52° C. (125.6° F.), U. S., 55° C. (131° F.), P. G., and boils at 195 C. (383° F.), being completely volatilized; monochloracetic acid, which is also crystalline, melts at 62.5° C. (144.5° F.). If heated with potassium hydroxide solution, the crystals develop a decided odor of chloroform, due to the following reaction: $CCl_3COOH + 2KOH = CHCl_3 + K_2CO_3 + H_2O$. Sodium and potassium carbonate will likewise break down trichloracetic acid into chloroform and carbon dioxide. If 10 Gm. of trichloracetic acid be liquefied by the addition of 1 Gm. of water, a permanently fluid mixture results.

Tests.—If to 10 Cc. of a 10 per cent. aqueous solution of trichloracetic acid be added 2 drops of tenth-normal silver nitrate solution, the liquid should not become more than faintly opalescent (limit of chlorine in such combination as to be capable of reacting with the silver salt); the chlorine of trichloracetic acid behaves like the chlorine of chloroform and does not precipitate silver nitrate solution. If to its aqueous solution (1 in 10) ferric chloride test-solution be added, a faint reddish color is developed. 1 Gm. when diluted with 50 Cc. of water should not require less than 6.1 Cc. of normal sodium hydroxide solution (1 Gm. acid, when dried, not more than 6.1 Cc., P. G.) for neutralization, using phenolphthalein as indicator.—U. S.

Action and Uses.—Trichloracetic acid is an excellent cauterizing agent, as it causes very little pain and only slight inflammation. Its application is said to prevent putrefactive changes and promote rapid healing. When applied, it produces a smooth, dry, white scurf, which falls off in a few days. This acid has been quite largely employed in dental practice for the removal of small vegetations from the buccal cavity. It is claimed that it will destroy papillomata and vascular nævi. Trichloracetic acid is highly recommended in ozæna and chronic nasal catarrh associated with hypertrophy of the mucous membrane or polypoid degeneration. A solution of 1 part in 1000 of water sometimes does good in acute coryza, pharyngitis, and chronic tonsillitis. Chronic gleet may occasionally be cured by the local application of a solution containing 1 part of the acid in 20 parts of water; a 25 per cent. solution has also been used successfully in treating nasal tuberculosis. M. L. Hensner recommends the following formula: Balsam of Peru, 15 grains (1 Gm.); formic acid and chloral, each, 75 grains (5 Gm.); and 1 ounce of alcohol (30 Cc.), in the treatment of refractory localized forms of bromidrosis. This acid is not employed in internal medicine.

ACIDUM VALERIANICUM.—Valerianic Acid.

Acidum valericum.—Acide valérianique, Acide valérique, Fr.; *Baldriansäure, Valeriansäure,* G.; *Acido valerianico,* It., Sp.

Formula, $HC_5H_9O_2 = (CH_3)_2.CH.CH_2.COOH$. Molecular weight, 101.31.

Origin and Formation.—Valerianic acid has received its name from valerian root, from which it was obtained and recognized as a distinct acid by Grote (1830); it has been found in the flowers of *Anthemis nobilis,* in wormwood, angelica root, etc., and in dolphin oil, obtained from *Delphinus globiceps* Cuvier, by Chevreul (1817), who named it *delphinic acid;* it is found among the products of oxidation of a large number of organic substances, and is prepared for medicinal purposes almost exclusively by oxidizing amyl alcohol with potassium dichromate and sulphuric acid, a process recommended by Balard (1845).

Preparation.—Valerianic acid may be prepared either from valerian root or from amyl alcohol. Both kinds are offered on the market. The acid made from the root is specified in the French Pharmacopœia, the directions for which are as follows: Dissolve 600 Gm. of potassium dichromate in 10 liters of water and add 1000 Gm. of concentrated sulphuric acid, 10,000 Gm. of crushed valerian root are digested for 24 hours with this chromic acid mixture and 40 liters of water. Then distil until about 12 liters of liquid (containing essential oil) have passed over, return the distillate to the still, and again distil until the distillate no longer shows an acid reaction. Saturate the distilled liquid with sodium carbonate, reduce the solution by evaporation to a syrupy consistence, add slowly a slight excess of sulphuric acid, and allow to stand in a cylinder. The valerianic acid will collect at the surface, forming an oily layer. Decant, and rectify by distillation from a glass retort.

Valerianic acid from amyl alcohol is prepared by gradually adding 5 parts of fermentation amyl alcohol, boiling at 130° C. (266° F.), to a mixture of 5 parts of powdered potassium dichromate and 4 parts each of concentrated sulphuric acid and water. When the violent reaction has subsided, the mixture is distilled until the contents of the flask have assumed a uniform dark-green color. The oxidation of the amyl alcohol occurs as follows: $3C_5H_{11}OH + 2K_2Cr_2O_7 + 8H_2SO_4 = 3HC_5H_9O_2 + 2K_2SO_4 + 2Cr_2(SO_4)_3 + 11H_2O$. After neutralizing the distillate with caustic soda, it is evaporated to dryness and the resulting sodium valerianate is decomposed with sulphuric acid, the liberated valerianic acid being rectified by distillation. Since a small quantity of amyl alcohol escapes oxidation in the above process, it is attacked by the newly formed acid and passes over into the distillate as valerianic acid amyl ester, $C_5H_{11}C_5H_9O_2$. The name apple oil has been given to this compound on account of its apple-like odor when diluted. It separates as an oily layer on the solution of sodium valerianate, and may then be removed.

Properties.—Valerianic acid is a colorless thin oily liquid, with a disagreeable odor resembling that of valerian and of old cheese, and has a sour, acrid, unpleasant taste, producing upon the lips and tongue the sensation of burning; diluted with water, the taste is less disagreeable, with a sweet after-taste. When heated, valerianic acid evaporates without residue, and ignited burns with a luminous flame. It is soluble at 15° C. (59° F.) in 30 parts of water, and by agitation with a small quantity of that liquid takes up about 20 per cent. of its weight, without losing its oily consistence. It dissolves in all proportions in alcohol, ether, chloroform, carbon disulphide, and volatile oils, the hydrated acid, however, producing a turbid mixture with the last-named liquids. The specific gravity is 0.935, which increases if the acid becomes more hydrated; its boiling-point is 175° C. (347° F.). Musgiller ascertained that an acid of 0.933 specific gravity boils between 177.2° and 178.9° C. (351° and 354° F.); if of greater density, the boiling-point is lower.

The *normal salts* of valerianic acid, when perfectly dry, are inodorous; in the presence of moisture, and still more in contact with carbonic acid, they have the odor of valerianic acid; their taste is decidedly sweet. Most of the salts are soluble in water, several dissolve also in alcohol; from these solutions valerianic acid is liberated by nearly all the mineral and organic acids, even by acetic acid.

Tests.—The solubility of valerianic acid, in not less than 26 and not more than 30 times its weight of water, affords a ready means of discovering the presence of certain impurities. Alcohol decreases, and water, acetic acid, and butyric acid increase the

density of valerianic acid, and render it more soluble in water, while it becomes less soluble and of less density through the presence of amyl alcohol, amyl aldehyde, amyl valerianate, and fixed oils. On adding ammonia water slightly in excess to valerianic acid, a clear solution should be produced; this is turbid or separates an oily layer in the presence of one or more of the four compounds last mentioned. Butyric acid, if present, will, according to Laroque and Huraut, produce with concentrated solution of acetate of copper pale-blue scales of copper butyrate, while pure valerianic acid mixed with the same solution yields a mixture which is transparent for several minutes, then separates oily drops of copper valerianate, which are gradually converted into a greenish-blue crystalline powder. Acetic acid is readily detected by neutralizing the acid with ammonia and adding to the cold clear liquid a slight excess of diluted ferric chloride or subsulphate, when ferric valerianate will be precipitated and ferric acetate form a deep brown-red solution. Admixtures of hydrochloric or sulphuric acid are detected in the aqueous solution of valerianic acid, after adding a little nitric acid, by the nitrates of silver and barium.

Action and Uses.—Valerianic acid is employed in medicine only in combination. Ammonium valerianate is used in various nervous and hysterical manifestations, but the benefit gained by its administration is attributed principally to its disagreeable odor. Large amounts of the acid weaken the heart and increase the rapidity of its action; the respiration becomes hurried, and general weakness, paralysis of the extremities, or convulsions ensue. The mucous membrane of the gastro-intestinal tract and of the kidneys is congested, and the urine is turbid and bloody.

ACONITINA, *U. S.*, *Br.*—Aconitine.

Aconitia, E.; *Aconitine* Fr.; *Aconitin*, G.; *Aconitina*, It., Sp.

Formula, $C_{34}H_{47}NO_{11}$ (U. S.); $C_{33}H_{45}NO_{12}$ (Br.). Molecular weight, 640.55 or 642.52.

History.—The name aconitine was first applied by Geiger and Hesse in 1833 to an amorphous base obtained from the root of *Aconitum Napellus*. Since that time much work has been done with the view of obtaining the alkaloid in crystalline form and determining its true composition. Duquesnel in 1871 and Wright and Luff in 1878 succeeded in preparing crystalline aconitine, the last-named investigators proposing the formula $C_{33}H_{43}NO_{12}$. Much controversy has existed between the different investigators, which, unfortunately, up to the present time has not been harmonized. The very thorough work of Freund and Beck in 1894 and 1895, on the constitution and derivation of aconitine, led them to assign the formula given in the U. S. P., based on 14 determinations of the crystallized alkaloid, whereas the British Pharmacopœia has adopted the formula proposed in 1891 by Dunstan and Ince, of England.

Aconitine occurs in aconite root in combination with aconitic acid, associated with picraconitine and aconine.

Preparation.—In order to guard as far as possible against any change during the process of preparation, the following method of W. Dunstan may be employed: Exhaust powdered aconite root with cold rectified fusel oil and shake the resulting tincture with diluted (1 per cent.) sulphuric acid. The acid solution is treated with chloroform to remove resin, made alkaline with sodium carbonate, and shaken out with ether. The alkaloid obtained by evaporation of the ethereal solution may be dissolved in dilute hydrochloric or hydrobromic acid, and purified by recrystallization; or the solution may be precipitated by addition of gold chloride solution, the double chloride being separated and decomposed by hydrogen sulphide; after removal of the gold the alkaloid is liberated by sodium carbonate and extracted with ether, to which solution petroleum ether is then added and the alkaloid allowed to crystallize.

The French Pharmacopœia recommends a modification of Duquesnel's process, as follows: Powdered aconite root is exhausted with alcohol containing 0.5 per cent. of tartaric acid; the alcohol is distilled and evaporated at a low temperature or *in vacuo;* the extract is diluted with an equal bulk of water, filtered from the oil and resin, agitated with ether or petroleum naphtha, whereby more resin is removed, and then precipitated by excess of potassium or sodium carbonate; the alkaline liquid retains the amorphous bases in solution, while the washed precipitate, after dissolving in ether, mixing

this solution with petroleum naphtha, and evaporating, yields crystallized aconitine, which still, however, retains a small proportion of amorphous alkaloids.

Properties.—Commercial aconitine still is found in both the amorphous and crystalline forms; only the latter should be used, since the amorphous variety is a mixture of aconitine and derivative products, chiefly picraconitine, and is from 15 to 20 times less active than the crystallized article. Pure aconitine occurs in colorless hexagonal plates or prisms of the rhombic system, which melt, according to Freund and Beck, at 197° to 198° C. (386.6°–388.4° F.), and, according to the British Pharmacopœia, between 189° and 190° C. (372.2° and 374° F.). When heated rapidly, aconitine melts at 195° C. (383° F.); when heated slowly, decomposition takes place and it melts at 182° C. (359.6° F.).—U. S. Upon ignition it is consumed without leaving a residue. It is soluble in 3200 parts of water, 22 parts of alcohol, 44 parts of ether, 5.6 parts of benzene, and 3580 parts of petroleum benzin, at 25° C. (77° F.); also very soluble in chloroform (U. S.). Aconitine gives a weak alkaline reaction, dilates the pupil like atropine, and is extremely poisonous. A mere trace of the alkaloid, 1 drop of a 0.1 per cent. solution, placed on the tongue causes a persistent tingling and pricking sensation.

Tests.—Pure aconitine is not colored by solution in concentrated sulphuric acid or nitric acid; and if a mixture with phosphoric acid be evaporated in a porcelain dish on a water-bath, at most but a faint pink color will appear, whereas the impure article is colored by sulphuric acid at first yellow, then brown, and finally reddish violet, and, if treated with phosphoric acid, as before stated, an intensely violet-colored liquid results. If rubbed with sulphuric acid containing a crystal of ammonium vanadate, an orange color is produced (U. S.). Dilute solutions of aconitine yield precipitates with test-solutions of mercuric potassium iodide, tannic acid, and gold chloride, but only concentrated solutions with test-solutions of platinic chloride, mercuric chloride, and picric acid (U. S.). On evaporating 0.01 Gm. of aconitine with 5 drops of fuming nitric acid, the resulting yellow residue, when cooled, should not yield a violet color when treated with alcoholic potassium hydroxide test-solution (difference from pseudaconitine and atropine).—U. S.

"Any soluble salt of aconitine in dilutions of 1 in 1000 produces, with a drop of potassium permanganate test-solution, a blood-red precipitate of aconitine permanganate. Aconitine containing decomposition products (amorphous aconitine) produces this precipitate only in solutions containing not less than 1 in 200. Cocaine, hydrastine, and papaverine also yield a similar precipitate, but only when in more concentrated solutions."—U. S. A dilute solution of the alkaloid, even 1 part in 4000 parts of water, faintly acidulated with acetic acid, deposits a red crystalline precipitate on the addition of a few drops of solution of potassium permanganate (Br.). This reaction, which was first pointed out by Dunstan and Carr (1896), is quite characteristic and extremely delicate.

If aconitine be boiled for several hours with water, it is split up into acetic acid and picraconitine benzoate. The latter salt may be crystallized from hot water or diluted alcohol in the form of needles, which melt at 203.5° C. (398.3° F.); if decomposed by sulphuric acid and the benzoic acid removed with ether, the base may be extracted by a further treatment with ether, after addition of alkali carbonate in excess. *Picraconitine*, $C_{32}H_{45}NO_{10}$ (Freund and Beck), $C_{31}H_{43}NO_{11}$ (Dunstan), thus obtained and dried in a vacuum, occurs as a white amorphous, very bitter, but non-poisonous, mass, which melts at 125° C. (257° F.) (Dunstan), or 150°–163° C. (302°–325.4° F.) (Freund and Beck). If heated with alcoholic solution of potassium hydroxide, it is split up into benzoic acid and *aconine*, $C_{25}H_{41}NO_9$ (Freund and Beck), $C_{24}H_{39}NO_{10}$ (Dunstan), an amorphous varnish-like base, readily soluble in water and in alcohol, less so in chloroform, and insoluble in ether. Aconine is non-poisonous, has a very bitter taste, and melts at 132° C. (239.6° F.). These successive hydrolyses lead to the constitution of aconitine as acetyl-benzoyl-aconine, $C_{25}H_{39}NO_9.CH_3CO.C_6H_5CO$.

The salts of aconitine are crystalline and readily soluble in water; the hydrobromide, hydrochloride, and nitrate are used in medicine, as also the oleate, which latter, of course, is insoluble in water. Aconitine hydrobromide melts at 164° C. (327.2° F.) and the hydrochloride at 149° C. (300.2° F.) (Br.).

Other varieties of the aconite plant produce alkaloids not identical with aconitine, but resembling the latter in some respects. The two best known of these alkaloids are

offered in commerce as pseudaconitine and japaconitine, both of which are more toxic in character than crystallized aconitine, the former about twice as strong, the latter about one-fifth stronger. *Pseudaconitine*, $C_{36}H_{49}NO_{12}$, obtained from *Aconitum ferox*, occurs in prismatic crystals containing 1 molecule of water, which if anhydrous melt at 201° C. (393.8° F.) (Dunstan and Carr), or 211° C. (411.8° F.) (Freund and Niederhofheim). It is almost insoluble in water and difficultly soluble in ether, but readily soluble in alcohol and chloroform. It has a burning taste, and is said to be twice as poisonous as crystallized aconitine. Pseudaconitine if boiled with water for several hours breaks up into acetic acid and a basic substance called picropseudaconitine, which has the same empirical formula as aconitine. If picropseudaconitine be boiled with alcoholic potassium hydroxide solution, it splits up into veratric acid (dimethylprotocatechuic acid), $C_6H_3(OCH_3)_2COOH$, and pseudaconine, $C_{21}H_{25}(OCH_3)_4(OH)_2NO_2$, an amorphous base, differing from aconine in containing 2 atoms of hydrogen and 1 of oxygen less, but, like it, containing 4 methoxy and 2 hydroxy groups, and which has been called anhydroaconine. The hydrolyses of pseudaconitine point to its constitution as acetylveratroylanhydroaconine, $C_{25}H_{37}NO_8.CH_3CO.C_6H_3(OCH_3)_2CO$.

Japaconitine, $C_{34}H_{49}NO_{11}$, was first isolated from the root of *Aconitum japonicum* by Paul and Kingzett in 1877, and investigated later on by Wright and Luff. For a long time it was considered identical with aconitine until Dunstan and Read (1900) pointed out the difference between the two alkaloids, and determined the correct composition and melting-point of the former. It occurs as prismatic needles, usually crystallizing in colorless rosettes and melting at 204.5° C. (400.1° F.). When saponified by heating its sulphate with water under pressure, japaconitine is split up into acetic acid and japbenzaconine (corresponding to picraconitine), which latter crystallizes in rhomboidal plates melting at 183° C. (361.4° F.). Upon further hydrolysis japbenzaconine yields japaconine and benzoic acid, thus showing a close relationship between the alkaloids of *Aconitum Napellus* and *A. Japonicum*.

Pharmaceutical Preparations.—Oleate of Aconitine, N. F.; Aconitine Ointment, Br. The two preparations are of the same strength, containing 2 per cent. of crystallized aconitine.

Action and Uses.—Locally applied to mucous membranes, aconitine first causes a prickling, burning sensation, which is followed by anæsthesia of the part. It irritates the conjunctiva and produces mydriasis. When taken internally, its action is practically the same as that of aconite (for action and uses, see Aconitum). Aconitine is so powerful and so uncertain in its action, that it should rarely if ever be prescribed in internal medicine, especially as it possesses no distinct advantage over aconite. An ointment containing from 4 to 8 grains (0.25–0.50 Gm.) of aconitine to 1 ounce (30 Gm.) of lard is sometimes employed by inunction in the treatment of superficial neuralgia, as, for example, supra-orbital neuralgia, or a solution containing 1 grain (0.05 Gm.) of the alkaloid in 2 fluidrachms (8 Cc.) of alcohol, may be applied with a camel's-hair brush. Care should be taken in its application. Only a small quantity should be used, and it should never be applied upon an abraded surface lest it be absorbed and produce its powerful constitutional effects.

The dose for internal use is generally stated to be from $\frac{1}{200}$ to $\frac{1}{100}$ of a grain (0.0003–0.0005 Gm.); but because of its variable composition this dose should be used cautiously. As much as 2 grains have been taken without producing an untoward effect, while $\frac{1}{100}$ of a grain (0.0006 Gm.) has caused death.

ACONITUM, *U. S.*—Aconite; German Aconite.

Aconiti Radix, Br.; *Tubera Aconiti*, P. G.; *Monkshood, Wolfsbane, Wolfroot, Blue rocket, Cuckoo's cap, Friar's cap*, E.; *Aconit Napel*, Fr.; *Eisenhut, Sturmhut*, G.; *Radix Napelli*, Russ.; *Aconito*, F. It., Sp.

The dried tuberous root of *Aconitum Napellus* L. (Fam. *Ranunculaceæ*), collected in autumn; yielding, when assayed by the U. S. P. process, not less than 0.5 per cent. of aconitine.

Official in all pharmacopœias. The U. S. P. demands that, when assayed by the process given below, it shall yield not less than 0.5 per cent. of aconitine. The Italian requires that it contain 0.2–0.8 per cent. of aconitine. The British requires that it be collected in the autumn from plants cultivated in Britain, but this supply is incapable

of yielding more than a small fraction of what is used under that Pharmacopœia. The French recognizes *A. ferox* Wall.

Description.—Conical, 5 to 10 Cm. (2 to 4 In.) long, or tapering to a greater length, and 1 to 2 Cm. ($\frac{2}{3}$ to $\frac{4}{5}$ In.) thick at the crown, longitudinally wrinkled, dark brown, marked with the white scars of scattered coarse roots; occasionally split to facilitate drying; fracture short; internally whitish, more or less starchy, the bark rather thick, the central axis about 7-rayed and with 5 to 7 small vascular bundles; odorless; taste sweetish, then acrid, producing a tingling sensation, followed by numbness which persists for some time.

The powder is yellowish-gray and odorless or nearly so. Its important elements are small starch-grains, the compound ones 10 to 20 mikrons, the single 5 to 15 mikrons (Jelliffe); colorless stone-cells; spiral, reticulated, and border-pitted vessels; and brown endodermal cells.

Fig. 3.

Japanese aconite (Nat.).

Fig. 4.

Tubers of *Aconitum Napellus* L. with a transverse section (Nat.).

The B. P., in forbidding the presence of any portions of the stem, and requiring that of an undeveloped terminal bud, as well as a starchy and not hollow or spongy interior, specifies an autumn-collected tuber, but it is by no means certain, though generally believed, that such an one is richest in aconitine. On theoretical grounds alone, an abundance of starch should decrease such percentage. One of the richest specimens which ever came into our possession was hollow and shrivelled.

The Aconite Plant.—The seedling aconite does not flower until after it has developed the perfect tuber elsewhere described, and this is said not to occur before the third year. The plant is smooth, except for a very slight pubescence toward the summit. The flower-stem is thrown up from a bud which terminates the tuber. It rises to a height of 2 to 5 feet, and may be either simple or productive of a number of erect or strongly ascending flower-branches, forming a very handsome paniculate inflorescence, for which it often is cultivated. The radical leaves are very long-petioled, the stem-leaves developing successively shorter petioles until they become sessile toward the summit. The lowest leaves are nearly circular in outline, with a deeply and narrowly cordate base, often 6 inches or more in diameter, palmately 3-parted, the segments again 3-parted, and these divisions 2- to 3-lobed, the lobes toothed and more or less pointed. The ultimate divisions are thus linear or narrowly oblanceolate, thickish, and grooved along the midrib upon the upper surface. The upper leaves become smaller, reduced at length to 2 inches in diameter, and less divided, until finally only 3-lobed or 3-parted, and all the sinuses broader. The showy, deep-blue flowers, of peculiar hooded form, and the 3-celled capsule are shown in Fig. 5.

During the flowering period, the tuber is becoming exhausted of its stored nourishment, chiefly starch, and a new or "daughter" tuber is developing from it by means of a lateral bud near the crown. This bud develops into a rhizome so short as to leave the 2 tubers almost or quite in contact. The free end of the rhizome enlarges, developing a thickened stem-base with concealed terminal bud and a long vertically descending root, which together gradually develop into a resemblance to the parent tuber. The aconite drug is, therefore, a combination of rhizome and root, although the term "tuber" is properly applicable to it. It is obvious that the condition and appearance of the parent and daughter tubers will vary according to the stage of development when collected. At the close of the season, the daughter tuber will look exactly as the parent did at the beginning of the season, with an undeveloped terminal bud. At the same time, the parent will have become a shrivelled shell, with the hollow exhausted stem attached to its summit. Autumn-collected tubers, strictly speaking, will, therefore, be free from both stem-development and the skeleton of the parent. If collected when in flower, the daughter will be rather small, while the parent will

be somewhat hollow and deeply and coarsely wrinkled, chiefly longitudinally, with the roots either attached or showing scars where broken off, and surmounted by a stout, strong, hollow stem-base. The two may be attached, or, as is more usual, separated.

Fig. 5.

Aconite plant (⅓ Nat.); flower and fruit (⅔ Nat.). (After Baillon.)

The aconite plant is not likely to be mistaken for any other, except through gross carelessness, as in a case in which poisoning occurred through mistaking it for celery. The statement has been published and has become widely copied in text-books, that poisoning by aconite has occurred frequently through mistaking its tubers for horse-radish, and there is fairly good evidence that such mistakes have occurred, though very rarely. They are difficult to explain, since there is almost no resemblance between the white, nearly cylindrical and large root of the latter and the small conical brownish tuber of aconite.

Notwithstanding the numerous statements which have been published upon the subject and the great amount of work which has been done in studying the constituents of aconite, the distribution of the alkaloids during the different stages of its development and exhaustion cannot be considered as determined, nor, therefore, the relative medicinal value of the root as collected at different periods. So far as the wild tuber is concerned, collection easily admits of confusion and admixture with other species growing in the same locality, especially *A. variegatum.* To avoid this accident, it is demanded elsewhere that collection be made when the plant is in full flower, when identification is comparatively easy. When the plant is cultivated, such danger of confusion does not exist, and it is unfortunate that we have not some fully determined rule regarding the period of collection. Aconite is extensively cultivated both on the continent and in England, and opinions differ as to the relative activity of the wild and cultivated drugs. Certainly the cultivated English drug has been proved of good quality.

The official species of aconite grows only in the lower mountain regions of central Europe, although it is stated in various works that it grows in western North America and in India. Works on the flora of India generally state that several varieties of *A. Napellus* grow there, some of them being highly poisonous, while others are not at all so. Even in the absence of any specific knowledge of these forms, we should not hesitate to deny the possibility of their pertaining to this species, under the existing conditions, and we must pronounce *A. Napellus* as being purely a European plant.

Substitutes and Adulterants.—The only species growing with *A. Napellus* in such a way as to be liable to admixture is *A. variegatum.* This tuber is usually smaller than the official variety, but closely resembles small specimens of it, and its detection by the ordinary pharmacist is extremely unlikely. Japanese aconite, from *A. Fischeri* Reichb., is imported quite largely into Europe, and frequently finds its way to the United States. Its characteristic form, size, and surface are well shown in Fig. 9, contrasted with those of the official tuber. Its surface is of a rather light-gray color, and distinctly plump and smooth. Its starch-grains are nearly twice as large as those of the official tuber. Indian aconite, from *A. ferox* Wall., scarcely ever is seen in this country, and need hardly be guarded against. It is of great size, from 4 to 6 inches long and one-third as thick. It is nearly black upon the surface, yellowish just underneath it, and brownish-red internally, showing darker imbedded masses. The texture is very hard and has a resinous fracture. The pith is small and surrounded by a circular fibro-vascular zone inside of the principal star-shaped zone.

The principal characteristics of the official tuber, distinguishing it from others, are its elongated or slenderly conical shape, the very heavy longitudinal wrinkling of most

of the older tubers, the dark-brown color, and particularly the very short white stumps, chiefly toward the crown, where the roots have been broken off.

Constituents.—The active constituent of aconite is the crystallizable alkaloid *aconitine* (*napaconitine*), elsewhere discussed. With it are large and apparently variable amounts of its 2 derivative non-crystallizable alkaloids *benzaconine* (*picraconitine* or *isaconitine*, at least in part) and *aconine*. Another, *napelline*, has been reported as a derivative intermediate between the two last mentioned, while others have claimed that it is identical with the last. The presence of a fourth derivative has also been regarded as probable. The percentage of total alkaloids appears to vary widely, but has been estimated very differently by different analysts, even when their average results are considered and when the same processes were followed, so that it must be doubted if such processes are adapted to successful general use. Our best information points to about 0.75 per cent. as the probable average. Keller reported it a little more than 1 per cent. The normal relative amounts of the several alkaloids are still more uncertain. Decomposition is effected so readily as to have vitiated the results of many experiments. Dunstan reported (*Pharm. Jour.*, March 18, 1893) that at least 75 per cent. of the total alkaloids might be regarded as amorphous, which would make the average of aconitine about 0.2 per cent. The point is of great importance, since not only is benzaconine inert, but aconine even appears to be antagonistic to aconitine in its cardiac effects. Aconitine is reported by Richards and Ashley (*Chem. and Drug.*, 38 [1891], 205 and 242) as occurring in the cambium, vascular bundles, and sieve-tubes. Dunstan (*loc. cit.*, 1892, 265) states that very little of it is contained in the expressed juice. An abundant constituent is *aconitic acid* ($H_3C_6H_3O_6$), chiefly in combination with calcium, and practically inert. It is soluble in water, alcohol, and ether, and crystallizes in colorless plates or warts. It occurs abundantly in this family, especially in *Adonis* and *Delphinium*, as well as in other families. It can be prepared from citric acid by heating it rapidly in a retort until oily streaks appear in the neck, when the residue is exhausted with ether. The percentage of starch is most variable, depending largely upon the stage of development when collected. Resin, fat, sugar, and a little mannite also occur.

The Aconite Herb.—The herb or leaves of aconite, though no longer official, nor recognized by good authority as suitable for use, are still collected and used upon a very extensive scale. No other description of them is necessary than that of the plant, already given. They should be collected during the flowering period. Their composition is in general similar to that of the tuber, but the average amount of total alkaloids is not greater than 0.25 or 0.5 per cent.

Assay of Aconite.—Aconite, in No. 40 powder, 10 Gm. alcohol, distilled water, ether, ammonia-water, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, hematoxylin test-solution, of each a sufficient quantity. Introduce the aconite into a 200 Cc. Erlenmeyer flask, add 75 Cc. of a mixture of alcohol, 7 parts, and distilled water, 3 parts (by volume), stopper the flask securely, and agitate it at intervals during 4 hours. After placing a plug of cotton in the bottom of a small cylindrical glass percolator (25 Mm. in diameter), carefully transfer the contents of the flask to the percolator. When the liquid has all passed through, continue the percolation with more of the same menstruum until 150 Cc. of the percolate have been obtained. Pour the percolate into a shallow porcelain evaporating dish, and evaporate it to dryness at a temperature not exceeding 60° C. (140° F.). Add 5 Cc. of tenth-normal sulphuric acid solution and 10 C. of distilled water. When the extract is dissolved, filter the liquid into a separator, washing the dish, and filter with about 40° Cc. of distilled water. When this has passed through, add 25 Cc. of ether and 2 Cc. of ammonia-water to the separator, and agitate for one minute. Draw off the lower layer into a flask, and filter the ethereal solution into a beaker. Return the contents of the flask to the separator, add 15 Cc. of ether, and agitate for one minute. Draw off the lower layer into the flask, and filter the ethereal solution into the beaker. Repeat the shaking out with two other portions of 10 Cc. each of ether. Evaporate the combined ethereal solutions to dryness, and dissolve the residue in 3 Cc. of tenth-normal sulphuric acid solution. Add to the solution 5 drops of hematoxylin test-solution, and then carefully run in fiftieth-normal potassium hydroxide solution until a violet color is produced, the transition stages being as follows: first yellow, then green, finally passing into violet. Divide the number of Cc. of fiftieth-normal potassium hydroxide solution used by 5, subtract this number from 3 (the 3 Cc. of tenth-normal acid used), multiply the remainder by 0.064, and this product by 10 (or multiply at once by 0.64), which will give the percentage of alkaloid in the aconite.—U. S.

The addition of about 5 Gm. of powdered pumice to the percolate before evaporation will be found to facilitate solution of the residue in the acid and also the subsequent filtration.

Pharmaceutical Preparations.—Fluidextract of Aconite, U. S. P.; Liniment of Aconite, Br.; Tincture of Aconite, U. S. P.

Action and Uses.—Aconite when locally applied to either skin or mucous membrane produces a tingling sensation in these parts, which is probably due to a primary stimulation of the end-organs of the sensory nerves, but which in a short time is followed by depression of their acuity. The drug acts as a local anæsthetic, but is too irritating for use upon mucous membranes, especially that of the eye. In full medicinal dose it may cause salivation and epigastric pain. It is stated that the drug possesses diaphoretic properties, but it probably has no direct influence upon the sweat-glands, the perspiration induced being the result of capillary depression and relaxation. In susceptible individuals the drug sometimes produces pruritus, or vesicular or pustular eruptions. Internally its dominant action is that of a depressant. It depresses the perceptive centres of the brain, the sensory side of the cord, and especially the peripheral ends of the sensory nerves. Poisonous doses paralyze the motor side of the cord and the motor nerves. Reflex action is decreased. The pulse is slowed by a direct depression of the heart-muscle and by stimulation of the pneumogastric nerve. Blood-pressure is lowered by the depressant action of the drug upon the heart itself. Aconite probably has no effect upon the vasomotor center unless given in very large doses, when it acts as a depressant. Temperature is lowered by the increase in heat-dissipation, which is mainly due to impaired circulation; but when the drug is exhibited in large doses the fall in temperature is aided by the capillary relaxation which occurs. Upon the respiration aconite has little effect in moderate amounts, but may be considered a depressant rather than a stimulant. In overdoses it produces death by respiratory paralysis. In febrile states the drug increases urinary flow, but in the normal individual it has no effect upon this secretion. Aconite is absorbed rapidly and destroyed in the body by oxidation, its effects usually lasting about 3 hours.

Aconite may be used with benefit in the early stages of all acute inflammatory conditions; as, for example, in beginning lobar pneumonia, quinsy, tonsillitis, spasmodic croup, and certain types of asthma, depending upon spasm without depression of the heart. In the sthenic fevers of children, where the pulse is full and bounding and the reflexes exaggerated, it may be given with benefit. It is of value in menstrual suppression due to exposure to cold. Frequently pericarditis in its early stages and cardiac palpitation are influenced favorably by its use. Locally, in the form of the oleate of aconitine, it has been employed in superficial neuralgias. The drug should never be used in asthenic conditions, and unless used in the very earliest stages is contraindicated in acute inflammations.

In poisonous dose aconite produces first a tingling sensation in the mucous membrane with which it comes in contact. This is followed shortly by severe burning pain in the mouth, œsophagus, and stomach. There occurs a tingling sensation, followed by numbness of the lips, finger-tips, or over the entire surface of the body. Vomiting and purging rarely occur, muscular relaxation is common, and the reflexes are greatly depressed. Exophthalmos may be present, the sclerotic coat of the eye presents a pearly luster, and the pupils may be either normal, contracted, or dilated. Syncope may occur, or the patient may retain consciousness until death takes place. The respirations are slow and shallow. The pulse at first is slow, but later becomes running, rapid, and thready. The face is pallid, and the surface of the body becomes covered with a cold, clammy sweat. The temperature becomes abnormal. Occasionally there may be stiffness or spasm of the muscles, or even clonic convulsions. Death may occur from respiratory failure, or sudden exertion on the part of the patient may cause sudden death, the heart stopping in wide diastole. When poisonous doses of aconite have been taken, the patient should at once be placed in a prone position. If possible, the head should be on a lower level than the feet. If seen early, the stomach-pump or syphon may be used with benefit. If vomiting occur, it should be into a towel, the patient remaining prone, with the head turned to one side but not elevated. The application of external heat by means of hot-water bottles or bricks is essential. The administration of alcohol, ether, or ammonia, followed by digitalis, may be resorted to to support the heart. Strychnine may be given with advantage both as a circulatory and respiratory stimulant.

Aconite is given most commonly in the form of the tincture, in the dose of 3 to 15 minims (0.20–1 Cc.). The dose of the extract is from $\frac{1}{10}$ to $\frac{1}{2}$ grain (0.005–0.025 Gm.); of the fluid extract, from 1 to 2 minims (0.05–0.10 Cc.).

The best results probably are obtained by its administration in divided doses frequently repeated.

Other Species of Aconite.—The genus *Aconitum* L. is credited with the possession of some 60 species, widely distributed throughout the Northern hemisphere. They do not generally agree in their composition and properties, some of them being used even as articles of food. The two most important species, *A. Fischeri* Reichb., yielding Japanese aconite, and *A. ferox* Wall., yielding the most important of the Indian aconites, are known in India as *bish*, *bikh*, or *bachnag*. Japanese aconite contains as its active constituent an alkaloid which has been called *japaconitine*, and which is now generally believed to be identical with aconitine. The Indian aconite here named contains, however, a totally distinct alkaloid *pseudaconitine* (*peraconitine*), quite as active as aconitine, and its action is in general similar.

A. LYCOCTONUM L., of Europe and northern Asia, is actively poisonous. The alkaloids *lycoctonine* and *acolyctine* have been reported in it. The former is probably in part at least pseudaconine, the latter uncertain and very similar to napelline.

A. HETEROPHYLLUM Wall. is another Indian species, very abundant in the northwestern Himalayas at from 7000 to 10,000 feet, where it is known by the name of *atis*. It contains the alkaloid *atisine*, which is not poisonous like aconitine. In its native home it is used largely as an antiperiodic.

A. PALMATUM Don. is found in Sikkim, India, where it is known as *seto-bikhoma*. It is sold largely under the name of *bikhma* or *bishma*, and is used like the last.

A. NAPELLUS L. does not, as already stated, occur in India, though several so-called varieties of it are there found. Watt states that the more western of these varieties are poisonous, while those of the east are not. Of the latter, the var. *multifida* and var. *rotundifolia* yield tubers which are rather important articles of food among the natives.

A. SEPTENTRIONALE Koelle, of northern Europe, has been considerably studied and 3 alkaloids have been extracted from it, but it is not safe to attempt to define their resemblance to other alkaloids of the genus.

ADEPS, *U. S.*, *Br.*—Lard.

Adeps suillus, P. G.; *Axungia porci*, *Axungia.*—*Graisse de Porc*, *Axonge*, *Saindoux*, Fr.; *Schweineschmalz*, G.; *Grasso Suino*, *Sugna*, It.; *Grasa de Cerdo*, Sp.; *Banha*, Port.

The prepared internal fat of the abdomen of *Sus Scrofa* L. (class *Mammalia*; order *Pachydermata*), purified by washing with water, melting, and straining.

Lard should be kept in well-closed vessels impervious to fat, and in a cool place.

Description.—A soft white unctuous solid, having a faint odor free from rancidity, and a bland taste. Insoluble in water; very slightly soluble in alcohol; readily soluble in ether, chloroform, carbon disulphide, or benzin. Specific gravity about 0.917 at 25° C. (77° F.), and about 0.904 at 40° C. (104° F.), water at 25° C. (77° F.) taken as a standard. It melts at 38° to 40° C. (100.4°–104° F.) to a perfectly clear liquid, which is colorless in thin layers, and which should not separate an aqueous layer. At or below 30° C. (86° F.) it is a soft solid.

Distilled water boiled with lard should not acquire an alkaline reaction (absence of alkalies), nor should another portion be colored blue by iodine test-solution (absence of starch). A portion of the water, when filtered, acidulated with nitric acid, and treated with silver nitrate test-solution, should not yield a white precipitate soluble in ammonia (absence of chlorides).

If 10 Gm. of lard be dissolved in chloroform, and the solution mixed with 10 Cc. of alcohol and 1 drop of phenolphtalein test-solution, it should not require more than 0.2 Cc. of normal potassium hydroxide solution to produce a pink tint after strong shaking (limit of free fatty acids).

If 5 Cc. of melted and filtered lard be, while warm, intimately mixed, by agitation, in a test-tube, with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of deodorized alcohol and adding 2 drops of nitric acid), and the mixture then heated for 5 minutes on a water-bath, the liquid fat should not acquire a reddish or brown color, nor should a dark color be produced at the line of contact of the two liquids (absence of more than about 5 per cent. of cottonseed fats).—U. S.

Lard is official in all pharmacopœias, which variously state the melting-point at from 35° to 44° C. (95° to 111.2° F.), and the solidification-point at from 26° to 30° C. (78.8° to 86° F.). The Italian specifies its iodine number at 47 to 48. The British gives the following directions for preparing it, which can hardly be improved upon:

From the perfectly fresh fat of the abdomen of the hog remove as much of the external membranes as possible; suspend the fat so that it shall be freely exposed to the air for some hours; cut it into small pieces; reduce these to a uniform mass in which the membranous vesicles are completely broken, by beating in a mortar or by some similar process; put the mass thus produced into a vessel surrounded by warm water; heat to a

temperature not exceeding 57.2° C. (135° F.) until the fat has melted and separated from the membranous matter; strain.

The principal defects in the quality of lard are (1) the presence of an excessive amount of water; (2) that of potassium carbonate or other alkali carbonate, added to cause it to take up such water; (3) rancidity, resulting from decomposition of the fat, with the production of free acid; (4) the presence of common salt, added to prevent such rancidity or to remove the odor caused by it; (5) the presence of starch; (6) the presence of other fats, more especially of cotton oil. The detection of each of these is provided for in the official description quoted above.

Composition.—The most important of the constituents of lard is stearin, which is associated with variable amounts of olein and palmitin, and the larger or smaller percentage of which renders the lard more or less firm in consistency. Both the liquid (lard oil) and the solid (stearin) portions of lard are articles of commerce upon a very extensive scale. They are separated by pressure, at or about the freezing temperature of water.

Pharmaceutical Uses.—Lard is extensively employed as a vehicle in the preparation of ointments, either alone or in admixture with wax or wax and resin. It should be preserved in impervious containers of glass or porcelain, and be kept in a dry and moderately cool place. Dehydrated lard is to be preferred on account of its freedom from water; it is prepared by melting prime leaf lard with just sufficient water-bath heat, and then adding some substance having great affinity for water, but not affecting the lard itself, such as dried calcium sulphate, or anhydrous calcium chloride, sodium sulphate, or magnesium chloride. After keeping the melted lard in contact with the dehydrating agent for an hour or longer, with frequent stirring, it is carefully strained and then stirred until cool. If much water be present in the lard, a dense liquid layer is likely to be formed on the bottom of the dish if either of the three last-named salts be used, from which the lard can be readily poured off. Dehydrated lard is now manufactured on a large scale and offered in packages of convenient size.

Action and Uses.—When applied to the skin by inunction, lard is perhaps to a certain extent absorbed. Locally, it acts as an emollient, and has been employed as a protective for abraded surfaces, burns, and scalds. In scarlet fever lard has been used to anoint the body during desquamation, but on account of its tendency to become rancid is now seldom used.

ADEPS BENZOINATUS, *U. S.*—Benzoinated Lard.

Adeps benzoatus, Br., P. G.; *Unguentum benzoini*, *Axungia balsamica s. benzoinata s. benzoata.*—*Benzoated lard*, *Ointment of benzoin*, E.; *Axonge (Graisse) benzoinée (balsamique)*, Fr.; *Benzoe Schmalz*, G.; *Grasso con benzoino*, It.; *Manteca con benjui*, Sp.

Hog's lard impregnated with benzoic acid and the odorous principle of benzoin.

Preparation.—Benzoin, in coarse powder, 20 Gm.; lard, 1000 Gm. Add the benzoin to the lard; then melt the lard by means of a water-bath, and, stirring frequently, continue the heat for 2 hours, covering the vessel and not allowing the temperature to rise above 60° C. (140° F.). Lastly, having removed the benzoin, strain the lard, and stir while cooling. When benzoinated lard is to be kept or used during warm weather, 5 per cent. (or more if necessary) of the lard should be replaced by white wax.—U. S.

Take of lard, 1 pound; benzoin, reduced to coarse powder, 210 grains. Melt the lard by the heat of a water-bath, add the benzoin, and, frequently stirring them together, continue the application of heat for 2 hours; finally, remove the residual benzoin by straining.—Br.

Dissolve 1 part of benzoic acid in 99 parts of lard, previously melted on a water-bath.—P. G.

The result of the U. S. and Br. processes is practically identical, though the first formula directs for 1 pound avoirdupois only 140 grains of benzoin. By enclosing the benzoin in a muslin bag and regulating the temperature, it is more thoroughly exhausted than if allowed to melt, and empyreuma is prevented.

Much of the commercial lard is of inferior quality, containing water and other impurities. Only prime leaf lard should be used and the temperature be kept within the prescribed limits. A perfectly smooth preparation can be obtained only if the

strained lard be constantly stirred until a thick, creamy consistence is reached, after which it may be set aside until cold. In our experience very satisfactory results are obtained if a concentrated solution of benzoin 1 part in alcohol 2 parts (by weight) be used in place of the powdered benzoin. Of such a solution, 450 grains may be added to 1 pound of lard, melted on a water-bath, and a moderate heat, not above 50° C. (122° F.), continued for 2 hours or more, until, with occasional stirring, all traces of alcohol have been dissipated. The resinous matter will all deposit on the bottom of the dish, and the fluid lard may then be strained through muslin and stirred until cold. Like all fats, benzoinated lard should be kept in glass or French porcelain jars in a moderately cool, dry place.

Fixed oils and other fats dissolve the benzoic acid and odorous principles contained in benzoin, which protect them against rancidity.

Action and Uses.—Except for the fact that its odor is less offensive, and that it does not become rancid so rapidly, benzoinated lard has no apparent advantage over adeps. The small quantity of benzoin present is not capable of exercising any marked medicinal action.

ADEPS LANÆ, *U. S.*, *Br.*—Wool Fat.

Adeps lanæ anhydricus, P. G.—*Suint de laine*, Fr.; *Wollfett*, G.

The purified cholesterin-fat of sheeps' wool.

Occurrence.—The wool of sheep contains a natural grease, known as *suint*, which consists largely of insoluble fatty matter and a soluble soap, and is obtained in the process of washing the wool. Some varieties of wool yield more than half their weight of fat. Impure wool fat was used centuries ago under the name of *œsypum*. Natural wool fat contains about 30 per cent. of free fatty acids and numerous fatty acid esters of cholesterin and other alcohols. The cholesterin compounds are the constituents chiefly sought. For the purpose of purification, crude wool fat is treated with weak alkali solutions and the resulting emulsion centifruged, whereby an aqueous soap solution is obtained, on which a creamy layer of fairly pure wool fat is found floating. The creamy layer is removed and treated with calcium chloride, after which the fat is separated and dehydrated by fusing in the presence of unslaked lime. Acetone is employed to extract the pure wool fat from this mixture, and yields the same upon subsequent distillation of the solvent.

Properties and Tests.—Wool fat occurs as a brownish or yellowish fatty substance, inclined to be somewhat tough, and is miscible with 2 or 3 times its weight of water, yielding a light-colored, almost white mass of the consistence of a soft ointment. The U. S. P. describes it as a yellowish, tenacious, unctuous substance, having a slight peculiar odor (almost inodorous, Br.), melting at about 40° C. (104° F.) (40°–44.4° C. (104°–112° F.), Br.), and readily soluble in ether or chloroform, but sparingly soluble in cold alcohol. A solution in chloroform (1 in 50) poured gently over the surface of sulphuric acid acquires a deep brownish-red (purplish-red, Br.) color. The following tests for impurities are given: "When wool fat is incinerated it should leave not more than 0.3 per cent. of ash, which should not show an alkaline reaction to litmus (freedom from alkalies). If 2 Gm. of wool fat are dissolved in 10 Cc. of ether, and 2 drops of phenolphthalein test-solution be added, a colorless liquid should be obtained (absence of free alkalies), which, on the addition of 1 drop of normal potassium hydroxide solution, should develop a deep-red color (absence of free fatty acids). If 1 Gm. of wool fat be boiled with 20 Cc. of alcohol, and the solution filtered after cooling, the filtrate should not be rendered turbid by the addition of an alcoholic solution (1 in 20) of silver nitrate (absence of chlorides). If 10 Gm. of wool fat be heated with 50 Cc. of water on a bath of boiling water until completely fused, the lower aqueous layer, when filtered through a well-wetted filter, should not yield glycerin on evaporation, and when boiled with potassium hydroxide test-solution it should not give off vapors of ammonia (absence of organic nitrogenous matter)."—U. S. "1 Gm. should dissolve almost completely in 75 Cc. of boiling alcohol (90 per cent.), the greater part separating in flocks on cooling. 10 Gm. dissolved in 25 Cc. of ether, 2 drops of solution of phenolphthalein being added, should not require more than 0.1 Cc. of volumetric solution of sodium hydroxide to produce a permanent red coloration (limit of acidity). Heated

with solution of sodium hydroxide, no ammoniacal odor should be evolved (absence of nitrogenous animal matter)."—Br.

The description and tests of the P. G. are practically identical with the preceding. A characteristic test for wool fat is the following, known as Liebermann's cholestol reaction: If 1 Gm. of the fat be dissolved in 3 to 4 Cc. of acetic anhydride (not anhydrous acetic acid), and 6 drops of concentrated sulphuric acid be added, a pink coloration will ensue, soon changing to green or blue.

Pharmaceutical Uses.—Anhydrous wool fat is used chiefly for preparing the hydrous variety. It is admirably adapted for admixture with other fats when larger quantities of water or aqueous solutions are to be incorporated.

Uses.—For uses, see ADEPS LANÆ HYDROSUS.

ADEPS LANÆ HYDROSUS, *U. S., Br.*—Hydrous Wool Fat.

Adeps lanæ cum aqua, P. G.; *Lanolinum.—Lanolin,* E.; *Wasserhaltiges Wollfett,* G.

The purified fat of the wool of sheep (*Ovis Aries* L.; class *Mammalia;* order *Ruminantia*), mixed with an amount of water not exceeding 3 parts of the latter to 7 parts of the former.

These proportions are identical with those ordered by the British Pharmacopœia, whereas the German Pharmacopœia directs that 75 parts of anhydrous wool fat shall be mixed with 25 parts of water.

Perfect admixture is best effected by placing the wool fat in a warm mortar and adding the water gradually with constant stirring.

When heated, hydrous wool fat separates into an upper oily and a lower aqueous layer.

Description.—A yellowish-white or nearly white ointment-like mass, having a faint, peculiar odor. Insoluble in water, but miscible with twice its weight of the latter without losing its ointment-like character. With ether or chloroform it yields turbid solutions which are neutral to litmus-paper. Hydrous wool fat melts at about 40° C. (104° F.). When heated on a water-bath, it leaves a residue amounting to not less than 70 per cent., which is transparent while melted, and when cold appears as a yellow tough, unctuous mass, completely soluble in ether or chloroform, and only sparingly soluble in alcohol. If hydrous wool fat be thus deprived of water, it should respond to the tests given under ADEPS LANÆ. —U. S.

Defects in the quality of lanolin are very similar to those in lard, and their detection is provided for by the above official tests.

Action and Uses.—Lanolin is principally used as an ointment base. As it does not become rancid, it has certain apparent advantages over many other ointment bases, and can be used with many chemical substances, as, for example, peroxide of hydrogen, with which lard cannot be employed. When applied to the epidermis by inunction, it is slightly absorbed. It is questionable whether or not this substance is more rapidly absorbed than other fats, the general opinion at present being that in this respect it has no advantage over lard.

ADONIS.—Adonis.

Bird's-eye, False hellebore, Ox-eye, Pheasant's eye, E.; *Adonisröchen,* G.; *Adonide,* Fr., It.

The herb of *Adonis vernalis* L., *A. æstivalis* L., and *A. annua* L. (*A. autumnalis* L.—Fam. *Ranunculaceæ*).

Adonis should be collected when in full bloom and dried in the shade. The two first-named species are natives of Europe and Asia; the third, of southern Europe only. All are more or less cultivated for ornament. *A. annua* is also called *Red morocco, Red mathas, Red camomile,* and *Rose à rubie.* It has crimson-red flowers, while those of *A. vernalis* are bright-yellow and those of *A. æstivalis* are orange. *A. vernalis* is perennial, the others annual. Similar constituents and properties have been found in several others of the 12 or 13 species.

Description.—Stems 10 to 25 Cm. (4 to 10 In.) long, terete, leafy, those of *A. vernalis* having only sheathing scales below; leaves repeatedly pinnatifid, the segments almost capillary, smooth except in *A. vernalis,* where, like the sepals, they are pubescent, especially when young; sepals 5, petals 5 to 15, clawed (oblong and subdenticulate in *A. vernalis*); stamens numerous and pistils several.

Constituents.—Adonis contains about 10 per cent. of aconitic acid. *Adonidin* or *adonin* is the so-called active principle of commerce, which was obtained by Mordagne to the extent of 2 Gm. from 10 Kg. It occurs in all parts of the plant. It is a crystalline, very bitter powder, of a variable shade of yellowish-white, becoming yellow over sulphuric acid and brown upon heating. It is nearly insoluble in chloroform, benzene, and oil of turpentine; sparingly soluble in ether, but freely soluble in water and alcohol. Placed upon moistened blue litmus-paper, it changes the color to red. The watery solution is precipitated by tannin and basic lead acetate, but not by normal lead acetate. Sulphuric acid imparts a brown color, changing to violet. It is a mixture, ascertained by Podwissotzki (1888) to consist of yellow *adonidoquercitrin*, *adonidodulcit* (adonit [$C_5H_{12}O_5$]?), *adonitic acid*, and a brown glucoside, with the active principle *picradonidin*, which is an amorphous glucoside, soluble in water, alcohol, and ether, strongly bitter, and a powerful heart poison; its solution is not disturbed by lead salts, but is precipitated by tannin.

FIG. 6.

Adonis vernalis (½ Nat.).

Pharmaceutical Preparation.—FLUIDEXTRACT OF ADONIS, N. F.

Action and Uses.—Adonis is chiefly used in medicine as a substitute for digitalis in those cases in which idiosyncrasy or other causes prevent the administration of the latter. Like digitalis, it is an irritant to mucous membranes, and it may cause nausea, vomiting, and purging. The chief action of adonis is upon the circulation. It slows the heart, increases the force of the heart beat, and stimulates the vasomotor system, causing an increase in blood-pressure. The drug acts as a diuretic, increasing principally the watery constituents of the urine.

Adonis may be tried in cardiac dropsy, and has been given with asserted success after digitalis and other remedies had failed. It may be tried in all cases of cardiac incompetency in which the more common remedies have failed or in which because of idiosyncrasy or cumulative action they cannot be exhibited.

The dose of adonidin is from $\frac{1}{10}$ to $\frac{1}{4}$ grain (0.005–0.015 Gm.).

An infusion made from all portions of the plant, $\frac{1}{2}$ to 2 drachms in 6 fluidounces (2–8 Gm. in 180 Cc.) of water, may be given in 4-drachm (16 Cc.) doses every 4 hours.

ADRENALINUM.—Adrenalin.

The name adrenalin was applied in 1901 to a crystalline substance obtained independently by Takamine and Aldrich from the suprarenal gland of beeves, and claimed to be the active blood-pressure-raising principle of the gland.

Much work has been done during the past 5 or 6 years with a view to determine the character of the constituent to which the remarkable physiological activity of the suprarenal gland is due, and since 1896 several substances have been isolated by different investigators. These substances are not identical in every respect, but strongly resemble each other, and have been designated by different names. The earliest publication on the active principle of the suprarenal gland was by J. J. Abel (*Johns Hopkins Hospital Bulletin*, 1897), who applied the name epinephrin to this product. In 1898 von Fuerth called attention to a substance which he claimed to be different from the preceding, and which he named suprarenin. As stated above, in 1901 the crystalline substance adrenalin was brought to the notice of the medical world. Abel's first product was later found to be a monobenzoyl derivative of the native substance, the result of incomplete saponification of a benzoylated compound made with the view of obtaining a purer product.

The following methods of manufacture have been suggested:

According to Takamine, adrenalin, to which he assigned the formula $C_{10}H_{15}NO_3$, is prepared as follows:

Suprarenal capsules, finely minced, are digested in water acidulated with hydrochloric or acetic acid for 5 hours at a temperature of about 70° C. (158° F.), with frequent agitation. At the end of that time the temperature is raised to 90° C. (194° F.) for an hour, for the purpose of coagulating the albuminoids present. A layer of fat is preferably kept floating on the surface of the mass during digestion, to protect the active constituent against oxidation by the air. The mixture is now expressed and the residue again digested for several hours in slightly acidulated water, and again expressed. Having mixed the expressed fluids and separated any fat present, the clear extract is concentrated, preferably in a vacuum apparatus, and mixed with 2 or 3 times its volume of alcohol (or wood alcohol), whereby inert matter is precipitated. After separation and washing of the precipitate with alcohol, the alcohol is recovered by distillation, 10 per cent. ammonia water is added to the residual liquid, and the mixture set aside for several hours. Crude adrenalin is precipitated as a brownish-yellow crystalline mass, which may be purified by re-solution in alcohol and acid, and subsequent addition of ether. After filtration for removal of precipitated impurities, the filtrate is again made alkaline with ammonia water, when a nearly white crystalline precipitate of adrenalin will separate, and may be washed with water and then with alcohol, and dried (*Am. Jour. Pharm.*, Nov., 1901).

The following method of Aldrich differs slightly from the preceding, and evidently yields a purer product:

Finely divided suprarenal glands are repeatedly extracted, at a moderate temperature, with water acidulated with acetic acid. The united extracts are heated to boiling, and, after cooling, the coagulated proteids are removed by filtration, the filtrate being evaporated in a vacuum at 45° C. (113° F.) to a small volume. Lead acetate is now added to complete the precipitation of inert matter, which is removed by filtration, and the excess of lead gotten rid of by passing hydrogen sulphide into the filtrate. The clear liquid having again been evaporated to a small bulk, 4 or 5 times its volume of 94 per cent. alcohol is added, the mixture filtered, and the alcoholic filtrate evaporated to a very small bulk, or even to dryness, taken up with water and filtered. To this filtrate ammonia water is added, which causes a precipitate in the form of small lumps with radial markings, or as individual crystals. The precipitate is washed with very dilute ammonia water by decantation and then on a filter with cold water until all alkali is removed, after which it is dried in air or in vacuo (*Am. Jour. Physiol.*, Aug. 1, 1901).

Aldrich has assigned the formula $C_9H_{13}NO_3$ to this product.

Abel (*Johns Hopkins Hospital Bulletin*, Feb.–March, 1902) states that a pure crystalline form of his epinephrin may be obtained thus:

A highly concentrated slightly acidulated aqueous extract of suprarenal glands is mixed with absolute alcohol, actively shaken, and after standing a few hours is filtered. Upon recovering the alcohol under reduced pressure a straw-colored syrup remains, which, on cooling, congeals and is then dissolved in ammoniacal zinc chloride solution. An impure zinc compound of epinephrin is obtained by gradually adding to the solution, while stirring, about 11 times its volume of absolute alcohol, filtering, and drying the slightly reddish-yellow precipitate at 50° C. (122° F.). The powder is dissolved in very dilute acetic acid, hydrogen sulphide added to remove the zinc, and after filtration the liquid is concentrated to a small bulk under diminished pressure. On now adding ammonia water in successive portions until the liquid smells strongly and permanently of ammonia, a crystalline compound is obtained, which is separated by filtration without delay, and may be still further purified by repeated solution in hydrochloric acid and reprecipitation by ammonia.

This crystalline product obtained by Abel's zinc-ammonia process is undoubtedly identical with adrenalin. Both substances fail to react with alkaloidal reagents; but if hydrolyzed in an autoclave at low temperature, they assume alkaloidal properties and are precipitated in an amorphous flocculent condition by ammonia; such precipitate, at first white or yellowish-white, darkens on exposure to air. Neither substance suffers appreciable loss of weight if heated for 2 hours at 60°–125° C. (140°–257° F.), but if heated in dry air to 177°–180° C. (350.6°–356° F.) for 30 minutes, some loss in weight occurs, the color changes to reddish and later to reddish-brown, and the substance is converted into the alkaloidal form (personal communication from Prof. Abel). The same change into the alkaloidal variety may be brought about by treatment in an autoclave, exposure to hydrochloric acid gas, or solution in strong hydrochloric or sulphuric acid. Both bodies, when thus transformed, readily form salts with acids which are difficultly crystallizable, and both energetically reduce Fehling's Solution on boiling. It is claimed by Abel that his own crystalline form of epinephrin as well as adrenalin are both derivatives of the native active principle of the suprarenal gland. More investigation seems necessary to harmonize these and other conflicting views. In a recent article by Aldrich (*Am. Jour. Physiol.*, July, 1902) it is stated that the removal of

adrenalin from a concentrated extract of suprarenal glands, effected without the use of hydrogen sulphide or other reducing agent, by simple direct precipitation with a saturated solution of sodium carbonate, or 10 per cent. ammonia water, very largely (but not entirely on account of incomplete precipitation) destroys the blood-pressure-raising capacity and copper-sulphate-reducing power of the extract, thus pointing to adrenalin as the active principle of the gland. These results, it is claimed, show that the former statement, that the active principle as present in the gland does not reduce Fehling's Solution, is erroneous, as also the suggestion that the action of hydrogen sulphide, or other reducing agent, on the native principle is essential for the development of the copper-sulphate-reducing power.

While the empirical formulas given by Abel, Aldrich, and Takamine for their respective crystalline products vary somewhat, it seems fair to assume that the products are identical, barring possible impurities, since they agree in general properties and behavior toward reagents.

Properties.—Adrenalin occurs on the market as a light-grayish or brownish-white micro-crystalline substance, having a slightly bitter taste and leaving a numb feeling when applied to the tongue. It is difficultly soluble in cold water, but more readily in hot water, the aqueous solution being oxidized by air and becoming colored. Adrenalin in dry form is perfectly stable. On heating, it turns brown at 205° C. (401° F.), and melts, decomposes, and swells simultaneously at 207° C. (404.6° F.). In contact with moistened litmus-paper it shows a weak alkaline reaction, as well as with phenolphtalein. It is easily soluble in acids, forming salts, which thus far it has not been possible to obtain in crystalline form, but merely as a very hygroscopic mass, and is also soluble in potassa solution, but does not dissolve in ammonia or alkali carbonates. Adrenalin is not precipitated by tannic acid, picric acid, mercuric chloride, Mayer's reagent, phosphomolybdic acid, lead acetate, and platinum chloride. In various ways, as by exposure to hydrochloric acid gas, adrenalin can be converted into the alkaloidal variety, which responds to all these alkaloidal reagents. The relationship is evidently a simple one, but at the present time it is impossible to express it in quantitative terms. Ferric chloride colors a solution of adrenalin emerald-green while iodine imparts a vivid pink color. The color reaction with ferric chloride is of a fleeting character, the fine green color soon changing to a dirty brown. Abel has found that the addition of a solution of potassium thio-benzene-sulphonate to a solution of adrenalin or epinephrin causes the green color produced by the iron to persist for a long time, and he has suggested that a quantitative colorimetric method of estimation may be based on this fact. Careful addition of caustic alkali to the green solution colored by ferric chloride causes various shades from purple to carmine-red. Gold chloride is energetically reduced by adrenalin, and complete separation of the metal follows from an acid solution, by application of gentle heat, the liquid assuming a pink or red color, as with nitric acid, potassium dichromate, and other oxidizing agents.

Action and Uses.—Suprarenal gland is sometimes employed in the form of a desiccated powder, more commonly as a liquid extract, and still more commonly in the form of what is known as adrenalin chloride, already described. The influence of adrenalin when injected intravenously is that of a powerful vasoconstrictor, so that it causes a marked rise of arterial pressure. This effect is due to the stimulation of the muscular coat of the bloodvessels, and not to any influence upon the vasomotor centres. Hypodermic injections of it produce similar but less marked effects, and it is probable that its instillation into the eye may be followed by sufficient absorption from the lachrymal and nasal mucous membranes to produce some physiological influence. If held in the mouth, it may also be absorbed; but if swallowed, the gastric juices seem to alter it, so that the internal use of adrenalin for its effect upon the vascular system is not followed, as a rule, by advantageous results. Because of its ability to cause constriction of the bloodvessels, it has been employed for the purpose of overcoming vascular relaxation and surgical shock. For these conditions it is best administered by intravenous infusion or hypodermoclysis in normal saline solution: 1 or 2 drachms (4–8 Cc.) of the 1:1000 solution of adrenalin chloride to 1 pint (480 Cc.) of the saline solution. As infinitesimal quantities of the drug produce a powerful influence upon the muscular coats of the bloodvessels, this solution for intravenous administration should be injected very slowly. Strong solutions should not be used hypodermically, because they produce localized ischæmia at the area of injection, and should this area become infected a slough

may ensue. It increases the force of systole of the heart by stimulation of the cardiac muscle-fibres, but it is rarely if ever used in medicine for its effect upon the cardiac muscle. By far the widest field in the employment of adrenalin is in connection with its influence upon the bloodvessels supplying the mucous membranes in the nose, ear, throat, and eye, and to a less extent in connection with disorders of the capillary network in the mucous membranes of the genito-urinary and alimentary tracts. For these purposes it is always applied locally, in the form of a solution of 1 : 5000 or 1 : 1000 normal saline, although even so weak a solution as 1 : 20,000 may produce distinct physiological effects, and in many instances 1 : 10,000 is a better strength than 1 : 5000. Almost immediately after its application to a mucous membrane, even if it be turgid with blood, the membrane becomes shrunken and blanched through the powerful constriction of its capillaries by the action of the drug. This constriction, as a rule, lasts at least half an hour, and sometimes for several hours, and its action may or may not be followed by a return of the turgescence. Because of this effect of adrenalin it is an exceedingly valuable substance for overcoming local hyperæmias, and for diminishing hemorrhages from mucous membranes in the areas that we have named, or in any area in which there is a capillary hemorrhage. It is worthy of note that if the congestion of a mucous membrane has lasted so long that paralytic dilatation of its bloodvessels is present, adrenalin fails to cause contraction, because the muscular fibers and the walls of the vessels are incapable of contraction by reason of their paralysis. As the influence of adrenalin and cocaine in producing ischæmia is very similar, these two substances are frequently applied together when both local anæsthesia and ischæmia are required. It has been claimed that adrenalin is a local anæsthetic, but any diminution in sensation produced by its influence is probably due more largely to the anæmia of the parts which it produces than through any direct influence which it may exert upon sensory nerve filaments.

Suprarenal gland, its extract, and adrenalin have all been employed internally in the treatment of Addison's disease. In some instances good results have been produced, but the hopes which at first were held, that it might prove a specific in this malady, have been blasted, probably because all cases of Addison's disease are not due to the same cause.

The best way of applying suprarenal extract or adrenalin chloride solutions to mucous membranes is by means of a medicine-dropper, a small atomizer, or by wetting a pledget of cotton which is held in contact with the mucous membrane till the desired effect is produced. Notwithstanding the great power of adrenalin, it has produced few untoward results, and no fatal ones so far as we know. The patient in some instances has complained of disagreeable sensations in connection with the mucous membrane upon which the drug was acting. Very large amounts are capable of causing death if injected intravenously, and somewhat smaller ones produce glycosuria. The dose of the dried extract is from 3 to 5 grains (0.20–0.30 Gm.).

AER.—Air.

The air or atmosphere (from *ἄτμος*, vapor, and *σφαῖρα*, sphere) is the gaseous envelope surrounding the earth which sustains the most intimate relation to animal and plant life. The essential constituents of the atmosphere, which are also indispensable to vegetation, are oxygen, nitrogen, water vapor, carbon dioxide. Other components, occurring in much smaller quantity, are ammonium nitrite and nitrate, argon, helium (two lately discovered elements), ozone, hydrogen peroxide, and a few other substances which are present in very minute quantities. The composition of purified dry air by volume and by weight is:

	Volumes.	Parts by weight.
Nitrogen	78.4	75.95
Oxygen	20.94	23.10
Argon	0.63	0.90
Carbon dioxide	0.03	0.05
	100.00	100.00

The proportions of oxygen, nitrogen, and argon remain constant in the atmosphere in spite of climatic changes, elevation, vegetation, etc. The tendency to diminution of the oxygen by animal respiration is counterbalanced by the life-processes of plants, which liberate oxygen from the carbon dioxide formed in respiration. The percentage of water vapor in air is variable, the average being 0.84. The density of water

vapor is 0.62 (air = 1), hence moist air is lighter than dry air. 1 liter of air freed from water vapor and carbon dioxide weighs 1.29318 Gm. (Regnault) at 0° C. (32° F.) and 760 Mm. pressure.

Air can be liquefied by low temperature and great pressure; for example, —145° C. (—229° F.) and 31.5 atmospheres. In liquid air carbon dioxide solidifies and can be filtered off, leaving a clear liquid composed of liquefied nitrogen, oxygen, and a little argon. In an open vessel the liquid boils or vaporizes, and its temperature falls to —191.2° C. (—312.2° F.), at which point alcohol and ether are solidified. In vaporizing, the nitrogen goes off first, leaving a liquid which gradually becomes richer in oxygen and assumes a blue color. It has been proposed to manufacture oxygen for commercial purposes in this manner from liquefied air. Liquid air is lighter or heavier than water according to the amount of nitrogen that has escaped by vaporization.

While nitrogen and oxygen had been liquefied by Cailletet and Pictet in 1876 (*Compt. rend.*, 85, 851, and 1270) by cooling highly compressed air with an artificial cooling agent, it was not until Linde, of Germany, Hampson, of England, and Tripler, of New York, perfected their machines, about 1898, that liquid air was produced by a continuous process, in any desired quantity. In these machines the cooling of the compressed air is accomplished by the cold produced by expansion of the air when allowed to escape from a tube. This cooled air is made to surround the tube containing the compressed air, which is thus gradually reduced in temperature to such a point that it liquefies.

Liquid air is a very useful cooling agent in some chemical reactions which cannot be carried out at ordinary temperature. In other instances chemical change does not take place at the temperature of liquid air. (For a description of apparatus and experiments with liquid air, see *Ber. d. Deutschen Pharm. Gesell.*, 1901, p. 277; Erdmann's *Anorg. Chem.*, 1900.) Hempel (*Chem. Industrie*, 22, 1) is very sanguine in his prediction that liquid air will be a source of oxygen for industrial purposes in the future. Linde's apparatus can be so modified that the liquid obtained contains about 80 per cent. of oxygen. Liquid air cannot be preserved in air-tight vessels, as explosions would result owing to the increase of pressure as the liquid evaporates. Small quantities are best kept in so-called Dewar vacuum bulbs, which are vessels with double walls having a vacuum between them, the vacuum being a very poor transmitter of heat. The Weinhold vessel is constructed similarly. In such vessels 1–2 liters of liquid air will last from 8 to 14 days, the daily loss being about 100 Gm.

Action and Uses.—Liquid air has been employed as a therapeutic agent for many conditions, but because of the difficulty in handling it, this substance has never been generally accepted by the profession.

It is stated that when micro-organisms are placed in contact with it, their action is held in abeyance for some time, and advantage has been taken of this fact in the treatment of various septic conditions. When locally applied, liquid air acts as a freezing agent and causes anæsthesia; hence it may be employed where minor surgical operations are to be performed. When applied for a sufficient length of time, it acts as a cauterizing agent, and as such has been used in the removal of lupus, nævi, adenoids, and polypi. It is stated that its employment has the distinct advantage of producing little or no scar in the above conditions. This remedy has been employed to abort beginning inflammatory conditions, and in such conditions would appear to be an excellent remedy, as it not only produces excessive cold, but also checks the activity of the invading micro-organisms. The vapor arising from liquid air has been suggested as a substitute for the Brand method in the reduction of temperature; it is probable, however, that it would be inadequate as such, as the reaction from the latter method depends largely upon the friction caused by accompanying massage. This vapor has also been recommended in the treatment of acute bronchitis and laryngitis, tubercular laryngitis, and in pulmonary tuberculosis.

Argon.—Ar. Atomic weight, 39.6; density (air = 1), 1.38.—This element was discovered in the atmosphere in 1894 by Lord Rayleigh, of England. It resembles nitrogen very closely in properties, but is even less active chemically; hence its name argon (from ἄργον, sluggish—*i. e.*, no activity). It forms about 0.9 per cent. of air by weight. It occurs also in the gases from some springs, as at Reykjavik, Iceland; Wildbad, Germany; Harrogate, England; and in many Pyrennes springs. It does not form chemical compounds. Its molecule contains only 1 atom.

Helium.—He. Atomic weight, 4; density (air = 1), 0.14.—This element was recognized by Janssen in 1868 in the chromosphere of the sun by means of the spectroscope, and later also by Lockyer, who called it helium (from ἥλιος, the sun). Ramsay and Cleve, independently of each other, found the gas in the mineral *cleveite*, in 1895. It occurs combined in several other minerals of the rare elements, found chiefly in Scandinavia, and in the free state in very minute quantity in the atmosphere. It stands next to hydrogen in density, being twice as heavy, and resembles nitrogen and argon in its inertness. It does not liquefy at —264° C. (—443.2° F.) (Olszewski). Its molecule contains 1 atom.

ÆTHER, *U. S., Br., P. G.*—Ether.

Æther sulphuricus, Naphtha vitrioli.—Sulphuric ether, E.; *Ether hydrique s. vinique s. sulfurique*, Fr.; *Æther, Schwefeläther*, G.; *Etere*, It.; *Eter sulfurico*, Sp.

Formula, $(C_2H_5)_2O$. Molecular weight, 73.52.

History and Formation.—Ether, or a mixture of ether and alcohol, was probably obtained by the alchemists in the thirteenth century, but a process for its preparation from equal parts of oil of vitriol and alcohol was first devised in the sixteenth century, by Valerius Cordus, who called it *oleum vitrioli dulce verum* (true sweet oil of vitriol). The name "ether" (spiritus æthereus) was first used for this liquid by Frobenius in England (1730). Fourcroy and Vauquelin (1797) regarded ether as alcohol deprived of water by the action of sulphuric acid, and Valentin Rose proved (1800) that ether contains neither sulphur nor an acid. Berzelius explained the action of sulphuric acid upon alcohol by catalytic force. Liebig regarded sulphovinic acid as a double sulphate of water and ethylic oxide (ether), which is decomposed by heat, with the liberation of ether. Rose explained this decomposition by water displacing the ether from the compound mentioned. Graham ascribed the result to the polymerizing power of sulphuric or sulphovinic acid, whereby alcohol ($C_2H_2 + HO$, old notation) is converted into ether ($C_4H_4 + HO$). Williamson (1851) advanced the theory which now prevails, that when alcohol and sulphuric acid are mixed, ethylsulphuric (sulphovinic) acid is formed, which reacting with more alcohol on the application of heat produces ether, while sulphuric acid is regenerated at the same time. The discovery later of ethers containing two distinct alcohol radicals supported this view.

Preparation.—A detailed account of the process of ether manufacture in this country will be found in Squibb's *Ephemeris*, vol. ii. 590, *et seq.* In outline it may be stated as follows: A mixture of alcohol and sulphuric acid is heated in a suitable still to about 130° C. (266° F.), and when the distillation of ether has begun a continuous supply of fresh alcohol is turned into the still, and so regulated as to keep the mixture at a constant quantity and temperature. The vapors are passed through two purifiers, the first containing a solution of potassium hydroxide, for the purpose of thoroughly washing the vapors in alkaline liquid; the second purifier is provided with a bed of pebble-stones, and here the alcohol and other vapors having a higher boiling-point than ether are condensed and removed. In order that no ether may be lost, both purifiers are kept heated, and the purified ether vapor is finally condensed in a large worm surrounded by water. The theoretical yield of absolute ether is never wholly obtained, and the quantity will vary with the care and attention bestowed. It is important that the temperature be carefully kept between 130° and 138° C. (266° and 280° F.); if it fall below 130° C., an excess of alcohol in the still causes other products to be formed. Since in the formation of ether sulphuric acid is continually regenerated, its power of etherification is theoretically unlimited; but in practice it will be found that the impurities in the alcohol will set a limit, and gradually the acid becomes dark and tarry, and the mixture in the still liable to frothing. According to Squibb, a charge of 360 pounds of sulphuric acid will etherify about 120 barrels of alcohol, provided the latter be clean and of good quality.

The reaction occurring may be illustrated thus: $C_2H_5OH + H_2SO_4 = C_2H_5HSO_4$ (ethylsulphuric acid) $+ H_2O$; then $C_2H_5HSO_4 + C_2H_5OH = (C_2H_5)_2O$ (ether) $+ H_2SO_4$. While the apparent result of the entire reaction consists in the abstraction of 1 molecule of water from 2 molecules of alcohol, the remaining elements forming 1 molecule of ether, other decomposition-products are also obtained, and these it is designed to remove by washing the vapor in warm solution of potassium hydroxide.

The U. S. Pharmacopœia recognizes but one variety of ether, containing about 96 per cent. by weight of absolute ether and about 4 per cent. of alcohol containing a little water; such a preparation has a specific gravity of 0.725–0.728 at 15° C. (59° F.) or 0.716–0.717 at 25° C. (77° F.). The present official ether was formerly known in the Pharmacopœia as *æther fortior*, and is still at times met with under that name. A weaker preparation, containing about 74 per cent. of absolute ether and 26 per cent. of alcohol and water, is sometimes offered as ether, U. S. P. 1880. It has a specific gravity of about 0.750 at 15° C. (59° F.), and should not be confounded with the present official ether. Some manufacturers offer but one article of U. S. P. ether, while others specially designate that intended for anæsthesia. The commercial varieties of "washed" and "concentrated" ether should not be employed for medicinal purposes, as their composition and purity are not stated. The British Pharmacopœia recognizes both Ether and Purified Ether (Æther Purificatus). The former contains not less than 92 per cent. of absolute ether and has the specific gravity 0.735; purified ether, which should have a specific gravity between 0.720 and 0.722, is made by washing ether with water to remove most of the alcohol, and rectifying over calcium chloride and recently burned lime. While the German Pharmacopœia recognizes only ether having the specific gravity 0.720 at 15° C. (59° F.), it makes a distinction between ether and ether for anæsthesia, by directing greater rigidity in the tests to be applied to the latter.

Properties.—Absolute ether is a colorless, very limpid, not solidifiable liquid, of a strong refractive power and having a specific gravity 0.710 at 20° C. (68° F.), Richter, to 0.712 at 25° C. (77° F.), Gay-Lussac, of 0.7188 at 15° C. (59° F.), Squibb. It has a peculiar penetrating odor and a sweetish pungent taste. It boils at 34° to 35° C. (93° to 95° F.), the vapors having a specific gravity of 2.58, and volatilizes very rapidly at ordinary temperature, thereby producing a considerable diminution of temperature. It is easily ignited, and burns with a bright flame, yielding water and carbon dioxide. Its vapor, mixed with a large quantity of air, if ignited, explodes with great violence. In consequence of this property and of the great density of its vapor great care should be exercised in handling ether or manipulating with it in the vicinity of a flame. It dissolves phosphorus, sulphur, iodine, bromine, some metallic sulphides, chlorides, bromides, and iodides, bromoform, chloroform, alcohols, benzene, benzin, fats, volatile oils, many resins, most alkaloids, and some organic acids. When shaken with an equal bulk of water, absolute ether loses one-fourteenth of its volume, which is dissolved by the water, a little of this liquid being dissolved by the ether (Boullay). The presence of water and alcohol is detected by mixing the ether with an equal bulk of carbon disulphide, which should result in a perfectly clear liquid. Aniline-violet is insoluble in absolute ether, but in the presence of 1 per cent. of alcohol colors the liquid distinctly (Stefanelli, 1875).

Official ether boils at about 35° C. (95° F.), U. S., P. G., below 40.5° C. (105° F.), and purified ether not under 34.5° C. (91.4° F.), Br. It is soluble in about 10 volumes of water at 25° C. (77° F.), U. S., and is miscible in all proportions with alcohol, chloroform, benzene, petroleum benzin, fixed and volatile oils.

Tests.—The pharmacopœias prescribe the following tests for the purity of ether: It should have no action on moistened pale-blue litmus-paper and leave no fixed residue upon evaporation. Ether shaken occasionally within one hour with one-tenth its volume of normal potassium hydroxide solution should not develop any color, showing the absence of aldehyde, etc. (U. S.). If 1 Cc. of 10 per cent. potassium iodide solution be frequently shaken with 10 Cc. of ether in a completely filled glass-stoppered vial and protected against light, no coloration should occur in one-half hour; for ether intended for anæsthesia the time is extended to 3 hours (absence of hydrogen peroxide).—P. G. If 100 volumes of ether be agitated with an equal volume of water, at least 90 volumes should separate (absence of excess of alcohol). Ether should dissolve without coloration when added drop by drop to sulphuric acid kept cool during the test (absence of organic impurities). Purified ether should dissolve in an equal volume of carbon disulphide (absence of excess of water); when shaken with half its volume of a dilute solution of potassium dichromate acidulated with sulphuric acid, and set aside, the supernatant liquid should not have a blue color (absence of hydrogen peroxide).—Br. An undue amount of water or alcohol may be detected by shaking 20 Cc. of ether in a graduated tube with 20 Cc. of water previously saturated with ether; upon separation the ethereal layer should not measure less than 19.8 Cc. (U. S.). If 10 Cc. of ether be poured in portions upon clean odorless blotting-paper, and allowed to evaporate spontaneously, no foreign odor should become perceptible when the last traces of ether leave the paper (U. S.).

Pharmaceutical Preparations.—Spirit of Ether, U. S.; Compound Spirit of Ether, U. S.

Action and Uses.—When locally applied, ether produces a cooling sensation, which is due to its rapid evaporation. Advantage has been taken of this fact to produce freezing of the tissues and local anæsthesia when minor surgical operations are to be performed. When administered by the mouth, it has at first a sweetish and afterward a burning, pungent taste. It first causes a burning, and afterward a cooling sensation in the stomach, which rapidly extends over the entire body. The heart and vasomotor system are stimulated, respiration is quickened, the face becomes flushed, a sensation of warmth is felt over the surface of the body, and diaphoresis frequently follows. The mind is powerfully stimulated, ideas follow one another in rapid succession, and the cerebral phenomena produced by alcohol are apparent. These effects are fleeting, and in a short time a feeling of general contentment, mental quiet, and sleep succeed them. When given hypodermically, ether acts more rapidly and more powerfully than when taken by the stomach, but otherwise its general effects are the same. Inhalations of ether vapor at first irritate the mucous membrane of the respiratory tract, and at times cause a temporary arrest of respiration. The face becomes suffused, the conjunctiva injected, and the individual struggles in an attempt to remove the inhaler and obtain fresh air. The primary stage of struggling is rapidly succeeded by one of quiet, during which period the pulse is rapid, full, and strong, and the respiration is accelerated, but the breathing is deep and regular and the reflexes are intact. In a short time the stage of excitement or a second period of struggling occurs. This period varies greatly with the individual; in some cases there may be merely a slight movement of the fingers or hands, but in others violent struggling may ensue. Patients under its influence display various traits and effects, and cursing, screaming, laughing, crying, or praying frequently occur. Following this is the stage of anæsthesia, during which sensation to pain and reflex action are abolished, and if the drug is sufficiently pushed complete muscular relaxation occurs. The pupils are usually normal, and, unless the patient is profoundly anæsthetized, should react to light. Ether first depresses the intellectual centers of the brain, then the sensory tracts of the cord, the motor tracts of the cord, the sensory centers of the medulla, and finally the respiratory center, causing death by respiratory failure. It exerts no effect upon the nerve-trunks unless it is directly applied. Ether is a rapidly acting, diffusible, and consequently a fleeting cardiac stimulant. It also stimulates the vasomotor center; blood-pressure is increased and the pulse becomes more rapid and forcible. In overdoses it acts as a cardiac depressant. It has been shown by J. Chalmers Da Costa that the inhalation of ether decreases both the number of red blood-corpuscles and the hæmoglobin. While ordinary amounts of this drug stimulate the respiratory center, overdoses paralyze it, and so cause death. The primary arrest of respiration which is seen during its early administration is due to irritation of both the vagal and trifacial nerves. Prolonged etherization very materially lowers the bodily heat; this is due to the rapid evaporation of the drug from the lungs and to the depression which it produces upon the nervous system. Ether is eliminated by the lungs and kidneys. It is a renal irritant, and may cause an acute nephritis and at times complete suppression of the urine.

Large quantities of mucus sometimes collect in the bronchial tubes during etherization, but this may usually be overcome by the hypodermic administration of a full dose of atropine. Accidents occurring during the administration of ether should be treated by the removal of the drug and the institution of artificial respiration. Hypodermic injections of strychnine, atropine, and digitalis should also be given. If the face is pallid, it indicates cardiac embarrassment and the head and shoulders should be lowered. If the face becomes suffused and cyanotic, it indicates respiratory difficulty, and this position should not be resorted to. Hypodermic injections of alcohol or ether are of little value in these conditions, provided the cause is the direct result of an overdose of the anæsthetic; but they may be successfully administered when the respiratory failure is due to asphyxia resulting from mechanical interference with free breathing.

Because of the vomiting which it produces, ether is contraindicated in gastritis and peritonitis. It should not be employed when bronchitis, catarrhal pneumonia, or acute nephritis is present. It is well to substitute chloroform for it in aneurism or in the presence of marked vascular atheroma.

Locally ether may be employed in an atomizer for producing local anæsthesia.

Internally by the stomach it is of service in the flatulent colic of adults and children. It may be given also either by the mouth or hypodermic needle in the treatment of uræmia, especially if the cardiac or respiratory complications are marked. Ether may be employed with advantage as a rapidly acting cardiac and respiratory stimulant in cases of collapse. By inhalation it is employed to produce surgical anæsthesia, to cause muscular relaxation in hernia. When a moderate amount is inhaled, it frequently relieves spasmodic hiccough, local muscular spasms, and the pain of angina pectoris.

The dose of ether is from 30 minims to 2 fluidrachms (2–8 Cc.), given either in ice water or preferably in capsules. The spirit of ether and compound spirit of ether are also given in the same dose.

Allied Compounds.—ÆTHER FORMICUS.—*Formic ether, Ethyl formate*, E.; *Ameisenäther*, G. $C_2H_5CHO_2$ or $HCOOC_2H_5$.—It was first obtained by Bucholz (1782), and may be prepared by distilling a mixture of 8 parts of dry sodium formate, 7 parts of alcohol (88 per cent.), and 11 parts of strong sulphuric acid. Usually sufficient heat is produced upon addition of the acid to volatilize the ester, and the distillate, if acid, is shaken with sodium carbonate solution, and finally rectified from calcium chloride. Formic ether is a thin colorless, inflammable liquid, of strong agreeable odor and pungent taste. Its specific gravity is 0.918 at 17° C. (62.8° F.) and its boiling-point 55° C. (131° F.); it is soluble in 9 parts of water and in all proportions in alcohol, ether, fixed and volatile oils. When inhaled, it lowers the temperature as much as 3.5° C. (6.3° F.), inducing signs of asphyxia, and causes muscular relaxation and anæsthesia. In man 6 or 8 Gm. occasion no other symptoms than drowsiness.

ÆTHER METHYLICUS.—*Methyl ether, Methyl oxide*, E.; *Methyläther, Holzäther*, G. $(CH_3)_2O$.—It was discovered by Dumas and Peligot (1835), and is prepared by distilling a mixture of 1 part of methyl alcohol and 4 parts of sulphuric acid; the vapors are washed by passing through potassium hydroxide solution or milk of lime, whereby carbon and sulphur dioxides, as well as methyl sulphuric ether, are removed. The latter body, having a garlic-like odor, is decomposed. Methyl ether is a colorless, inflammable gas, heavier than air, of an ethereal odor and aromatic taste. At —36° C. (—32.8° F.) it forms a colorless liquid which boils at —21° C. (—5.8° F.). Water dissolves 35 volumes of the gas, acquiring its odor and taste, and evolving it again at a moderate heat. It is more soluble in sulphuric acid, and still more freely in alcohol, methyl alcohol, and ether. A solution in the latter liquid saturated at 0° C. (32° F.) has been recommended by Dr. B. W. Richardson under the name of methyl-ethyl ether (see below) as a safe, rapidly acting anæsthetic; it should be kept in well-corked bottles in a cool place.

ÆTHER METHYL-ETHYLICUS.—*Methyl-ethyl ether, Methyl-ethyl oxide*, E.; *Methylaethyläther*, G. $CH_3C_2H_5O$.—This compound, which must not be confounded with the solution of Dr. Richardson mentioned above, was first obtained by Williamson by the action of ethyl iodide upon sodium methylate, and this has proved to be the best method since. The two substances are caused to react in a retort, and the vapors made to pass through a weak sodium hydroxide solution cooled to 15° C. (59° F.), whereby volatile by-products are removed, the methyl-ethyl ether being finally condensed in a well-cooled receiver. It is a colorless liquid, very inflammable, of peculiar characteristic odor, boiling at 11° C. (51.8° F.). Its use as an anæsthetic has been very limited.

ÆTHER ACETICUS, *U. S., Br., P. G.*—Acetic Ether.

Naphtha aceti.—Ethyl acetate, E.; *Ether acétique. Acétate d'éthyle*, Fr.; *Essigäther, Essignaphtha*, G.; *Etere acetico*, It.

Formula, $C_2H_5C_2H_3O_2$ or $CH_3COOC_2H_5$. Molecular weight, 87.40.

Preparation.—The following method, recommended by Hager, yields very satisfactory results, and is admirably adapted to the manufacture of acetic ether in small lots: 63 parts by weight of alcohol (specific gravity 0.820) are carefully mixed with 109 parts by weight of 94 per cent. sulphuric acid, and the mixture set aside for a day or two in a well-closed flask, so that ethyl-sulphuric acid may be formed; having prepared anhydrous sodium acetate by heating at 130° C. (266° F.) to constant weight, 82 parts of the powdered acetate are put into a retort and the acid alcohol mixture carefully added. The retort is heated on a water-bath, and the vapors are condensed in a well-cooled receiver as long as reaction continues brisk; the final distillate is collected separately, as it is apt to contain more acetic acid. The process involves the following reactions: (1) $C_2H_5OH + H_2SO_4 = C_2H_5HSO_4$ (ethyl-sulphuric acid) $+ H_2O$; (2) $C_2H_5HSO_4 + NaC_2H_3O_2 = C_2H_5C_2H_3O_2$ (ethyl acetate) $+ NaHSO_4$.

Crude acetic ether usually contains acetic acid, alcohol, and water, and to remove these it is first well shaken with one-third of its volume of an aqueous solution containing 20 per cent. sodium chloride and 2 per cent. sodium carbonate; caustic alkalies or milk

of lime are inadmissible. The washing is repeated two or three times, and the ether is then freed from water by shaking with freshly ignited potassium carbonate, and finally is distilled; calcium chloride is not suitable for dehydration, as it is apt to combine chemically with the acetic ether.

The U. S. Pharmacopœia defines acetic ether to be a liquid containing about 90 per cent. by weight of ethyl acetate and 10 per cent. of alcohol, mixed with a little water.

Properties and Tests.—Acetic ether is a colorless, limpid, volatile liquid having an agreeable, refreshing, ethereal, and somewhat acetous odor and taste. The densities given by the pharmacopœias are: 0.883 to 0.885 at 25° C. (77° F.), U. S., 0.900 to 0.904, P. G., and 0.900 to 0.905, Br. The density is no evidence of purity, since acetic ether dissolves ether, alcohol, and chloroform in all proportions, and at 15° C. (59° F.) one-twenty-fourth of its volume of water. It is also soluble in water, requiring of that menstruum at 0° C. (32° F.) 8 volumes, and at 15° C. (59° F.) 9 volumes, or 10 parts by weight (Clark), not less than 10 parts, Br.; about 7 parts at 25° C. (77° F.), U. S. It boils between 74° and 76° C. (165° and 168.8° F.), P. G.; at 73.9° to 77.8° C. (165°–172° F.), Br., at about 72° C. (161.6° F.), U. S. It is very inflammable, though less so than ether, and burns with a yellowish-white flame, giving off vapors having the odor of acetic acid. It has a neutral reaction to test-paper, but if kept in contact with the air, and particularly in the presence of water, free acetic acid is formed. Solutions of potassium, sodium, and other hydroxides decompose it gradually, if heated, into acetic acid and alcohol; but metallic sodium does not act upon acetic ether in the cold except in the presence of water or alcohol (Wanklyn, Ladenburg). It dissolves a little phosphorus and sulphur, and is a good solvent for volatile and fixed oils, many resins, cantharidin, and other organic compounds.

The *purity* of acetic ether is determined by its neutral reaction, its specific gravity, its volatility without residue, and its behavior to water; when 10 Cc. of it are agitated with an equal volume of water, just previously saturated with acetic ether, in a graduated tube, the ethereal layer, after its separation, should measure not less than 9 Cc. If a portion be allowed to evaporate spontaneously from clean, odorless blotting-paper, the final odor should not resemble that of pineapple (absence of butyl and amyl derivatives). —U. S. If acetic ether is allowed to flow carefully upon an equal volume of concentrated sulphuric acid, no dark color should be formed at the line of contact of the two liquids.—U. S., P. G.

Action and Uses.—Acetic ether closely resembles sulphuric ether in its action on the system, but being less volatile than the latter it is absorbed more slowly, and is consequently not so prompt in producing anæsthesia. The drug is also eliminated with less rapidity than is sulphuric ether, hence it is not sufficiently fleeting in its effect to lend itself as a useful anæsthetic. The inhalation of small quantities may be useful in bronchial and laryngeal irritation, and in nervous cough and syncope. Internally it is stimulant and antispasmodic, and small doses have been employed in flatulent colic. Externally it is an irritant, and may be employed as an embrocation in the treatment of muscular rheumatism and in other conditions in which liniments are commonly recommended.

The dose is from 15 to 30 minims (1–2 Cc.), well diluted.

ÆTHYLENI BICHLORIDUM.—Ethylene Bichloride.

Æthylenum chloratum, Elaylum chloratum, Liquor Hollandicus.—Ethene chloride, Dutch liquid, E.; *Liqueur des Hollandais, Huile du gas olefiant*, Fr.; *Æthylenchlorid, Elaylchlorid*, G.

Formula, $C_2H_4Cl_2$ or $CH_2Cl.CH_2Cl$. Molecular weight, 98.18.

Preparation.—Ethylene or olefiant gas and Dutch liquid were discovered by Dieman, Troostwyk, Bondt, and Lauwernburgh (1795). The latter is produced on bringing the former in contact with chlorine gas. 1 part of strong alcohol is mixed with 3 or 4 parts of sulphuric acid and sufficient sand to form a thick mixture, which is heated, and the gas passed successively through sulphuric acid, solution of potassium hydroxide, and sulphuric acid, whereby it is deprived of alcohol, ether, and sulphur and carbon dioxides. The gas thus purified is conducted into a retort containing a mixture of 2 parts of manganese dioxide, 3 of common salt, 4 of water, and 5 of sulphuric acid.

The retort is at first very moderately warmed, and afterward heated, when the liquid distils. The distillate is washed with water and rectified over calcium chloride.

Properties.—It is a colorless, thin, oily liquid, having an ethereal odor resembling that of chloroform, and a sweetish, ethereal taste; it has the specific gravity 1.28 at 0° C. (32° F.) or 1.254 at 15° C. (59° F.), is sparingly soluble in water and freely soluble in alcohol and ether. It is inflammable, and burns with a yellowish flame having a green border, and giving off vapors containing hydrochloric acid. When agitated with water the latter does not acquire an acid reaction to litmus-paper, and when agitated with sulphuric acid the mixture is not blackened. On being mixed with alcoholic solution of potassium hydroxide, water and potassium chloride are formed, and gaseous *chlorethyline*, CH_2CHCl, is given off at a moderate temperature; this gas condenses at —18° C. (—4° F.).

Action and Uses.—Considerable difference of opinion as to its value exists among the various authors who have experimented with ethylene bichloride. This is probably due to the fact that in some cases an impure article was employed. However, even when the pure drug is used, all are not agreed upon its efficacy as a practical anæsthetic. Simpson claims it to be entirely too irritating to the mucous membranes, and that very few can inhale it sufficiently long to cause anæsthesia. Mr. Nunnelly has employed it in many cases, and he and Dr. Reichert both state that while it does irritate the respiratory tract, its effects are no more marked than those of ether, and that it acts as a cardiovascular depressant, causing a gradual decrease in blood-pressure, although its effect is less marked than that of chloroform. The drug causes less excitement during the early stages of its administration than does ether, and in overdose produces death by centric respiratory paralysis. It has been applied as a local anæsthetic for the relief of neuralgia and other limited painful areas, but because of its high price the drug is rarely employed.

ÆTHYLIS BROMIDUM.—Ethyl Bromide.

Æther bromatus, P. G.; *Monobromethane, Hydrobromic ether*, E.; *Bromure d'éthyle, Ether hydrobromique (bromhydrique)*, Fr.; *Æthylbromid, Bromäthyl, Bromwasserstoffäther*, G.

Formula, C_2H_5Br. Molecular weight, 108.12.

Preparation.—Serullas (1827), the discoverer of this ether, recommended its preparation by the action of bromine upon alcohol in the presence of phosphorus. Personne (1861) replaced the latter by amorphous phosphorus. The German Pharmacopœia gives the following directions for its manufacture: To a well-cooled mixture of 12 parts of sulphuric acid and 7 parts of alcohol (specific gravity 0.816), 12 parts of potassium bromide in powder-form are gradually added, and the mixture then distilled on a sand-bath; the distillate is well washed by agitation, first with an equal volume of sulphuric acid and then with a 5 per cent. solution of potassium carbonate; finally, it is dehydrated with calcium chloride and redistilled on a water-bath. This process involves a double reaction: first, the formation of ethylsulphuric acid, $C_2H_5OH + H_2SO_4 = C_2H_5HSO_4 + H_2O$; and secondly, the formation of ethyl bromide, $C_2H_5HSO_4 + KBr = C_2H_5Br + KHSO_4$.

Properties.—Ethyl bromide is a colorless, highly refractive, very volatile liquid, of a strong ethereal odor and a sweetish and warm taste. It has the density 1.453–1.457 at 15° C. (59° F.), boils at 38°–40° C. (100.4°–104° F.), burns with some difficulty with a green non-sooty flame, is sparingly soluble in water, and dissolves in all proportions in alcohol and ether. It is easily decomposed by light and air, turning brown, and then containing hydrobromic acid and free bromine. The presence of 1 per cent. of alcohol or 3 per cent. of ether renders the liquid more stable.

Tests.—Ethyl bromide should have a neutral reaction, and if shaken with an equal volume of pure concentrated sulphuric acid no color should be produced within one hour (absence of ethylene and amyl compounds). If shaken with an equal volume (5 Cc.) of water for a few seconds, a portion (2.5 Cc.) of the latter, removed with a pipette, should remain clear for at least 5 minutes upon addition of 1 drop of silver nitrate test-solution, showing absence of hydrobromic acid.

This preparation should not be confounded with *ethylene bromide*, $C_2H_4Br_2$, a faintly brown-colored liquid, with chloroform-like odor and a sweet taste, followed by a burning sensation. Its specific gravity at 21° C. (69.8° F.) is 2.163 and boiling-point at 131° C.

(267.8° F.); at 0° C. (32° F.) it solidifies to a snow-white crystalline mass. When inhaled, marked poisonous effects have been produced.

Action and Uses.—Ethyl bromide is commonly employed as an anæsthetic, and the advantages claimed for it are its agreeable odor, slight irritant properties, and great rapidity of action, with sudden return to consciousness after withdrawal of the drug. It is also stated that this compound is less liable to cause an outpouring of mucus, salivation, headache, and vomiting than the older anæsthetics. At present, pure ethyl bromide is considered a safe anæsthetic, and it is probable that the many fatalities resulting from its employment were due to the administration of an impure article. It has been suggested that the decomposition of the drug may also have been the cause of some fatal issues. Like other anæsthetics, it depresses the central nervous system. It has only a slight depressing effect upon the circulation and respiration when given in moderate amount. The pulse is slowed by stimulation of the vagi, and arterial tension is slightly lowered. Excessive quantities cause death by respiratory failure. Ethyl bromide is rapidly eliminated by the lungs and kidneys. When moderate amounts are inhaled, the face becomes suffused, the pupils dilated, and the pulse somewhat slower. Muscular relaxation takes place and the respiration is slightly impeded. Sudden death due to respiratory paralysis occasionally occurs from its administration, and in other cases death has taken place in from 8 hours to 3 days after its employment. Occasionally syncope, nervous twitchings, or tetanic convulsions have resulted from its use, but they are usually of short duration, and little importance may be attached to them. The treatment of accidents occurring during the administration of this drug consists first in its removal, and second in the prompt institution of artificial respiration. The administration of respiratory stimulants, such as alcohol, strychnine, and atropine, is also to be recommended.

Ethyl bromide has been employed in an atomizer as a local anæsthetic, but ethyl chloride has now almost supplanted it for this purpose. As a general anæsthetic it is to be recommended in all minor surgical operations, such as the opening of boils or abscesses. E. E. Montgomery recommends it highly as an anæsthetic in minor gynæcological operations and in labor; especially in the latter condition, as it is less apt to cause uterine relaxation and post-partum hemorrhage.

Ethyl bromide should be given in as concentrated a form as possible. The cloth or inhaler containing it should be so placed that little or no air is inhaled during its administration. As a general anæsthetic, from 45 minims to 3 fluidrachms (3–12 Cc.) are usually required, and when major surgical operations are to be performed, it is to be followed by ether or chloroform. Internally it has been recommended as a soporific in doses of from 5 to 20 minims (0.30–1.30 Cc.), largely diluted with ice water.

ÆTHYLIS CARBAMAS, *U. S.*—Ethyl Carbamate.

Ethyl urethane, Urethane, E.; *Uréthane,* Fr.; *Carbaminsäure-Æthylester, Æthylurethan, Urethan,* G.

Formula, $C_2H_5CH_2NO_2$ or $CO.NH_2.OC_2H_5$. Molecular weight, 88.42.

An ester of carbamic acid obtained by the reaction of alcohol upon urea or one of its salts. It should be kept in well-stoppered bottles.—U. S.

In chemistry the general term "urethane" is applied to all ethers of carbamic acid, which acid, however, has thus far never been isolated, and is only known in combination: its most familiar compound is ammonium carbamate, $NH_4NH_2CO_2$, one of the constituents of official ammonium carbonate. If the formula for carbamic acid is assumed to be HNH_2CO_2, then the formation of all urethanes may be explained by the substitution of a univalent radical for the 1 atom of displaceable hydrogen, which may be brought about in various ways.

Preparation.—Ethyl carbamate may be prepared by allowing an excess of alcohol to react with urea nitrate at a temperature of about 125° C. (257° F.) in a sealed tube for several hours. The resulting mass, when cool, becomes crystalline, and is then dissolved in just sufficient water, the solution being subsequently repeatedly shaken out with ether. After recovery of the ether, the residue is distilled and recrystallized from water. The reaction involved is shown by the following equation: $(NH_2)_2COHNO_3 + C_2H_5OH = CO.NH_2.OC_2H_5 + NH_4NO_3$. It may also be obtained by the action of

ammonia on ethyl carbonate or chlorocarbonate, or by direct union of cyanic acid with ethyl alcohol.

Properties and Tests.—Ethyl carbamate occurs in columnar colorless crystals or scales, odorless, and having a cooling saline taste. It is soluble at 25° C. (77° F.) in less than its own weight of water, 0.6 part of alcohol, 1 part of ether, 1.3 parts of chloroform, and 3 parts of glycerin. When heated to 47.5°–50° C. (117.5°–122° F.) it melts, and at a higher temperature is decomposed, burning without leaving a weighable residue. If 1 Gm. of ethyl carbamate be added to 5 Gm. of sulphuric acid and gently heated, it is decomposed with evolution of carbon dioxide, while alcohol and acid ammonium sulphate remain in solution. If 1 Gm. of ethyl carbamate be heated with 5 Cc. of concentrated potassium hydroxide solution, ammonia gas is given off, recognizable by the usual tests. If 0.5 Gm. of ethyl carbamate be dissolved in 5 Cc. of water, and warmed with 1 Gm. of dry sodium carbonate and 0.01 Gm. of iodine, yellow crystals of iodoform separate on cooling. If 6 Gm. of ethyl carbamate be dissolved in 6 Cc. of water, and the solution be divided into 3 equal parts, the addition severally of 5 Cc. of nitric acid, of mercuric nitrate test-solution, or of oxalic acid test-solution should not produce a white precipitate (distinction from, and absence of, urea or carbamide).—U. S.

Action and Uses.—Ethyl carbamate is a hypnotic resembling paraldehyde in its physiological action and is devoid of the unpleasant odor and taste of the latter drug. It exercises practically no direct analgesic influence. Reports concerning the value of the drug are very contradictory, and it is generally considered an unreliable hypnotic. In those instances in which it is effective, the sleep produced is quiet and tranquil, usually unattended by depression or unpleasant after-effects. Overdoses cause distinct depression of the spinal cord, heart, and respiration. Death from a fatal quantity is due to asphyxia. Urethane may be employed in nervous or functional insomnia, as in that due to mental or physical depression, chronic alcoholism, and insanity. A case of traumatic tetanus in a boy of fifteen years is said to have been cured by 4-grain doses of urethane every 2 hours. The dose is from 15 to 45 grains (1–3 Gm.), in powder, capsule, or solution. It has been administered hypodermically in about one-fourth the dose given by the mouth.

Allied Compounds.—EUPHORIN. *Ethyl phenylcarbamate. Phenylurethane,* $C_2H_5NHC_6H_5CO_2$ or $CO(NHC_6H_5)(OC_2H_5)$.—This compound is obtained by the interaction of aniline and ethyl chloroformate, and is purified by recrystallization from diluted alcohol. It is a white or colorless crystalline powder, of faint aromatic odor and slight clove-like after-taste. Euphorin is sparingly soluble in cold, but more readily in hot water, and soluble in alcohol, ether, and hydroalcoholic mixtures, such as wines, etc. The compound melts between 49° and 50° C. (120.2° and 122° F.), and dissolves without color in cold sulphuric acid. Euphorin possesses analgesic, antipyretic, and antirheumatic properties given in doses of from 2 to 8 grains (0.10–0.50 Gm.). It is also used as an antiseptic, applied in powder or made into an ointment, in the treatment of ulcers and other cutaneous lesions.

NEURODIN. *Acetyloxyphenylurethane,* $C_6H_4(CO_2CH_3)NH.CO_2C_2H_5$.—Colorless, odorless crystals, melting at 87° C. (188.6° F.), and soluble in 1400 parts of cold or 140 parts of hot water. It is obtained by acetylating paraoxyphenylurethane, an intermediate product of the action of ethyl chloroformate upon para-amidophenol. Neurodin is said to possess antipyretic as well as antineuralgic properties, and is given in doses of from 7½ to 22½ grains (0.5–1.5 Gm.).

THERMODIN. *Acetylethoxyphenylurethane. Phenacetin-urethane,* $C_6H_4(OC_2H_5)N(COCH_3)CO_2C_2H_5$.—Colorless, odorless, and tasteless needle-shaped crystals, melting at about 87° C. (188.6° F.), and soluble in 2600 parts of cold or 450 of boiling water. It is obtained by acetylation of paraethoxyphenylurethane, an intermediate product of the action of ethyl chlorocarbonate upon paraphenetidin. Used like the preceding compound in doses of from 7½ to 15 grains (0.5–1 Gm.).

ÆTHYLIS CHLORIDUM, *U. S.*—Ethyl Chloride.

Æthylum chloratum, Æther chloratus.—Monochlorethane, Hydrochloric ether, E.; *Chlorure d'éthyle, Ether hydrochlorique,* Fr.; *Æthylchlorid, Chloræthyl, Chlorwasserstoffäther,* G.

The names *Chelen* and *Kelen* are used for ethyl chloride in some parts of Europe.

Formula, C_2H_5Cl. Molecular weight, 64.00.

A haloid derivative, prepared by the action of hydrochloric acid gas upon absolute alcohol. On account of its extreme volatility it should be preserved in hermetically sealed glass tubes, and kept in a cool place remote from lights or fire.—U. S.

Preparation.—Ethyl chloride is obtained by passing dry hydrochloric acid gas into cold absolute alcohol, distilling at a very moderate heat, washing the distillate with water and a weak alkaline solution, and rectifying. It is said also to be made on a large scale by heating a mixture of alcohol and concentrated hydrochloric acid for some time under increased pressure (40 atmospheres) at a temperature of 150° C. (302° F.), and then distilling the resulting product. The ethyl chloride vapors are passed through water warmed to 25° C. (77° F.), then dried by passing over calcium chloride, and finally condensed in well-cooled vessels. The reaction between alcohol and hydrochloric acid is shown by the following equation: $C_2H_5OH + HCl = C_2H_5Cl + H_2O$.

Properties and Tests.—"Ethyl chloride is a colorless, mobile, very volatile liquid, having a characteristic, rather agreeable odor, and a burning taste. Its specific gravity is 0.918 at 8° C. (46.4° F.). It is slightly soluble in water, readily soluble in alcohol. Ethyl chloride boils at a temperature of 12.5° to 13° C. (54.5–55.4 F.), and at its ignition temperature burns with a smoky, green-edged flame, with the production of gaseous hydrochloric acid. When liberated, at ordinary room-temperature, from its sealed glass tube, ethyl chloride vaporizes at once; the gas is very inflammable, and consequently it should not be used in proximity to a gas-flame or fire."—U. S. If chlorine be allowed to act on ethyl chloride, ethylidene chloride, also known as monochlorinated hydrochloric ether, $C_2H_4Cl_2$, is produced, which is isomeric with ethylene bichloride and resembles the same in odor, but differs from it in density (1.198) and boiling-point (57.5° C.). "If 10 Cc. of ethyl chloride, while cold, be dissolved in alcohol, and a few drops of silver nitrate test-solution be added, no turbidity should be produced (absence of hydrochloric acid). If 10 Cc. of ethyl chloride be agitated with 10 Cc. of cold water, and the supernatant stratum of ethyl chloride be evaporated spontaneously, and if a few drops of potassium dichromate test-solution be added to the remaining aqueous liquid, followed by some diluted sulphuric acid, and the mixture boiled, no odor of aldehyde should be devoloped, and a greenish or purplish color should not be produced in the liquid (absence of alcohol). On allowing ethyl chloride to evaporate from clean, odorless blotting-paper which has been saturated with it, no unpleasant odor should remain upon the paper (absence of sulphur compounds, etc.)."—U. S.

Action and Uses.—Ethyl chloride is employed in medicine for two purposes: as a local anæsthetic and as a general anæsthetic. When employed as a local anæsthetic, it is sprayed upon the part which is to be anæsthetized, being driven, from a glass tube which contains it, through a fine opening at the end of the tube, the heat of the hand causing sufficient vaporization to produce pressure and to cause free escape of the liquid. Its rapid evaporation as it strikes the skin produces a momentary redness, followed by the sudden appearance of a white spot, which is due to freezing taking place, and, while this lasts, the incision is made. Certain manufacturers combine with ethyl chloride various drugs like the oil of mustard, the active principle of capsicum, and menthol, all of which are designed to aid in producing the local anæsthesia or to cause a therapeutic effect in addition to that produced by the freezing of the part. This local freezing is useful not only for the production of anæsthesia in small operations, but also for the benumbing of painful nerves, as in cases of supraorbital neuralgia. Ethyl chloride has more recently been advocated by some persons as a general anæsthetic. When given by inhalation, it is not suited to prolonged operations, because its action is fleeting and not profound. When it is inhaled, the reflexes are usually entirely abolished, but muscular rigidity is not always overcome. Its vapor should be given in concentrated form. A useful way to give it is to place a large funnel over the patient's nose and mouth, to close the space between the edge of the funnel and the angles of the mouth by the hands or by a napkin, and then to spray the drug into the small end of the funnel, a little cotton being placed loosely in the funnel to collect the liquid and to permit its rapid volatilization. Given in this form, so that the patient inhales the concentrated vapor, moderate anæsthesia is quickly produced. Many practitioners prefer using specially prepared inhalers for the administration of this anæsthetic. Given by inhalation, the drug has the advantage that it is more pleasant in odor than sulphuric ether.

ÆTHYLIS IODIDUM.—Ethyl Iodide.

Hydriodic ether, E.; *Iodure d'éthyle, Ether hydriodique*, Fr.; *Jodäthyl, Jodwasserstoffäther*, G.

Formula, C_2H_5I. Molecular weight 154.72.

Preparation.—This compound was prepared by its discoverer, Gay-Lussac (1815), by distilling a mixture of absolute alcohol and concentrated hydriodic acid, and separating the ether from the distillate by means of water. Much better results are obtained by distilling a mixture of alcohol, phosphorus, and iodine, as proposed by Serullas (1827); and the substitution of amorphous for ordinary phosphorus, first used by Personne (1861), affords still greater advantages. The method now followed consists in adding 40 parts of iodine, in small portions, to a mixture of 60 parts of 95 per cent. alcohol and 5 parts of amorphous phosphorus contained in a retort. The vessel is set aside for 24 hours, and then, after attachment of a Liebig condenser, is heated on a sand-bath to about 80° C. (176° F.). The yellow-colored distillate is shaken with a dilute solution of acid sodium sulphite, after which the supernatant ethereal layer is twice washed with double its volume of water, dehydrated by means of calcium chloride and rectified on a water-bath. The residue in the retort from the first distillation consists of phosphoric acid, the reaction occurring according to the following equation: $5I_2 + P_2 + 10C_2H_5OH$ yields $10C_2H_5I + 2H_3PO_4 + 2H_2O$.

Properties.—Ethyl iodide is a colorless non-inflammable liquid having a peculiar penetrating odor. It is freely soluble in alcohol, nearly insoluble in water, does not react upon litmus, boils near 72° C. (161.6° F.), and has at 15° C. (59° F.) the specific gravity 1.944. Exposed to air and light, it liberates iodine, and is gradually colored red and brown; the presence of metallic mercury, or preferably silver, prevents the coloration but not the decomposition. Iodine is liberated also by chlorine gas, nitric acid, and strong sulphuric acid.

Action and Uses.—Ethyl iodide is said to possess no soporific or anæsthetic properties when employed in moderate amounts. In large quantities, however, it produces anæsthesia. Small quantities when inhaled do not produce irritation of the respiratory tract, but, on the contrary, cause the breathing to become deeper and easier. Hydriodic ether has been recommended for the purpose of bringing the organism rapidly under the influence of iodine in the treatment of pulmonary tuberculosis and chronic bronchitis and chronic laryngitis. As it possesses certain antispasmodic properties, it has been suggested as a remedy in the treatment of spasmodic asthma. The dose for inhalation is from 10 to 15 minims (0.60–1 Cc.) several times daily or as occasion requires. It may be kept in glass pearls, which may be crushed in a handkerchief and inhaled as needed.

AGAR-AGAR.—Vegetable Gelatin; Gelosine.

A gelatin-like substance, extracted in the East Indies from various species of seaweeds. The largest production is in China, but the best product, at least for bacterial purposes, comes from Japan. The complete list of species yielding it is very uncertain, but it appears to come principally from *Eucheuma gelatinum* Agardh., *E. spinosum* Agardh., *Gelidium corneum* Lam., *G. cartilagineum* Gaill., *Gloiopeltis tenax* J. Agardh., *Sphærococcus* (*Plocaria* Montez; *Gracilteria* Greville) *compressus* Agardh., and *S. lichenoides* Agardh. The last-named species is the source of the celebrated Chinese "birds'-nest pudding." Agar-agar is extracted by hot water and dried for commercial purposes in the form of bundles of shreds about 2 feet long or (the Japanese product) in yellowish-white sticks a foot long and an inch wide, or in small cakes or thin sheets.

Agar-agar consists practically of gelose, which dissolves in 500 parts of water and is precipitated in an impure form by alcohol. Its acidulated aqueous solution will not form into a jelly.

Pharmaceutical Uses.—Agar-agar jelly, made by dissolving 1 part of commercial agar powder in 29 parts of water on a water-bath, and adding to the resulting acid solution sodium bicarbonate in the proportion of 1 part to 100 parts by weight, has been suggested for the preparation of suppositories, but experience has shown that it is not

desirable, owing to the fact that the jelly requires for fusion a temperature far above that of the human body; moreover, the suppositories when exposed to air become dry and hard. A thinner jelly, made in the proportion of agar-agar 1 part and water 100 parts, has been used as a vehicle for ointments and dermatologic pastes, for which the advantage is claimed that, upon drying, the resulting film is non-contractile.

Agar-agar has also been proposed as a substitute for sodium stearate in the manufacture of glycerin suppositories, but it has been found to be impossible to make such suppositories stronger than 75 per cent. of glycerin, whereas the official glycerin suppositories contain 90 per cent. (see *Am. Jour. Phar.*, 1895, page 599).

Action and Uses.—Agar-agar is practically never used in medicine. It possesses demulcent and emulsifying properties in common with the other species of algæ. It is principally used at present in bacteriological laboratories as a culture-medium for micro-organisms.

AGARICUS.—Boletus; White or Purging Agaric.

Larch agaric, Male agaric, German tinder, E.; *Lärchenschwamm* G.; *Agaric blanc officinal, Polypore du Méleze,* Fr. Cod.

The dried plant *Polyporus officinalis* Fries (*Boletus laricis* Jacq., *B. purgans* Pers.—Fam. *Polyporei*).

Origin.—This fungus grows on old trunks of the European larch in central and southern Europe, and on *Larix Sibirica* Ledebour, in northern Asia, whence it is brought into commerce. We have also found apparently the same upon *Pinus ponderosa* Dougl. in Arizona, and it is said to come from Central America.

Description.—It is sessile, hoof-shaped or irregularly conical, 10 to 20 Cm. (4 to 8 In.) broad, 5 to 10 Cm. (2 to 4 In.) thick, and sometimes 20 to 30 Cm. (8 to 12 In.) high, externally grayish or yellowish; the hymenium on the lower side is in the form of small yellowish pores. It is collected in autumn and winter, and deprived of the firm outer rind. In commerce it occurs in irregular pieces of the size of the fist, and frequently much larger. It is white, light, somewhat spongy, resinous, very friable, but not readily pulverizable; has a faint odor and a sweetish, afterward acrid and lastingly bitter taste.

Constituents.—Agaricin, the so-called active principle in commerce, is not the *agaracin* of the P. G., which is *agaric* (or *agaricic*) *acid.* It is far better, therefore, to prescribe it under the latter name.

White agaric, when treated with alcohol, yields 4 resinous principles, which are separated during evaporation of the alcohol, when 3 white resins are precipitated, the other, red-colored resin, remaining in solution. The precipitate is collected and treated with alcoholic potassium hydroxide solution, which dissolves only the α resin. The residue, containing the β and the γ resin, is treated with water, when only the former, as potassium salt, is dissolved. This aqueous solution is precipitated with barium chloride, the precipitate collected, dissolved in boiling dilute alcohol, and the resin freed by sulphuric acid. The alcoholic filtrate yields on cooling agaricin, which may be obtained in the crystalline state from 30 per cent. alcohol, which the P. G., however, does not require.

The total amount of resinous matter in agaric is said to reach 79 per cent. (Lloyd). This mixed resin is also used medicinally in doses of 0.015 Gm.

Action and Uses.—Agaricin when applied to abraded surfaces or mucous membranes acts as a distinct counterirritant. Its subcutaneous injection may even produce suppuration. Internally in overdose it is an irritant to the gastro-intestinal mucous membrane, and may cause nausea, vomiting, and purging. It is stated that the drug has a selective action upon the peripheral nerves supplying the sweat-glands, as that secretion is greatly decreased during its administration. Apparently it has no effect upon other secretions. In overdose it may cause depression and dyspnœa. Agaric has been employed in the dose of 5 grains (0.30 Gm.) in the night-sweats of phthisis, but in the writer's experience it has seldom given benefit. As the drug is slowly absorbed, it should be given several hours before the expected sweat.

Agaricin may be given in the dose of 1 or 2 grains (0.06–0.12 Gm.).

Other Species.—P. SUAVEOLENS Fr. (*Boletus salicis, Weidenschwamm*), *P. annosus* Fr. (*Birkenschwamm*), *P. squamosus* Fr., and other species, have apparently a similar composition and similar properties. *P. anthelminthicus* (*Chu-tan* of the Chinese) is used as an

anthelmintic. *P. hirsutus* Fr. (*Borstenlächerschwamm* or *Pugak*), and *P. tinctorius* Quel., yield dye-stuffs.

P. FOMENTARIUS (L.) Fr. (*Surgeons' agaric, Fungus chirurgorum, Oak agaric, Spunk, Punk, Touchwood, Amadou, Agaric du chêne, Wundschwamm, Feuerschwamm, Zünder*) is a very different substance; its uses mechanical. It is collected in central and southern Europe, chiefly from oak and beech, peeled and trimmed down to the cellular tissue, sliced, washed in weak alkali, then in water, beaten, and worked until soft, washed in niter and dried. The slices are then soft and tough, light, elastic and cushion-like, the surface of a light-brown velvety appearance. It is without taste and is inert.

Similar, but harder products are yielded by *P. igniarius* and *P. marginatus* Fries, the former internally rust-brown or dark cinnamon-brown, the latter yellowish.

AJOWAN.—Ajava; Ajwan; Omam; Bishop's Weed.

The fruit of *Ptychotis Coptica* DC. (*Carum Ajowan* B. et H.) (Fam. *Umbelliferæ*).

The plant is indigenous and cultivated in India, as well as in the countries farther west and in Egypt. The fruit is an important condiment and medicine, being a much-used carminative and intestinal antiseptic in cholera and other diseases presenting similar conditions.

The accompanying illustration answers better than any description. The color is of a very pale-brown and the small tubercles between the ribs are characteristic. It contains 6 oil-tubes. In odor and taste it strongly resembles thyme.

FIG. 7.

Ajowan fruit (× 9).

Ajowan yields 5 or 6 per cent. of volatile oil, having a specific gravity of 0.896. About half of this oil is thymol; the remainder is cymene and a terpene, and is in commerce under the name of *thymene*.

Action and Uses.—Ajowan is practically never used in medicine in this country. It has been considered an antispasmodic and antiseptic. By the physicians of the East it is considered the most powerful of all umbelliferous carminative fruits. When combined with asafetida and rock salt the drug is frequently employed by the natives of India for its carminative effect. It is stated that it may be employed with advantage in chronic bronchitis with excessive secretion. When exhibited in combination with mercury, ajowan has met with favor in the treatment of Asiatic cholera.

The drug is given in the dose of 10 to 30 grains (0.60–2 Gm.) of the Extractum Ptychotis Liquidum P. I., Aqua Ptychotis P. I. Omam water, made by distillation with the fruit, is given in the dose of 1 or 2 fluidounces (30–60 Cc.). The dose of the volatile oil is 1 to 3 minims (0.05–0.20 Cc.).

ALBUMEN.—Albumen.

Albumen Ovi.—White of egg, E.; *Blanc d'œuf*, Fr.; *Eiweiss, Hühnereiweiss*, G.; *Clara de huevo*, Sp.

White of egg is no longer recognized in the pharmacopœias of the world, with the exception of the German, which prescribes a dried form of albumen, to be used in the preparation of iron albuminate and similar compounds.

Egg albumen consists of two or three laminæ, the total average weight for one egg being 23–24 Gm. (355–371 grains). It is composed of 82–88 per cent. of water, and, on an average, 13.32 per cent. of solid matter, as well as minute traces of fat, sugar, and extractive, and yields about 0.65 per cent. of ash. The ash of egg albumen consists of 42 per cent. of potassium chloride, 9 per cent. of sodium chloride, phosphates and sulphates of the alkalies, together with some silica, lime, iron, and magnesia. The organic portion of egg albumen consists of a protein compound, the albumen proper or albumin, having the following average elementary composition: carbon, 53.7 per cent.; nitrogen, 15.5 per cent.; hydrogen, 7.1 per cent.; oxygen, 22.1 per cent.; and sulphur, 1.6 per cent. An aqueous solution of albumen when heated to 75° C. (176° F.) is coagulated. It is precipitated by most mineral and some organic acids, but not by phosphoric or acetic acid. Alcohol coagulates albumen and ether precipitates it, the precipitate being only partially soluble in water. It is soluble in caustic alkalies, but forms precipitates with the salts of most heavy metals; this latter property renders it valuable in

cases of poisoning by salts of mercury, copper, etc. Albumen is also precipitated by volatile oils, camphor, carbolic acid, and tannic acid (see *tannalbin*, under Tannic Acid).

Albumen.—*Albumen Ovi Siccum*, P. G.—*Dried egg albumen*, E.; *Trockenes Hühnereiweiss*, G.—This is prepared by carefully separating the yolk from the white of fresh eggs and passing the latter through a fine bolting-cloth sieve, for the purpose of removing any membranes present. The white of egg is next poured on shallow porcelain plates and completely dried in well-ventilated drying closets at a temperature not exceeding 55° C. (131° F.). Evaporation to dryness in a vacuum apparatus may also be resorted to. The yield amounts to about 100 Gm. of dried albumen from 30 eggs. It occurs in yellowish, amorphous, translucent masses, easily reduced to a coarse powder having but a faint odor and an insipid taste. It should yield a nearly clear solution with 20 parts of water, which is coagulated by heating to 75° C. (176° F.), and is precipitated by lead acetate, mercuric chloride, ferric chloride, cupric sulphate, picric acid, carbolic acid, chloral hydrate, nitric acid, metaphosphoric acid, etc.

The valuation of albumen is made by determining the amount of nitrogen present, usually by Kjeldahl's method (see Nitrogen), the weight of nitrogen found, multiplied by 6.25, expressing the total amount of albumen.

Serum albumen or blood albumen is obtained by collecting the blood of slaughtered animals, allowing the same to coagulate in the cold and draining the serum from the coagulum placed on sieves. Upon subsequent evaporation of the serum dry albumen may be obtained.

Tata-albumen represents a modified form of albumen produced by keeping hen's eggs for several days in a 10 per cent. sodium hydroxide solution at a temperature of 45° C. (113° F.) and then placing the eggs in boiling water for 15 minutes. The albumen, instead of becoming hard and opaque, forms a translucent gelatinous mass which, after leaching with cold water, is readily soluble in boiling water. It may be dried and reduced to powder. Such modified egg albumen will be dissolved by acidulated pepsin solution in one-tenth the time necessary for a solution of a like weight of hard-boiled ordinary egg albumen. It has been recommended as a dietetic.

Tropon is the name applied to a whitish, odorless, and tasteless powder, said to contain 90 per cent. of albumen and about 1 per cent. of inorganic matter. It is free from gelatin and nucleins. The mode of preparing tropon has not been published, but it is said to be obtained from both animal and vegetable matter, and subsequently purified by treatment with hydrogen peroxide. It is intended as a nutrient agent.

Action and Uses.—Albumen is employed as an antidote in poisoning by corrosive sublimate and copper sulphate. Albumen water, made by agitating the white of one egg with one pint of cold water, is a very valuable article of diet in the summer diarrhœa of children. It is also said to be a valuable food in Bright's disease, as it supplies much nutriment and does not increase the albuminuria. A poultice made by coagulating this substance with alum (see Alum) is a valuable application for recent ecchymoses, acute conjunctivitis, and the bites and stings of insects. The ingestion of eggs is said to act as an irritant poison to some individuals, but this is extremely rare. Albumen is also largely employed for the clarification of liquids, because of the property which it has of involving in its coagulum the undissolved particles, after which it either rises to the surface or sinks to the bottom of the container.

ALCOHOL.—Alcohol.

Alcohol ethylicum, Alcohol vini.—*Ethyl alcohol, Ethyl hydroxide*, E.; *Alcool*, Fr.; *Æthylalkohol, Alkohol*, G.

Formula, C_2H_5OH. Molecular weight, 45.7.

Origin.—Alcohol may be obtained synthetically by first preparing acetylene, C_2H_2, by direct union of its elements, converting this into ethylene, C_2H_4, and by combination with the elements of water forming alcohol. It has been detected by Gutzeit (1875) in the juice of a number of plants. Béchamp (1880) proved its presence in the urine

and in the muscles of animals, and in putrid meat; and Muentz (1882) showed it to be contained in minute quantities in air, river-water, and river-soil. It is extensively prepared by the fermentation of saccharine liquids.

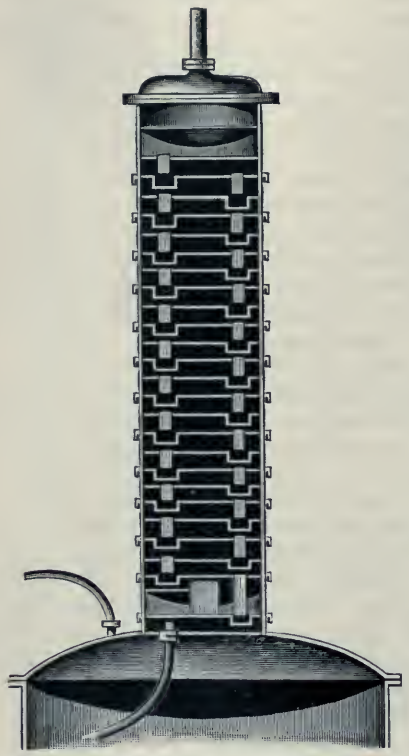
Although the knowledge of various fermented alcoholic liquids dates back to remote antiquity, alcohol does not appear to have been separated from spirituous beverages until about the eighth century, and soon afterward its strength was increased by repeated distillation. Under the name of *fermentation* various processes of decomposition are embraced, apparently depending upon the mere presence of a certain substance or compound, called the *ferment*, which does not enter into chemical composition with the fermenting substance or its products, and is capable of producing a large, if not unlimited, quantity of the latter. The several varieties of fermentation are distinguished from each other by the products obtained; thus, *saccharine* fermentation when starch is converted into dextrin and sugar by diastase; *lactic* fermentation when milk-sugar is transformed into lactic acid by casein; *butyric* fermentation when milk-sugar and lactic acid yield butyric acid in the presence of the same compound; *mucic* fermentation when cane-sugar is changed into mucus and mannite by protein compounds; *alcoholic* or *vinous* fermentation when grape-sugar or fruit-sugar is split into alcohol and carbon dioxide under the influence of yeast; and *acetic* fermentation when alcohol is oxidized to acetic acid. The exact manner in which these ferments act has not yet been determined, and with respect even to vinous fermentation is still a subject of controversy, notwithstanding the numerous experiments performed with the view of solving the problem. When, in 1810, Gay-Lussac demonstrated that sugar solutions would ferment only in the presence of atmospheric air, the process was regarded as depending upon the action of oxygen. Although the presence of organisms in yeast was afterward demonstrated, their connection with the process itself was not ascertained. Liebig (1839) perfected and enlarged the theory which was advanced by Stahl during the preceding century, and regarded fermentation as a metamorphosis induced by nitrogenized substances in a state of decomposition or putrefaction. Chiefly through Pasteur's investigations, begun in 1858, it is now generally conceded that under ordinary circumstances the ferment of alcohol fermentation is of vegetable origin, and consists of the so-called yeast-cells or yeast-plant, *Saccharomyces* (torula, Turpin) *cerevisiæ*, Meyen, the sporules of which are widely diffused in the air, and are thus easily supplied to all liquids, and if their further supply is arrested by admitting only air which has been filtered or passed through sulphuric acid, vinous fermentation does not take place. Alcohol and the other compounds formed during fermentation are regarded not merely as decomposition-products of sugar, but they result from the growth and multiplication of the yeast-plant, the existence of which depends upon the presence of sugar and protein, and by these cells the new compounds are generated.

Preparation.—The first step necessary in the manufacture of alcohol is the saccharine fermentation, known also as the mashing process, for the purpose of converting all the starch of grain or other material into sugar. While in this country grain is almost exclusively used for the manufacture of alcohol, potatoes form the chief source of starch in Europe. During the mashing process large quantities of starchy material are kept in contact with malt and water at a moderately elevated temperature, whereby the starch by the action of diastase (the ferment present in malt, and produced during the partial germination of barley) is first changed to maltodextrin and maltose, and finally all converted into dextrose, apparently by the simple appropriation of water, as shown by the following equations: $3C_6H_{10}O_5$ (starch) $+ H_2O = C_6H_{10}O_5$ (dextrin) $+ C_{12}H_{22}O_{11}$ (maltose); and $C_6H_{10}O_5$ (dextrin) $+ C_{12}H_{22}O_{11}$ (maltose) $+ 2H_2O = 3C_6H_{12}O_6$ (dextrose). The saccharine solution thus obtained is known as *wort*, and, after addition of some yeast is allowed to undergo fermentation at a temperature which is maintained between 15° and 30° C. (59° and 86° F.), whereby a weak alcoholic liquid is produced, due to the splitting up of dextrose into alcohol and carbon dioxide; thus, $C_6H_{12}O_6 = 2C_2H_5OH + 2CO_2$. Besides alcohol and carbon dioxide, however, some amyl alcohol and other homologous products, collectively designated as *fusel oil*, are also produced, and Pasteur has shown that small quantities of glycerin (3 per cent.) and succinic acid (0.6 per cent.) are invariably formed. The composition of these so-called low wines or weak spirits varies with the starchy material used in their manufacture; thus, potato starch always yields a much larger proportion of amyl alcohol than grain starch, while grain spirit is contaminated with œnanthic and other ethers. The percentage of alcohol in

mashed and fermenting mixtures never exceeds 14 per cent., since the yeast-plant cannot live in fluid containing a larger percentage.

Distillation of the fermented liquid furnishes a product much richer in alcohol (raw whiskey), which is then further rectified by treatment with recently burned charcoal and subsequent distillation in stills provided with a series of condensers, in the first of which much of the water and amyl alcohol is retained, allowing a purer and stronger alcohol to pass on to the other condensers. For the further removal of water and foreign odors from alcohol, distillation over sodium manganate, anhydrous sodium acetate, and freshly burned lime is employed. For the purpose of facilitating the rectification of alcohol on a large scale, use is made of a distilling column or dephlegmator, which is interposed between the still proper and the condenser, and, as shown in Fig. 8, consists of a series of communicating chambers, one above the other. The vapor rising from the still enters the lowest chamber through a narrow tube projecting upward into the chamber, and, having filled the space, passes into the next compartment through a second tube situated on the opposite side to that through which the vapor entered. By this arrangement the less volatile vapors will be condensed, and the resulting fluid collects on the bottom of each compartment, and if in sufficient quantity to rise above the projecting tube it flows into the next lower chamber, thus gradually separating the less volatile vapors from the more volatile, which latter are finally allowed to pass from the uppermost compartment into the condenser. Naturally the continual influx of hot vapor from the still keeps the liquid collecting on the bottom of the several compartments warmed, whereby the more volatile portions are constantly being vaporized and loss thus avoided.

Fig. 8.



Distilling column or dephlegmator.

During the past eight or nine years alcohol has been successfully produced from cellulose by treating dried peat with very dilute sulphuric acid for several hours at a temperature of 120° C. (248° F.), whereby peat-sugar is formed, which is subsequently fermented with yeast and distilled, yielding as much as 62 liters of absolute alcohol for 1000 kilogrammes of dry peat used (about 15 gallons for each ton).

The pharmacopœias recognize alcohol of different strengths, which latter can be determined by means of a special modification of the hydrometer, known as an alcoholometer. The Tralles' alcoholometer is preferred, because it is graduated to indicate percentage by volume, sinking to 0 on the scale when immersed in distilled water, and each division of the scale indicating 1 per cent. of absolute alcohol. As the density of alcohol varies directly with the temperature, an additive correction must be made in the reading of the percentage scale of the instrument when used at temperatures below the standard, 15.5° C. (60° F.), or a subtractive correction if used above the standard temperature. Every degree of variation on the centigrade scale corresponds to 0.27 per cent., or on the Fahrenheit scale to 0.15 per cent.

Alcohol Absolutum, U. S., Br.; *Alcohol absolutus,* P. G.—*Absolute alcohol,* E.; *Alcool absolu,* Fr.; *Absoluter Alkohol,* G.; *Alcool assoluto,* It.—The article recognized by this name contains not less than 99 per cent. by weight (U. S., Br.), 99.4–99.7 per cent. by volume (P. G.), of ethyl hydroxide, C_2H_5OH The absence of traces of moisture is practically impossible, although the amount is reduced to less than 0.3 per cent. by some manufacturers. In the manufacture of absolute alcohol, high-grade commercial alcohol (95 per cent.), free from foreign odor, is either shaken with freshly burned lime in coarse powder for some time and then heated with the same prior to dis-

tillation, or it is caused to percolate repeatedly through alternate layers of fine and coarse granules of the lime, in an apparatus so arranged as to avoid all contact with air, after which it is transferred, without exposure, to a column-still and distilled at a low temperature, under reduced pressure.

Absolute alcohol is a colorless limpid liquid, of refreshing characteristic odor and pungent taste. It is very hygroscopic, and should be preserved in tightly stoppered bottles, preferably with addition of some anhydrous cupric sulphate or freshly burned lime. It has a specific gravity not higher than 0.797 at 15° C. (59° F.) or 0.790 at 25° C. (77° F.) U. S., 0.7969–0.794 at 15.5° C. (60° F.) Br., 0.796–0.800 at 15° C. (59° F.) P. G., and boils at 78.5° C. (173.3° F.) P. G. Absolute alcohol has a neutral reaction toward litmus, and is miscible in all proportions with ether or water. Whenever alcohol and water are mixed, heat is generated and contraction of volume results, both varying with the proportions of the liquids used. According to Flückiger, the rise of temperature is greatest when 30 parts by weight of absolute alcohol are mixed with 70 parts by weight of water, amounting to 9 degrees C., or 16.2 degrees F., and the greatest contraction occurs when 58 volumes of absolute alcohol are mixed with 54 volumes of water, amounting to a loss of 4 volumes or 3.57 per cent. of the total mixture. It is entirely volatilized, readily inflammable, and burns with a non-luminous blue flame.

A mixture of equal volumes of absolute alcohol and water and one-fifth volume of glycerin, when allowed to evaporate spontaneously from clean odorless filter-paper, should leave no foreign odor. The absence of amyl alcohol or non-volatile carbonizable impurities may be determined by the absence of a red or brown color if after spontaneous evaporation of 25 Cc. of absolute alcohol in a porcelain capsule protected from dust, until only moisture is left, a few drops of colorless concentrated sulphuric acid be added. The red color imparted to absolute alcohol by addition of one-tenth its volume of 0.1 per cent. potassium permanganate solution should not change to yellow in less than 20 minutes (P. G.), indicating the absence of reducing substances, such as aldehyde, etc.

Alcohol, U. S.; *Spiritus Rectificatus,* Br.; *Spiritus,* P. G.—*Spiritus vini rectificatissimus—Alcohol, Rectified spirit, Spirit of wine,* E.; *Alcool,* F.; *Weingeist, Alkohol,* G.; *Alcoole,* It.; *Alcohol, Espiritu rectificado de Vino,* Sp.—This variety of alcohol is by far the most extensively used. It should contain 94.9 per cent. (U. S.), 90 per cent. (Br.), 90–91.2 per cent. (P. G.) by volume of ethyl hydroxide, and has the specific gravity 0.816 at 15.6° C. (60° F.) or 0.809 at 25° C. (77° F.), U. S., 0.834 at 15.5° C. (60° F.), Br., and 0.830–0.834 at 15° C. (59° F.), P. G. It boils at 78° C. (172.4° F.), U. S. Its other properties are nearly identical with those given under Absolute Alcohol.

The present official alcohol corresponds closely to the *deodorized alcohol* of the 1890 Pharmacopœia, both in strength and purity requirements. It should not affect the color of blue or red litmus-paper previously moistened with water, and if 50 Cc. be evaporated in a clean glass vessel, no color or weighable residue should remain. In addition to the following tests for absence of impurities, the Pharmacopœia gives a special test for the presence of methyl alcohol, which latter has at times been found in pharmaceutical preparations, having been fraudulently added to the alcohol used as menstruum. "If 25 Cc. of alcohol be mixed with an equal volume of water and 5 Cc. of glycerin, and the mixture allowed to evaporate spontaneously from a piece of clean, odorless blotting-paper, *no foreign odor* should become perceptible when the last traces of the alcohol leave the paper (absence of fusel oil constituents). If 25 Cc. be allowed to evaporate spontaneously in a porcelain evaporating dish, carefully protected from dust, until the surface of the dish is barely moist, no red or brown color should be produced upon the addition of a few drops of colorless, concentrated sulphuric acid (absence of amyl alcohol, or non-volatile, carbonizable, organic impurities, etc.). If 10 Cc. of alcohol be mixed in a test-tube with 5 Cc. of potassium hydroxide test-solution, the liquid should not at once become dark colored (absence of aldehyde or oak tannin). If 20 Cc. of alcohol be shaken in a clean, glass-stoppered vial with 1 Cc. of silver nitrate test-solution, the mixture should not become more than faintly opalescent, or acquire more than a faint brownish tint when exposed for six hours to diffused daylight (limit of organic impurities, amyl alcohol, aldehyde, etc.)."—U. S.

Methyl Alcohol Test.—Into a test-tube of the capacity of about 40 Cc. 1 Cc. of the alcohol or spirit to be tested should be poured, and, if it be undiluted enough,

distilled water added to make 10 Cc. in all. If the alcohol be already diluted, a correspondingly larger measure of it is taken and diluted to 10 Cc., so that the proportion of the alcohol in the liquid shall not be more than about 10 per cent. by volume. A copper wire spiral (made by winding a piece of No. 18 clean copper wire 1 meter long closely around a glass rod 7 millimeters thick, making a coil about 3 centimeters long, the end of the wire being formed into the handle) is to be heated to redness in a flame free from soot, then plunged steadily quite to the bottom of the liquid in the test-tube and held there for a second or two, then withdrawn and dipped into water to cool. This treatment with red-hot copper should be repeated five or six times, immersing the test-tube in cold water to keep down the temperature of the liquid. The contents of the test-tube are now filtered into a wide test-tube and boiled very gently. If the odor of acetaldehyde be perceptible, the boiling is to be continued until the odor ceases to be distinguished clearly. The liquid is now cooled, and to it is added 1 drop of a solution containing 1 part of resorcinol in 200 parts of water. A portion of this liquid is then poured cautiously into a second tube containing pure sulphuric acid, the tube being held in an inclined position, in such a way that the two liquids shall not mix; this tube is allowed to stand for three minutes, and then slowly rotated. No rose-red ring should show at the line of contact of the two layers (absence of more than 2 per cent. of methyl alcohol. —U. S.

Commercial alcohol does not always come up to the official requirements, averaging as a rule from 91 to 93 per cent. in volume strength; but the variety known as *cologne spirit* generally contains 94–95 per cent. of ethyl alcohol. Alcohol which has been stored in barrels for some time, particularly if the latter were imperfectly charred, is apt to be contaminated with coloring-matter and tannin. As found on the market, ordinary alcohol, and even *cologne spirit*, frequently has an acid reaction, due to acetic acid derived from the aldehyde always more or less present. It is therefore necessary to redistil such alcohol from potassium or calcium hydroxide before using it for analytical work, especially the titration of alkaloids.

Alcohol Dilutum, U. S.; *Spiritus dilutus,* P. G.—*Diluted alcohol,* E.; *Alcool dilué,* Fr.; *Verdünnter Weingeist,* G.—Diluted alcohol of the U. S. P. is made by mixing 500 Cc. each of official alcohol and distilled water. The contraction incident to the mixing of the two liquids amounts to about 3 per cent. at 25° C. (77° F.), and hence if 94.9 per cent. alcohol has been used the mixture, when cool, will contain about 48.9 per cent. by volume of ethyl hydroxide and have a specific gravity of about 0.936 at 15.6° C. (60° F.), or about 0.930 at 25° C. (77° F.). It boils at 82° C. (179.6° F.), and its freedom from impurities is ascertained in the same manner as in the case of a stronger alcohol. If it is desired to make diluted alcohol of any other percentage strength, it may be done as follows: Mix as many volumes, fluidounces or cubic centimeters, of the stronger alcohol as are expressed by the volume percentage of the weaker alcohol, with as many volumes of water, as are expressed by the difference in volume percentage between the stronger and weaker alcohols. When complete contraction has taken place and the mixture has cooled, add sufficient water to bring the volume up to that expressed by the percentage of the stronger alcohol. Thus, to reduce 94 per cent. alcohol to 60 per cent. alcohol, mix 60 fluidounces or cubic centimeters of the stronger alcohol with 34 fluidounces or cubic centimeters of water and subsequently make up the volume to 94 fluidounces or cubic centimeters by addition of more water.

The term *proof spirit* is applied in the United States Custom-House and Internal Revenue Service to a spirit containing 50 per cent. by volume of absolute alcohol.

The Br. Pharmacopœia directs the preparation of 4 varieties of diluted alcohol, designated as 70 per cent., 60 per cent., 45 per cent., and 20 per cent. alcohol, respectively, and having the following specific gravities at 15.5° C. (60° F.): 0.8900, 0.9035, 0.9436, and 0.9760. They are made by mixing 100 volumes of 90 per cent. alcohol with 31.05 volumes of distilled water to produce 70 per cent. alcohol; with 53.65 volumes to produce 60 per cent. alcohol; with 105.34 volumes to produce 45 per cent. alcohol; and with 355.8 volumes to produce 20 per cent. alcohol.

The *spiritus dilutus* of the German Pharmacopœia is made by mixing 7 parts by weight of alcohol with 3 parts of water, and has a specific gravity of 0.892–0.896 at 15° C. (59° F.). It contains 68-69 per cent. by volume of absolute alcohol.

The following table, condensed from one published by Dr. Squibb in *Ephemeris*, vol. ii., will prove convenient for reference:

Specific gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.		Specific gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.		Specific gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.	
At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.
0.9985	0.9970		1	0.9490	0.9424	35	42	0.8793	0.8713	67	
0.9981	0.9966	1		0.9470	0.9402	36	43	0.8769	0.8689	68	75
0.9970	0.9953		2	0.9452	0.9382	37	44	0.8745	0.8665	69	76
0.9965	0.9948	2		0.9434	0.9363	38	45	0.8721	0.8641	70	77
0.9956	0.9938		3	0.9416	0.9343	39	46	0.8696	0.8616	71	78
0.9947	0.9927	3		0.9396	0.9323	40	47	0.8672	0.8591	72	
0.9942	0.9922		4	0.9381	0.9307		48	0.8664	0.8583		79
0.9930	0.9909	4	5	0.9376	0.9302	41		0.8649	0.8568	73	
0.9914	0.9893	5	6	0.9362	0.9288		49	0.8639	0.8558		80
0.9898	0.9876	6	7	0.9356	0.9280	42		0.8625	0.8544	74	
0.9890	0.9868		8	0.9343	0.9267		50	0.8611	0.8530		81
0.9884	0.9862	7		0.9335	0.9259	43		0.8603	0.8522	75	
0.9878	0.9855		9	0.9323	0.9246		51	0.8581	0.8500	76	82
0.9869	0.9846	8	10	0.9314	0.9237	44		0.8557	0.8476	77	83
0.9855	0.9831	9	11	0.9303	0.9226		52	0.8533	0.8452	78	
0.9841	0.9816	10	12	0.9292	0.9214	45		0.8526	0.8444		84
0.9828	0.9801	11	13	0.9283	0.9205		53	0.8508	0.8426	79	
0.9821	0.9793		14	0.9270	0.9192	46		0.8496	0.8414		85
0.9815	0.9787	12	15	0.9262	0.9184		54	0.8483	0.8401	80	
0.9802	0.9773	13	16	0.9249	0.9171	47		0.8466	0.8384		86
0.9879	0.9759	14	17	0.9242	0.9164		55	0.8459	0.8377	81	
0.9778	0.9746	15	18	0.9228	0.9150	48		0.8434	0.8352	82	87
0.9776	0.9733	16	19	0.9221	0.9143		56	0.8408	0.8326	83	88
0.9753	0.9719	17	21	0.9206	0.9128	49		0.8382	0.8300	84	
0.9741	0.9706	18	22	0.9200	0.9122		57	0.8373	0.8291		89
0.9728	0.9692	19	23	0.9184	0.9106	50		0.8357	0.8275	85	
0.9716	0.9678	20	24	0.9178	0.9100		58	0.8340	0.8258		90
0.9709	0.9668		25	0.9160	0.9081	51	59	0.8331	0.8249	86	
0.9704	0.9661	21		0.9135	0.9056	52	60	0.8305	0.8223	87	91
0.9698	0.9655		26	0.9113	0.9034	53	61	0.8279	0.8197	88	
0.9691	0.9646	22	27	0.9090	0.9011	54	62	0.8272	0.8191		92
0.9678	0.9631	23	28	0.9069	0.8989	55	63	0.8254	0.8173	89	
0.9665	0.9617	24	29	0.9047	0.8969	56	64	0.8237	0.8156		93
0.9652	0.9603	25	30	0.9025	0.8947	57	65	0.8228	0.8147	90	
0.9643	0.9594		31	0.9001	0.8923	58	66	0.8199	0.8118	91	94
0.9638	0.9590	26		0.8979	0.8901	59		0.8172	0.8091	92	
0.9631	0.9582		32	0.8973	0.8895		67	0.8164	0.8083		95
0.9623	0.9574	27		0.8956	0.8878	60		0.8145	0.8064	93	
0.9618	0.9567		33	0.8949	0.8870		68	0.8125	0.8044		96
0.9609	0.9556	28	34	0.8932	0.8853	61		0.8118	0.8037	94	
0.9593	0.9538	29	35	0.8925	0.8846		69	0.8089	0.8008	95	
0.9578	0.9521	30	36	0.8908	0.8829	62		0.8084	0.8003		97
0.9565	0.9507		37	0.8900	0.8821		70	0.8061	0.7980	96	
0.9560	0.9500	31		0.8886	0.8807	63		0.8041	0.7960		98
0.9550	0.9489		38	0.8875	0.8796		71	0.8031	0.7950	97	
0.9544	0.9482	32		0.8363	0.8784	64		0.8001	0.7920	98	
0.9535	0.9473		39	0.8850	0.8771		72	0.7995	0.7914		99
0.9528	0.9465	33		0.8840	0.8761	65		0.7969	0.7888	99	
0.9519	0.9456		40	0.8825	0.8746		73	0.7946	0.7865		100
0.9511	0.9446	34		0.8816	0.8736	66		0.7938	0.7858	100	
0.9503	0.9438		41	0.8799	0.8719		74				

Action and Uses.—When alcohol is applied to the skin, it causes a sensation of coolness; if confined, however, it induces redness and irritation. Upon mucous membranes it produces a burning sensation, with blanching and corrugation of the tissue. Internally in moderate amount it acts as a powerful stimulant to all the vital functions, but when given in overdose causes a corresponding depression. The entire nervous system is stimulated by small doses of alcohol. Thoughts follow one another with

greater rapidity than usual. Increased reflex action is noted; the conductivity of nerves, the acuity of sensation, and the activity of muscles, are increased. When the amount ingested is in excess, this effect is very transient, and rambling and incoherence, decreased reflex activity, and incoördination, followed by complete muscular relaxation, loss of sensation, and profound sleep, passing into coma rapidly succeed. When locally applied to peripheral nerves, alcohol at first excites, and later paralyzes them. The force and frequency of the pulse are increased by its stimulating effect upon the heart muscle and its accelerator nerves. Blood-pressure is also increased by the stimulating effect of the drug upon the heart and vasomotor system. Large amounts, however, depress both the heart and peripheral circulation, and toxic doses paralyze them. The respiratory function is increased by moderate doses and depressed by excessive amounts of alcohol, The temperature falls after the administration of this drug. This is due to the dissipation of heat caused by the excessive distribution of hot blood to the periphery. The feeling of warmth felt after the ingestion of alcohol is the result of the distribution of the blood, for while more heat units are manufactured, more also are eliminated. Moderate amounts of alcohol are burned up in the system, and give it force, but any excess is eliminated by the skin, breath, kidneys, and intestines. It inhibits nitrogenous metamorphosis and acts as a conservator of power. Small quantities aid digestion by increasing the blood-supply to the stomach and by stimulating the peptic glands; larger amounts cause indigestion by inhibiting the flow of gastric juices, and by precipitating any peptonizing agent that may be in the stomach. We are very well aware that an immense amount of scientific laboratory research seems to prove that alcohol is never a stimulant and always a depressant. Clinical experience and that of the world in general are so opposed to a belief that the drug is a depressant in its general effects that the older views as to its effects are allowed to stand for our present views.

Alcohol is an invaluable remedy in the treatment of all acute diseases associated with debility. It is probably the best drug to employ in the treatment of enteric fever and other typhoid conditions, as it stimulates the circulation, lessens the nervous symptoms, aids digestion, and, being oxidized in the body, indirectly acts as a food. In the various forms of septic infection, such as erysipelas, septicæmia, and pyæmia, it is employed almost as a routine treatment. It is frequently employed with benefit in wasting diseases due to prolonged suppuration, such as tuberculosis, and may be given to the aged to aid in digestion, inhibit tissue waste, and stimulate their fagging vital functions. In the form of brandy with cracked ice it is an excellent remedy in treating obstinate vomiting. Alcohol is also employed as a rapidly acting circulatory and respiratory stimulant in collapse, during the crisis of the acute infectious diseases, such as pneumonia and scarlet fever, and for the bites of venomous serpents or insects. Under these circumstances it should be given hot and concentrated. When used as a stimulant during prolonged illness, it should be given well diluted. It may be employed as a cooling and antiseptic dressing over inflamed areas and contused wounds. It is valuable as a detergent and stimulating lotion, and is frequently employed as such for the prevention of bedsores. Pure alcohol is also the best antidote for local burns caused by the application of carbolic acid.

In advanced acute alcoholic poisoning, with coma, complete relaxation, and subnormal temperature, the application of external heat, and the administration of circulatory and respiratory stimulants, such as strychine, atropine, and digitalis, are required. Should convulsions occur, counterirritation at the nape of the neck should be employed. Later the bowels should be thoroughly moved with calomel and compound jalap powder or by elaterin. Spirit of Mindererus or aromatic spirit of ammonia may be given to stimulate the stomach, providing it is not too irritable. If gastric inflammation be marked, emollients may be employed. When vomiting occurs, minute pieces of cracked ice may be swallowed or small doses of cocaine or aconite may be given.

The symptoms of chronic poisoning are variable; the most common being cirrhotic changes in the liver and kidneys, mental aberration, multiple neuritis, gastric disorder, and nutritional disturbances. In treating this condition, the patient should be isolated. The drug may then be completely withdrawn, or, better, it may be gradually diminished in amount for a number of days. The depression following should be treated by the use of cloves and capsicum in conjunction with purges and bitters. Small doses of Fowler's

solution may be used if morning vomiting occurs. Highly seasoned nutritious broths and predigested foods should be given in small quantity at frequent intervals.

Brandy and whiskey are more commonly employed than the other preparations containing alcohol. The dose to a child 1 month old is 5 to 10 minims (0.3–0.6 Cc.); 2 months old, 10 to 20 minims (0.60–1.30 Cc.); 3 months old, 20 to 30 minims (1.30–2 Cc.); over 4 months old, 30 to 40 minims (2–2.60 Cc.) every 4 hours. To an adult the dose is from 4 fluidrachms to 2 fluidounces (16–60 Cc.) every 3 or 4 hours. In all cases it should be diluted with hot or cold water: with the former, when required as a rapidly acting stimulant; with the latter, or with food, when it is desired as an aid to digestion.

ALCOHOL AMYLICUM.—Amyl Alcohol.

Amylic alcohol, Primary amyl alcohol, Pentyl alcohol, Amyl hydroxide, E.; *Alcool amylique, Huile de grain*, Fr.; *Amyl-alkohol, Fuselöl*, G.; *Alcool isoamilico*, F. It.

Formula, $C_5H_{11}OH$. Molecular weight, 87.43.

A peculiar alcohol obtained as a by-product through the fermentation of potatoes, also grain, by continuing the distillation at a higher temperature, after the ordinary spirit has ceased to come over. It has been shown to be the product of the action of a bacillus, *B. amylozymicus*, upon starch.

In the Appendix of the B. P., amyl alcohol is recognized in the list of chemical reagents. It is defined as a liquid consisting principally of iso-primary amyl alcohol, $(CH_3)_2:CH.CH_2.CH_2OH$), and distilling between 125° and 142.8° C. (257°–289° F.).

Preparation.—During the alcoholic fermentation of grain, and particularly potatoes, some amyl alcohol is produced, the great bulk of which passes over with the last portions of the first distillation, which are milky, and contain besides amyl some ethyl alcohol and water, and variable quantities of propyl alcohol, isobutyl alcohol, pyridin, furfurol, and other compounds, differing with the source of the fusel oil. The portion remaining in solution with the distilled spirit is obtained in purifying the latter, either by the process of distillation or leaching. Commercial amyl alcohol contains variable quantities (between 20 and 30 per cent.) of ordinary (ethyl) alcohol, of which it cannot readily be completely deprived by fractional distillation and washing with water. Purified amyl alcohol is prepared by washing crude *fusel oil* with concentrated aqueous solutions of common salt (process of B. Hirsh, 1861), or with aqueous solutions of calcium chloride, and submitting the washed residuum to distillation, and collecting the portions distilling between 128° and 131° C. (262.4°–267.8° F.). In a very pure form, it may be obtained by boiling amyl-potassium sulphate with 10 per cent. of sulphuric acid for 5 hours under a reflux condenser, then neutralizing with sodium carbonate, distilling with steam, and further purifying the distillate as above.

Properties.—It is a colorless, thin, oily liquid, having a penetrating and oppressive odor, and a burning acrid taste. Its specific gravity is 0.818 at 15.5° C. (60° F.). It boils at 132° C. (269.6° F.), and evaporates without residue. It is sparingly soluble in water (1 to 40), but miscible in all proportions with alcohol, ether, glacial acetic acid, benzene, petroleum benzin, the lighter hydrocarbons, and fixed and volatile oils, and freely dissolves iodine, camphor, fats, and resins. It is a good solvent for morphine. It acquires a deep-red color with sulphuric acid, and reacts violently with concentrated nitric acid. Exposed to air in contact with platinum-black, it is slowly oxidized, yielding valerianic acid. Heated with an acetate and strong sulphuric acid *amyl acetate* results, having a characteristic pear oil odor. It takes fire with difficulty unless heated to about 55° C. (131° F.), when it burns with a bright flame. As met with in commerce, it contains variable quantities, sometimes 12 per cent., of *active amyl alcohol*, which has the same elementary composition, but turns polarized light to the left and boils at 127° C. (260.6° F.); its barium amyl sulphate is much more soluble in water than the corresponding salt obtained from inactive amyl alcohol. In addition to this, 5 other amyl alcohols have been prepared artificially, varying in their boiling-points between 97° and 137° C. (206.6°–278.6° F.).

Amyl alcohol is *amyl hydroxide*, $C_5H_{11}OH$, and yields a series of compounds homologous with those of ethyl alcohol—namely, amyl ether, $(C_5H_{11})_2O$, amyl aldehyde, or valer-aldehyde, $C_5H_{10}O$, and valerianic acid, $C_5H_{10}O_2$.

Tests.—It should be neutral to litmus, have a specific gravity of 0.814 to 0.818,

boil at 129° to 131° C. (264.2°–267.8° F.), evaporate without residue, not diminish materially in volume when agitated with an equal volume of concentrated aqueous solution of calcium or sodium chloride. When 5 Cc. are mixed with 5 Cc. of concentrated sulphuric acid, not more than a faint-red color should appear, nor should a solution of potassium hydroxide cause discoloration (*furfurol*) when shaken with an equal volume of the alcohol.

Pharmaceutical Uses.—Amyl alcohol is the source of valerianic acid and of various compound ethers (fruit-essences), and may be used as a solvent in the manufacture of alkaloids and other proximate principles.

Action and Uses.—In moderate amounts amyl alcohol acts as a direct stimulant to the nervous system. When given in overdose, it causes giddiness, diplopia, headache, coma, and a subnormal temperature. Later, muscular rigidity or tetanic convulsions, followed by complete muscular relaxation, cyanosis, and a peculiar fruit-like odor of the breath, are sometimes noted. A poisonous amount also acts as a powerful respiratory depressant. Amyl alcohol is practically never employed in medicine at the present time. Formerly it was recommended for the alleviation of the symptoms commonly present in advanced phthisis, but other more potent remedies have supplanted it. It has been employed also in controlling the nervous symptoms occurring in delirium tremens and in overcoming the nervous irritability sometimes found in confirmed alcoholics. Small amounts are nearly always present in ethyl alcohol and in all compounds containing the latter; this is especially true in regard to freshly distilled or raw preparations.

ALCOHOL METHYLICUM.—Methyl Alcohol.

Spiritus pyroxylicus rectificatus.—Pyroligneous (Pyroxylic) spirit or alcohol, Wood alcohol, Wood naphtha, E.; *Alcool méthylique, Alcool formique, Alcool de bois, Esprit de bois, Esprit pyroligneux*, Fr.; *Holzgeist, Methylalkohol*, G.

Formula, CH_3OH. Molecular weight, 31.79.

Preparation.—Methyl alcohol was first noticed by Boyle (1661); its difference from ordinary alcohol was observed by P. Taylor (1812), but it was not correctly characterized until investigated by Dumas and Peligot (1834). Commercially, methyl alcohol is produced principally from the strongly acid solution resulting from the destructive distillation of wood. The distillate on standing separates into a heavy oily layer, tarry and empyreumatic matter, and an aqueous layer containing about 1 per cent. of methyl alcohol, together with acetic acid, acetone, aldehyde, allyl alcohol, empyreumatic oils, and other compounds. The aqueous portion is neutralized with quicklime, subjected to fractional distillation, yielding crude methyl alcohol (*pyroligneous spirit*), from which pure methyl alcohol is obtainable by saturating with fused calcium chloride, resulting in the production of the crystalline compound $CaCl_2.4CH_3OH$, which is stable at the temperature of the water-bath. The crystals are separated, dissolved in water, subjected to fractional distillation and the distillate rectified over lime.

Absolutely pure methyl alcohol is best prepared by distilling crystallized methyl oxalate with solution of potassium hydroxide and then dehydrating the distillate with lime.

Properties.—Pure methyl alcohol is a colorless limpid liquid, of a peculiar somewhat alcoholic odor, and a warm taste. Its specific gravity at 15.5° C. (60° F.) is 0.7997; it boils at 66° C. (150.8° F.); burns with a pale-blue, scarcely luminous flame; is miscible in all proportions with water, alcohol, and ether; dissolves volatile oils and many resins, and in many ways resembles ethyl alcohol in its general properties, the derivatives corresponding with those mentioned under *ethyl alcohol*, being methyl ether $(CH_3)_2O$, methaldehyde or formaldehyde (HCOH), and formic acid (HCO_2H). It is easily oxidized by potassium permanganate in the cold. Crude methyl alcohol used for denaturing spirit should have a specific gravity not to exceed 0.840 at 15° C. (59° F.), and contain about 90 per cent. of methyl alcohol.

Tests.—When 1 Cc. of an aqueous solution of $KMnO_4$ (1:500) is added to 20 Cc. of methyl alcohol, the pink color is destroyed at once, whereas in pure ethyl alcohol the color is permanent for some minutes. If a few Cc. of the alcoholic liquid be boiled in a test-tube and a copper spiral heated to redness be plunged into the vapors, the odor of formic aldehyde becomes recognizable by its pungency (F. A. Sieker). Mulliken and

Scudder's test is the most practical in general use. A spiral of copper wire 2 Cm. in length is superficially oxidized in a Bunsen flame and plunged into 3–4 Cc. of the solution contained in a test-tube, whereby the methyl alcohol is oxidized to formic aldehyde. The operation is repeated several times, the spiral being rinsed each time before reheating. (A concentrated spirit should be diluted with 3 to 4 volumes of water before the oxidation.) Next add 1 drop of a 0.5 per cent. aqueous solution of resorcin, and then carefully pour the mixture upon a few Cc. of concentrated sulphuric acid contained in a test-tube. The presence of methyl alcohol is indicated by the appearance of a *pure rose-red* zone at the line of demarcation, and above it a white to pinkish coagulum increasing ultimately in intensity and rising as purplish flakes. Alcohol, acetone, furfurol, and the ordinary alcohols do not give the reaction. Trillat's test, depending upon the formation of a pure blue color from the interaction of the oxidized methyl alcohol and dimethylamine (*Compt. rend.*, cxxvii. 234; *Proc. Am. Pharm. Assoc.*, vol. xlvii. p. 690), serves to identify methyl in ethyl alcohol.

Methyl alcohol is much used in the arts as a solvent of resinous varnishes, and as a base for the manufacture of formic aldehyde. Its high heating value makes it a cheap fuel substitute for alcohol.

For some years a purified methyl alcohol, containing 97–98.5 per cent. of CH_3OH, has been offered, under the name *Columbian Spirit*, for pharmaceutical purposes. It should never be used, however, for internal remedies, since even the purest methyl alcohol has been shown to be decidedly toxic. Recent investigations also point to the danger of using methyl alcohol in liniments and other external remedies.

Action and Uses.—Because of its comparative cheapness, wood alcohol is largely employed in the arts as a substitute for ethyl alcohol. It should never be employed as a substitute for the latter in medicine, however, because of its decidedly poisonous properties. It is a sedative and narcotic, but is never used in medicine in this country. The drug has been recommended, however, in the treatment of pulmonary tuberculosis, chronic diarrhœa, and dysentery. When excessive quantities of methyl alcohol are ingested, nausea, vomiting, violent headache, vertigo, coma, and amblyopia of varying degrees frequently result. A number of deaths and many cases of permanent blindness have been reported as the result of ingestion of this drug, when employed by unscrupulous manufacturers in the preparation of the various essences, especially of ginger and peppermint, for sale as a beverage in "local-option" towns.

The internal dose of wood alcohol is stated to be from 10 to 20 minims (0.60–1.3 Cc.) several times daily.

ALETRIS.—Unicorn Root.

Ague-root, Blazing-star, Crow-corn, False devil's-bit, Husk-wort or Star-grass, E.; *Mehlige Aletris; Einhornwurzel*, G.; *Aletris farineux*, Fr.

The dried rhizome and roots of *Aletris farinosa* L. (Fam. *Hæmoderaceæ*).

The habit and appearance of both plant and drug are displayed in the accompanying illustration. The plant is from a half to a yard high, and nearly smooth, the specific name referring to the mealy indumentum of the whitish flowers. It grows in low sandy soil in the eastern half of the United States, especially in the southern pine-barrens.

The rhizome consists of 4 to 6 rather indistinct joints, is brown-gray externally, white internally, breaks with a mealy fracture, with protruding scattered wood-bundles, is inodorous, and has an amylaceous, afterward acrid, but not bitter taste. It is grayish-brown, bears papery remains of the leaf-bases and more or less of the light-colored, thin, tough roots.

The only constituents known to exist in aletris are an abundance of starch and a bitter principle, soluble in both water and alcohol, more so in the latter.

False unicorn root, Devil's bit, Blazing star, Drooping starwart, and *Red-seed* are names which have been applied to the rhizome of *Chamælirium luteum* (L.) A. Gray (*Veratrum l.* L.; *C. Carolinianum* Willd.; *Helonias dioica* Pursh.—Fam. *Melanthaceæ*), of eastern North America. By others, the terms "False" and "True" are transposed. By far the better custom is to call them by their technical names. The flowers are in dense terminal racemes, that of the pistillate plant erect, that of the staminate drooping at the summit, like a beautiful creamy white plume. The rhizome is frequently substituted for or mixed with aletris. Our illustration shows the two contrasted. Aletris is tufted and more flattened at the crown,

and its roots are finer and lighter colored. Chamælirium is bitter. The rhizome contains 10 per cent. of *chamælirin*, an amorphous, light-yellowish-red, bitter powder, freely soluble,

FIG. 9.

A–D, *Aletris farinosa*; E, *Chamælirium luteum*.
(A and B, × ½; C, enlarged; D and E, Nat.)

with frothing, like saponin, in water and alcohol, and insoluble in chloroform. Dilute acids change it to glucose and *chamæliretin*, a resinous body soluble in water. The so-called *helonin* of the eclectics is the hydro-alcoholic extract of the rhizome.

Pharmaceutical Preparation.—FLUIDEXTRACT OF ALETRIS, N. F.

Action and Uses.—Aletris is a simple bitter which at present is not used to any great extent. It has been recommended as a powerful uterine tonic, and is said to possess diuretic, emetic, purgative, and antirheumatic properties, and it has been reported as successful in the treatment of spermatorrhœa, but is probably of little use in this condition.

Aletris may be administered in the form of an infusion (50 Gm. in 1000 Cc. of water) in 4 fluidrachm (16 Cc.) doses.

The dose of the powdered drug is 10 grains (0.60 Gm.).

ALISMACEÆ.—The Water-plantain Family.

A family of 10 genera and about 50 species, aquatics, distributed through most tropical and temperate regions. The rhizomes of *Sagittaria sagittifolia* L. (*Wapatoo*) and *S. Chinensis* (*Ts'ze-ku*) are used respectively by the North American Indians and the Chinese as starchy foods, as are some other species. That of *Echinodorus ellipticus* Mich., of Brazil, is used as an astringent. The family in general contains acrid juices, on account of which a number of species are used as diuretics and antiscorbutics. The following has been considerably used medicinally and is a drug of commerce.

Alisma (*Water-plantain*); *Froschlöffel, Wasserwegerich*, G.; *Plantain d'eau, Pain de grenouilles*, Fr.—The plant, and more especially the rhizome, of *Alisma Plantago-aquatica* L.

The plant grows in shallow water or muddy places and is apparently indigenous throughout the entire north temperate zone.

The rhizome consists of 2 or 3 united fleshy tuberous pieces, which vary in shape from oblong to subglobular, externally of a blackish color and beset with numerous fine roots, inter-

nally white and with scattered wood-bundles, and is, in the fresh state, of a disagreeable sharp odor and taste. The leaves are on long petioles, very smooth, ovate, oblong or lanceolate, acute, frequently with a heart-shaped base, 5- to 9-nerved, light green, and of an acrid taste. The scape is about 2 feet (60 Cm.) high, 3-edged, and bears a loose panicle of whitish perfect flowers, having 3 sepals, 3 petals, 6 stamens, and numerous pistils upon a flattish receptacle.

Water-plantain contains a butyraceous pungent volatile oil, of which Zuch (1818) obtained 0.6 per cent. Neljubin found in it also an acrid resin. Alisma is rarely employed in medicine at the present day. The rhizome formerly enjoyed some repute as a specific in hydrophobia, but its employment in this disease has been abandoned. The bruised leaves are rubefacient and have been locally applied over bruises and swellings. The drug has been recommended in renal calculus, dysentery, chorea, and epilepsy, but is of doubtful efficacy in any of these conditions. The dose of the powdered rhizome is 8 grains (0.50 Gm.); of the leaves, 15 grains (1 Gm.). A decoction of the leaves (50 Gm. in 1000 Cc. of boiling water) may be given in doses of 4 to 8 fluidrachms (16–30 Cc.).

ALLIUM.—Garlic.

Poor man's treacle, E.; *Knoblauch. Gartenlauch*, G.; *Bulbus allii.—Ail.* Fr.

The undried bulb of *Allium sativum* L. (Fam. *Liliaceæ*).

This well-known culinary plant is indigenous to central Asia, and is everywhere cultivated, exhibiting several well-marked varieties, some with white, some with red bulbs. All parts of the plant are active.

Bulb an inch or two broad, subglobular, compound, surrounded by a few dry membranaceous scales, which cover the remnant of the upright stem and the 5 to 8 small bulbs arranged in a circle around its base. These bulblets are oblong in outline, compressed from both sides, wedge-shaped toward the stem, and rounded upon the back. They consist of a few thick fleshy scales and a short fleshy axis. Garlic has a peculiar pungent and disagreeable odor and an acrid, burning taste. It is used in the fresh state only.

Garlic is best preserved in a dry place at a moderate temperature, in which state it slowly parts with its water. If put into a jar with the addition of a small quantity of alcohol—about 2 ounces to the quart—the vitality of the bulbs is destroyed, and they retain their properties for a long period, but change in color, acquiring a brownish, somewhat diaphanous appearance.

Constituents.—Besides the cellular tissue, garlic contains between 50 and 60 per cent. of water, 35 per cent. of mucilage, some albumin, sugar, starch, and about 0.25 per cent. of volatile oil, to which its odor and taste are due. In its crude state *oil of garlic* is of a dark brown-yellow color, heavier than water, of a very repulsive taste. It contains a sulphur-bearing compound, formerly believed to be allyl-sulphide, but now known not to be so. Terpene is wanting.

Action and Uses.—Locally applied, garlic acts as an irritant and rubefacient. Internally it is a carminative, causing an increase in the secretion of gastric juice. If given in overdose, it may produce nausea, vomiting, colicky pains, and purging. In small amounts it acts as a condiment and aids in the digestion and absorption of food. In chronic inflammation of the bronchial tubes, garlic in the form of a poultice applied to the chest and given internally in boiled milk will often be found of service. Poultices of this drug when applied to the spine are recommended in infantile convulsions, and may be applied over the abdomen in gastro-intestinal catarrh. In the dose of 2 to 5 minims (0.10–0.30 Cc.) the oil of garlic is said to relieve nervous vomiting. Internally it is commonly employed as the syrup of garlic (Syrupus Allii) in the dose of ½ to 1 fluidrachm (2–4 Cc.) to a child or to an adult.

Other Species.—The genus *Allium* contains about 250 species, distributed over almost the entire world, in temperate and subtropical regions. Many of them are highly ornamental, while others, the leek (*A. Porrum* L.), the onion (*A. Cepa* L.), the chives (*A. Schœnoprasum* L.), the shallot (*A. Ascalonium* L.), are well-known foods. Many indicate by their odor the presence of constituents similar to that of garlic, which have indeed been extracted from some of them. *A. Victorialis* L., *Allermannsharnisch*, *Mäuselauch*, *Radix Victorialis longæ*, of southern Europe, is used as an anthelmintic. The bulb of *A. Macleanii* Back., of Afghanistan, is the source of the "Royal Salep" of history. It has almost no alliaceous odor and apparently contains only gum. That of *A. xiphopetalium* Aitch. et Back., is also believed to have yielded a portion of this product, but has a distinct odor. The volatile oil of the common onion was found by Semmler to consist mainly of $C_6H_{12}S_2$.

ALOE, *U. S., Br., P. G., F. It.*—Aloes.

Acibar, Sp.

Definition.—The inspissated juice of the leaves of *Aloe vera* (Linné) Webb, *Aloe Chinensis* Baker, *Aloe Perryi* Baker, or other species of *Aloe* (Fam. *Liliaceæ*).

Aloe Socotrina, Socotrine or Sucotrin aloes, Socotrinische Aloe or Zanzibar Aloe, is from *A. Perryi* Baker, and perhaps also from *A. Succotrina* Lam. (*A. vera* Mill., *non* L.). Aloe Barbadensis, Curaçao, Barbadoes, or (U. S. terminology) Hepatic aloes, Aloès hépathique, Aloes des Barbades, ou de la Jamaique, is from *A. vera* (L.) Webb (*A. perfoliata vera* L.; *A. vulgaris* Lam.; *A. Barbadensis* Mill.; *A. Indica* Royle: *A. littoralis* Koenig; *A. Chinensis* Baker).

Some doubt still exists as to the identity of the Barbadoes and other West Indian products. The producers declare the plants identical, but Holmes appears to have shown that the Curaçao article is yielded by *A. Chinensis* Baker, and he insists that the appreciable differences in the products may be due to differences in the plants.

Regarding aloin as the active constituent of aloes, various propositions have been made to state its percentage as a part of the definition, either retaining the Socotrine and Curaçao varieties under separate titles or uniting them, or recognizing under one title any variety containing the required percentage of aloin. Certainly, a very large portion of that now sold for Socotrine is in reality Curaçao aloes.

The Fr. and It. Pharmacopœias recognize *Aloe Barbadensis* and *Aloe Capensis* (*Cape aloes, Kapaloe, Aloes du Cap, Aloe lucida* or *Glassy aloes*), from *A. ferox* Mill. and *A. spicata* L. The Belgian, Portuguese, and Spanish recognize all three varieties. The Austrian, Danish, Dutch, Norwegian, Russian, Swedish, and Swiss recognize only *Aloe Capensis*. In spite of the fact last stated, Cape aloes is in growing disfavor.

Origin.—The species yielding Socotrine aloes are natives of eastern Africa, our sole source of supply; that yielding Barbadoes aloes (if distinct from *A. Chinensis*, source of Curaçao aloes) is native of northwestern Africa. Some authorities regard it as native also of India, while others consider it introduced there, as it is in the West Indies, whence come our supplies. The aloe plants resemble small century plants, with bayonet-shaped fleshy and succulent leaves and racemose or spicate yellow or orange-red tubular flowers.

The methods of collection and preparation differ somewhat in different localities, but the general principles are the same. Two juices, one insipid, thick and mucilaginous, in the central portion, the other thin, watery, yellow, and very bitter, in the superficial portions, exist in the leaves. The latter only is useful. Since the leaves are nutritive (it is said that after exhaustion they are used as cattle-food), it appears quite likely that this superficial active juice exerts a protective influence in favor of the plant. The thick juice, expressed doubtless with more or less of the other, is used for poultices, and is credited, in the producing countries, with strong emmenagogue properties. Collection occurs soon after the rainy season, when the juice is neither too scanty nor too watery. The leaves being cut off close to the stem, are quickly laid in a slanting or vertical position, so that the thin juice will drain into suitable receptacles. Great care is taken to avoid pressure, even that resulting from the weight of too large a mass, because of the tendency to expel the undesirable juice. The degree of care exercised in the collection and preservation of the juice varies, being greatest probably in the West Indies. Evaporation may be performed by artificial heat, as in the West Indies, or allowed to occur spontaneously, as in the case of the Socotrine variety. If the degree of artificial heat be moderate, the medicinal activity remains unaltered, though it apparently imparts a heavier odor. Evaporation (in Curaçao) of the juice at once, below the boiling-point, yields a variety called "Capey," because of its greater luster, and yielding a yellowish powder; but if kept a year and then evaporated, the surface is dull, the odor suggesting fermentation, the powder brownish, and the water-soluble matter 4 to 13 per cent. less (Holmes). The product may be stored for shipment in casks, kegs, tin-lined boxes, or skins of animals (as is usual with the Socotrine variety), or in boxes of 60 to 100 pounds or emptied gourds containing 2 to 50 pounds, as in the West Indies. The latter is said to improve, and it brings a higher price, upon keeping. It is produced chiefly in Curaçao, Aruba, and Bonaire. Barbadoes no longer produces any, but a much higher price is frequently obtained for Curaçao aloes sold as Barbadoes. Curaçao aloes was formerly much used for producing a brown dye. The most expensive and highly esteemed product is Socotrine aloes in kegs

or, as here mostly marketed, in cans. That contained in monkey or goat skins brings a lower price, but is probably equal in quality, though apt to contain stones, nails, etc.

Description.—ALOE SOCOTRINA.—Usually solid, with the central portion often semifluid or soft, of a yellow-brown color, bright-yellow, rarely with a slight orange tint, where freshly abraded, the harder portions having a lightly conchoidal fracture with little or no luster. Occasionally liquid, then usually separating into two layers, the upper transparent and liquid, the lower a brown-yellow, semisolid, crystalline mass; more rarely, and an inferior form, homogeneous, of the consistency of soft tar and dark-brown or nearly black. Odor, when breathed upon, finely aromatic, somewhat resembling saffron or myrrh; the powder is of a bright- or slightly brownish-yellow, exhibiting crystals under the microscope, as does its mixture with alcohol, and should not cake when dried and then heated to 100° C. (212° F.). About 50 per cent. soluble in cold water, almost completely soluble in alcohol and boiling water, from the latter solution, on cooling, about 40 to 60 per cent. separating, which constitutes the so-called *resin of aloes*, and which is taken up by alkalies and reprecipitated by acids; 4 to 5.5 per cent. soluble in ether, the latter acquiring only a slight yellowish color. In contact with chloroform the latter remains uncolored, even when heated to boiling. With nitric acid it assumes a reddish-brown color, and mixed with sulphuric acid a blue color should not be imparted by blowing over the mixture the vapor of nitric acid.

ALOE BARBADENSIS (including the Curaçao product).—Rather hard and brittle, opaque or translucent in thin splinters, orange-brown to deep-brown (the genuine Barbadoes usually a little lighter), bright orange-yellow on the freshly abraded surface; fracture slightly conchoidal, of a waxy luster or in the "Capey" form resinous or barely glassy. Odor, when breathed upon, stronger but less fine and agreeable than that of Socotrine aloes. Not more than 30 per cent. should be soluble in cold water nor more than 10 per cent. in ether, the latter acquiring a yellow color. With alcohol, boiling water, and chloroform, it acts similarly to Socotrine aloes, and its powder or alcoholic mixture exhibits similar crystals. With nitric acid it acquires a red color; mixed with sulphuric acid, no change, or only a faint greenish-blue tint, should be acquired upon blowing over it the vapor of nitric acid; upon adding a little copper sulphate solution, then a saturated salt solution, an intense carmine color should be developed (Kremel). The Italian Pharmacopœia requires not more than 8 per cent. of water or 2 per cent. of ash, the Swiss not more than 1.5 per cent. of ash, the Russian not more than 4 per cent.

Composition.—The activity of the drug probably resides in *emodin* or *trioxymethylanthraquinone* ($C_{15}H_{10}O_5$), which crystallizes in orange-red needles, and bitter crystalline *aloin*. Aloes also contains resin, and a minute quantity of a pale-yellow volatile oil, different in the different varieties, and to which the disagreeable odor is due. Cold water extracts the active principles, the insoluble inactive matter being taken up by boiling water and deposited again on cooling. Aloes leaves 1 to 4 per cent. of ash. The yield of *aloin* varies from 4.5 to 9 per cent. (Treumann) in Cape aloes, 6 per cent. in Uganda, 7.5 to 10 per cent. in Socotrine, and 18 to 25 per cent. in Barbadoes or Curaçoa aloes. Treumann estimates that less than half the aloin in the drug can be extracted. It is probable that at least 3 different aloins exist, their respective sources being indicated by a prefix, viz., *socaloin* ($C_{15}H_{16}O_7$) and *barbaloin* ($C_{17}H_{20}O_7$ or $C_{16}H_{16}O_7 3H_{20}$), with similar properties, and *nataloin* ($C_{16}H_{18}O_7$ or $C_{25}H_{28}O_{11}$), which is little purgative to man. *Emodin*, but recently discovered, occurs in Cape and Barbadoes aloes (0.15 to 2 per cent.), but not in the Natal or Socotrine varieties. It develops in aloin exposed to the air, or heated with a 1 per cent. solution of potassium hydroxide, and is possibly the *aloëtin* of Stoeder. Like aloin, the resin differs according to its source, the different kinds being esters of various acids with aloresino-tannol. That of Barbadoes aloes is the cinnamic ester, and that of Cape aloes the paracumaric ester. The yield varies from 12 to 50 per cent.

Pharmaceutical Preparations.—EXTRACT OF ALOES, U. S. P.; PILLS OF ALOES, U. S. P.; PILLS OF ALOES AND ASAFŒTIDA, U. S. P.; PILLS OF ALOES AND IRON, U. S. P.; PILLS OF ALOES AND MASTIC, U. S. P.; PILLS OF ALOES AND MYRRH, U. S. P.; PURIFIED ALOES, U. S. P.; TINCTURE OF ALOES, U. S. P.; TINCTURE OF ALOES AND MYRRH, U. S. P.; PILLS OF ALOES AND PODOPHYLLUM, N. F.

Aloe Purificata, U. S.—*Purified Aloes*, E.; *Aloès depuré*, Fr.; *Gereinigte Aloe*, G.—The official directions for purifying aloes are to melt 1000 Gm. of aloes by means of a water-bath, and, after addition of 200 Cc. of alcohol, to stir the mixture well and pass it through a No. 60 sieve which has just been dipped into boiling water. The strained mixture is evaporated on a water-bath with constant stirring until a thread of the mass, upon cooling, becomes brittle; the product may then be broken into lumps of convenient size and preserved in well-closed containers in a cool, dry place.

The process is strictly one of mechanical purification, the object being the removal

of pieces of wood, leaves, and other foreign matter usually found in aloes; the alcohol is added simply to render the melted aloes more fluid and to facilitate straining. By dipping the sieve into boiling water, chilling and adhesion of the mixture are avoided.

Action and Uses.—Aloes has a disagreeably bitter taste and leaves an unpleasant after-sensation in the mouth. Because of its bitter principle it has been employed as a stomachic and tonic in depraved conditions of the stomach when attended with a sluggish liver or torpor of the large intestine, and increases the peristaltic action, but when given for a long time probably causes some atony of the muscular coat.

Aloes is a slowly acting purge, and its efficacy is increased when it is combined with alkalies such as soap. It rarely produces a watery stool, as it does not deplete, but, on the other hand, congests the bloodvessels of the abdominal viscera. It may be employed in habitual constipation resulting from impaired peristalsis, but its use should be discontinued as early as possible. If given in large doses, tenesmus and irritation of the large bowel may occur, but if combined with other resinous laxatives this may in a great measure be overcome.

It is stated by some that aloes possesses a certain curative power in the treatment of hemorrhoids; and in that variety resulting from a sluggish venous circulation, and not attended by inflammation, the drug may be of benefit. That this is true, however, is disputed by many physicians.

Aloes distinctly increases the menstrual flow. Whether this is due to some direct influence of the drug upon the uterus itself or whether it is caused by an extension of the irritation of the rectum to the uterus, is not definitely known, but it probably acts by increasing pelvic congestion. Amenorrhœa and menorrhagia resulting from anæmia are frequently relieved by aloes when combined with iron and other suitable remedies.

In the form of an enema the drug may be employed with benefit in the treatment of patients suffering from round worms, and as an injection it may be used with good result in chronic gonorrhœa.

Aloes should not be employed as a purge if irritation or inflammation of the intestine is present. It should not be used in the treatment of constipation in plethoric persons or in nursing women, as it may purge the nursling. The drug is contraindicated in pregnancy, proctitis, and in fevered states.

Because of its disagreeable taste aloes is commonly given in pill-form. Its usual dose is from 2 to 5 grains (0.12–0.30 Gm.), but as much as 20 grains (1.30 Gm.) may be given.

Other Varieties.—Aloe Capensis (synonyms and sources stated above).—Usually in strong boxes, frequently lined with sheep skin; color dark-brown or red-black, often with a greenish or olive tint and of a glassy luster; hard and brittle, the fracture strongly conchoidal, translucent in thin splinters; odor disagreeable, sourish; taste very bitter; powder yellowish-brown or greenish-brown, free from crystals; more soluble than either of the above in alcohol and water, and the solutions darker; from 1.5 to 6.5 per cent. soluble in ether. As much as 9 per cent. of aloin has been obtained from it, but the yield is ordinarily 5 to 7 per cent. Its production is probably equal to that of all other varieties combined. It is mostly used in Germany and southern Europe, but little in England and the United States.

Aloe Natalensis, or Natal Aloes.—Light or grayish liver-brown, without luster and opaque, exhibiting crystals under the microscope, almost odorless, and with less taste than any other, practically insoluble in alcohol or water. Its solution in sulphuric acid becomes blue upon exposure to the vapor of nitric acid. It is not known from which of the numerous African species this variety is derived.

Moka Aloes is probably produced from *A Succotrina* Lam., of eastern Africa, and is sold as Socotrine aloes, but is very inferior to the genuine. It is darker, softer, and of an unpleasant odor, and probably includes that of tarry consistence and color already described under Socotrine aloes.

Indian Aloes, or Jafferabad aloes, resembles Socotrine, but is harder, darker, and more glassy, its powder pale-brown, its odor and taste disagreeable. It is probably yielded by *A. Abyssinica* Lam., of northeastern Africa.

Zanzibar, while a general synonym for "Socotrine," is chiefly applied to the hepatic form, and especially to that arriving in monkey skins.

Hepatic has three significations: (1) the liver-colored variety of Zanzibar aloes; (2) (as chiefly applied in the United States) the Curaçao variety; (3) any liver-colored form.

Caballine Aloes was a very inferior variety, of African production, largely used in veterinary practice, but which has now disappeared from commerce.

ALOINUM, *U. S.*, *Br.*—Aloin.

The name aloin is used, both commercially and in the pharmacopœias, to designate the neutral, bitter, crystalline principle of aloes, irrespective of the source. The U. S. P. states that it is chiefly prepared from Curaçao aloes, whereas the Br. P. designates aloin as a product extracted from Barbadoes or Socotrine aloes. It is more than probable that a very large proportion of the aloin sold in this country is derived from Curaçao aloes, as this variety is much richer in aloin than either Barbadoes or Socotrine aloes, and, moreover, comparatively little of the latter variety reaches this market. Cape aloes, which was formerly supposed not to contain any crystalline aloin, has been shown to contain the same, and the name *capaloin* has been given to it. Tschirch, in 1898, succeeded in crystallizing capaloin from alcohol and ether in the form of colorless needles.

Various methods have been proposed for the manufacture of aloin, the best known of which is the treatment of aloes with hot water acidulated with either hydrochloric or sulphuric acid; after the infusion has been allowed to stand for a day it is carefully decanted from sediment, concentrated at a moderate temperature, and set aside in a cold place, when crystals or crystalline crusts of aloin will separate. The aloin may then be purified by recrystallization from hot water or very dilute alcohol. The addition of a little acid has been found advantageous in avoiding the contamination of aloin with non-crystallizable matter, which is less soluble in acidulated water than in plain water. A more recent method, suggested by Schaefer, depends upon the property of aloin of forming very difficultly soluble compounds with the alkaline earths in ammoniacal solution, which, upon decomposition with an acid, yield aloin. The following method for determining the aloin content in aloes indicates the process of manufacture for aloin on a large scale: 50 Gm. of aloes are mixed with 300 Cc. of hot water, with the addition of a few drops of hydrochloric acid. On cooling, the solution is decanted from the separated resin, mixed rapidly with 50 Cc. of 20 per cent. ammonia water and then with a solution of 15 Gm. of calcium chloride in 30 Cc. of water. On stirring rapidly, the aloin-calcium compound separates out and is collected after 15 minutes, the water is removed by draining or in a centrifugal machine, and the lime salt decomposed by triturating it in a mortar with a slight excess of hydrochloric acid. The resulting mixture of aloin and calcium chloride is then dissolved in a small quantity of hot water, filtered, the filter washed with hot water, and the aloin crystallized out at a low temperature with the aid of ice. As much as 30 per cent. of aloin, in fine, light-yellow crystals, has been obtained from commercial aloes by this method. The average yield of aloin from the different commercial varieties of aloes varies from 4 to 20 per cent. and over.

The names barbaloin, socaloin, nataloin, and capaloin are applied to the products obtained from different commercial varieties of aloes. Ugandaloin and Curaçaoaloin are identical with capaloin and barbaloin, respectively. These varieties of aloin differ in composition, solubility, and certain chemical reactions.

Properties.—Aloin occurs as a microcrystalline powder or minute acicular crystals, lemon-yellow to yellowish-brown in color, possessing a slight odor of aloes and an intensely bitter taste. It is slightly hygroscopic, the air-dried powder containing 1 molecule of water of crystallization at 100° C. (212° F.). Aloin is soluble in about 65 parts of water, 10.75 parts of alcohol, 664 parts of ether, 4260 parts of chloroform, 3120 parts of benzene, 1475 parts of petroleum benzin, and 21 parts of acetone, at 25° C. (77° F.). The melting-point of aloin which has been dried over sulphuric acid is about 147° C. (296.6° F.). When ignited, it is consumed without leaving a residue. Aloin dissolves in water, forming a yellow solution, which is neutral to litmus-paper, turns brown on standing, and has an intensely bitter taste. Ammonia-water and caustic alkalies dissolve aloin, forming a yellow solution, soon turning red and exhibiting a greenish-red fluorescence. Aloin when added to alkaline solutions is rapidly decomposed, but if mixed with acid solutions decomposition is slower. Added in minute quantity to concentrated sulphuric acid, aloin forms a yellowish-red solution, which, upon addition of a small crystal of potassium dichromate, changes to an olive green, then to a dark green, and, finally, on standing, to a blue. If a large amount of potassium dichromate be used, the yellowish-red solution first turns purple, then brown, and finally green. Bromine-water added to an aqueous solution of aloin produces a pink color. Gold chloride test-solution when added to an aqueous solution of aloin turns it carmine red, changing later to violet. A drop of ferric chloride test-solution added to an alcoholic solution of aloin

produces a brownish-green color.—U. S. The peculiar color reactions from orange to deep cherry red, observed when 5 per cent. ammonia-water is shaken with an ethereal extract, obtained from a decoction of aloes by agitation with ether, known as Borntraeger's reaction, are due to emodin, and not to aloin; pure aloin, freed from emodin, fails to show these colors.

Tests.—Aloin made from Curaçao aloes forms a cherry-red solution with nitric acid (distinction from nataloin, socaloin, and capaloin). On shaking 1 Gm. of aloin with 10 Cc. of benzene for 1 minute and filtering, the filtrate should not impart more than a faint pink color to an equal volume of 5 per cent. ammonia-water when shaken with it (limit of emodin). If to a dilute solution of aloin obtained from Curaçao aloes, 1 drop of copper sulphate test-solution be added, a bright-yellow color will be produced; upon adding a few drops of a solution of sodium chloride, the liquid will acquire a red color, and upon the further addition of a little alcohol the color will be changed to violet (distinction from nataloin and capaloin).—U. S. This last test, which is known as Klunge's reaction, depends, according to Tschirch, upon the presence of a small proportion (0.4 to 0.5 per cent.) of isobarbaloin, an isomeric body. The red color obtained in the reaction will be intensified if, in place of the sodium chloride, a small quantity of hydrocyanic acid be added. Aloin of commerce is sometimes contaminated with resinous and other matter, which can be detected by imperfect solubility of the sample in cold water.

Barbaloin. *Curaçaoaloin.* $C_{16}H_{16}O_7 + 3H_2O$ (Br.).—This is the chief aloin of the market, although largely made from Curaçao aloes. It conforms to the description and requirements given above. Boiled with nitric acid, barbaloin yields chrysammic acid, but if oxidized by means of potassium dichromate and sulphuric acid, aloxanthin (methyltetroxyanthraquinone), $C_{14}H_3.CH_3(OH)_4O_2$, results.

Socaloin ($C_{34}H_{38}O_{15} + 5H_2O$, Flückiger; $C_{15}H_{16}O_7$, Sommaruga and Egger), also known as *zanaloin*, may be obtained from Zanzibar aloes by treating the same repeatedly with cold 35 per cent. alcohol and expressing after each treatment. The residue is treated with hot alcohol and the resulting solution allowed to crystallize. It occurs in small, yellow, prismatic crystals, which are soluble at 15.5° C. (60° F.) in 90 parts of water, 9 parts of acetic ether, or 380 parts of ether. Treated with nitric acid it yields, like barbaloin, chrysammic acid, and with chromic acid, aloxanthin.

Nataloin ($C_{25}H_{28}O_{11}$, Tilden; $C_{16}H_{18}O_7$, Sommaruga and Egger).—This variety of aloin is obtained from Natal aloes, after treatment with warm 94 per cent. alcohol, by crystallizing the insoluble residue from boiling alcohol. It occurs in the form of yellowish rectangular plates, melting at 210° C. (410° F.), and soluble in 60 parts of 90 per cent. alcohol or 50 parts of acetic ether, but requiring 230 parts of absolute alcohol or 1250 parts of ether for solution. Nataloin may be readily distinguished from barbaloin and socaloin by the following reaction, known as Histed's reaction: If nataloin be dissolved in concentrated sulphuric acid and a glass rod previously dipped into fuming nitric acid be passed over the solution, the latter assumes a green color, changing to blue, then to violet, and finally to orange red. Barbaloin and socaloin are scarcely changed by this treatment. Natal aloin when treated with oxidizing agents yields neither chrysammic acid nor aloxanthin, but, instead, oxalic and picric acids (E. Schmidt).

Action and Uses.—Aloin is used very largely in place of aloes itself in laxative pills (see ALOES). The dose of aloin is ¼ grain (0.015 Gm.), usually given in pill.

ALSTONIA.—Dita Bark.

Ditarinde, G.; *Écorce de dita*, Fr.; *Pali-mari*, Ind.

The dried bark of *Alstonia scholaris* (L.) R. Br. (*Echites, s.* L.—Fam. *Apocynaceæ*).

Dita Bark is the product of a stately, fragrant-flowered tree of the East Indies, eastern Australia, and the Philippines and adjacent islands, which is held is superstitious reverence by the natives. Its wood yields a valuable timber. The bark is said to yield a yellow dye in Australia. It is a widely used antiperiodic and tonic in the countries where it grows.

The bark is in curved pieces, of variable size and 3 to 8 Mm. (⅛ to ⅓ In.) thick. It is externally of a yellowish color, has a scaly appearance from its longitudinal and transverse fissures, and is not infrequently marked with small black spots. Internally, it is light yellowish-brown, the inner surface brown-gray and longitudinally striate. The bark breaks with a short, or rather horny, somewhat porous fracture, showing in the outer layer groups of yellow stone-cells, and in the inner layer narrow wavy medullary rays, and yields a yellowish-gray powder, which is inodorous and has a slightly bitter, not unpleasant taste.

Constituents.—Three alkaloids have been investigated. *Ditamine* ($C_{16}H_{19}NO_2$, Hesse) is a white bitter amorphous powder, soluble in ether, alcohol, chloroform, and benzene, red with sulphuric acid, violet-red on warming, yellow by nitric acid, dark-green to violet on warming. *Echitamine* ($C_{22}H_{23}N_2O_4$, Hesse), about 1 per cent., is in glossy prisms, containing $4H_2O$, strongly basic, dissolves readily in water, alcohol, and, when freshly precipitated, in ether and chloroform, but is nearly insoluble in benzin and benzene. Its hydrochloride is sparingly soluble in cold water and nearly insoluble in hydrochloric acid and in alkaline chlorides. Sulphuric acid imparts a deep purplish-red color, changing to green. This alkaloid was first called *Ditaine* by Harnack, but this name had already been applied to an impure substance extracted by Gruppe. *Echitenene* ($C_{20}H_{27}NO_4$, Hesse) is amorphous, brown, soluble in alcohol and somewhat in water, reddish-violet by sulphuric acid, purple, afterward green and yellow, by nitric acid. A number of unimportant resinous substances have also been separated and determined.

FIG. 10.

Alstonia scholaris (⅔ Nat.).

Action and Uses.—Alstonia is rarely used in medicine in this country. In those countries in which it is native the drug has been used with success in the treatment of cholera and chronic dysentery. It has also been employed as an antiperiodic, and is said to be an excellent tonic during convalescence from exhausting diseases.

It is given in substance in the dose of from 3 to 5 grains (0.20–0.30 Gm.).

A tincture may be prepared by percolating 3 ounces and 148 grains of coarsely ground root with 1 pint of dilute alcohol (100 Gm. to 480 Cc.), the dose of which is 1 fluidrachm (4 Cc.). Tinctura Alstonia (P. I.—1 in 8), dose 1 to 2 fluidrachms (4–8 Cc.). Infusum Alstoniæ, dose 1 to 2 fluidounces (30–60 Cc.). Extractum Alstoniæ Liquidum, dose 3 to 8 minims (0.20–0.50 Cc.).

Alstonia constricta apparently possesses great antiperiodic and tonic properties. It has been likened to the combined action of quinine and nux vomica.

Other Species.—The genus contains about 30 species, growing in eastern Asia and the Pacific islands.

The closely allied *Poele bark* of Java, which comes from *Alstonia spectabilis* R. Brown, yielded to Hesse 0.8 per cent. of echitamine, or fully 6 times the quantity contained in dita bark; it contains also the other alkaloids in larger proportion than the latter; and in addition thereto *alstonamine*, which resembles ditamine in behavior, but is crystallizable; it was isolated by A. Scharlée in 1862, and then named *alstonine*, but this name is now used for one of the alkaloids of the next.

ALSTONIA BARK, from *Alstonia constricta* F. v. Mueller, a native of Australia, differs greatly in appearance from the dita bark in being 3 to 5 Cm. (1¼ to 2 In.) thick, deeply furrowed, externally brown-gray, or after abrasion ochrey-yellow and ridged upon the inner surface; the bast-layer is about 6 Mm. (¼ In.) thick, yellow, tough and fibrous, and is covered by the thick, spongy, and friable corky layer, which is composed of alternating bands of lighter and darker ochre color, these bands being present also in the much thinner bark from young wood, with a relatively thin periderm; the powder is grayish-yellow, odor slight, taste persistently bitter. The bark was described and its origin determined by Charles Mohr (1879). Palm (1863) found in it a neutral bitter principle, *alstonin;* Hesse (1865), 2 alkaloids *chlorogenine* and *porphyrine;* Mueller and Rummel described an alkaloid, *alstonine;* and Oberlin and Schlagdenhauffen (1879) a second uncrystallizable alkaloid, *alstonicine.* The alkaloids characterized by Hesse in 1881 are: *alstonine* (chlorogenine), $C_{21}H_{20}N_2O_4$, brownish-

yellow, amorphous, readily soluble in alcohol, and, when freshly precipitated, also in chloroform and water, sparingly soluble in ether; its salts are insoluble in dilute acids; *porphyrine* $C_{21}H_{25}N_3O_2$, white, amorphous, soluble in petroleum naphtha, freely soluble in ether, alcohol, and chloroform, the acid solutions of a blue fluorescence: sulphuric or nitric acid dissolves it with a purple color, that with nitric acid changing to yellowish- and brownish-green; *alstonidine* crystallizes from its solutions in chloroform, ether, alcohol, acetone, and hot petroleum naphtha; is not colored by sulphuric or nitric acid, but its solutions show blue fluorescence. One or more other alkaloids are present in minute quantity.

A. VILLOSA Bl., of Java, is also said to contain one or more alkaloids.

ALTHÆA, *U. S.*—Marshmallow.

Radix Hibisci, Radix Bismalvæ.—*White mallow, Wymote, Mortification-root,* E.; *Althee, Eibisch,* G.; *Guimauve,* Fr.; *Altea, Malvabisco,* Sp.; *Malvaisco,* Port.; *Malvavischio,* It.

The dried root of *Althæa officinalis* L. (Fam. *Malvaceæ*), collected from plants of the second year's growth and deprived of the periderm.

Althæa is official in most pharmacopœias, but not in the British. The German calls attention to the bright-yellow coloration of the infusion on treatment with dilute alkalies. Both the entire and the cut root should be free from a coating of chalk or other whitening substance.

The marshmallow plant is a native of Europe and Asia, but the drug is collected from cultivated plants. During the first and second years it consists of a nearly straight tap-root, bearing small rootlets, which in subsequent years develop into large branches, after which the main root is tough and woody and unfit for use. Sometimes the branches are then collected, but are inferior to the tap-root collected in the second year of its growth. Collection is made in the late fall or early winter, the outer bark is peeled off and the root carefully dried.

Description.—Slenderly conical, bearing several broad, shallow furrows, separated by blunt ridges; white externally, marked by brownish, more or less circular scars and fibrous-hairy with partially detached, long bast-fibers; internally yellowish-white, the fracture short and mealy, fibrous in the outer layer; bark occupying about $\frac{1}{10}$ of the radius, containing small groups of bast-fibers in indistinct concentric circles, and separated by a brown cambium from the slightly radiate central cylinder, which has narrow medullary rays and small indistinct vascular bundles of 3 or 4 pitted ducts; there is an abundance of starch in the thin-walled parenchyma. The starch-grains are mostly oval, occasionally indented at one edge, frequently have a simple or branched light band (the cleft hilum) running from end to end, and usually show the rings but faintly. Their polarization is unequal. They are of medium size, commonly about 10, occasionally up to 20, mikrons. There are many large cells filled with mucilage and a few containing crystalline clusters of calcium oxalate. The odor is slight but characteristic; taste sweet, starchy, and mucilaginous.

No substitute for althæa in the entire condition is likely to occur, though old and woody roots and discolored roots whitened with lime or calcium sulphate are commonly seen, and we have even received entire, branched wild roots in an unpeeled condition. All these are readily distinguished. Adulteration of the ground root is very common, almost always with other starchy substances, readily detected by the appearance of the starch-grains. Instead of being marketed in the above-described form, the root is frequently cut up into small cubes, and these are rather more frequently subject to artificial whitening.

Constituents.—A. Büchner reports starch 37 per cent., mucilage 35 per cent., pectin 11 per cent., sugar 11 per cent., fat 1.25 per cent., and asparagin up to 2 per cent. Betaine (*trimethylglycocoll*) was found by Orlow. The gum is said to contain one less water-molecule than that of acacia. The asparagin (*amido-succinamic acid*) is tasteless, and has been called *althein.*

Action and Uses.—Althæa is rarely used in medicine in this country. It possesses certain demulcent properties, and is employed in Europe in inflammatory conditions of the gastro-intestinal and genito-urinary tracts. The bruised leaves in the fresh state and the ground root are occasionally employed as poultices in localized inflammations of the skin. It may be given in infusion (50 Gm. to 1000 Cc. of water) in doses of from 1 to 4 fluidounces (30–120 Cc.), or as the syrup of althæa in the dose of 1 to 4 fluidrachms (4–16 Cc.).

ALUMEN, *U. S., Br., P. G.*—Alum.

Aluminii et potassii sulphas, U. S. 1870.—*Potassium alum, Aluminum and potassium sulphate*, E.; *Alun, Sulfate d'alumine et de potasse*, Fr.; *Alaun, Kalialaun*, G.; *Solfato di alluminia e di potassio*, F. It.; *Alumbre*, Sp.

Formula, $KAl(SO_4)_2 + 12H_2O$ or $K_2Al_2(SO_4)_4 + 24H_2O$. Molecular weight, 471.02 or 942.04.

Alumen, Br.; *Alum, Ammonium alum*, E.; *Alun ammoniacal*, Fr.; *Ammoniak-alaun*, G.

Formula, $(NH_4)_2Al_2(SO_4)_4 + 24H_2O$ or $NH_4Al(SO_4)_2 + 12H_2O$. Molecular weight, 904.42 or 452.21.

It should contain not less than 99.5 per cent. of pure aluminum and potassium sulphate.—U. S.

Origin.—The term alum is a class name given to a number of double sulphates, which consist of a molecule of a sulphate of a univalent metal and a molecule of a sulphate of a trivalent metal crystallizing together with 24 molecules of water, and are represented by the type formula $M'_2SO_4.M'''_2(SO_4)_3.24H_2O$. The name is derived from the oldest and principal member, namely, ordinary potassium alum (alumen). The alums readily crystallize in cubes and octahedra, and resemble one another closely in properties. In the type formula, M' may be K, Na, (NH_4), etc., and M''' may be Al, Cr, Fe, etc. Ordinarily, the name *alum* is indiscriminately used for the alumino-ammonium and for the alumino-potassium alum, both kinds being recognized as such by the British Pharmacopœia, while the United States, French, and German Pharmacopœias recognize the latter only.

The minerals used in the manufacture of alum are *bauxite, cryolite, clay, alum-stone*, or *alunite*, and *alum-slate*. Bauxite is aluminum hydroxide combined with considerable iron, found in rich deposits in Georgia and Alabama, and is a very important raw product for alum-making. *Cryolite* is sodium-aluminum fluoride, extensively employed in the manufacture of sodium hydroxide, whereby aluminum hydroxide is obtained as a by-product, which is worked up into the sulphate or alum. *Clay* is an aluminum silicate. Alum-stone contains aluminum and potassium sulphates and aluminum hydroxide. It yields the purest alum. *Alum-slate* or *schist* consists of a clayey material intermixed with pyrites (iron sulphide) and bituminous matter, and a small quantity of lime, etc.

Preparation.—Various methods are followed according to the raw material used:

1. Alum-stone is first calcined to render the aluminum hydroxide in it insoluble, and then made into piles which are kept moist; after several months the mass becomes disintegrated and converted into alum, which is extracted by water and purified.

2. Bauxite is fused with soda, which gives soluble sodium aluminate, Na_3AlO_3. CO_2 is passed through the solution of this, precipitating aluminum hydroxide, which, when dissolved in sulphuric acid, and mixed with potassium sulphate, forms alum. Cryolite is treated in a similar manner, or is heated directly with sulphuric acid, thus forming sulphate, from which alum is made.

3. Calcined clay moistened with strong H_2SO_4 and allowed to stand some time yields aluminum sulphate, from which alum is obtained as in 2.

4. Alum-slate is allowed to lie in heaps exposed to weather in the air or is slowly roasted by making heaps of alternating layers of slate and wood or coal, and igniting. By the one or other process sulphuric acid is formed from the sulphur in the pyrites, and ultimately aluminum sulphate, which, on lixiviating, is obtained in solution and converted into alum as above.

All alums of commerce are more or less impure, containing variable but small quantities of iron. The variety known as *Roman* or cubical alum is very pure; it crystallizes in cubes, which is an index to the absence of iron. *Roche* alum is a variety named after Rocca, Syria, where it first originated; it occurs in fragments about the size of an almond, of a pale-rose color.

Alum is manufactured on a very large scale, as it finds application in a variety of ways, for example, as a mordant in dyeing industries, in tanning, in preparing colors and lakes, in paper-making, etc., besides its extensive use in medicine.

Properties.—The two official alums are similar in every respect, except that the ammonium alum gives the odor of ammonia on the addition of an excess of potassium

hydroxide or carbonate, and, when heated to full redness, leaves finally alumina. Potassium alum, at a white heat, leaves a mixture of alumina and potassium sulphate.

Alum crystallizes in colorless, inodorous, transparent regular octahedrons, which are usually combined with the cube. Its specific gravity is 1.724—of ammonium alum, only 1.631. It has an acidulous sweetish and astringent taste, and an acid reaction to test-paper. Its aqueous solution dissolves iron, zinc, and other metals which are soluble in diluted sulphuric acid, with the evolution of hydrogen. It is insoluble in alcohol or ether, effloresces slightly on exposure to the air, losing at 40° C. (104° F.) 2.7 per cent., at 47° C. (116.6° F.) 9.6 per cent. of water; when heated to about 92° C. (197.6° F.) it fuses and loses all of its water of crystallization (45.51 per cent.) at 200° C. (392° F.), leaving a voluminous white mass (see Alumen Exsiccatum). Ammonium alum loses all its water of crystallization (47.6 per cent.) above 205° C. (401° F.). At a full red heat both are decomposed, but to effect the complete decomposition of potassium alum a white heat is required, when sulphuric and sulphurous anhydride and oxygen are given off. According to Poggiale (1843), 100 parts of water dissolve at—

	0°	10°	20°	30°	40°	50°	80°	100° C.
Ammonium alum . .	5.22	9.16	13.66	19.29	27.27	36.51	103.08	421.9 parts.
Potassium alum . . .	3.9	9.52	15.13	22.01	30.92	44.11	134.47	357.48 "

The determinations made by Mulder (1864) closely agree with those of Poggiale for ammonium alum, but differ considerably for potassium alum. 1 part of the latter, according to Redtenbacher (1865), dissolves at 17° C. (62.6° F.) in 7.41 parts, and according to Poggiale, at 20° C. (68° F.) in 6.61 parts, and at 10° C. (50° F.) in 10.5 parts of water; this last figure is given by both the British and German Pharmacopœias as the solubility of alum at 15° C. (59° F.), while Mulder's results at the same temperature are 10.9 parts.

The U. S. P. gives the solubility of potassium alum at 25° C. (77° F.) as 1 in 9 parts of water, and in 0.3 part of boiling water; it is also freely soluble in warm glycerin.

Tests.—The alkalies and alkali carbonates precipitate white gelatinous aluminum hydroxide, which is insoluble in ammonia and the carbonated alkalies, but dissolves in an excess of potassium or sodium hydroxide. Commercial alum always contains a little iron, from which it can not be completely freed by recrystallization. It is owing to its presence that solutions of alum become blue on the addition of potassium ferrocyanide, and yield a grayish precipitate with ammonium sulphide. The limit of this impurity is thus ascertained: A solution of 1 Gm. of alum in 20 Cc. of water should not at once assume a blue color on the addition of 5 drops of test-solution of potassium ferrocyanide. —U. S. The German Pharmacopœia requires the same limit. The solution of alum in potassium or sodium hydroxide should not give off the odor of ammonia (absence of more than traces of ammonium alum), nor should 10 Cc. of the aqueous solution (1 in 20), acidulated with 1 Cc. of diluted hydrochioric acid, be colored or rendered turbid by an equal volume of fresh hydrogen sulphide test-solution when kept at 35° C. (95° F.) for at least half an hour (absence of heavy metals). When a saturated solution of alum is shaken with sodium tartrate test-solution, it yields a white crystalline precipitate within half an hour (potassium).

Action and Uses.—Alum is at first sweetish to the taste, and afterward decidedly astringent. Primarily, it excites the flow of saliva, but subsequently materially decreases it. When locally applied to mucous membranes, it whitens and constringes the tissue, and when used upon the skin, thickens and toughens it. It contracts peripheral capillaries and decreases secretion; but if employed indefinitely, it may increase secretion. It has the power of coagulating albumin, and when injected into the blood causes thrombosis and embolism. Small doses of alum frequently cause constipation. Very large amounts produce gastro-enteritis, with vomiting and purging. The drug is only slightly absorbed, but traces of it may circulate in the blood without detriment, and it may be found in the liver and in the urine. Alum was at one time considered a panacea in many conditions, but at present its use in internal medicine has been largely replaced by other more efficacious and agreeable remedies. It is recommended in gastralgia, acute and chronic dysentery, and in diabetes mellitus and insipidus. It may be employed with success in hæmatemesis of a passive character, particularly that resulting from circulatory obstruction or cardiac incompetency. As an emetic, it may be employed

in pseudomembranous croup for the purpose of dislodging the membrane. As it is quite slow in its action, it is not wise to employ this drug for the purpose of emptying the stomach after the ingestion of poisons. Alum may be employed as an antidote in acute lead-poisoning, and in conjunction with opium is of value in the treatment of lead colic. A solution containing 20 grains (1.3 Gm.) in 1 fluidounce (30 Cc.) of water, may be employed in the form of a fine spray in the treatment of hæmoptysis, bronchorrhœa, and chronic bronchitis. Aphonia resulting from laryngeal atony may also be benefited in this way. The various forms of stomatitis are relieved by its use. A gargle containing 1 ounce (30 Gm.) in 8 fluidounces (240 Cc.) of water may be used successfully in the treatment of pharyngitis and tonsillitis; but as this agent has a destructive action upon the enamel of the teeth, it is better to employ a saturated solution upon a swab, or, in the case of follicular tonsillitis, to use the alum stick. A saturated solution is frequently recommended in the treatment of vaginal leucorrhœa resulting from a relaxed condition of the vaginal mucous membrane; and an injection containing from 5 to 10 grains (0.30–0.60 Gm.) to the ounce of water, may be effective in treating chronic gonorrhœa and gleet.

A lotion containing 2 grains (0.12 Gm.) to the ounce of water or dilute alcohol sometimes proves successful in combating the night-sweats of phthisis, and localized sweating of the feet and hands. This lotion is also largely employed for the purpose of preventing bedsores. Because of its great affinity for water and its power of coagulating albumin, dried alum is employed for the destruction of exuberant granulations and the stimulation of indolent ulcers. It is used for ingrowing toenail, a piece of lint or cotton having first been placed between the nail and the granulating surface. Alum in hot concentrated solution is largely employed as a hæmostatic in those conditions where the leaking vessels can be easily reached. In epistaxis and in hemorrhage following tooth extraction its application is usually attended with success.

The alum poultice, made by coagulating white of egg with alum and enclosing the coagulated albumin in a cambric bag, may be beneficial in overcoming recent ecchymosis. The curd obtained by coagulating milk may be employed in the same way.

Internally alum is given in doses of from 5 to 30 grains (0.30–2 Gm.). The emetic dose is from 1 to 2 drachms (4–8 Gm.), given in syrup or warm water. Alum whey is prepared by boiling 2 drachms (8 Gm.) in 1 pint (480 Cc.) of milk, and straining to separate the curd. The dose is 2 fluidounces (60 Cc.).

ALUMEN EXSICCATUM, *U. S., Br.*—Dried Alum.

Alumen ustum, P. G.—*Burnt alum*, E.; *Alun calciné, A. desséché, A. brulé*, Fr.; *Gebrannter Kali Alaun*, G.; *Allume usto*, It.

Formula, $KAl(SO_4)_2$ or $K_2Al_2(SO_4)_4$. Molecular weight, 256.46 or 512.92.

Preparation.—Alum, in small pieces, 100 Gm.; to make 55 Gm. Place the alum in a shallow porcelain capsule, so as to form a thin layer, and heat it on a sand-bath until it liquefies. Then continue the application of a moderate heat, with constant stirring, until aqueous vapor ceases to be disengaged, and a dry white porous mass is obtained, weighing 55 Gm. When cold, reduce the product to a fine powder, and preserve it in well-stoppered bottles.—U. S.

The Br. P. gives the same process, simply adding that the temperature shall not be allowed to rise above 204.4° C. (400° F.).

Properties.—After exsiccation, dried alum forms a light porous mass which is easily rubbed into a white granular powder. It is very slowly (but completely) soluble in cold water, about 17 parts, at 25° C. (77° F.), U. S., 30 parts at 15° C. (59° F.), P. G., but dissolves in a short time in 1.4 parts of boiling water (U. S.), these tests being sufficient to prove its faultless preparation. Owing to its slow solubility, its taste is at first slight, but soon becomes more styptic than that of crystallized alum. *Impurities* may be detected in the same manner as in alum.

Action and Uses.—Dried alum is a powerful astringent and stimulant, and when applied to tissues in process of growth may become escharotic. Hence, as was more particularly pointed out in the preceding article, it is used to repress fungous granulations and stimulate indolent and sanious ulcers, as well as mucous membranes tending to hypertrophy, or throwing off morbid secretions. Powdered dried alum is peculiarly fitted for insufflation.

ALUMINI HYDROXIDUM, *U. S.*—Aluminum Hydroxide.

Alumini hydras, U. S., 1890; *Alumina hydrata*, P. G., 1872; *Argilla pura s. hydrata.* —*Aluminum hydrate, Hydrated alumina*, E.; *Hydrate d'alumine*, Fr.; *Thonerdehydrat*, G.

Formula, $Al(OH)_3$ or $Al_2(OH)_6$. Molecular weight, 77.54 or 155.08.

It should contain not less than 99.5 per cent. of pure aluminum hydroxide.—U. S.

Preparation.—Alum, 100 Gm.; monohydrated sodium carbonate, 43 Gm. Dissolve each salt separately in 1000 Cc. of water, filter the solutions, and heat them to boiling. Then, having poured the hot solution of monohydrated sodium carbonate into a capacious vessel, gradually pour in the hot solution of alum with constant stirring, and add 2000 Cc. of boiling water. Allow the precipitate to subside, decant the clear liquid, and pour upon the precipitate 2000 Cc. of hot water. Again decant, transfer the precipitate to a strainer, and wash it with hot water until the washings produce not more than a faint cloudiness with barium chloride test-solution. Then allow it to drain, dry it at a temperature not exceeding 40° C. (104° F.), and reduce it to a uniformly fine powder.—U. S.

Nearly pure aluminum hydroxide is prepared from cryolite. The sodium aluminate obtained in the manufacture of sodium carbonate (see SODII CARBONAS) is treated with milk of lime, resulting in the production of sodium hydroxide and a precipitate of calcium aluminate; on dissolving a portion of the latter in hydrochloric acid, chlorides of aluminum and calcium are formed, and this solution, on being digested with another portion of the precipitate, yields more calcium chloride, which remains in solution, and aluminum hydroxide: $Al_2Cl_6 + Al_2(O_2Ca)_3 + 6H_2O$ yields $3CaCl_2 + 2Al_2(OH)_6$.

On mixing solutions of sodium carbonate and alum a decomposition takes place, resulting in the formation of sodium sulphate, potassium sulphate, aluminum hydroxide, and carbon dioxide: $3Na_2CO_3 + 2KAl(SO_4)_2 + 3H_2O = 3Na_2SO_4 + K_2SO_4 + 2Al(OH)_3 + 3CO_2$. On adding the alkali carbonate to the alum solution, the aluminum hydroxide persistently retains sulphuric acid and alkali; but on slowly adding the alum solution to the alkali carbonate, so that the latter remains continually in excess, only a minute amount of basic sulphate will enter into the precipitate, and will be almost completely decomposed by digesting the latter with the alkaline liquid. In order to obtain it absolutely free from sulphate, Berzelius found it necessary to redissolve the washed hydroxide in hydrochloric acid, and to precipitate this solution with an excess of ammonia. For the washing of the precipitate hot (not boiling) water is directed—a precaution necessary to avoid decomposition of the hydroxide. Sainte-Gille (1855) determined that by prolonged contact with boiling water the hydroxide, $Al_2(OH)_2O_2$, is formed, which is insoluble in dilute acids. Drying the hydroxide at a low temperature leaves it in a smooth condition and prevents it from becoming gritty.

Aluminum hydroxide is occasionally found native, forming the rare crystal mineral *gibbsite*, $Al_2(OH)_6$, of North America, and *diaspore*, $Al_2(OH)_2O_2$, of eastern Europe. It is more frequently found in the ashes of cryptogamous plants than those of phænogams.

Properties.—Aluminum hydroxide is a white, light, amorphous powder, permanent in dry air, odorless and tasteless, and insoluble in water or alcohol; soluble without residue in (dilute) hydrochloric or sulphuric acid, and also in solution of potassium or sodium hydroxide. When heated to redness, it loses 34.0 per cent. of water of hydration.—U. S. A portion of the water is given off at a temperature a little above 100° C. (212° F.), but for expelling the last 10 or 12 per cent. of it a full red heat is required, when *aluminum oxide*, Al_2O_3, is obtained. When added to a turbid or colored liquid the impurities suspended and the coloring-matter contained therein are precipitated; freshly precipitated aluminum hydroxide (*alumine engelée*, Fr.) is best adapted for this purpose; hence its use for the clarification of vegetable juices and the preparation of *lakes*, which consist of aluminum hydroxide united with and tinged by pigments.

Tests.—A solution of 1 Gm. of aluminum hydroxide in 20 Cc. of diluted hydrochloric acid should not at once assume a blue color on the addition of 1 drop of potassium ferrocyanide test-solution (limit of iron), and should not give more than a faint cloudiness with barium chloride test-solution (limit of sulphate). If 1 Gm. of the salt be boiled with 20 Cc. of distilled water, the filtrate should not have an alkaline reaction, and on evaporation should not leave a residue weighing more than 0.005 Gm. (limit of

alkali salts). A solution of the salt (1 in 20) in dilute hydrochloric acid should not yield a color or precipitate with an equal volume of fresh hydrogen sulphide test-solution after standing corked at 35° C. (95° F.) for at least half an hour (absence of heavy metals).—U. S.

Action and Uses.—Aluminum hydroxide may be used as an absorbent and protective in irritations of the skin. Internally it is a mild astringent antacid of some value in the treatment of diarrhœa, due to acidity in the intestine. The dose is from 3 to 6 grains (0.20–0.40 Gm.).

ALUMINI SULPHAS, *U. S.*—Aluminum Sulphate.

Aluminium sulfuricum, P. G.; *Sulfate d'alumine*, Fr.; *Aluminiumsulfat, Schwefelsaure Thonerde*, G.

Formula (crystallized), $Al_2(SO_4)_3 + 16H_2O$. Molecular weight, 625.93.

It should contain not less than 99.5 per cent. of pure aluminum sulphate.—U. S.

Preparation.—Aluminum sulphate, intended for medical purposes, should be made from freshly prepared aluminum hydroxide, which need not be previously dried, by dissolving it in the requisite quantity of diluted sulphuric acid, and crystallizing the resulting solution. Instead of setting the solution aside for crystallization, it may be evaporated on a water-bath to dryness. An excess of acid should be avoided, as well as an excess of the hydroxide; in the event of the latter, basic sulphates are likely to be formed. 100 Gm. of aluminum hydroxide, obtained from 607.33 Gm. of official alum, require 188.31 Gm. of absolute or 203.58 Gm. of official (92.5 per cent.) sulphuric acid to form a normal salt.

Properties and Tests.—Aluminum sulphate occurs as a white, crystalline powder, or shining plates, or crystalline fragments, without odor, having a sweetish and afterward an astringent taste, and permanent in the air. It is soluble in 1 part of water at 25° C. (77° F.), more soluble in boiling water, but insoluble in alcohol. When gradually heated to about 200° C. (392° F.), it loses its water of crystallization (45.7 per cent. of its weight). The aqueous solution of the salt has an acid reaction upon blue litmus-paper. With barium chloride test-solution, the aqueous solution of the salt yields a white precipitate insoluble in hydrochloric acid; and with potassium hydroxide test-solution, a white, gelatinous precipitate which is soluble in an excess of the alkali, but which is again separated on the addition of a sufficient amount of ammonium chloride test-solution. If 1 Gm. of aluminum sulphate be gently heated with 5 Cc. of potassium hydroxide test-solution, the liquid should not evolve the odor of ammonia. A filtered, aqueous solution of the salt (1 in 10) should not become more than faintly opalescent within 5 minutes after the addition of an equal volume of tenth-normal sodium thiosulphate solution (limit of free acid). The addition of 5 drops of potassium ferrocyanide test-solution to 20 Cc. of the aqueous solution of the salt (1 in 20) should not produce at once a blue coloration (limit of iron). The aqueous solution of the salt (1 in 10), when acidulated with a small quantity of diluted hydrochloric acid, and warmed to about 50° C. (122° F.), should not be colored or rendered turbid by the addition of an equal volume of freshly prepared hydrogen sulphide test-solution, after standing, well stoppered, in a warm place, 35° C. (95° F.), for at least half an hour (absence of heavy metals).—U. S.

For use in the arts, aluminum sulphate is prepared by heating ammonium alum to a dull-red heat, when the ammonium sulphate is decomposed and expelled, leaving anhydrous aluminum sulphate; or it is made from alum-shale and other aluminum silicates, and is known to dyers as concentrated alum or cake-alum.

Action and Uses.—As a remedy in internal medicine aluminum sulphate is rarely employed, and even as a topical application its use is limited. In saturated aqueous solution it may be applied as an astringent and mild caustic to enlarged tonsils, nasal polypi, and cancerous growths, and as a local stimulant to promote the healing of so-called ulcers of the cervix uteri. The addition of benzoin to the solution renders the action of the aluminum sulphate less irritating, but no less efficient, and in this form it is especially useful as an antiseptic and deodorant douche in fetid leucorrhœa. In powder it has been applied for its caustic action to cancerous and other chronic morbid growths.

Benzoinated Basic Aluminum Sulphate, Mentel's Solution, is prepared by dissolving 4 ounces of aluminum sulphate in 8 fluidounces of water, adding precipitated aluminum hydroxide to saturation, and finally 8 drachms of powdered benzoin. Warm to about 65° C. (149° F.) for 6–8 hours and stir occasionally. When the specific gravity has reached 1.26 filter and set aside in a cool place for a week. The solution acquires a balsamic odor and taste and is astringent. Diluted with 30–40 parts of water it is applied to chronic sores and ulcers.

Platt's Chlorides.—A well-known and popular disinfectant, said to be composed of aluminum sulphate, 170; zinc chloride, 40; sodium chloride, 55; calcium chloride, 85; water, 1000.

ALUMINUM—Aluminum.

Alumine, Fr.; *Aluminium*, G.

Symbol, Al. Atomic weight, 26.9.

Occurrence.—The metal aluminum occurs widely and abundantly distributed in nature, but always in combination. Next to oxygen and silicon it is the most abundant element in the solid crust of the earth. It is a constituent of the feldspars, micas, and clays, which occur in such abundance. It also occurs as oxide and hydroxide, and in the mineral *cryolite*, a fluoride of sodium and aluminum.

Preparation.—The metal was first isolated by Wöhler in 1827 by the action of potassium on aluminum chloride. In 1854 St. Claire-Deville obtained it on a commercial scale by heating sodium and the double aluminum sodium chloride, and in the same year Bunsen obtained it by electrolysis of molten aluminum chloride. At the present day nearly all of the metal is made by the action of powerful electric currents on molten mixtures of its compounds; for example, the oxide dissolved in cryolite. Formerly the metal was quite expensive, but it is now so cheap that it may be considered among the common metals. In 1879 a pound cost about 20 dollars, now it is worth from 35 to 40 cents. The chief works for producing aluminum in this country are located at Niagara Falls, and are operated by the Pittsburg Reduction Company. In 1897, 4,000,000 pounds of the metal were produced in this country alone.

Properties.—Aluminum is silvery-white, very malleable and ductile, has a specific gravity of about 2.6, melts at 628° C. (1162.4° F.), conducts electricity well, when pure does not tarnish in air, and approaches iron in toughness. These properties make it a highly useful metal, and it is being employed for many purposes for which iron was formerly used. Most of the metal is used for making alloys. Aluminum bronze is a golden-yellow alloy of 90 per cent. of copper and 10 per cent. of aluminum. Other alloys, containing silver, gold, zinc, iron, chromium, respectively, are made. It is scarcely affected by cold concentrated or dilute nitric or sulphuric acid. Hydrochloric acid and sodium or potassium hydroxide dissolve it with evolution of hydrogen. Acetic acid and phenol act similarly. Solutions of salts in general, but especially of ammonium salts, corrode the metal; hydrogen sulphide does not tarnish it.

COMPOUNDS OF ALUMINUM.

Alumini Acetas.—*Aluminum acetate*, E.; *Acétate d'alumine*, Fr.; *Aluminiumacetat*, G. $Al_2(C_2H_3O_2)_6 + Aq$.—Prepared by dissolving aluminum hydroxide in cold acetic acid; or by decomposing aluminum sulphate with lead acetate, and evaporating at a low temperature, it is obtained as a gum-like mass having an acid reaction and a styptic taste. The solution, heated in the presence of other salts, is decomposed, with the separation of basic aluminum acetate. An impure solution of the salt, containing also potassium or ammonium sulphate, obtained by mixing the aqueous solutions of 6 parts of sugar of lead and 5 parts of alum, and filtering from the precipitated lead sulphate, is extensively employed in dyeing as a mordant and is serviceable as a disinfectant.

Liquor Alumini Acetatis (*Acetici*, P. G.).—*Solution of aluminum acetate*, E.; *Soluté d'acétate d'alumine*, Fr.; *Aluminiumacetat-Lösung*, G.—Dissolve aluminum sulphate 30 parts in water 80 parts; add acetic acid (specific gravity 1.041) 36 parts; triturate calcium carbonate 13 parts with water 20 parts, and add this mixture slowly and with continued stirring to the first solution; set the whole aside for 24 hours without applying heat, and stir occasionally; then strain, press the precipitate without washing it, and filter the liquid. It is a clear colorless liquid, having the specific gravity 1.044 to 1.046, a faint odor of acetic acid, an acid reaction, and a sweetish, astringent taste. On adding to it one-fiftieth of its weight of potassium sulphate and heating it on a water-bath, it coagulates, but after cooling becomes clear again in a short time. The solution is not colored by hydrogen sulphide, and on being mixed with twice its volume of alcohol becomes opalescent, but does not produce a precipitate. On

precipitating 10 Gm. of the solution with ammonia, 0.25 to 0.30 Gm. of alumina should be obtained, proving 7.5 to 8 per cent. of basic aluminum acetate.—P. G. The formula of this compound is $Al_2(OH)_2(C_2H_3O_2)_4$; its molecular weight 323.44. The above process is more simple, and yields more uniform results, than the one devised by Hager (1871), in which aluminum sulphate was decomposed by basic lead acetate.

Alumini Acetotartras.—*Aluminum Acetotartrate*, E.; *Essig-weinsaure Thonerde, Alsol-Athenstädt*, G.—This compound was first prepared by *Athenstädt*, and the process for its manufacture has been patented in Germany. 5 parts of basic aluminum acetate are dissolved in a sufficient quantity of water by aid of 2 parts of tartaric acid, and the solution evaporated to dryness. Or, 100 parts of freshly prepared solution of aluminum acetate are evaporated on a water-bath with 3.5 parts of tartaric acid and finally dried at 30° C. (86° F.) or less on glass plates. It occurs in shining almost colorless amorphous masses, with faint acetous odor and an acidulous astringent taste. It forms with water an acid solution, but is insoluble in alcohol. According to Fresenius, it is a true chemical compound, having the following average composition: Alumina, 23.67; acetic anhydride, 30.77; tartaric acid, 27.17; water, 18.08. The salt has been used in aqueous solution as a non-toxic reliable antiseptic and astringent.

Alumini Betanaphtholdisulphonas.—*Aluminum betanaphtholdisulphonate, Alumnol.* $Al(C_{10}H_6(OH)SO_3)_3$.—A colorless powder, soluble in water and glycerin, slightly soluble in alcohol. Alkalies precipitate $Al(OH)_3$. Albumins and gelatins precipitate it, but excess redissolves it. Astringent and antiseptic.

Alumini Boras.—*Aluminum borate*, $Al_2(B_4O_7)_3$, is made by action of a solution of 11.5 parts of crystallized borax on 6.7 parts of crystallized aluminum sulphate in solution.

Alumini Boroformas.—*Aluminum boroformate*, approximately $(Al_2O_3)(H_3BO_3)(H_2CO_2)$. $5H_2O$, is made by dissolving $Al_2(OH)_6$ in a mixture of 2 parts of formic acid and 1 part of boric acid. Pearly crystals, soluble in water and alcohol. Disinfectant.

Alumini Borotannas.—*Aluminum borotannate, Cutal.*—Solution of 1 part of tannic acid, 4 parts of crystallized borax, in 80 parts of water, poured into 3 parts of crystallized aluminum sulphate in 12 parts of water. Light-brown insoluble powder.

Alumini Borotartras.—*Aluminum borotartrate, Boral.*—1 part of aluminum borate, 1 part of tartaric acid, 9 parts of water. Solution is evaporated to dryness.

Alumini Chloridum.—*Aluminum chloride.—Salzsaure Thonerde*, G., *Chlorure d'alumine*, Fr. Al_2Cl_6.—Prepared pure by passing chlorine over a mixture of Al_2O_3 and carbon at red heat. It forms colorless crystalline masses, giving off hydrochloric acid fumes in moist air. The commercial product contains iron and is yellow. It is used in organic synthesis, in what is known as the Friedel-Crafts reaction. Aluminum chloride in an impure state has been used to some extent. A solution sufficiently pure for disinfecting purposes is obtained by mixing the solutions of 2 parts of alum and 1 part of anhydrous calcium chloride and filtering from the precipitated calcium sulphate. The pure salt, Al_2Cl_6, is best prepared by dissolving aluminum hydroxide in hydrochloric acid and evaporating carefully, when crystals containing $12H_2O$ are obtained, which are readily soluble in water and alcohol and are decomposed by heat. In the anhydrous state, however, aluminum chloride is volatile.

Chloralum, a solution of 20 parts of aluminum chloride in 80 parts of water, containing as impurities lead, copper, iron, calcium, etc. A deodorizer and disinfectant.

Alumini Gallas.—*Basic aluminum gallate, Gallal.*—67 parts of crystallized aluminum sulphate in 500 parts of water, 29 parts of sodium bicarbonate in 500 parts of water, to which add 38 parts of gallic acid; add former to latter solution. Dry precipitate out of light. Brown tasteless powder, soluble in ammonia water, alkalies, hydrochloric and sulphuric acids. Recommended in ozæna.

Alumini Nitras.—*Aluminum nitrate*, E.; *Salpetersaure Thonerde*, G. $Al_2(NO_3)_6.18H_2O$.—The gelatinous aluminum hydroxide obtained from 33 parts of potassium alum or from 31.5 parts of ammonium alum, when dissolved in 20 parts of official nitric acid, yields a solution containing 26 parts of this salt; diluted with water to 260 parts, the solution contains 10 per cent. of the salt, which is with difficulty obtained in deliquescent crystals, soluble also in alcohol.

Alumini Oxidum.—*Alumina, Aluminum oxide*, E.; *Thonerde*, G. Al_2O_3.—This oxide, which is formed when aluminum hydroxide, $Al_2(OH)_6$, is heated to a high temperature, occurs in nature in a variety of forms, all of which are valuable.

Corundum, E., *Corindon*, Fr., *Korund*, G., is a mineral consisting of Al_2O_3. It varies in color, forms rhombohedric crystals, is nearly as hard as diamond, and has the specific gravity 3.9. Transparent varieties of it are the gems *ruby* (*rubis*, Fr., *Rubin*, G.), which is colored red by chromium; the *sapphire* (*saphir*, Fr., G.), which is blue, or if yellow is known as *Oriental topaz*, if green as *Oriental emerald*, and if violet-colored as *Oriental amethyst*. A coarse variety of corundum is known as—

Lapis Smiridis s. Smyris; Emery, E.; *Emeril, Corindon granuleux ferrifère*, Fr.; *Smirgel, Schmirgel*, G.—Its English and French names are derived from Cape Emeri, on the island of Naxos, where the mineral has been mined from ancient times. It is also found in other parts of Europe and in the United States. Owing to its hardness, it is largely employed for cutting and polishing glass, metals, and other hard substances, and is prepared for this purpose by crushing under stampers, sifting, and, for delicate operations, by elutriation. Its color varies between gray, bluish, and brown.

Alumini Paraphenolsulphonas.—*Aluminum paraphenolsulphonate, Sozal.* $Al(C_6H_4(OH)\text{-}SO_3)_3$.—A crystalline powder, soluble in water, alcohol, and glycerin, obtained by solution of $Al_2(OH)_6$ in sulphuric acid. It behaves toward albumin like alumnol. Disinfectant and astringent.

Alumini Salicylas.—*Aluminum salicylate, Salumin* (insoluble). $Al_2(C_6H_4(OH)CO_2)_6.3H_2O$. —A reddish-white powder, insoluble in water, obtained by double decomposition between an aluminum salt and sodium salicylate. Used in catarrh of the nasal passages and pharynx.

Salumin (soluble), obtained by treating insoluble salumin with ammonia water.

Alumini Silicas.—*Aluminum silicate.* Various double silicates of aluminum are known as minerals. The most useful and abundant silicate is *clay*, which is essentially a hydrous aluminum silicate, $Al_4Si_3O_{12}.4H_2O$ or $2Al_2O_3.SiO_2.4H_2O$. Clays are argillaceous or unctuous to the touch, adhere to the tongue, are easily scraped, form a pasty mass with water, may be moulded into forms, and resist high heat. They vary in color, texture, usefulness, etc., according to the impurities present, which usually are iron, calcium, and magnesium compounds, sand, etc. The purest clay is known as *kaolin, fullers' earth*, or *porcelain clay. Bolus* or *bole* is a name that was formerly applied to clays. Different kinds were distinguished: *bolus alba, terra alba, argilla*, is a white nearly pure clay.

Bolus Armena, Bolus rubra, Argilla ferruginea rubra, Armenian bole.—It is reddish-brown in color, due to iron. It was called also *terra sigillata rubra*, because it came into market in cakes bearing a seal.

Terra lemnia, Lemnian bole, is nearly the same as the preceding.

Bolus Veneta, Venetian red, is used in painting.

Creta rubra, Red chalk, Reddle, Rubrica fabrilis.—Deep yellow in color, firm and dense in texture. Used for crayons.

The boles were formerly used in medicines as absorbents and astringents, externally and internally, but are very seldom used now. The only one now found in the shops is Armenian bole, which is used mostly in tooth-powders to give color.

Terra Tripolitana, Tripoli.—Used in scouring metallic surfaces. It is variously colored and does not form a paste with water.

Sienna.—Known in two varieties. *Raw sienna*, a yellowish-brown, smooth clayey body, light in weight and compact. When burnt, it becomes reddish-brown and is known as *burnt sienna*. Both are used in paints. The Italian are the best grades.

Ultramarine. E., Fr.; *Outremer*, Fr.; *Ultramarin*, G., is a pigment which was formerly obtained from *lapis-lazuli* or *lazulite*, a mineral found chiefly in Asia, and composed of sulphur compounds and silicates of aluminum and sodium. The preparation of artificial ultramarine was first made known by C. Gmelin in 1828, and about the same time discovered by Guimet. Shortly afterward it was manufactured on a large scale, and its consumption, which was 3,500,000 kilos in 1862 and 8,500,000 kilos in 1872 (R. Hoffmann), was estimated by R. Wagner in 1880 to be 30,000,000 kilos. It is prepared by heating in crucibles a mixture of clay, sodium sulphate, and charcoal nearly to a white heat for several hours. A white compound is first formed, called *white* ultramarine; this passes into *green* ultramarine, which is employed in the arts to a certain extent, but is mostly converted into *blue* ultramarine, usually by roasting it in the presence of sulphur. By increasing the amount of silica in the first operation the product acquires a more purplish tint, and by treating these products at an elevated temperature with acids *violet* and *red* ultramarines are prepared. All these compounds are decomposed by acetic acid, which does not affect lazulite. Mineral acids decompose them, separating gelatinous silicic acid, sulphur, and hydrosulphuric acid; red ultramarine evolves sulphurous acid gas on being treated with acids. The exact composition is still unknown. Ultramarine blue is largely used for whiting—that is, neutralizing—the yellow tint of sugar, starch, paper, etc.

Alumini Tannas.—*Basic aluminum tannate, Tannal* (insoluble).—Is made by precipitating aluminum sulphate with tannic acid neutralized by ammonia. Insoluble brown powder. Astringent in chronic catarrh.

Tannal (soluble) is made by dissolving the former in tartaric acid and evaporating.

AMARANTHACEÆ.—The Amaranth Family.

Genera about 40, species nearly 500, very widely distributed except in cold countries, especially abundant in tropical America; many species widely distributed as pernicious weeds; economic importance slight, chiefly proteid-nutrient, many species used as pot-herbs, resembling those of the Chenopodiaceæ; many excellent fodder-plants, though not cultivated; some cultivated for ornament; constituents indefinite; none poisonous; none with distinct medicinal properties, though many ignorantly used in native practice as alteratives, as antidotes to snake-bite, etc.

Amaranthus spinosus L., *A. campestris* W., and many other species are used as diuretics. *Euxolus oleraceus* (L.) Moq. (*Amaranthus o.* L.), *Celosia cristata* L., *Ki Kwan* of China, and a few other species are used as astringents in diarrhœa and menstrual disorders. *Euxolus caudatus* (Jacq.) Moq. (*Amaranthus c.* Jacq.), of Africa and Java, *Ærva lanata* (L.) Juss. (*Achyranthes l.* L.), *Æ. tomentosa* Lam., *Kumra-pindi*, etc., of India, and a number of other species are used as anthelmintics.

AMARYLLIDACEÆ.—The Amaryllis Family.

Genera about 70, species about 700, in tropical and subtropical regions, some genera penetrating the temperate zones; highly ornamental, both wild and cultivated. Various species of *Agave* yield leaf-fibers of great use in the arts. Some (*Bomarea edulis* Herb., *Conanthera Simsii* Sweet, etc.) have starchy edible bulbs or rhizomes, while others (*Curculigo stâns* Lab., *Cumingia trimaculata* Don) are rich in mucilage or pectin, for which they are eaten. *Gethyllis Afra* L., of the Cape, yields an edible fruit. Although the family is scarcely known in professional medicine, it is rich in species physiologically active, some of them highly poisonous. The constituents have not been much investigated, but are bitter and probably for the most part glucosidal, though with many alkaloids. From what is known of their action, most of them should be classed physiologically with SCILLA. The following are worthy of special mention:

AGAVE AMERICANA L., the *Maguey* or *Century plant*, most inappropriately called *American aloe*, together with (and apparently for the most part) other species of *Agave*, is one of the most important cultivated vegetable products of the Mexican table-lands. The plant is chiefly propagated by offsets. At about the seventh year, on the average, it becomes of immense size, weighing several, often many hundred pounds and develops a great terminal bud preparatory to flowering. This bud is removed, leaving a cavity in which the watery sap collects. This sap is removed daily for weeks, several tons of it being said to be occasionally collected from a single plant. It may be evaporated to form a crude syrup, and is frequently drunk in the fresh state as a laxative and diuretic, but is usually fermented into the cider-like beverage *pulque*. A spirituous liquor, *mezcal*, of the nature of an impure rum, is also distilled from it. *Agave Virginica* L., of the Southern United States, yields a very bitter root, which is used as an antispasmodic and stomachic.

NARCISSUS PSEUDONARCISSUS L. (*Narcisse des prés*, *Porrillon* or *Gelbe Narcisse*), the common daffodil, native of Southern Europe and largely cultivated, yields an alkaloid, is emetic and poisonous, and has been considerably used in domestic medicine. The genus Narcissus contains some 35 species, more than a dozen of which have been similarly used or reputed poisonous.

Hæmanthus coccineus L., of the Cape of Good Hope, *Crinum Ceylanicum* L., of southeastern Asia, and other species of *Crinum*, have been used as substitutes for squill. *Galanthus nivalis* L. (*Schneeglöckchen*), of southern Europe, *Leucojum æstivum* L., which contains the alkaloids *leucojine* and *leucojitine*, as well as *L. vernum* L., *Hippeastrum Reginæ* Herb., of Brazil, *H. rutilum* Heck., and other species of *Hippeastrum*, *Amaryllis Belladonna* L., and other species of *Amaryllis*, one known in China as *Shau-tsze-kuh* or *Mau-kuh*, *Buphane toxicaria* Herb. (used in southern Africa as an arrow poison), *Crinum Asiaticum* L. (also used as an arrow poison), *Sprekelia formosissima* Herb., *Pancratium maritimum* L., and other species of *Pancratium*, *Hymenocallis tubiflora* Sal., *H. Caribæa* Herb., and several other species of *Hymenocallis*, are all emetics and heart poisons.

AMBRA GRISEA.—Ambergris.

Ambra cinerea.—Ambre, Ambre gris, Fr.; *Amber, Graue Ambra*, G.

Origin.—Ambergris is regarded as a morbid product of the sperm whale, *Physeter macrocephalus* L., and is found in its intestines as well as floating on the sea. One whale has been known to yield 750 pounds of this product.

Description.—It comes in irregular pieces, varying considerably in size, is opaque, of a gray or gray-brown color, with lighter and darker-colored streaks and spots, lighter than water, friable in the cold, but softening when held in the hand. It is of a waxy appearance, fusible in hot water, mixing with melted fats, and soluble in volatile oils, ether, and hot alcohol. It has a peculiar fragrance, is nearly tasteless, and on ignition leaves but little ash.

Composition.—Ambergris consists mainly (about 85 per cent.) of a fatty substance resembling cholesterin, which Pelletier and Caventou have named *ambreïn*. It crystallizes from hot alcohol in white, shining, tasteless, and inodorous needles, which fuse near 35° C. (95° F.). The remaining constituents, according to John (1818), are some balsamic matter, chloride of sodium, benzoic acid (?), and coloring-matter.

Adulterations.—Adulterated and fictitious ambergris can be readily recognized by its different physical properties.

Action and Uses.—Ambergris, like other strongly odoriferous animal products, has been believed to possess a stimulant action upon the nervous and circulatory systems, with a special influence on the generative organs. It was used in low fevers and in spasmodic disorders, especially of the hysterical sort, and often associated with musk, castor, and valerian. It was prescribed in substance in the dose of from 5 to 20 grains (0.3–1.3 Gm.), or more frequently in ethereal solutions. It is seldom if ever employed at the present day as a medicine, but it enters into various perfumes.

Tinctura ambræ of the French Codex is prepared by macerating 10 parts of ambergris, which, according to Stanislas Martin, should be finely powdered by trituration with washed sand, in 100 parts of 80 per cent. alcohol. It is often used for fixing very volatile delicate perfumes.

AMMONIACUM, *Br.*, *P. G.*—Ammoniac.

Gummi-resina ammoniacum or *Doremæ.*—*Ammoniakgummi*, G.; *Ammoniaque, Gomme-resine ammoniaque*, Fr.; *Gomma ammoniaco*, F. It., Sp.

A gum-resinous exudation from *Dorema Ammoniacum* Don. (Fam. *Umbelliferæ*).

Part of the commercial article is believed to come from *D. Aucheri* Boiss, and a distinct, though similar, production comes from *D. robustum* Loftus, both of western Persia.

Origin.—The plant, a tall, stout, naked, and hollow-stemmed perennial, abounds in the deserts of western Asia (see ASAFŒTIDA). Upon the production of the stem, at about the fifth year, the plant fruits and dies. The milky juice exudes, upon insect-puncture, from the stem and flowering branches, and hardens into the tears of commerce. From the base of the stem, among the leaves, there occurs an exudation which turns brown and remains semiliquid. This is often used as a matrix in which more or less of the tears are imbedded to form *cake-ammoniac*, an inferior form. *Drossy ammoniac* is either a similar substance, exuding and becoming mixed with the soil, or artificially so mixed. *Seed-ammoniac* consists of particles about as large as rice-grains or smaller. Sometimes such grains are mixed with the brown mass above mentioned.

Description.—In roundish tears, from 2 to 6 Mm. ($\frac{1}{12}$ to $\frac{1}{4}$ In.) or more in diameter: externally pale yellowish-brown, internally milk-white, brittle when cold, and breaking with a flat, conchoidal, and waxy fracture; or the tears are superficially united into irregular masses without any intervening, dark-colored substance. It has a peculiar odor, and a bitter, acrid, and nauseous taste. When triturated with water, it readily yields a milk-white emulsion.

Ammoniac is official in most pharmacopœias, which give the botanical name variously, as follows: *Diserneston gummiferum* Jaub.; *Heracleum gummiferum* W.; *Peucedanum Ammoniacum* Baill. The Australian admits a purplish-white or milky fracture. The British excludes an alliaceous odor. The Swiss requires that it yield not more than 5 per cent. of ash. Other requirements are that it soften at the heat of the hand; that the freshly fractured surface is colored yellow by solution of potassium hydroxide, and dark-red by solution of chlorinated soda; distinguished from galbanum and asafœtida by not exhibiting a blue fluorescence when a very dilute solution made, after strongly heating in a test-tube, with boiling water, is treated with ammonia solution.

Composition.—The greatest discrepancy exists in statements of the relative percentages of the volatile oil and gum, especially the former, which is placed all the way from $\frac{1}{4}$ to 4 per cent. The discrepancy is probably due in large part to the fact that different methods or degrees of care in the distillation result in the recovery of different products. The oil of the lower percentage yield is described as having a specific gravity of 0.891, and being dextrogyrate and free from sulphur. It has the characteristic odor of ammoniac and is dark-yellow. The amount of resin ranges from 65 to 72 per cent., the moisture about 6 per cent., gum (closely related to acacia) 18 to 26 per cent., and ash, in good samples, not more than 2 to 4 per cent. The resin is partly soluble, partly insoluble in ether. Ammoniac yields no umbelliferon. (For Dieterich's method of ascertaining the acid, resin, and saponification numbers, see *Pharm. Jour.*, June, 1900, page 647.)

African Ammoniac, from *Ferula tingitana* L., is not found in our market. It differs markedly from the official, in that it yields umbelliferon.

Action and Uses.—Ammoniac may be regarded as a circulatory stimulant. In large doses it produces nausea, vomiting, purging, and colicky pains. It has been recommended as an emmenagogue, diuretic, and diaphoretic. The drug may be considered a stimulant to mucous membranes, and has been used in the later stages of bronchitis after the acute inflammatory condition has subsided. In the later stages of gonorrhœa it has been found of value, but on account of its acrid taste is rarely employed.

Locally in the form of the plaster (*Emplastrum Ammoniaci cum Hydrargyro*) it is a mild counterirritant, and has been employed in chronic bronchitis, lumbago, chronic rheumatism, and in pleurisy.

Ammoniac may be administered in the dose of 10 to 30 grains (0.60–2 Gm.), either in pill or as an emulsion.

AMMONII BENZOAS, *U. S.*, *Br.*—Ammonium Benzoate.

Ammoniæ benzoas, Ammonium benzoicum.—Benzoate d'ammoniaque, Fr.; *Ammoniumbenzoat, Benzoësaures Ammonium*, G.

Formula, $NH_4C_7H_5O_2$. Molecular weight, 138.06.

It should contain not less than 98 per cent. of pure ammonium benzoate (C_6H_5-$COONH_4$), and should be kept in well-stoppered bottles.—U. S.

Preparation.—Dissolve benzoic acid in 20 per cent. ammonia water (specific gravity 0.925) by warming and stirring, so that the solution is always alkaline to test-paper. Set aside to crystallize. On evaporating a solution of ammonium benzoate, ammonia is given off; hence to prevent formation of an acid benzoate, the solution should be made alkaline by addition of ammonia water before setting aside to crystallize. The crystals should be dried on filter-paper in the air, and kept in well-closed bottles.

Properties.—Ammonium benzoate crystallizes in colorless or white thin 4-sided hygroscopic laminæ, having a slight odor of benzoic acid, and a saline, somewhat bitter taste, with a slight acrid after-taste; it is readily soluble in alcohol and water, requiring 10.5 parts of water or 25 parts of alcohol at 25° C. (77° F.) and 1.2 parts of boiling water or 7.6 parts of boiling alcohol (U. S.); 6 parts of cold water, 30 parts of alcohol (90 per cent.), and 8 parts of glycerin (Br.). The salt fuses at 193° to 194° C. (379.4°–381.2° F.), with decomposition, and when strongly heated gives off vapors of benzoic acid and ammonia, and finally evaporates without residue. Its neutral solution gives, with ferric salts, a bulky light-yellowish or flesh-colored precipitate, evolves ammonia when heated with potassium hydroxide, and, if it be not too dilute, deposits benzoic acid when acidulated with hydrochloric acid. The acid salt is less soluble, requiring about 60 parts of water and 12 parts of alcohol. Ammonium benzoate gradually loses ammonia in the air and acquires an acid reaction.

Tests.—If diluted nitric acid be added in slight excess to the aqueous solution of the salt (1 in 10), the precipitated benzoic acid, after collecting and washing, should respond to the tests of purity and identity given under Acidum Benzoicum, and the filtrate should not be affected by barium chloride test-solution (absence of sulphate) or by silver nitrate test-solution (absence of chloride). The filtrate from the aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, should give no color or precipitate when mixed with an equal volume of fresh hydrogen sulphide test-solution after standing corked at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals).—U. S.

Action and Uses.—Ammonium benzoate possesses slight diuretic properties, which are due to the acid radical present (see Acidum Benzoicum). It is employed in phosphaturia and in cystitis resulting from an alkaline urine, and to relieve muscular rheumatism. The salt is more efficient than benzoic acid, inasmuch as the ammonium base is eliminated by the kidney as nitric acid.

The dose is from 10 to 30 grains (0.60–2 Gm.), largely diluted, or given in capsule after meals, and repeated several times daily.

AMMONII BROMIDUM, *U. S.*, *Br.*—Ammonium Bromide.

Ammonium bromatum, P. G.—*Bromure d'ammonium*, Fr.; *Bromammonium, Ammoniumbromid*, G.; *Bromuro di ammonio*, F. It., Sp.

Formula, NH_4Br. Molecular weight, 97.29.

It should contain not less than 97 per cent of pure ammonium bromide, and should be kept in well-stoppered bottles.—U. S.

Preparation.—Ammonium bromide may be prepared by neutralizing hydrobromic acid with ammonia or ammonium carbonate, and evaporating the solution. It may also be obtained by the action of ammonia-water on a solution of ferrous bromide—$FeBr_2 + 2NH_4OH = Fe(OH)_2 + 2NH_4Br$—and filtering off the insoluble ferrous hydroxide;

or, according to Charles Rice (1873), by interaction of equivalent quantities of ammonium sulphate and potassium bromide in boiling strong solution, and when cold addition of alcohol to make about a 15 per cent. solution, which facilitates separation of the potassium sulphate formed: $(NH_4)_2SO_4 + 2KBr = K_2SO_4 + 2NH_4Br$. The bromide obtained by evaporating the filtrate is contaminated with small quantities of ammonium and potassium sulphate. Another method of preparation consists in dropping slowly bromine into ammonia water, 35 parts of bromine to 52 parts of 20 per cent. ammonia water (specific gravity 0.925) and cooling the flask in cold water to moderate the reaction: $3Br + 4NH_3 = N + 3NH_4Br$. The liquid, which should smell decidedly of ammonia, is allowed to stand 2 or 3 days or until a sample does not turn yellow on acidifying with dilute sulphuric acid (absence of bromate), and is then evaporated.

Properties.—The salt occurs as a white granular powder or in prismatic crystals, odorless, neutral to litmus-paper, and having a pungent, saline taste. When pure, it does not become discolored when exposed to light. Impure crystals exposed to light gradually turn yellow and acquire an acid reaction, this change being due usually to iron as an impurity. When heated, it sublimes without melting. It is soluble in 1.2 parts of water and in 12.5 parts of alcohol at 25° C. (77° F.), in 0.7 part of boiling water, and in 9 parts of boiling alcohol (U. S.). Ether dissolves a minute quantity of the salt. Chlorine-water, carefully added so as to avoid an excess, liberates from the aqueous solution of the salt bromine, which dissolves in carbon disulphide or in chloroform with a yellow, reddish-yellow, or yellowish-brown color, which is free from violet tint (iodine).

Tests.—Ammonium bromide may be regarded as pure if, on being heated upon platinum-foil, no residue is left behind. A small portion of the salt placed upon a porcelain tile should not at once acquire a yellow color on the addition of a few drops of diluted sulphuric acid (absence of bromate). 10 Cc. of an aqueous solution of the salt (1 in 20), when acidulated with acetic acid, should not give a turbidity with 1 Cc. of potassium sulphate test-solution (absence of barium), nor should another portion, when slightly acidified with hydrochloric acid, give a color or turbidity with an equal volume of fresh hydrogen sulphide test-solution on standing stoppered at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals). 20 Cc. of a 1 per cent. solution (5 per cent., P. G.) of the salt should not at once assume a blue color on addition of potassium ferrocyanide test-solution (limit of iron). If 3 Gm. of the salt be dissolved in water to 100 Cc., then 10 Cc. of this solution, after adding a few drops of potassium chromate test-solution, should require not more than 31.6 Cc. of tenth-normal silver nitrate solution to produce a permanent red color (U. S.). By this titration 3 per cent. of chloride is allowed. 1 Cc. of the silver nitrate solution represents 0.009729 Gm. of NH_4Br, hence for 0.3 Gm. of pure salt, 30.83 Cc. of the silver nitrate would be required. The presence of NH_4Cl in NH_4Br increases the amount of silver nitrate required, because of its lower molecular weight (53.11). If all the NH_4Br were replaced by NH_4Cl, 0.3 Gm. would require for titration 56.48 Cc. of silver nitrate (each Cc. representing 0.005311 Gm. of NH_4Cl)—that is, an excess of 25.65 Cc. over that required for 0.3 Gm. of NH_4Br. This excess represents 100 per cent. impurity of NH_4Cl, hence 0.77 Cc., the excess of 31.6 Cc. of silver nitrate allowed in the U. S. P. titration, over 30.83 Cc., the amount required for absolutely pure NH_4Br, represents 3 per cent. impurity of NH_4Cl in NH_4Br. This calculation holds good only in case the impurity reacting with silver is NH_4Cl. It is not likely, however, to be otherwise. The precipitate of 10 grains of ammonium bromide by sufficient silver nitrate, after washing with water acidulated with nitric acid and drying, will weigh 19.17 grains (1.917 Gm. from 1 Gm. of NH_4Br). The presence of ammonium chloride would increase the weight of the silver precipitate.

According to the British Pharmacopœia, 0.5 Gm. (or 0.3 Gm.) of dried NH_4Br should require not more than 51.8 Cc. (or 31.3 Cc.) nor less than 51.1 Cc. (or 30.66 Cc.) of decinormal silver nitrate solution.

Action and Uses.—Ammonium bromide may be employed in all conditions in which potassium bromide is successfully used unless gastric irritation is present (see POTASSII BROMIDUM). It is a slight stimulant to the circulation, but is not sufficiently powerful to be employed in cardiovascular depression. This salt is irritating to the mucous membranes, and, if given in doses sufficiently large to produce the physiological effects of the bromides, frequently produces gastric irritability. It is stated, however,

that when this drug is combined with other bromides, the combined action is more powerful than that produced by any one of them when administered alone. It may occasionally be given with advantage in epilepsy when some special condition contraindicates the employment of the potassium salt. Ammonium bromide is given in doses of from 10 to 30 grains (0.60–2 Gm.) 3 times daily, largely diluted with water.

AMMONII CARBONAS, *U. S.*, *Br.*—Ammonium Carbonate.

Ammoniæ sesquicarbonas; Ammonium carbonicum, P. G.; *Sal volatile siccum, Alkali volatile.—Volatile salt*, E.; *Carbonate d'ammoniaque, Alcali volatil concret, Sel volatile d'Angleterre*, Fr.; *Ammoniumcarbonat, Kohlensaures Ammon, Flüchtiges Laugensalz, Reines Hirschhornsalz*, G.; *Carbonato di ammonio*, F. It., Sp.

Formula, $NH_4HCO_3NH_4NH_2CO_2$. Molecular weight, 156.01.

It should contain not less than 97 per cent. of a mixture of acid ammonium carbonate and ammonium carbamate, and should yield not less than 31.58 per cent. of ammonia-gas. It should be kept in well-stoppered bottles in a cool place. For dispensing purposes, only the translucent portions should be used.—U. S.

Origin.—Ammonium carbonate was first prepared by Raymund Lully, in the thirteenth century, by the distillation of putrid urine, which contains the normal carbonate, $(NH_4)_2CO_3$, formed from urea, CON_2H_4, and $2H_2O$, water. It was subsequently obtained by the dry distillation of horn, bone, blood, and other animal matters, and for a long time purified by resubliming this crude product in the presence of animal charcoal. In the fifteenth century Basil Valentine observed its production from sal ammoniac and potassium carbonate, in place of which afterward chalk was employed. At present it is largely manufactured by modifications of this process.

Preparation.—A mixture of powdered sal ammoniac with twice its weight of chalk, or of 4 parts each of ammonium sulphate and chalk with 1 part of charcoal, is gradually heated to dull redness in an iron or earthen retort, the vapors being passed through an iron pipe into a leaden chamber, where they condense. The chalk is used in excess to prevent sublimation of undecomposed ammonium chloride, which would otherwise be apt to contaminate the product. It is then purified by resublimation from iron vessels. The reaction results in the formation of calcium chloride (or sulphate) and neutral ammonium carbonate, which on condensation is converted into a salt of the above composition, water and ammonia being given off: $4NH_4Cl + 2CaCO_3$ yield $2CaCl_2 + N_3H_{11}C_2O_5 + NH_3 + H_2O$. The ammonia is utilized either by passing the uncondensed vapors into water or through a cylinder filled with coke which is impregnated with dilute sulphuric acid, resulting in the formation of ammonium sulphate. Barium carbonate may be employed in the place of chalk, and is advantageously used with ammonium chloride, when barium chloride is obtained at the same time. The ammonium salts used being almost exclusively those obtained from coal-gas liquor, the first sublimate contains tarry products, from which it is freed by resublimation.

Properties.—Ammonium carbonate is found in commerce in white crystalline translucent masses, having a strong ammoniacal odor, an alkaline reaction, and a pungent, saline and caustic taste. Exposed to the air, it parts with ammonia and carbon dioxide, becomes opaque, and yields a white powder of acid ammonium carbonate, NH_4HCO_3; this salt is likewise obtained by washing the powdered official carbonate with a little cold water, which dissolves chiefly ammonium carbamate. It is slowly but completely soluble in about 4 parts of water at 25° C. (77° F.), U. S.; in 5 parts of water at 15° C. (59° F.); in 4 parts of water (Br.). It is decomposed by hot water, with the elimination of ammonia and carbon dioxide, and is completely dissipated by prolonged boiling with water. Alcohol dissolves ammonium carbamate, and on being heated yields a sublimate of this salt. The salt should be kept in well-stoppered bottles.

Composition.—The formula given above represents the salt as a compound of 1 molecule of acid ammonium carbonate with 1 of ammonium carbonate from which a molecule of water has been separated. The last-mentioned compound is regarded as the ammonium salt of carbamic acid (which is unknown in the isolated state), and hence is called *ammonium carbamate*, the formula of which is $NH_4NH_2CO_2$. In its pure state this forms tabular crystals, is deliquescent, volatilizes completely at 59° C. (138.2° F.), with decomposition into ammonia and carbon dioxide, and in aqueous solution is soon

converted into normal ammonium carbonate: the solution of the official salt, therefore, contains a mixture of normal and acid ammonium carbonate.

Tests.—Ammonium carbonate should be completely volatilized without charring when heated upon platinum-foil (absence of organic matters and non-volatile salts). It should dissolve in diluted acids without residue, and this solution should be free from empyreumatic odor. 1 Gm. of the salt, on being supersaturated with nitric acid and evaporated to dryness by means of a water-bath, should leave a colorless (white) residue, which at a higher heat volatilizes completely.—U. S., P. G. Empyreumatic products impart a yellow or brown color to the residue. Ammonium thiosulphate, which may be present from decomposition of the sulphate during sublimation, is detected by the brown color produced on adding to the aqueous solution of the salt first an excess of solution of silver nitrate and afterward of nitric acid. After dissolving the salt in a slight excess of diluted nitric acid, it should not be precipitated by barium chloride (sulphate), silver nitrate (chloride). The aqueous solution of the salt (1 in 20), slightly acidified with hydrochloric acid, should not be colored or made turbid by an equal volume of fresh hydrogen sulphide test-solution after being stoppered at 35° C. (95° F.) for at least half an hour, either before or after rendering alkaline with ammonia-water (absence of heavy metals). The presence of ammonium bicarbonate is indicated by the change of the translucent mass into an opaque pulverulent condition. Occasionally the bicarbonate has been observed in translucent solid masses mixed with the official article. In this condition it has but a faint odor of ammonia, and dissolves slowly in water at the ordinary temperature, giving off carbon dioxide.

If 2 Gm. of unaltered, translucent ammonium carbonate be dissolved in a mixture of 50 Cc. each of distilled water and normal sulphuric acid, boiled for a few minutes to expel the liberated carbon dioxide, and then cooled, not more than 12.7 Cc. of normal potassium hydroxide should be required for exact neutralization, litmus test-solution being used as indicator, U. S.; each Gm. should require at least 18.7 Cc. of normal sulphuric acid, Br. Each Cc. of the normal acid solution represents 0.052033 Gm. of the salt. Hence the 37.3 Cc. (50–12.7) of acid required represents 97 per cent. of the pure salt.

Ammonii Bicarbonas, *Ammonium bicarbonate,* NH_4HCO_3, is obtained by treating the powdered official ammonium carbonate with about twice its weight of water, when the bicarbonate will be left as residue, or by keeping the former for two weeks under a bell-glass over sulphuric acid and slaked lime, when the carbamate will evaporate, being decomposed into carbon dioxide, CO_2, and ammonia, NH_3. Ammonium bicarbonate is a white powder, when perfectly dry free from ammoniacal odor, of a cooling, saline taste, insoluble in alcohol, but soluble in 8 parts of water at 15° C. (59° F.); the solution, heated to 36° C. (96.8° F.), begins to give off carbon dioxide. From a concentrated solution clear rhombic prisms of the salt may be obtained. Vogler (1878) ascertained that the salt is not permanent in the air, but is slowly volatilized, with the production of an ammoniacal odor.

Ammonii Carbonas, *Normal ammonium carbonate.* $(NH_4)_2CO_3.H_2O$.—It is obtained by moistening the commercial carbonate with very concentrated ammonia water, letting stand 2 or 3 days in a cool place, and drying the powder quickly between filter paper. It is decomposed quickly in the air into ammonia, water, and bicarbonate. Easily soluble in water, difficultly in alcohol. It is to be distinguished from official *Ammonii carbonas.*

Ammonii Carbamas, *Ammonium carbamate.* $NH_4NH_2CO_2$.—It may be prepared by bringing together dry carbon dioxide and dry ammonia gas, or by passing both into absolute alcohol. It is a crystalline deliquescent powder, smelling strongly of ammonia. Heated to 140° C. (284° F.) in a sealed tube, it yields water and urea, $CO(NH_2)_2$. With water it reacts thus, $NH_4NH_2CO_2 + H_2O + (NH_4)_2CO_3$.

Action and Uses.—Ammonium carbonate is similar to the preparations of ammonia in its action upon the system. When locally applied to mucous membranes, it acts as a decided irritant, and if given by the stomach in overdose causes gastro-enteritis, with burning pain in the œsophagus, stomach, and intestines. Vomiting, purging, spina

convulsions, and collapse may occur. Moderate amounts when given for a long period sometimes produce indigestion, colicky diarrhœa, and emaciation. Ammonium carbonate is a rapidly acting stimulant. It is quickly absorbed from the stomach and intestines, enters the blood, increasing its alkalinity, and is eliminated by the skin, breath, and kidneys. This drug sometimes augments the secretion of the urine and sweat. Ammonium carbonate may be employed in nearly all conditions which demand a rapidly acting stimulant to the heart or respiration. It is employed to overcome surgical shock, especially in children. It may be used during the course of low fevers, in various adynamic conditions, and at the crisis of the acute infectious diseases. Either alone or in combination with ammonium chloride, it is of value in the treatment of the later stages of croupous and catarrhal pneumonia, and in subacute and chronic bronchitis. The atonic stomach of drunkards is also said to be benefited by its use, as it liquefies the mucus covering the viscus and stimulates the glands to normal secretion. Alcoholic intoxication is moderated by its employment. Locally a solution has been used to neutralize the poison of and relieve the pain caused by the bites of insects and venomous serpents. Poisoning by the drug requires the prompt administration of mild acids, such as vinegar or lemon-juice. If convulsions occur, inhalations of amyl nitrite should be employed. The maintenance of bodily heat should not be forgotten. Stimulants such as strychnine and digitalis should be given when indicated.

The dose of ammonium carbonate is from 2 to 10 grains (0.12–0.60 Gm.), best administered in syrup of acacia and water.

AMMONII CHLORIDUM, *U. S.*, *Br.*—Ammonium Chloride.

Ammonium chloratum, P. G.; *Ammonium muriaticum s. hydrochloratum depuratum, Sal ammoniacum, Ammoniæ hydrochloras s. murias.—Purified ammonium chloride, Muriate of ammonia, Sal ammoniac*, E.; *Chlorure d'ammonium, Sel ammoniac, Chlorhydrate d'ammoniaque*, Fr.; *Salmiak, Chlorammonium, Ammoniumchlorid, Reiner Salmiak*, G.; *Cloruro di ammonia*, F. It.; *Clorhidrato de amoniaco*, Sp.

Formula, NH_4Cl. Molecular weight, 53.11.

It should contain not less than 99.5 per cent. of pure ammonium chloride.—U. S.

Origin.—The sal ammoniacum of ancient writers was perhaps in all cases rock-salt. In the eighth century Geber prepared sal ammoniac from urine. Subsequently it was manufactured in Egypt from camels' dung and urine, and exported to Europe, where its manufacture was begun in Venice in the seventeenth century, in Great Britain in 1756, and soon after in Germany and France. At present it is obtained from the products of the dry distillation of bones and other animal matters, and of coal. It is frequently met with in the neighborhood of volcanoes, and is a constituent of several mineral springs, such as Hall, Homburg, Wiesbaden, and others.

Preparation.—The so-called coal-gas liquor is a watery liquid condensed in the preparation and purification of illuminating-gas from coal, and contains principally ammonium carbonate, besides some sulphide, cyanide, and empyreumatic products. The liquor is distilled with lime and the generated ammonia gas is passed into sulphuric acid, forming ammonium sulphate. Most of the gas liquors are now worked up into this salt. By subliming a mixture of the sulphate and sodium chloride, ammonium chloride is formed, $(NH_4)_2SO_4 + 2NaCl = Na_2SO_4 + 2NH_4Cl$. The ammonia gas may also be passed directly into hydrochloric acid to form the chloride.

Any liquid containing ammonia or ammonium carbonate, like the aqueous liquor obtained on the destructive distillation of bones or other animal matter, may be employed in the same manner as coal-gas liquor.

When the crude article is refined by carefully resubliming it, ammonium chloride may be obtained sufficiently pure for medicinal use. Commercial sal ammoniac contains, usually, variable quantities of ferrous and ferric chloride, and should be purified by dissolving 2 parts of it in 3 parts of hot water, adding a small quantity of chlorine water to convert the ferrous into ferric chloride, and afterward ammonia water in slight excess, then filtering the hot solution from the precipitated ferric hydroxide. If the sal ammoniac has been otherwise pure, the filtrate may be evaporated to dryness, and the salt granulated by stirring it continually. If, however, it contains other saline impurities besides the iron, it is best to allow the filtrate to cool, stirring it occasionally, and to

collect the crystalline powder upon a muslin strainer. The impurities will remain in the mother-liquor.

Perfectly pure chloride may be made by bringing together in a suitable apparatus vapors of ammonia and hydrochloric acid, or by neutralizing the pure acid with pure ammonia water. Practically all of the salt used in this country is imported. The *crude* salt, known as sal ammoniac, comes from Calcutta, and is used principally by metal-workers in brazing, to keep surfaces bright; the *refined* salt comes from England.

In chemistry the chloride is the most important ammonium salt, as it is the starting-point for making the various ammonium compounds.

Properties.—Impure ammonium chloride, known in commerce as sal ammoniac, is imported in casks, and consists of colorless or whitish translucent masses which are of a fibrous crystalline structure, very tough and difficult to powder. It is free from odor and has a cooling and strongly saline taste. Its specific gravity is 1.53, and it is soluble in about 3 parts of cold and in little more than its own weight of boiling water. During the solution of the salt in water a considerable reduction of temperature is observed. When the solution is heated with potassium hydroxide or lime ammonia is given off, and when treated with silver nitrate a curdy white precipitate soluble in ammonia is produced. It is less freely soluble in spirituous liquids, requiring 14 parts of boiling alcohol for solution. The salt is permanent in the air, but its solution on being boiled evolves a little ammonia and acquires an acid reaction. At an elevated temperature ammonium chloride evaporates completely without melting, and on cooling is condensed unchanged. Metals which are dissolved by hydrochloric acid are likewise attacked by the hot solution or the vapor of this salt; hence commercial sal ammoniac contains iron, derived from the vessels in which it has been prepared, and its solution turns blue on the addition of potassium ferrocyanide.

Purified ammonium chloride forms a snow-white granular, crystalline powder, the hot solution of which has a faint acid reaction, and does not acquire a bluish-black color by tannin or a blue coloration on the addition of potassium ferrocyanide. It is soluble in 2 parts of water; in 50 parts of alcohol, and in 5 parts of glycerin, at 25° C. (77° F.), and its own weight of boiling water, U. S.; in 3 parts of cold water and 60 parts of alcohol (90 per cent.), Br.

Tests.—The salt should be completely volatilized from platinum-foil (non-volatile salts), and should yield a clear solution with 4 parts of water (absence of barium sulphate, lead salts). The solution, in 20 parts of water, acidulated with hydrochloric acid, should not be affected by an equal volume of fresh hydrogen sulphide test-solution within at least half an hour at 35° C. (95° F.), either before or after adding ammonia-water to slight alkalinity (heavy metals); nor should the neutral solution be affected by ammonium oxalate (calcium), diluted sulphuric acid (barium), barium chloride (sulphate), nor, after acidulating with hydrochloric acid, by ferric chloride; a red color produced with the last test would indicate the presence of sulphocyanate, observed by Warington. The limit of iron, according to the U. S. and P. G., is to be tested by solution of potassium ferrocyanide (10 per cent.), 5 drops of which should not at once produce a blue color if added to 20 Cc. of a 5 per cent. solution of the salt. Empyreumatic and non-volatile impurities may be detected by moistening 1 Gm. of the salt with nitric acid and drying at the heat of a water-bath, when it should not acquire a brown tint, and on heating to a higher temperature the residue should be completely volatilized. If 1 Gm. of the salt be dissolved in distilled water to 100 Cc., then 10 Cc. of this solution should, after adding 5 drops of potassium chromate test-solution, require not less than 18.73 Cc. of tenth-normal silver nitrate solution to produce a permanent color.—U. S. Each Cc. of the silver solution represents 0.005311 Gm. of NH_4Cl.

Ammonii et Ferri Chloridum. *Ammonium chloratum ferratum*, P. G.; *Ferrum ammoniatum; Ammonio-chloride of iron, Ammoniated iron*, E.; *Sel ammoniac martial*, Fr.; *Eisensalmiak*, G.—32 parts of ammonium chloride are mixed with 9 parts of solution of ferric chloride (P. G.), and evaporated with constant stirring to dryness. It is an orange-colored, somewhat deliquescent powder, having a strongly saline and ferruginous taste, and containing 7.25 per cent. of ferric chloride, Fe_2Cl_6, equal to 12.1 per cent. of crystallized ferric chloride or to 2.5 per cent. of metallic iron. It should yield a clear

solution with water, and, being decomposed in the sunlight, should be kept in a dark place.

Because of its disagreeable taste ammoniated iron has been practically discarded. It has received some mention in the treatment of epilepsy, scrofula, and rickets, and especially in those cases in which a marked anæmia exists.

The dose is from 5 to 10 grains (0.30–0.60 Gm.) 3 times daily.

Action and Uses.—Large doses of ammonium chloride irritate the stomach, and cause a burning sensation, which is sometimes followed by nausea and vomiting. It is rapidly absorbed by the stomach and intestines, combines with the blood cells, circulates in the blood, and is eliminated unchanged by all of the mucous membranes, especially those of the lungs and kidneys. Ordinary doses occasionally augment the flow of urine, but in man have no effect upon the central nervous system, respiration, or circulation. Ammonium chloride is employed chiefly for its stimulating effect upon depraved mucous membranes. In the later stages of croupous pneumonia, and in subacute and chronic bronchitis, especially when the mucus is tough, glairy, and ropy, and expectorated with great difficulty, it is one of the best remedies to employ. It increases the flow of and liquefies the mucus, causes desquamation of dead epithelium, and excites the rapid formation of new and healthy mucosa. This drug is also equally valuable in the subacute and chronic gastro-intestinal catarrhs of children, and will often be found of service after all other remedies have failed. It has been recommended in subacute hepatitis, chronic hepatic torpor, hepatic abscess, cirrhosis of the liver, and in catarrhal jaundice, but it is probably most efficacious in the last-named condition. Intercostal neuralgia, trifacial neuralgia, ovarian neuralgia, hemicrania, sciatica, myalgia, and dysmenorrhœa are said to be benefited by its use. It has also been employed with success in the treatment of pyrosis. This remedy has been used with asserted success in the treatment of many glandular enlargements, especially those of the thyroid and prostate glands, but its value in these conditions is questionable. A solution containing 1 ounce (30 Gm.) of the salt in 12 fluidounces (360 Cc.) of water and 4 fluidounces (120 Cc.) of alcohol, may be employed locally in the treatment of senile gangrene. In the above condition it should be used as a fomentation. The same solution is also useful in recent contusions, and in contused and lacerated wounds.

Ammonium chloride is given internally in the dose of from 5 to 20 grains (0.30–1.30 Gm.). As a rule, however, the larger dose is given only to combat neuralgia. It is best administered in a mixture of fluid extract of glycyrrhiza and water, or when employed as an expectorant in *Mistura Glycyrrhizæ Composita*. A spray containing from 10 to 20 grains (0.60–1.30 Gm.) of the salt in 1 fluidounce (30 Cc.) of water is occasionally employed. The fumes may be obtained for inhalation by heating a few grains of the drug in an iron spoon or by means of three bottles, one containing water of ammonia, another hydrochloric acid, and the third water; the first two are connected with the third by glass tubing, and the third is provided with a tube from which the patient inhales. As the vapors pass from the first two bottles into the third, they combine, pass through the water, and any excess either of ammonia or hydrochloric acid which they may contain is in this way prevented from reaching the patient.

AMMONII IODIDUM, *U. S.*—Ammonium Iodide.

Ammonium jodatum.—Iodure d'ammonium, Fr.; *Jodammonium, Ammoniumiodid*, G.; *Yodhidrato de amoniaco*, Sp.

Formula, NH_4I. Molecular weight, 143.83.

It should contain not less than 99.5 per cent. of pure ammonium iodide.—U. S.

Preparation.—This salt is most advantageously prepared by the process recommended by Jacobsen in 1863, which, with some modifications, was adopted by the U. S. Pharmacopœia of 1870. After correcting the errors in the latter this process is as follows: Mix potassium iodide in coarse powder 2½ parts, and ammonium sulphate in coarse powder 2 parts; add to the mixture 2 parts of boiling water; stir well, allow to cool slowly, add 1 part of alcohol, and place the mixture in a bath of iced water, stirring occasionally; throw the mixture into a glass funnel stopped with moistened cotton, collect the clear liquid, and wash the crystalline salt with diluted alcohol; lastly evaporate the

filtrate rapidly to dryness, stirring constantly. Contact with iron or other metals is to be avoided. The two salts interact, forming ammonium iodide and potassium sulphate, which, because of its lesser solubility, crystallizes in great part on cooling and is separated nearly completely by the addition of alcohol. The minute quantity of potassium sulphate contained in the ammonium iodide does not interfere with its medicinal properties. If a still purer salt is desired, the product may be dissolved in alcohol, filtered from the insoluble potassium sulphate, and evaporated as before.

Other processes have been proposed, of which the following may be mentioned: Hydriodic acid is neutralized with ammonia or ammonium carbonate. Ferrous iodide is decomposed by ammonium carbonate, and the filtrate evaporated (Ch. Ellis, 1835). Potassium iodide and ammonium bitartrate are made to react upon each other in hot solutions; on cooling, potassium bitartrate crystallizes, and the evaporated filtrate, still containing a little of this salt, is treated with 70 per cent. alcohol, which dissolves only the ammonium iodide (W. H. Pile, 1862). Iodine is treated with ammonium sulphide until the brown color has completely disappeared, when the solution is boiled, filtered from the liberated sulphur, and evaporated (Spencer, 1852).

When iodine is added to ammonia water, ammonium iodide is produced, but at the same time the extremely explosive compound nitrogen iodide results. Mixtures of the two substances named should therefore be made with great caution.

Ammonium iodide should be preserved in small, well-stoppered vials, protected from light. When deeply colored, it should not be dispensed, but it may be deprived of free iodine by adding to its concentrated aqueous solution sufficient ammonium sulphide test-solution to render it colorless, then filtering, and evaporating on a water-bath to dryness.—U. S.

Properties.—Ammonium iodide is in white granular crystals, and on the slow evaporation of its solution, which should be kept slightly alkaline by ammonia, is obtained in colorless and inodorous cubes having the specific gravity 2.498. If the air is excluded, the salt sublimes undecomposed when heated; in contact with the atmosphere it acquires a yellowish-brown color and a slight odor of iodine. The salt is very deliquescent, and dissolves freely in water and alcohol, requiring 0.6 part of water and 9 parts of alcohol at 25° C. (77° F.), 0.43 part of boiling water, and 3.7 parts of boiling alcohol for solution (U. S.); the solutions have a slight acid reaction and become yellow on exposure. Iodine is liberated on addition of nitric acid, and ammonia by addition of potassium hydroxide or lime. On the addition of a little chlorine-water to the aqueous solution of the salt, iodine is set free, which will dissolve in chloroform or in carbon disulphide with a violet color, and will impart a blue color to mucilage of starch; excess of chlorine will prevent these color-reactions through the formation of colorless compounds.

Tests.—The purity of the salt is recognized by its complete volatility, and by its solution yielding not any, or only a slight, turbidity with barium chloride (sulphate). Ammonium bromide and chloride are recognized by precipitating the solution with silver nitrate and adding ammonia water in excess, in which silver iodide is very sparingly soluble, so that the ammoniacal liquid will yield merely a slight turbidity on the addition of nitric acid. If a precipitate occurs, this is agitated with chlorine water gradually added in the presence of chloroform, which will be colored red if bromine be present; if the chloroform is not colored, the impurity is a chloride. The limits of impurities are thus ascertained: 10 Cc. of a 5 per cent. solution, when acidified with hydrochloric acid, should not be rendered turbid by 1 Cc. of potassium sulphate test-solution (absence of barium). Another portion of this solution, when treated with hydrogen sulphide solution as directed under Ammonii Chloridum, should not be affected (absence of heavy metals). If 0.25 Gm. of the salt be dissolved in 5 Cc. of ammonia-water, then shaken with 19 Cc. of decinormal silver nitrate solution, and the filtrate be supersaturated with 5 Cc. of nitric acid, no cloudiness should make its appearance within 10 minutes (absence of more than about 0.5 per cent. of chloride or bromide). A 1 per cent. aqueous solution should not at once be colored blue by test-solution of potassium ferrocyanide (limit of iron), nor, after being agitated with 1 Cc. of chloroform, should the latter assume a violet color (limit of free iodine).—U. S. The solution of 10 grains of ammonium iodide, treated with sufficient silver nitrate, yields a precipitate of silver iodide, which, after washing and drying, weighs about 16.2 grains (or 1.618 Gm. from 1 Gm. of NH_4I).

Action and Uses.—Ammonium iodide is employed both internally and externally as an alterative. It may be used in all conditions in which potassium iodide (see

POTASSII IODIDUM) is of service. It is to be remembered that while the ammonium base is less depressing to the circulation, it is much more irritating to mucous membranes, and if given in large doses is apt to cause gastric irritability, It has been employed internally in the treatment of scrofulosis, syphilis, gout, and chronic rheumatism. An ointment containing from 20 to 40 grains (1.30–2.60 Gm.) of the drug in 1 ounce (30 Gm.) of lard is recommended in the treatment of scaly affections of the skin, such as psoriasis, lepra, tinea capitis, and those arising from syphilitic infection. A 10 per cent. solution of the salt in glycerin locally applied to enlarged tonsils, particularly if the enlargement is due to struma, is frequently attended with benefit.

Ammonium iodide, or any preparation containing it, should be excluded from light and air, as it is easily decomposed. The ordinary dose of this salt is from 3 to 5 grains (0.20–0.30 Gm.), but as much as 20 grains (1.30 Gm.) can be tolerated by the stomach in some cases.

AMMONII SALICYLAS, *U. S.*—Ammonium Salicylate.

Ammonium salicylicum.—Salicylate d'ammoniaque, Fr.; *Ammoniumsalicylat, Salicylsaures Ammon.*, G.

Formula, $NH_4C_7H_5O_3$ or $C_6H_4(OH)CO_2NH_4$. Molecular weight, 153.94.

It should contain not less than 98 per cent. of pure ammonium salicylate, and should be kept well stoppered and protected from heat and light.

Preparation.—The salt may be prepared by dissolving 10 parts of salicylic acid in 12 parts of 10 per cent. ammonia-water. The solution, which should be slightly acid, is then evaporated to dryness. A colorless crystalline powder or satiny needles are obtained.

Properties.—The salt is odorless and has at first a slightly saline, bitter taste, with a sweetish after-taste. It is permanent in dry air, soluble in 0.9 parts of water and 2.3 parts of alcohol at 25° C. (77° F.), and 1 part of boiling alcohol. When heated the salt fuses with decomposition, emitting inflammable vapors and an odor of phenol, and is finally completely volatilized. The concentrated aqueous solution should be colorless, and it should redden blue litmus-paper.

Tests.—The tests for impurities and for salicylic acid may be found under Sodii Salicylas. Ammonia may be tested for by the methods given under any of the ammonium salts.

Action and Uses.—Ammonium salicylate is considered less depressing than any of the other salts of salicylic acid. It is probably more irritating to mucous membranes than the others, and should be given with caution when repeated large doses are needed. It may be employed in those conditions in which salicylic acid (see Acidum Salicylicum) is beneficial, and it has been especially recommended by Wood in the treatment of rheumatic fever. This drug has also been used with some success as a stimulating expectorant in the later stages of bronchitis.

The ordinary dose of ammonium salicylate is from 2 to 10 grains (0.12–0.60 Gm.), repeated as occasion demands. Larger amounts than the above dose frequently cause gastric irritability.

AMMONII VALERAS, *U. S.*—Ammonium Valerate.

Ammonii valerianas, U. S. 1890.—*Ammonium valerianate*, E.; *Valérianate d'ammoniaque*, Fr.; *Ammoniumvalerianat, Baldriansaures Ammon.*, G.; *Valerianato de amoniaco*, Sp.

Formula, $NH_4C_5H_9O_2$. Molecular weight, 118.24.

It should contain not less than 98 per cent. of pure ammonium valerate, and should be kept in well-stoppered bottles.—U. S.

Preparation.—The practical details of the process recognized by the U. S. Pharmacopœia of 1870 were published by B. J. Crew (1860), and are based upon Chevreul's observations that concentrated valerianic acid, placed in an atmosphere of ammonia, yields this salt in crystals. A convenient quantity of valerianic acid (specific gravity 0.935) is placed in a tall, narrow glass vessel and saturated with dry ammonia gas, which is generated from a mixture of equal weights of ammonium chloride and slaked lime, the gas being dried by passing it through a bottle filled with pieces of burned lime. On the

combination of the dry ammonia gas with the acid much heat is produced, and after neutralization has been attained the salt crystallizes readily on cooling; after several hours the mass is broken into pieces, drained, if necessary, in a glass funnel, dried on bibulous paper, and preserved in a well-stoppered bottle. Valerianic acid which is weaker than the above and of higher specific gravity yields few or no crystals by this process.

Properties.—Ammonium valerate, thus prepared, forms colorless or white quadrangular plates having the odor of valerianic acid and possessing a sharp and sweet taste. It effloresces when placed in a dry atmosphere, and deliquesces in moist air. On the application of heat, it fuses, giving off ammoniacal and acid vapors, and is finally dissipated without residue. It dissolves freely in water and alcohol, the solutions being neutral and on evaporation acquiring an acid reaction from the loss of ammonia. Alkalies decompose it with the evolution of ammonia, and the stronger acids with the separation of oily valerianic acid, floating upon the aqueous solution. Should the salt have an acid reaction, its solution, when dispensed, should be neutralized by the careful addition of ammonia, whereby the disagreeable odor and taste of valerianic acid are masked to a considerable extent. The commercial salt very often has an acid reaction, due to decomposition and loss of ammonia.

Tests.—Heated to redness upon platinum-foil, the salt should leave no residue (potassium, etc., salts). If a neutral solution of the salt be completely precipitated by ferric chloride test-solution, the filtrate should not possess a deep-red color (absence of acetate). The aqueous solution (1 in 20), when slightly acidified with hydrochloric acid and filtered through a small, wetted filter, should not be affected by an equal volume of fresh hydrogen sulphide test-solution after being corked at 35° C. (95° F.) for at least half an hour, either before or after making alkaline with ammonia.—U. S.

Action and Uses.—The spinal cord is slightly stimulated by small doses and depressed by large doses of ammonium valerate. The salt is chiefly used in the nervous manifestations occurring during pregnancy and in hysterical women. It is probable that its virtue depends more upon the mental impression made by the disagreeable and lasting odor of the drug rather than upon any direct physiological action which it possesses. It has been recommended in chorea, epilepsy, and in other clonic convulsions, but its administration in these conditions is of little value.

The dose of ammonium valerate is from 2 to 10 grains (0.12–0.60 Gm.), usually given in the form of the elixir (see Elixir Ammonii Valerianatis, N. F.).

OTHER AMMONIUM SALTS.

Ammonii Acetas, *Ammonium acetate.* CH_3COONH_4.—The salt cannot be prepared by evaporating its solution, as it volatilizes with the water vapor and is also broken up. It is prepared by saturating glacial acetic acid as free as possible from water with dry ammonia gas. It forms colorless crystalline masses, melting at 89° C. (192.2° F.). Very easily soluble in water and alcohol. It is hygroscopic, and should be kept in bottles with paraffined corks. Because of its deliquescent properties, ammonium acetate is rarely employed in medicine except in solution (see Liquor Ammonii Acetatis).

Ammonii Arsenas, *Ammonium arsenate.* $(NH_4)_2HAsO_4$.—Obtained by saturating a concentrated solution of arsenic acid with ammonia water or the carbonate, and evaporating spontaneously. The crystals have an alkaline reaction, and lose half their ammonia on exposure to the air. It has been recommended in stubborn skin affections.

Ammonii Biboras, *Ammonii boras, Ammonium borate.* $(2NH_4HB_2O_4).3H_2O$.—Obtained by dissolving 1 part of boric acid in 3 parts of warmed ammonia water, specific gravity 0.96, and allowing to cool slowly. Semitransparent crystals, with alkaline taste and reaction, efflorescing and losing ammonia in air, soluble in 11 parts of water. Highly recommended in calculus, renal colic, and chronic catarrh of the bladder. Dose 10–20 grains (0.60–1.30 Gm.) in liquorice water every hour.

Ammonii Borofluoridum, *Ammonium borofluoride.* NH_4BF_4.—A salt of hydroborofluoric acid, HBF_4, which is formed when gaseous boron fluoride, BF_3, is brought into water. Used as an antiseptic, by inhalation, in all infectious diseases of the nose and throat.

Ammonii Camphoras, *Ammonium camphorate,* a salt of camphoric acid, $C_8H_{14}(COOH)_2$.—White soluble crystals. A nerve sedative, dose 1 to 3 grains (0.06–0.20 Gm.).

Ammonii Embelas, *Ammonium embelicum, Ammonium embelate.* $C_9H_{13}O_2NH_4$.—A brick-red powder, soluble in dilute alcohol. It is said to be an efficient anthelmintic. Dose 3 grains (0.2 Gm.) for children, 8 grains (0.5 Gm.) for adults.

Ammonii Fluoridum, *Ammonium fluoride.* NH_4F.—Small prismatic crystals, stable in air, obtained by subliming a mixture of 1 part of NH_4Cl and 3¼ parts of NaF in a platinum crucible. Used in decomposition of silicates; to prevent butyric and lactic fermentation in spirit manufacture; in medicine, chiefly in enlargement of the spleen, also as antipyretic. Dose beginning with 5 drops, increased to 30 drops of a solution 4 grains to the ounce.

Ammonii Glycerophosphas, *Ammonium glycerophosphate.* $C_3H_5(OH)_2OPO(ONH_4)_2$.—A translucent salt of glycerophosphoric acid, and used for the same purpose (see under Acida).

Ammonii Molybdas, *Ammonium Molybdate.* $(NH_4)_6Mo_7O_{24}+4H_2O$.—Large colorless prisms, obtained by dissolving molybdic oxide ("acid"), MoO_3, in ammonia water and crystallizing. By precipitating the solution with alcohol, normal ammonium molybdate is obtained, $(NH_4)_2MoO_4$, in small unstable prisms. The salt is a valuable reagent in the laboratory for detecting alkaloids and phosphoric acid. With the latter in nitric acid solution it gives a fine yellow insoluble precipitate, ammonium phosphomolybdate, $(NH_4)_3PO_4.12MoO_3.6H_2O$.

Ammonii Nitras (U. S. 1890), *Ammonium nitrate, Ammonium nitricum, Nitrum flammans.* NH_4NO_3.—For preparing ammonium nitrate, nitric acid is neutralized with ammonia water or ammonium carbonate, or, in place of the latter, the pulverulent bicarbonate which accumulates in the shops may be advantageously employed; the solution is concentrated by evaporation and crystallized, or until it congeals on cooling. On the large scale it is manufactured from ammonium sulphate and potassium nitrate, the mixed solutions of which yield, first, crystals of the less freely soluble potassium sulphate, afterward crystals of ammonium nitrate, which require to be purified by recrystallization. Ammonium nitrate crystallizes in colorless hexagonal prisms, or on the rapid refrigeration of the concentrated solution in long, flexible, thread-like needles; after fusion it forms colorless crystalline inodorous masses. It has the specific gravity 1.70, and possesses a sharp, bitterish taste. It deliquesces in contact with moist air, and dissolves at ordinary temperatures in about half its weight, and in much less of boiling water. It dissolves in 20 parts of alcohol at 15° C. (59° F.), and in 3 parts of boiling alcohol. The solutions on exposure or on heating lose ammonia and acquire an acid reaction. The salt deliquesces in ammonia gas, forming a solution in liquefied ammonia, as observed by Divers (1872). When rapidly heated, it is decomposed into water, nitrogen trioxide, and nitrogen, or into nitrous and nitric oxides, ammonium nitrite, and ammonia; but if gradually heated, it is decomposed into water and nitrous oxide, or *laughing gas,* N_2O. This decomposition is effected according to the following equation: $NH_4NO_3 = N_2O + 2H_2O$. It is evident from this that in the preparation of nitrous oxide gas to be used for inhalation the heat should be carefully regulated and the gas passed through solutions of potassium hydroxide (or lime water) and ferrous sulphate, whereby all the gaseous impurities, except the nitrogen which may be present, are completely removed, even if chlorine should have been evolved in consequence of the presence of ammonium chloride in the nitrate. The salt detonates when thrown upon red-hot charcoal or when mixed with powdered charcoal and heated to 170° C. (338° F.). When mixed with sulphuric acid, nitric acid vapors are given off, and potassium or calcium hydroxide evolves ammonia when heated with the aqueous solution. The salt should be completely volatilized without charring when heated upon platinum-foil, and a 10 per cent. aqueous solution acidulated with nitric acid should not be precipitated either by silver nitrate or barium chloride (absence of chloride and sulphate). Ammonium nitrate is rarely employed in medicine. It is stated that its properties are similar to those of potassium nitrate, and that it causes less cardiac depression than the latter drug. It may be given in doses of from 5 to 20 grains (0.30–1.30 Gm.) 3 times daily.

Ammonii Oxalas, *Ammonium oxalate.* $(NH_4)_2C_2O_4.H_2O$.—Obtained by neutralizing oxalic acid with ammonia water and crystallizing. Long, colorless, shining prismatic crystals, soluble in 23.7 parts of water at 15° C. (59° F.). Used as a reagent and test for calcium salts.

Ammonii Persulphas, *Ammonium persulphate,* $(NH_4)_2S_2O_8$, obtained by electrolysis of a saturated solution of ammonium sulphate, $2(NH_4)_2SO_4 = H_2 + (NH_4)_2S_2O_8$. Colorless crystals, stable at 100° C. (212° F.) when dry. When moist, it decomposes slowly, giving oxygen which is strongly ozonized: $(NH_4)_2S_2O_8 + H_2O = 2NH_4HSO_4 + O$. Soluble in 2 parts of water.

Ammonii Phosphas (Br.); *Ammonium phosphate, Ammonium phosphoricum, Diammonium orthophosphate,* E.; *Ammonium Phosphat, Phosphorsaures Ammon,* G. $(NH_4)_2HPO_4$.—The salt may be prepared by adding ammonia water (about 20 per cent.) to phosphoric acid (about 50 per cent.) until a strongly alkaline reaction results, and evaporating to the point of crystallization. Ammonia water should be added occasionally to preserve the alkaline reaction, in order to avoid the formation of monophosphate, $NH_4H_2PO_4$. The crystals should be quickly dried on filter-paper and placed in a securely stoppered bottle. The salt may also be obtained from bones calcined to whiteness by the process for sodium phosphate (which see), if the sodium carbonate there directed is replaced by ammonium carbonate. If necessary, the salt obtained is to be purified by recrystallization from distilled water, with the addition of a little ammonia, until the crystals are free from sulphate. If the crystallizing liquid should have been rendered excessively alkaline by ammonia, the salt would consist of or contain tri-ammonium (the so-called basic) orthophosphate, of the formula $(NH_4)_3PO_4$. By boiling solutions of di- or tri-ammonium phosphate until ammonia ceases to come off, mono-ammonium phosphate is formed on crystallization. Ammonium phosphate crystallizes in transparent, colorless, monoclinic prisms having the specific gravity 1.678 (Buignet, 1861). It has a cooling and sharply saline taste, effloresces superficially in a damp atmosphere through loss of ammonia, is insoluble in alcohol, but dissolves in 4 parts of water at 15° C. (59° F.) and in 0.5 part of boiling water, yielding a solution which is at first slightly alkaline, but on exposure becomes neutral through loss of ammonia, and by continued boiling loses one-half of it. The solution yields a yellow precipitate with silver nitrate, soluble in nitric acid and ammonia, and evolves ammonia when heated with potassium hydroxide. The salt, when heated, fuses and

is gradually decomposed into metaphosphoric acid, ammonia, and water, and at a bright-red heat is completely volatilized. 2 Gm. of the salt, dissolved in water and precipitated by a solution of ammonio-magnesium sulphate, yield a crystalline precipitate, which, when well washed with diluted ammonia water, dried, and ignited, weighs 1.68 Gm. (Br.). The solution should not be affected by ammonium sulphide, or, after being acidulated with nitric acid, by hydrogen sulphide (absence of metals), and should yield no precipitate with barium chloride (sulphate) or silver nitrate (chloride). 10 grains of the salt, gradually heated upon platinum-foil to redness, should leave a residue weighing 6.1 grains. Ammonium phosphate has never been employed to any extent in medicine. It was first introduced as a remedy in the treatment of rheumatism and gout, but probably has no distinct advantages over the other alkaline preparations employed for these conditions. It is also recommended in the treatment of diabetes resulting from a gouty or lithæmic diathesis. Ammonium phosphate is given in doses of from 10 to 30 grains (0.60–2 Gm.), dissolved in water, 3 times daily.

Ammonii Picras, *Ammonium picrate, Ammonium carbazotate.* $C_6H_2(NO_2)_3ONH_4$.—Obtained by neutralizing picric acid, 1 part in 8 parts of water, with ammonia water, in hot solution, and adding 8 parts of alcohol. On cooling, small orange-colored needles form. It is very bitter, and stains organic bodies permanently yellow; for example, silk, hair, skin, and nails. It precipitates most alkaloids as picrates from their salts. It is used chiefly in preparing histological staining fluids.

Ammonii Silicofluoridum, *Ammonium silicofluoride.* $(NH_4)_2SiF_6$.—Ammonium salt of hydrosilicofluoric acid, H_2SiF_6 (see under Acida). An antiseptic in infectious diseases of throat and nose. It is said to be effective in diabetes, gout, and tuberculosis.

Ammonii Sodii Phosphas, *Ammonium sodium phosphate, Microcosmic salt.* $(NH_4)NaHPO_4.4H_2O$.—Obtained by the alchemists by evaporation of ammoniacal urine. May be prepared by crystallizing a mixture of disodium and mono-ammonium phosphates, as transparent prisms. When heated, ammonia and water escape, leaving a molten bead of $NaPO_3$, sodium metaphosphate, which, like the borax bead, has the property of dissolving metallic salts with characteristic colors. Hence it is a useful salt in qualitative chemical analysis.

Ammonii Succinas, *Ammonium succinate.* $C_4H_4O_4(NH_4)_2$.—Colorless crystals, soluble in water. Specific in cramp colic.

Ammonii Sulphas, *Ammonium sulphate, Ammonium sulphuricum; Schwefelsaures Ammon, Ammoniumsulfat,* G. $(NH_4)_2SO_4$.—Ammonium sulphate was observed by Libavius (1595), and first prepared from oil of vitriol and volatile alkali by Glauber (1667), after which time it was much employed as a purgative. The salt is a constituent of a few minerals, and is sometimes found in the neighborhood of volcanoes. Ammonium sulphate is largely obtained from coal-gas liquor (see Ammonii Chloridum) by mixing it with lime, and distilling off the ammonia and catching it in sulphuric acid. Most of the salt obtained thus is used as fertilizer. In England, about 200,000 tons are made annually from the gas liquors, shale distilling, and coke burning; in Germany about 100,000 tons, and in France 35,000 tons. In this country about 20,000 tons are made yearly. Crude ammonium sulphate is impure, often containing sulphocyanate, NH_4CNS, which is injurious to plants, and therefore depreciates the value of the sulphate as a fertilizer. A pure sulphate for chemical purposes is manufactured by neutralizing pure diluted sulphuric acid with ammonia water and crystallizing. It forms colorless rhombic prisms isomorphous with potassium sulphate, free from odor, and of a sharp saline and bitterish taste. It has the specific gravity 1.76, fuses at 140° C. (284° F.), and is decomposed at a heat exceeding 260° C. (500° F.), yielding ammonia, water, nitrogen, and a sublimate of ammonium sulphite with a little ammonium sulphate. It is soluble in 1.3 parts of water at 15° C. (59° F.) and in 1 part of boiling water. The solution in cold water has a neutral reaction to test-paper, but on exposure or on boiling evolves a little ammonia and acquires a faint acid reaction (Debbits, 1872). It is insoluble in absolute alcohol, requires for solution about 500 parts of alcohol (specific gravity 0.88), but dissolves more freely in weaker alcohol. Its solution evolves ammonia when heated with potassium or calcium hydroxide, and barium chloride produces in it a white precipitate insoluble in diluted nitric acid. When gradually heated to redness the salt should not be blackened, and should finally leave no residue upon platinum-foil. Metals, chlorides, and other impurities are detected in the same manner as in other ammonium salts. Ammonium sulphate is never employed in medicine; it is used in the manufacture of other ammonium preparations.

Ammonii Uras, *Ammonium (acid) urate.* $C_5H_3N_4O_3(NH_4)$.—Obtained by adding an excess of ammonium chloride to a solution of uric acid in 10 per cent. caustic alkali and digesting in a warm place for some time, then allowing to stand a day in a cool place. A granular, crystalline, white, odorless, nearly tasteless powder, soluble in about 1600 parts of cold water.

AMYGDALA AMARA, *U. S.*—Bitter Almond.

Bittere Mandeln, G.; *Amandes amères,* Fr.; *Almendra amarga,* Sp.; *Amendoas amargas,* Port.; *Mandorle amare,* It.

The ripe seed of *Prunus Amygdalus amara* DC. (*Amygdalus communis* L.—Fam. *Rosaceæ*).

Bitter almond is official in most pharmacopœias. The Portuguese requires the seed to be preserved in the shell until needed, an unnecessary precaution, since, if kept with ordinary care, there is little deterioration—not enough to compensate for the inconvenience. Bitter almonds should be kept unbroken and in a dry atmosphere, to prevent the decomposition of amygdalin and of the fixed oil.

FIG. 11.

Bitter almond.

Origin.—The generic identity or distinction of *Prunus* L. and *Amygdalus* L. has long been a bone of contention. The present tendency of systematists is to regard them as distinct.

The almond is probably native of western Asia, but is now cultivated in many subtropical regions. It has the habit of a peach-tree. The fruit is like a peach, but the sarcocarp is thinner, leathery, and dehiscent, leaving the unshelled almond as the equivalent of a peach-stone. The seed, removed from this shell or endocarp, is the official article.

Description.—About 25 Mm. (0.98 In.) long, oblong-lanceolate, flattish, covered with a cinnamon-brown, scurfy testa, marked by about 16 lines emanating from a broad scar at the blunt end. The embryo has the shape of the seed, is white, oily, consists of 2 plano-convex cotyledons, and a short radicle at the pointed end, and has a bitter taste.

When triturated with water, bitter almond yields a milk-white emulsion, which emits the odor of hydrocyanic acid.—U. S.

Almonds, the embryo of which has become discolored or acquired a rancid odor and taste, or has been partly converted into gum (bassorin), as described by Vulpius (1878), are unfit for medicinal purposes.

Adulteration is chiefly with the cheaper sweet almond (especially the Valencia variety) and with peach-seeds. Owing to the existence of several varieties of the bitter, and many of the sweet, no absolute rule for the distinction of the two by their general appearance can be stated, though commonly the bitter variety is shorter, broader, thinner or more flattened, slightly less plump and darker than the sweet. The flavor will, of course, immediately determine any suspected seed. In the ground condition, the adulteration can be detected only by the determination of the percentage of amygdalin. Peach-seeds are readily distinguished by their much smaller size. An artificial almond has been reported in European commerce, consisting chiefly of glucose and scented with nitrobenzol, which bears a remarkably close resemblance to the genuine.

Constituents.—The brown testa contains (Ludwig and Scheitz) tannin, a green resin, and a bitterish, acrid yellow substance (glucoside?). Preserved in dilute alcohol for several days they become covered with minute crystals of asparagin (Portes). The kernel contains fixed oil (*Oleum Amygdalæ Expressum*) about 46 per cent., mucilage 3 per cent., sugar (chiefly glucose, some saccharose) 6 per cent., proteids 24 to 30 per cent., amygdalin (the important constituent) 1 to 3 per cent., and ash (chiefly the phosphates of potassium, calcium, and magnesium) 3 to 5 per cent. The two proteids are modifications of vegetable casein (Ritthausen). Both are soluble in cold water; one, *conglutin* or *amandin*, being precipitated by acetic acid, the other, *emulsin* or *synaptase*, together with some inorganic salts, by alcohol. Both act as emulsifying agents in suspending the fixed oil when almonds are triturated with water, but it appears to be the emulsin only which is capable of decomposing the amygdalin into hydrocyanic acid and benzaldehyde (see OLEUM AMYGDALÆ AMARÆ). This change cannot take place in the unbroken seed, since the amygdalin exists in the parenchymatic tissue of the cotyledons, while the enzyme lies in their vascular bundles and in the caulicle. *Amygdalin* ($C_{20}H_{27}NO_{11}$) was discovered by Robiquet and Boutron-Charlard in 1830, by exhausting bitter almonds deprived of their fixed oil, by alcohol, they observing that the residue would not yield oil of bitter almond. Liebig and Wöhler found in 1837 that grape-sugar was also yielded by amygdalin, this being the first discovery of a glucoside. Amygdalin occurs sometimes in an amorphous condition, but as obtained by alcohol from bitter almonds, peach-seeds, etc., it crystallizes with $2H_2O$, this water being expelled at 120° C. (248° F.). It is soluble in about 15 parts of water, has no odor, a bitter taste, and is not poisonous unless decomposed by emulsin. 17 grains of anhydrous amygdalin yield 1 grain of hydrocyanic acid. The seeds yield nearly 1 per cent. of volatile oil and 0.25 per cent. of hydrocyanic acid. On boiling amygdalin with an alkali, it is decomposed into ammonia and *amygdalic acid* ($C_{20}H_{28}O_{13}$), the latter, on being boiled with dilute acids, yielding glucose and *mandelic* or *phenylglycolic acid* ($C_8H_8O_3$ or $C_6H_5.CHOH.COOH$). Amygdalin can also be decomposed by enzymes present in the flours of rye, wheat, peas, and probably of other seeds.

Action and Uses.—The oil of bitter almond, because of its hydrocyanic acid, has been employed in the coughs of phthisis and in the irritative coughs of children. Because of its rapid elimination it is probably of less service than was formerly supposed. The drug should be given in small quantities at first, because of the variable amount of hydrocyanic acid which it contains. The synthetic oil of bitter almond contains no HCN, and is used only for flavoring purposes. The ordinary dose is from $\frac{1}{4}$ to $\frac{1}{2}$ minim (.015–0.025 Cc.).

Other Amygdalin-yielding Seeds.—The seeds of many other plants related to the almond, both in the *Drupaceæ* (peach, plum, apricot, and cherry) and in the *Pomaceæ* (apple, pear, *Eriobtrya*, etc.), contain amygdalin, and can be made to yield hydrocyanic acid and oil of bitter almond. The former class of seeds are marketed on a large scale for this purpose. The product does not probably go usually into pharmaceutical channels, but is found equally good for confectioners' purposes. It is said that apricot seeds have thus very largely replaced bitter almonds in the manufacture of some classes of confectionery. Peach-kernel oil undoubtedly often substitutes that of bitter almonds and there are tests for distinguishing it (see Oil of Bitter Almond).

AMYGDALA DULCIS, *U. S.*—Sweet Almond.

Süsse Mandeln, G.; *Amandes douces*, Fr.; *Almedra dulces*, Sp.; *Amendoas doces, Mido de Amendoas*, Port.; *Mandorle dolce*, It.

The ripe seed of *Prunus Amygdalus dulcis* D. C. (*Amygdalus communis* L.—Fam. *Rosaceæ*).

Official in most pharmacopœias, which usually apply the important safeguard of cautioning against admixture of the bitter variety. The adulteration of sweet almond with bitter almond is not economical, and need not be expected to occur except by accident. The general distinctions have been stated under Bitter Almond. Admixture in the ground condition is at once determined by the odor when water is added. Adulteration of the paste, oil, and similar preparations with those of the peanut is practised upon a large scale. This subject is treated under Oleum Amygdalæ Expressum.

The native home of the sweet is the same as that of the bitter almond, and it is even more widely cultivated, large quantities being now produced in southern California.

Description.—Closely resembling the bitter almond (see Amygdala Amara), but having a bland, sweetish taste, free from rancidity.

When triturated with water, it yields a milk-white emulsion, free from the odor of hydrocyanic acid.

The cultivated varieties of the sweet almond are very numerous, but hardly require consideration here, since they vary but little in composition.

Composition.—The composition of the sweet almond is practically identical with that of the bitter, with the single exception that it contains no amygdalin, yielding therefore no hydrocyanic acid nor oil of bitter almond. It yields from 6 to 10 per cent. more of the fixed oil than does the bitter. The presence of peptone has been fully demonstrated, E. Lemport having obtained 0.25 per cent. from them.

Pharmaceutical Preparations.—Emulsion (Mixture) of Almond, U. S. P.; Syrup of Almond, U. S. P.

Action and Uses.—Sweet almond when made into an emulsion with water forms an excellent vehicle for the administration of other drugs. The fixed oil is a demulcent, and has been employed in irritated states of the upper air-passages, stomach, and intestines. When deprived of the fixed oil, sweet-almond flour forms a useful article of diet for diabetic patients, as the bread prepared from it contains no starch.

The drug is usually administered in the syrup or emulsion, the dose of either being from 1 to 4 fluidrachms (4–16 Cc.). The expressed oil is given in the dose of from $\frac{1}{2}$ to 1 fluidrachm (2–4 Cc.) or more.

AMYLENUM HYDRATUM, *P. G.*—Amylene Hydrate.

Dimethyl-ethylcarbinol, Tertiary amyl alcohol, E.; *Hydrate d'amylène*, Fr.; *Amylenhydrat*, G.

Formula, $2CH_3.C_2H_5.C.OH = C_5H_{12}O$. Molecular weight, 87.43.

Origin.—Of the alcohols corresponding to the general formula $C_5H_{11}OH$, no less than 8 are theoretically possible, and of this number 7 have been actually prepared.

The best known of the amyl alcohols is that produced in the fermentation of grain, potatoes, etc. (see page 129), and designated as isobutyl carbinol. Tertiary amyl alcohol was first prepared by Wurtz.

Preparation.—A mixture of 100 measures each of sulphuric acid, water, and commercial amylene is exposed to a low temperature with frequent agitation; the amyl-sulphuric acid formed is separated after a lapse of 30 minutes, and added to twice its volume of ice-cold water, filtered, and neutralized with milk of lime or solution of sodium hydroxide, after which it is distilled. The distillate is dehydrated with potassium carbonate, and subjected to fractional distillation, the portion being collected which comes over between 100° and 102.5° C. (212° and 216.5° F.).

Properties.—Amylene hydrate is a limpid, colorless, volatile, neutral liquid of peculiar penetrating odor which reminds of camphor and peppermint, and a burning taste; its specific gravity at 15° C. is 0.815 to 0.820, and its boiling-point, when pure, 102.5° C. (216.5° F.); it congeals at —12.5° C. (9.5° F.). It is hygroscopic. It is soluble in 8 parts of water, and miscible in all proportions with alcohol, chloroform, benzin, glycerin, and fixed oils.

Tests.—It should be neutral to litmus, and in solubility, specific gravity, and boiling-point agree with the above. When 2 drops of potassium permanganate test-solution are added to 20 Cc. of a 5 per cent. aqueous solution of amylene hydrate, the solution should not become decolorized within 10 minutes (absence of amyl alcohol, aldehyde, etc.). If ammonium-silver nitrate solution be added to the aqueous solution and the mixture heated for 10 minutes on a water-bath, no reduction to metallic silver should take place (absence of aldehyde).

Action and Uses.—Amylene hydrate acts purely as an hypnotic, but its effect is exercised only in functional insomnia, and not upon that resulting from pain. According to Hannach and Meyer, it at first stimulates the respiration and nervous system, but afterward paralyzes them. It depresses the heart and causes a continuous fall in blood-pressure. If the dose be sufficiently large, the heart's action becomes irregular and cardiac paralysis eventually occurs. This drug causes a great decrease of bodily heat, prevents tissue-waste, and lessens the excretion of urea. It may be employed as a hypnotic in those cases in which paraldehyde is of service, but it is stated to be more rapid and more fleeting in its effect. W. Niersen has used amylene hydrate with success in the treatment of diabetes insipidus, effecting a cure in a few cases and marked improvement in others.

Excessive amounts of this drug cause deep sleep or stupor, slow irregular respiration and slow pulse, great fall of temperature with loss of reflex action, and finally death. This condition should be treated by the application of external heat, and, if need be, artificial respiration. Appropriate stimulants, such as strychnine, digitalis, and atropine, should be promptly given.

As a hypnotic amylene hydrate should be given in doses of from 15 to 60 minims (1–4 Cc.). It is best administered in capsules, but may be given in alcoholic solution.

Allied Compounds.—AMYLENUM, *Amylene, Valerene, Pentene*, E.; *Iso-amylen, Fuselöl-amylen*, G. C_5H_{10}.—This hydrocarbon was first obtained by Balard (1844). It is prepared by mixing equal parts of amyl alcohol and fused zinc chloride in a capacious retort, and, after a few days, subjecting the mass to distillation on a sand-bath. The distillate, treated with fused calcium chloride to remove moisture, is distilled, and the portion coming over between 30° and 40° C. (86°–104° F.) collected. Amylene consists of varying proportions of 2 or 3 isomeric compounds boiling between 32° and 40° C. (89.6°–104° F.), trimethylethylene, besides isopropylethylene, etc. Amylene is a colorless, thin, volatile, highly inflammable liquid, with a disagreeable, cabbage-like odor, and sweetish taste. Its specific gravity at 15.5° C. is 0.660 to 0.670. It boils at 30°–40° C., but is readily polymerized into compounds having higher boiling-points. It should be neutral to wet litmus-paper and have the specific gravity and boiling-point as above.

AMYL HYDRIDE. C_5H_{12}.—One of the lightest liquids known. Contained in the volatile products of petroleum and cannel coal. A thin, colorless, tasteless, highly inflammable liquid, having an agreeable ethereal odor resembling chloroform. Specific gravity 0.626 at 17° C. (62.6° F.), and boiling at 38° C. (100.4° F.). It is soluble in water, but miscible with alcohol, ether, and chloroform. This product has been recommended as an antiseptic. It is never employed as an internal medicine.

PENTAL, *Trimethyl-ethylene, Beta-isoamylene*.—This is a purer form of amylene, and is prepared from amyl alcohol by digestion with zinc chloride for 24 hours and subsequent fractional distillation, or by the interaction of crystallized oxalic acid and amylene hydrate at 60° to 90° C. (140°–194° F.). It is a colorless liquid, very volatile and inflammable, insoluble

in water, and with a mustard-like odor. Its specific gravity is 0.667, and its boiling-point at 38° C. (100.4° F.). Its solubility is similar to that of amyl hydride. Used as a general anæsthetic in dental surgery. 2 to 3 drachms (8–12 Cc.) being sufficient.

AMYLIS NITRIS, *U. S.*—Amyl Nitrite.

Amyl nitris, Br. (U. S. 1890); *Amylium nitrosum*, P. G.; *Amylæther nitrosus.—Amylo-nitrous ether*, E.; *Azotite d'amyl, Ether amylazoteux*, Fr.; *Amylnitrit*, G.; *Etere isoamil nitroso*, F. It.; *Nitrito de amilo*, Sp.

Formula, $C_5H_{11}NO_2$. Molecular weight, 116.24.

A liquid containing about 80 per cent. of amyl (chiefly isoamyl) nitrite, when assayed by the process given below.—U. S.

The British Pharmacopœia defines amyl nitrite as a liquid produced by the interaction of amyl alcohol which has been distilled between 127.7° and 132.2° C. (262° and 270° F.) and nitrous acid, consisting chiefly of isoamyl nitrite, but containing also other nitrites of the homologous series. It requires that a 5 per cent. volume solution of amyl nitrite in alcohol shall yield not less than 6 times its bulk of nitric oxide gas.

Preparation.—The process now generally followed is identical with the one prescribed in the U. S. P., 1890, for the manufacture of ethyl nitrite in the preparation of spirit of nitrous ether, except that amyl alcohol is substituted for common or ethyl alcohol. A mixture of sodium nitrite, amyl alcohol, and diluted sulphuric acid is subjected to distillation in a retort, that portion being collected which vaporizes between 95° and 100° C.; the distillate is well washed with a solution of sodium bicarbonate, dehydrated with fused calcium chloride, and redistilled below 100° C. (212° F.). The reaction occurring is explained by the following equation: $2C_5H_{11}OH + 2NaNO_2 + H_2SO_4 = 2C_5H_{11}NO_2 + Na_2SO_4 + 2H_2O$; theoretically, 138 parts of sodium nitrite and 176 parts of amyl alcohol are capable of producing 234 parts of amyl nitrite; this yield, however, is never obtained, owing to impurities in the amyl alcohol and sodium salt, as well as possible carelessness during the process. Amyl nitrite is a mixture of α-amyl nitrite and β-amyl nitrite. The former is optically inactive, and boils at 97° C. (206.6° F.), while β-amyl nitrite boils at 94° C. (201.2° F.) and shows dextrorotatory power (Dunstan and Williams, *Pharm. Jour. and Trans.*, Dec. 22, 1888, p. 487). Isobutyl nitrite, boiling-point 67° C. (152.6° F.), is a frequent impurity in amyl nitrite.

Properties.—Amyl nitrite is an ethereal liquid, of a yellowish color, neutral reaction, a peculiar fruit-like odor, and a pungent, aromatic taste, very volatile and inflammable. Its specific gravity is 0.865 to 0.875 at 25° C. (77° F.) (U. S.), or 0.870 to 0.880 at 15.5° C. (60° F.) (Br., P. G.). It boils at 96° to 99° C. (204.8°–210.2° F.), and its vapor (specific gravity 4.03), as well as the liquid, when ignited, burns with a fawn-colored, sooty flame. It is insoluble in water, but dissolves in all proportions in alcohols, in ethers, carbon disulphide, benzene, benzin, and other hydrocarbons. It dissolves fixed oils, fatty acids, phosphorus, and a small proportion of sulphur, caoutchouc, and gutta-percha. On exposure to air and light it acquires an acid reaction, and should therefore be preserved in small glass-stoppered vials kept in a cool and dark place. Strong alkali solutions decompose it into amyl alcohol and nitrite of the base of the alkali. The decomposition is accelerated by heat and the presence of alcohol. If it be added drop by drop to potassium hydroxide heated to fusion, potassium valerianate is formed.

Tests.—Amyl nitrite should remain transparent, or nearly so, when exposed to the temperature of melting ice (absence of water).—U. S., Br., and P. G. If 1 Cc. of normal potassium hydroxide solution and 10 Cc. of water be mixed with a drop of phenolphthalein solution, and then shaken with 5 Cc. of amyl nitrite, the red tint of the aqueous layer should still be perceptible (limit of free acid).—U. S. If equal volumes of amyl nitrite and 5 per cent. solution of potassium hydroxide be thoroughly mixed, the aqueous layer should not acquire a deeper tint than pale yellow (limit of aldehyde).—Br. Absence of aldehyde is indicated when a mixture of 1 volume of amyl nitrite, 1.5 volumes of 5 per cent. solution of nitrate of silver, and 1.5 volumes of absolute alcohol, with sufficient ammonia-water added to just redissolve the precipitate, fails to turn brown or discolor on gently warming the mixture. Submitted to distillation, about 70 per cent. passes over between 90° and 100° C. (194° and 212° F.), the bulb of the thermometer not dipping below the surface of the residual liquid.—Br. The U. S. P. gives the following method of assaying the amyl nitrite content of any commercial sample: Transfer 3 Cc. of the amyl nitrite, which has been previously shaken with 0.5 Gm. of

potassium bicarbonate, and carefully decanted, to a tared 100 Cc. measuring flask, and weigh it accurately. Add sufficient alcohol to bring the volume to exactly 100 Cc., and mix thoroughly. Introduce into a nitrometer exactly 10 Cc. of the alcoholic solution (representing $\frac{1}{10}$ of the original quantity of amyl nitrite), followed by 10 Cc. of potassium iodide test-solution, and afterward by 10 Cc. of normal sulphuric acid. When the volume of gas has become constant (within 30 to 60 minutes) note the volume of gas collected. Multiply this volume in cubic centimetres by 4.8, and divide the product by the original weight of the amyl nitrite. At the standard temperature and pressure the quotient will represent the percentage of amyl nitrite in the liquid. The temperature correction is one-third of 1 per cent. of the total percentage just found for each degree—additive if the temperature is below 25° C. (77° F.), and subtractive if it is above 25° C. (77° F.). The barometric correction is four-thirtieths of 1 per cent. for each millimetre; additive if it is above, and subtractive if it is below 760.

The reaction occurring in the above test is shown by the following equation: $C_5H_{11}NO_2 + KI + H_2SO_4 = NO + C_5H_{11}OH + I + KHSO_4$, from which it is seen that 116.24 parts of absolute amyl nitrite will yield 29.81 parts of nitrite oxide gas. 1 Cc. of this gas at 25° C. (77° F.) weighs 0.0012234 Gm., and corresponds to 0.004773 Gm. of amyl nitrite, and as only one-tenth of the original weight of amyl nitrite is used in the assay, the Pharmacopœia directs that the number of Cc. of gas obtained be multiplied by 4.8, and divided by the original weight of the sample, to find the percentage, which is practically equivalent to multiplying by 0.004773 and by 100, and dividing by one-tenth of the original weight. The temperature and pressure corrections, given in the Pharmacopœia, are sufficiently accurate for all practical purposes.

The "Chlorate Method," proposed by Carl E. Smith (*Am. Jour. Pharm.*, June, 1898, 273–285), is based on the method of B. Grützner for the valuation of alkali nitrites. It is readily applied and is capable of greater accuracy than the gasometric method in general use. The details are as follows: Dissolve 5 or 6 Gm. of amyl nitrite in sufficient alcohol to make 100 Cc. Pour into a flask successively 10 Cc. of distilled water, 10 Cc. of a cold aqueous saturated solution of potassium chlorate, and 10 Cc. of the amyl nitrite solution, add 10 Cc. of 10 per cent. nitric acid, stopper the flask quickly, and shake frequently during 30 minutes. Then add 20 Cc. of decinormal silver nitrate solution, shake briskly for a few moments, add 10 drops of ferric ammonium test-solution as indicator, and titrate the excess of silver solution with decinormal potassium sulphocyanate solution without delay. The interaction between the amyl nitrite and potassium chlorate results in the formation of amyl nitrate and potassium chloride; the latter is decomposed by the silver nitrate, forming silver chloride, which is precipitated. Since each Cc. of decinormal potassium sulphocyanate solution used represents a like volume of the silver nitrate solution in excess, the number of Cc. used subtracted from 20 leaves the volume of silver solution precipitated by potassium chloride. Each Cc. of decinormal silver nitrate solution thus precipitated corresponds to 0.0351 Gm. of amyl nitrite.

Carbonic oxide amyl nitrite is amyl nitrite charged with carbonic acid. The preparation is more suitable for inhalation than the plain amyl nitrite.

Action and Uses.—Amyl nitrite produces cyanosis, throbbing in the head, vertigo, staggering, roaring in the ears, hurried and deep or occasionally irregular respiration, increase in the force and rapidity of the heart, decrease in blood-pressure and temperature, and finally complete relaxation. Medicinal amounts depress the motor centers of the spinal cord, and overdoses depress the motor nerves, the sensory centers of the cord, and the muscles. Small quantities stimulate the heart muscle, but moderate doses depress the circulation. It depresses the vasomotor center, the muscular coats of the arteries, and the vagus center. By so doing, it increases the rapidity but not the force of the pulse. Oxyhæmoglobin is converted into methæmoglobin, and the oxygen-carrying power of the blood is decreased. Amyl nitrite first stimulates the respiratory center, but overdoses produce death by respiratory paralysis. After its administration an increased secretion of urine frequently occurs, and transient glycosuria occasionally results: the former condition is said to be due to vascular dilatation in the kidneys, and the latter to a similar condition in the liver. Tissue-waste is probably lessened, and there may be a decrease in the excretion of urea. Normal temperature is lowered because of the vascular dilatation, the decreased oxygenation, and possibly of some effect

upon the centres governing heat-production and heat-dissipation. The drug is rapidly absorbed, and rapidly eliminated by the lungs and kidneys; a part of it, however, is oxidized in the tissues. Amyl nitrite probably has no direct action upon the cerebrum. The confusion, fulness in the head, and occasional convulsions which it causes are usually attributed to vascular dilatation; while the peculiar visual symptoms, such as an object surrounded by a yellow circle, and that again by a blue one, are possibly the result of medullary irritation. After the ingestion of poisonous amounts consciousness usually remains until death occurs.

Amyl nitrite is always employed by inhalation except in those cases in which spasm of the respiratory muscles prevents its administration by inhalation. When such conditions exist, it should be given by hypodermic injection. This drug lends itself to the control of all forms of general and local spasm. It is successfully employed in controlling and preventing the convulsions accompanying hysteria, tetanus, and strychnine-poisoning. Epileptiform convulsions may be relaxed, and, if preceded by an aura, prevented or aborted by its inhalation. It may be employed in puerperal convulsions, but post-partum hemorrhage may result from the uterine relaxation which it not infrequently causes. Infantile convulsion has also been successfully combated by its administration. Minor spasmodic conditions, such as whooping-cough, laryngismus stridulus, spasmodic croup, asthma, dysmenorrhœa, and the convulsive movements occurring in cocaine-poisoning, are all benefited by its employment. Small quantities have been given with asserted success during labor complicated by an over-distended heart and failing right ventricle. Its momentary administration is also valuable in the treatment of sudden cardiac failure, especially that occurring during the administration of an anæsthetic. It is a good drug to employ in the treatment of angina pectoris, as it relieves the arterial spasm and also the pain. This drug has been successfully used in migraine with hemianopsia, and de Schweinitz recommends it also in the treatment of quinine amblyopia.

Amyl nitrite may be administered by the mouth, but is usually given by inhalation or hypodermic injection. The ordinary dose is from 3 to 5 minims (0.20–0.30 Cc.), but as much as 10 minims (0.6 Cc.) may be inhaled without deleterious results. Pearls made of very thin glass containing these amounts may be obtained, and, when needed, crushed in a handkerchief and their contents inhaled.

According to Bals and Broglio, tertiary amyl nitrite is said to possess the same physiological action without the toxic effects of ordinary amyl nitrite. Slight hypnotic properties have also been ascribed to it. The dose is stated to be from 3 to 5 minims (0.20–0.30 Cc.), as required. It is never employed as a hypnotic.

The following derivatives of amyl alcohol are allied to the preceding, and are of interest:

AMYLIS ACETAS.—*Amyl acetate, Oil of pear,* E.; *Amylacetat, Essigsäure-amylester,* G. C_5H_{11}-$C_2H_3O_2$ or $CH_3CO_2C_5H_{11}$.—A fruit ether. 105 parts of amyl alcohol and 130 parts of concentrated sulphuric acid are mixed, and after several days poured upon 100 parts of dry sodium acetate, or 120 parts of potassium acetate, and the mixture submitted to distillation. The distillate, washed with dilute alkaline solution, is dehydrated by means of fused calcium chloride and again distilled. A colorless liquid, of an agreeable pear-like odor. Specific gravity 0.875 at 15° C. (59° F.). Boils at 138° C. (280.4° F.). It is but slightly soluble in water, but is miscible with alcohol and ether. It is a good solvent of some resins. Used as a component of fruit essences and as a solvent of resins in the preparation of lacquers and varnishes.

AMYLIS NITRAS.—*Amyl nitrate.* $C_5H_{11}NO_3$.—It was discovered by W. Hofmann (1848), and is most advantageously prepared, according to Chapman and Smith (1867), by dropping through a long tube, and *with constant stirring,* 50 Cc. of amyl alcohol into 150 Cc. of a mixture made of 1 volume of nitric and 2 volumes of sulphuric acid, and kept cool by ice and table-salt. Without visible reaction an oily layer of amyl nitrate separates on the surface, which is obtained pure by washing with dilute potassium hydroxide solution and water, drying with calcium chloride, and rectifying. It is a colorless oily liquid of a peculiar odor and sweet and burning taste. Its density at 15° C. (59° F.) is 0.902, and it boils at 147° C. (296.6° F.). It dissolves in glacial acetic acid, benzene, and in ethyl, methyl, and amyl alcohol, but not in water. Amyl nitrate is never employed in internal medicine.

AMYLIS SALICYLAS.—*Amyl salicylate,* E.; *Amylsalicylat, Salicylsäure-amylester,* G. $C_5H_{11}C_7$-H_5O_3 or $C_6H_4OHCO_2C_5H_{11}$.—This compound may be prepared by treating a mixture of amyl alcohol, salicylic acid, and sulphuric acid after the manner stated under Methyl Salicylate. It is a colorless, refractive liquid, emitting an odor resembling that of salol, and boiling at 270° C. (518° F.). Amyl salicylate is soluble in alcohol, ether, and chloroform, but is almost insoluble in water. It is preferred by some to methyl salicylate, for internal and external use

in the treatment of rheumatism, and may be given in capsules, in doses of 8 to 10 grains (0.5–0.6 Gm.), 3 times a day.

AMYLIS VALERIANAS.—*Amyl valerianate or valerate, Apple oil*, E.; *Amylvalerianat, Baldriansäure-amylester*, G. $C_5H_{11}C_5H_9O_2$ or $(CH_3)_2CH.CH_2.CO_2.C_5H_{11}$.—A fruit ether. 105 parts of concentrated sulphuric acid and 88 parts of amyl alcohol are mixed, cooled, added to 124 parts of dry sodium valerianate and the mixture distilled on a sand-bath. The distillate is washed with a dilute solution of sodium bicarbonate, dehydrated with fused calcium chloride, and redistilled. A colorless liquid of an agreeable apple-like odor, having a specific gravity of 0.880 at 15° C., and boiling at 188°–190° C. (370.4°–374° F.). Used as a component of fruit essences. Amyl valerianate has been successfully employed in the treatment of gall-stone colic. It is stated that it not only acts as a sedative and aids in the expulsion of the calculus, but that it also possesses the power of dissolving cholesterin. Its employment in renal colic is said to be less satisfactory. The drug is given in doses of from 2 to 3 grains (0.10–0.20 Gm.), usually in capsule, 2 or 3 times daily.

AMYLUM, *U. S., Br.*—Starch.

Corn-starch, E.; *Kraftmehl, Maisstärke*, G.; *Fécule (Amidon) de Maize*, Fr.

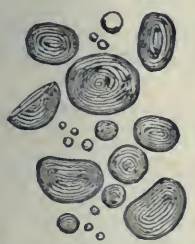
Formula, $C_6H_{10}O_5$. Molecular weight, 161.62.

The starch grains obtained from the fruit of *Zea Mays* L. (Fam. *Gramineæ*).

The maize plant, as well as its grain, is too well known to call for description. It originated in tropical America, and is now cultivated in tropical and warm-temperate regions throughout almost the entire world. Besides its enormous use in the form of meal, it is an important source of glucose and glucose syrup, fixed oil, Bourbon whiskey, alcohol, and starch. The average composition of corn is water 11, starch 55, gum and sugar 3, cellulose 13, gluten 8, fat 4.7, and ash 1.1. The starch is formed by the action of chloroplastids on carbon dioxide and water, in sunlight, in the leaf and other chlorophyll-bearing parts of the plant, first in the form of related saccharine compounds, then dissolved and in this state transported to the growing seed. Here, in the absence of light, it is taken up by amyloplasts, by which it is accumulated in successive layers. These layers, containing water in different proportions, have different refractive powers, thus imparting a stratified appearance to the starch-grain, usually indistinct in corn starch. The nucleus continues to occupy a nearly central position, and is recognized as the "hilum." As the starch-grain matures, several fissures usually radiate from this hilum, imparting to it an irregularly stellate appearance. The grains are at first solitary and rounded in outline, but with growth they become polyhedral by close packing and very commonly cohere in groups of 2 to several, the so-called "compound starch-grain," in the extracted starch. Each starch-grain consists of a thin resistent membrane, enclosing starch-granulose and starch-cellulose, the latter forming an outside layer.

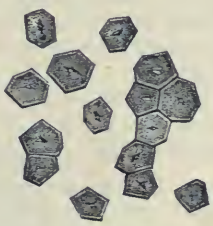
Various methods, differing chiefly in the mechanical details, are followed in the extraction of starch. The "alkaline" or "sweet" process is commonly used in America.

FIG. 12.



Wheat starch.

FIG. 13.



Corn starch.

FIG. 14.

Rice starch.

Each magnified 250 diameters.

The corn is steeped in large tanks until soft, to remove most of the oil and inorganic matter. It is then ground and, with a stream of water, is passed through strainers, the settled matter being stirred for some hours with a solution of caustic soda. The alkali takes into solution the remaining oil and some albuminoid, and precipitates the gluten and other impurities as a dark heavy layer, upon which the white starch subsides. This starch is moulded into blocks, partly dried over porous bricks, and then kiln-dried for 3 to 15 days at 68.8° to 80° C. (156° to 176° F.). Kept at the higher temperature for a short time, it produces the "small pipe" masses or "crystals"; while at the lower temperature, for a longer time, it forms large irregular chunks. It now con-

tains 0.5 to 1 per cent. of moisture, but quickly absorbs up to 15 to 18 per cent. from the air.

Description.—In irregular, angular masses, which are easily reduced to a fine powder; white, inodorous, and tasteless; insoluble in ether, alcohol, or cold water. Under the microscope appearing as granules, nearly uniform in size, averaging about 0.019 Mm. (0.0012 In.), more or less angular in outline, with indistinct striæ and with a distinct hilum near the center.

Triturated with cold water, it gives neither an acid nor an alkaline reaction with litmus-paper.

When boiled with water, it yields a white jelly having a bluish tinge, which, when cool, acquires a deep-blue color on the addition of iodine test-solution.

When completely incinerated, starch should not leave more than 1 per cent. of ash.—U. S.

The Ph. It. limits the loss of moisture at 120° C. (248° F.) to 20 per cent. Starch is official in all pharmacopœias, but there is the greatest diversity in the variety or varieties specified. If pure, there is little difference among them, from a pharmaceutical standpoint, except as to abundance and price. There is, however, considerable difference in the liability to impurity.

Adulteration.—The only object in the selection of corn starch as the official article is to secure an abundant, cheap, and unobjectionable article. Because these objects are so well attained, adulteration is largely excluded. The only serious danger is of adulteration by potato starch, or possibly by sweet potato or yam starch, which two latter are considered toward the close of this article.

Fig. 15.

Potato starch.

Potato starch (Fig. 15) when boiled with acidulated, and to a less extent with pure, water gives off a peculiar and unpleasant, "herbaceous" odor. The paste produced by mixing it with twice its weight of hydrochloric acid is transparent and jelly-like. Its grains float upon chloroform. They are of exceedingly irregular size, the larger and characteristic ones 0.06 to 0.1 Mm. (0.0024 to 0.0039 In.), ovate, the hilum at the smaller end only occasionally stellate or fissured, the rings incomplete, coarse, and strongly marked, so that the appearance of the grain has been compared with that of an oyster shell. The smaller grains are nearly circular.

Pharmaceutical Preparations.—Glycerite of Starch, U. S. P.; Iodized Starch, N. F.

Action and Uses.—In the form of a very fine powder, starch is an excellent remedy for intertrigo or chafing. It may be dusted upon the skin to absorb secretions, and is commonly dusted about the genitals of infants to prevent excoriation.

Internally starch is demulcent and nutritive, and in the form of starch paste, made by boiling it with water, is used in gastro-enteritis and in inflammatory conditions of mucous membranes elsewhere. Starch paste is the best antidote to iodine-poisoning.

Starch water, made by diluting starch paste with water, is an excellent vehicle for the administration of drugs by the rectum.

Starch poultices, made by boiling starch with a sufficient amount of water to make a gelatinous mass, may be employed in chronic skin diseases to aid in the separation of crusts, and are also of value in removing excessive quantities of iodine from the skin.

Other Starches.—Starch (*Stärke*, G.; *Amidon*, Fr.; *Almidon*, Sp.; *Amido*, It.) is the most widely distributed and abundant hydrocarbonaceous reserve food of plants. It may be stored in the most temporary way, that made during the day consumed during the following night, or it may be stored during one season in buds, fleshy rhizomes, tubers, or roots, to provide for the next season's growth, or in seeds for the use of the newly germinated embryo. From this it may be supposed that the sources of commercial starch are numerous. Besides the enormous quantities of many sorts in general trade, many others are extracted upon a smaller scale for local consumption by both civilized and savage peoples. An enumeration of all the plants which have been thus utilized for the extraction of their starch, or for consumption because of its presence, would make a formidable list.

Quite aside from these economic considerations, starch possesses great interest because of its extensive use, or that of substances containing it, for purposes of adulteration or sophistication, an interest that is of special importance to the pharmacist, since it applies so largely to powdered drugs. Since the different starches usually present individual characteristics, they commonly afford evidences of such adulteration, and frequently of its precise nature. This

aspect of the subject is omitted from the present article, but is taken up in connection with the different drugs to which it relates.

The origin, mode of formation, and nature of starch have been indicated in a general way in our account of the official variety. There are, however, numerous general or special deviations from that type. The starch grains may remain single, instead of uniting in groups, as there described. This form will then be free from angular outlines. Their form is subject to the widest variation, as is the degree of flattening, the position and appearance of the hilum, the character and distinctiveness of the rings. The size of the grains must, of course, be non-characteristic in the smaller direction, since they are in different stages of growth, but in their degree of enlargement they are usually subject to a fair degree of definition, so that the upward limit becomes of value in identification. In some plants starch is not in grains, appearing in rod-like forms, or is even amorphous. A small amount may exist in the amorphous state, while most is in granules.

ARROW-ROOT STARCH (Fig. 16) (*Maranta starch; Marantastärke*, G.; *Arroru*, Sp.), from the rhizome of *Maranta arundinacea* L. (Fam. *Marantaceæ*).—This plant is a native of tropical America, and has been largely introduced to cultivation in other tropical countries. Its cultivation is one of the most important industries of the West Indies, especially of Bermuda and St. Vincent, which latter island is said to have exported nearly 21,000 barrels in 1890. It is often known as "Bermuda arrow-root," because at one time chiefly exported from there. Although highly prized and expensive, its qualities differ little from those of other starches. One reason for this preference is doubtless the great care and scrupulous cleanliness observed in its preparation. The name "arrow-root" was derived from the fanciful idea that it was useful as an antidote to arrow poisons. The fresh rhizome yields from 13 to 20 per cent. Because of its high price, this variety is largely subject to adulteration, or even entire substitution, especially by potato, sweet potato, and yam starches (which see). It emits no disagreeable odor when boiled with acidulated water, and the paste produced by mixing it with twice its weight of hydrochloric acid is white and opaque. 1 part with 96 parts of boiling water gives a moderately thin, pellucid mucilage. It occurs either as a powder or in lumps less than ¼ inch in diameter. The most of the grains are shortly and broadly ovate, a few circular, 0.0327 to 0.0375 Mm. (0.00129 to 0.00148 In.) in diameter, hence much more uniform than other starches. The hilum is near the larger end, and is almost invariably fissured or stellate. Viewed under water, the rings are very distinct. The use of arrow-root starch has declined enormously, especially in the United States. That which is known as Florida arrow-root is the starch of the stem of *Zamia integrifolia* Jacq. (coontee or wild sago), produced chiefly in Florida, but also, from this and other species of *Zamia*, in the West Indies. *Talcahuana arrow-root starch*, produced in Chili, is from *Alstræmeria Ligtu* L. (Fam. *Amaryllidaceæ*). *Tahiti arrow-root starch* is from *Tacca pinnatifida* and *T. oceanica* Forst. (Fam. *Taccaceæ*). The grains are of about the size of those of cassava, but are flattened and angular. Used principally as a food for infants and invalids.

FIG. 16.

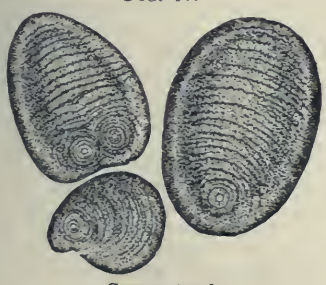
Maranta starch

ARUM STARCH or ARUM ARROW-ROOT (*Amido da Serpentina*), from *Arum Dracunculus* L. (Fam. *Araceæ*), is somewhat like tapioca, but is commonly truncated at two ends, with the hilum eccentric, and rarely exceeding 0.014 Mm. (0.00055 In.) in diameter.

BARLEY STARCH consists usually of very small, angularly circular grains, about 0.0185 Mm. (0.00073 In.) in diameter, but with a few grains reaching to nearly four times this size.

CANNA STARCH (Fig. 17) (*Tous-les-mois, Toulema, Amidon de canne, Fécule de Tolomane, Cannastärke*).—From the rhizome of *Canna edulis* Ker. (Fam. *Cannaceæ*, according to some authors

FIG. 17.



Canna starch.

FIG. 18.

Curcuma starch.

a subfamily of *Marantaceæ*). This showy plant is a native of tropical America, and is considerably cultivated for its starch in the West Indies. Probably other species of the genus contribute part of the product. It is decidedly similar in general characters to arrow-root starch, but its granules are much larger, about the largest in commerce,

measuring 0.0469 to 0.132 Mm. (0.0018 to 0.0052 In.). Three distinct forms are recognized, the smallest ovoid, the intermediate pear-shaped, while the largest are oval-elliptical or sometimes pointed at the ends. The hilum is near one end, almost always circular, and the rings are fine, regular, and incomplete. The grains swell very rapidly in potassium hydroxide solution. Potato starch may be easily mistaken for this, but its polarization is not nearly so regular.

Curcuma Starch (Fig. 18) (*Curcuma arrow-root, East India arrow-root*), from *Curcuma angustifolia* Roxb. (Fam. *Marantaceæ*), possesses elongated triangular or irregularly oval, nearly transparent grains, from 0.0304 to 0.0609 Mm. (0.0012 to 0.00238 In.) in diameter. The rings are distinct but very incomplete, the eccentric hilum faint. Under the influence of potassium hydroxide solution they swell very irregularly, becoming greatly deformed.

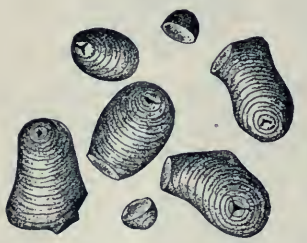
Oat Starch is quite similar to corn starch, irregularly 3- to 6-sided, and 0.0044 to 0.03 Mm. (0.00018 to 0.00118 In.) in diameter.

Potato Starch (*Amylum Solani; Kartoffelstärke*, G.; *Fécule de pomme de terre*, Fr.; *Fecula de Patata*, Sp.; *Amido da Bapata*, Port.), official in the Belgian, Dutch, French, Portuguese, and Spanish Pharmacopœias. From the tubers of *Solanum tuberosum* L. (Fam. *Solanaceæ*). This well-known tuber has the following composition in round numbers: water 13, starch 82, nitrogenous matter 2¼, woody fiber 1, fat ⅕, ash ½, besides some unimportant water-soluble constituents, including nearly ½ per cent. of sugar. The characters of the starch-grains have been given under the adulterants of the official article.

Rice Starch (Fig. 19) (*Amylum Oryzæ; Rice flour; Reisstärke*, G.; *Farine de riz*, Fr.; *Amido do Rizo*, It. and Sw.), from the grain of *Oryza sativa* L. (Fam. *Gramineæ*). Rice is native of India and is cultivated in most tropical and warm-temperate countries. It is the most important food-plant of India, China, and other eastern countries. Its composition is, in round numbers, water 14, nitrogenous substance 7, fat ½, starch 78, ash ½. Its starch-grains are the smallest of any commercial variety, about ⅛ as large as those of maize, 0.005 to 0.0075 Mm. (0.0002 to 0.0003 In.) in diameter, of similar form and very much inclined to be compound. The hilum is usually stellate.

Sago Starch, or *Sago* (Fig. 19), is the product of *Arenga saccharifera* Labill. (*Saguerus Rumphii* Roxb.), the *Areng. Sugar, Condiar*, or *Lantar palm* of the East Indies, *Phœnix farinifera* Roxb., *Cycas circinalis* L., *C. revoluta* Thunb., and other species of *Cycas*, as well as from several species of *Metroxylon* Rottb. Sago is obtained from the pith of the stems of these plants. It exists in commerce in both the raw and prepared forms, the latter having been subjected to partial cooking, which obliterates or obscures the hilum and the rings and makes it somewhat transparent. Obtained as it is from so many different species, it presents marked differences of size and form. In general it may be stated that the grains range from 0.0282 to 0.066 Mm. (0.00111 to 0.0026 In.) and from oval to ovate in form, the hilum circular and at the more rounded end, the opposite end tending to be truncate. The rings are indistinct. The prepared sago is commonly in the form of globules, "Pearl Sago." This form is very frequently only potato or other starch, sold under a fictitious title.

Fig. 19.



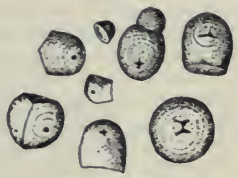
Sago starch.

Sweet Potato Starch, from the tuberous root of *Ipomœa Batatus* Poiret, the sweet potato or camote (Fam. *Convolvulaceæ*), is quite largely manufactured and much used for purposes of adulteration, especially of pepper and other species. Its grains are very large, 0.022 to 0.0352 Mm. (0.0008 to 0.0014 In.), oval in shape, with the hilum near one end and with numerous distinct rings.

Tapioca Starch or Tapioca (Fig. 20) (*Amylum manihot, Cassava starch, Cassavastärke, Brazilian arrow-root, Manihot, Manioca* or *Mandioca starch*), from the tuberous roots of *Manihot Manihot* (L.) Lyons (*Jatropha M.* L., *M. utilissima* Pohl), the *Sweet cassava*, etc., *M. palmata* (Vell.) J. Muell. (*Jatropha p.* Vell., *J. dulcis* Gmel., *M. Aipi* Pohl), the *Bitter cassava*, etc., and occasionally perhaps from other species or varieties (Fam. *Euphorbiaceæ*). These plants are natives of tropical America, where they are enormously cultivated under the names indicated by the above titles for the starch, as well as under the name *Yuca* (not *Yucca*), and where they constitute one of the most important of the food-products. There we have seen them cultivated by savages who had never before seen a white man, and with whom such cultivation must have been original. The plants exhibit many cultivated forms, some of them so striking as to raise the question of their being distinct species. These varieties exhibit different degrees of adaptability to varying climate, from the most humid to the most arid. The plant is, therefore, recommended highly as a famine-food in districts subjected to severe drought. It has been estimated that it will yield 10 tons per acre, and that 1 man can readily till 6 acres. The roots are used in other important ways besides the extraction of the starch. Boiled, fried, baked, or roasted, the sweet variety is a staple article of diet, occupying the place of the potato among us. Grated, dried, and ground into flour, it furnishes a breadstuff scarcely second in local importance to ordinary flour. The bitter variety, after being freed from its hydrocyanic acid by a process of fermentation, is used similarly, and is also used for the extraction of the starch. The tapioca, commonly in yellowish or brownish-white, smoothish, hard grains resembling pebble-stones, is masticated dry at the table as a substitute for bread when this is not obtainable, The unfermented roots of the bitter variety are highly

poisonous. having been found to contain on an average 0.0275 per cent. of prussic acid, distributed throughout the tissue. Sweet cassava contains about half as much, confined chiefly to the rind. Even after cooking, doubtless imperfectly performed, deaths are frequent. Drinking water soon after eating it is said to greatly increase the danger. This, like sago starch, is sold in a natural and a prepared form, though the former is scarce. The latter is usually in irregular flake-like pieces, reminding one somewhat of pieces of popped-corn, very hard and slightly translucent. A "pearl" form is also common and, like pearl sago, is very commonly factitious. The grains of tapioca starch are usually combined in groups. The individual grains measure from 0.014 to 0.0188 Mm. (0.00055 to 0.00075 In.). They are lenticular in form when natural, having the hilum nearly central, angular, cleft or stellate, and the rings coarse and only moderately distinct. In the prepared form, most of them have become altered to the forms shown in the accompanying cut. The Ph. Port. recognizes the value of this starch to such an extent that it directs its use when no particular variety is specified.

Fig. 20.



Cassava starch.

Wheat Starch (Fig. 12) (*Amylum tritici, Midon de ble*, Fr.; *Amido di frumento*, It.; *Almidon de Trigo*, Sp.; *Amido do Trigo*, Port.), from the grain of various species and varieties of *Triticum* L. (Fam. *Gramineæ*), the well-known wheat of cultivation. The composition of this grain is in round numbers water 13½, nitrogenous substances 12½, fat nearly 2, sugar 1½, gum and dextrin 2½, starch 64, fiber 2½, ash 1¾. Its starch is official in all pharmacopœias except that of the United States. It is subject to great adulteration, especially with potato, rye, and corn starch. The detection of potato starch has already been considered. The grains of corn starch are more uniform in size and ⅔ as large, irregularly angular, much inclined to be compound, the layers indistinct, the hilum usually split. Corn starch may also be distinguished by the relative amount of the swelling of the grains in an accurately measured time period in a potassium hydroxide solution of definite strength. A sample of the starch is mixed with 10 Cc. of 1.8 per cent. solution of potassium hydroxide and prevented from settling during 2 minutes. 4 or 5 drops of 25 per cent. hydrochloric acid are then added and the mixture shaken vigorously. The reaction should be alkaline. If examined within a minute, the corn starch will be found unaffected, the wheat starch greatly swollen (*Baumann*). Wheat starch yields no jelly, but, slowly, a strongly opalescent solution when agitated for 10 minutes with a mixture of 2 parts of hydrochloric acid and 1 part of water. The grains of wheat starch are almost circularly lenticular and of extremely variable size, ranging from 0.0022 to 0.052 Mm. (0.00009 to 0.0019 In.). The hilum is indistinct and the rings are moderately so.

Rye Starch is very similar, but contains many more split grains than the wheat.

Yam Starch, from various species of *Dioscorea* (Fam. *Dioscoreaceæ*), is used for the same purpose as sweet potato starch. Its grains are even larger, 0.05 to 0.07 Mm. (0.0019 to 0.0027 In.) ovate, with one end much narrowed, the round (rarely fissured or stellate) nucleus at the smaller end, the rings moderately distinct, the grains frequently in pairs.

ANACARDIACEÆ (TEREBINTHINACEÆ).—The Cashew Family.

Genera about 60, species nearly 600, mostly tropical, a few extending into temperate regions, the juices commonly milky and often intensely irritant cutaneous poisons (see Rhus Toxicodendron); of great economic importance in many directions. Some of the timbers are valuable, owing to their durability and insect-proof qualities, while others, as of *Rhus glabra*, are of great beauty in cabinet-work. Many species are rich in tannin and are used in important ways as astringents (see Rhus glabra, Galla and *Quebracho extract*, under Quercus), others in resins and oleoresins, this property having given one name, "Terebinthinaceæ," to the family (see Mastiche), while many yield beautiful varnishes of the Japanese lacquer type (see Rhus Toxicodendron). Several of the gums have been noticed under Acacia. Others of local importance are yielded by *Odina gummifera* Bl., of Java, *Sclerocarya* Sp. (*Dila*) and by the stem of the *Mango* (*Amba*) and that of *Schinus mollis* L. That from the stem of *Anacardium occidentale* L. is in commerce under the name of *Cashew-gum* and very similar gums are yielded by *A. humile* St. Hil. and *A. nanum* S. Hil., of Brazil. From the seeds of *Sclerocarya Birrea* Hochst. (*Spondias B.* A. Rich.), of Senegambia, a commercial fixed oil is extracted. The fruit of *Mangifera macrocarpa* Bl., of Java, and the bark of *Comocladia integrifolia* Jack., of eastern Asia, are used as hypnotics, and the barks of *Mangifera fœtida* Lour. and *M. cæsia* Jack., both of the East Indies, as fish poisons. The fruit of *Bouea oblongifolia* (the *Cangoura* of Salvador) is a convulsive, and the embryo of *Corynocarpus lævigata* Forst., of New Zealand, is poisonous. Though many of the juices are such powerful irritant poisons, others find valuable uses as vulneraries, especially those of *Astronium fraxinifolium* Schott, the *Gurubu preto* or *Gonzalo albez* of Brazil, and *A. graveolens* Jacq., of New Granada. Of *Duvaua dependens* DC. (*Schinus d.* Orteg.), the bark itself is similarly used. The wood, bark, and leaves of *Schinus mollis* L. are all aromatic and variously employed in native medicine, as are those of nearly a dozen other species of that genus, also those of *Lithræa Arocirinha* March (*Schinus molleoides* Vell.). The fruit of *Schinus mollis* L., the *Pepper tree* of western South America, is a well-known condiment, used as a substitute for black pepper, and also medicinally like cubeb. Its essential oil has been found to contain carvacrol

and phellandrene. The juice of *Holigarna longifolia* Roxb. is used to ease toothache. For the same purpose, and as vulneraries, are used the resinous bark and fruits of *Myracrodendron urundum* Fr. All., of Brazil.

Besides those specifically mentioned below, the following yield edible fruits: a half dozen species of *Spondias*, especially *S. purpurea* Mill. (*Spanish Prune, Mombin-plum, Hog-plum, Otaheiti apple, Ciruelo*), *S. lutea* L., both of tropical America, *S. dulcis* Forst., of the South Sea Islands, and *S. mangifera* W. (*Ngan-mo-leh, Yuh-kan-tsze, Ambra* or *Ambada, Pundi*, etc.), of India. The bark and wood of all these species are used as astringents, and the last-named yields a resin. The same is true of *S. venulosa* Mart., of Brazil and Paraguay, which also yields a gum very similar to that of the Caju. The fruit of *Dracontomelum mangiferum* Bl., of the East Indies, is used like citrons, and the leaves of this and other species of the genus find medicinal employment. From the seeds of *Duvaua dependens* (Ort.) D.C., the *Huingan* of western South America, is prepared a fermented drink which enjoys a great local medicinal repute. Other edible fruits are yielded by *Comocladia integrifolia* Jack., of tropical America, *Mauria multiflora* Mart., of the Amazon Valley, *Bouea Gardaria* Bl., of Java, and *B. Burmanica* Griss., of Burmah.

The following requires special mention:

ANACARDIUM, the *Cashew* or *Caju-nut* (*Caschunuss*, G.; *Acajou à pommes*, Fr.; *Anacardo*, Sp.), is the fruit of *Anăcardium occidentale* L., removed from its fleshy peduncle. This plant is a large shrub or small sprawling tree, native of tropical America, but largely cultivated and somewhat naturalized in many tropical countries. The root is said to be used as a purgative. After flowering, the peduncle becomes fleshy and enlarges to the size and form of a medium-sized pear. Until perfectly ripe, this is extremely astringent, and is medicinally so employed. After maturing, it is sweet, and consists almost entirely of a watery juice which is used for its thirst-quenching and refrigerant properties. In Brazil a wine is made from it, closely resembling Madeira and having a high repute for its use in so-called torpidity of the liver. Its alcohol is also distilled. The drug Anacardium, here considered, is the ripened 1-seeded ovary, borne upon and slightly imbedded in the tip of this fleshy portion. When mature, it is shaped like a large kidney bean, about 25 Mm. (1 In.) long, nearly as broad, and ½ to ⅓ as thick. It is of a grayish-brown to a dark-brown color, smoothish, with a rough scar at one end, and inodorous. It has a hard, brittle shell, and contains a white seed of its own form and having a mild oily taste. This kernel is roasted and eaten like chestnuts or peanuts. The fixed oil expressed from it is an article of commerce. In the middle layer of the shell exists an oily acrid liquid, capable of poisoning the skin like RHUS TOXICODENDRON, turning intensely black on exposure to the air and somewhat utilized as an indelible writing-fluid. The pericarp has been found to contain tannin, a little gallic acid, and resin. The brown oil is soluble in potassium hydroxide, with a red color, darkening on exposure, and its alcoholic solution yields a red precipitate with basic lead acetate (*Basiner*). Stædeler (1847, 1848) separated the vesicating principle, *cardol*, $C_{21}H_{30}O_2$, as a yellowish or reddish oil, evolving, when heated, a faint aromatic odor, and readily soluble in alcohol and ether. It is obtained from the ethereal extract, which is washed with water to remove tannin, dissolved in alcohol, and digested, and afterward boiled with hydrate of lead to remove *anacardic acid* and ammonia salt. The remaining color is removed by a little basic lead acetate. Cardol may be separated from mixtures by extraction with glacial acetic acid and subsequent agitation of the latter with benzol (*Basiner*). Anacardic acid, when pure, is white and crystalline, has an aromatic, afterward burning taste, but is not vesicating.

FIG. 21.

Anarcadium occidentale L.

The *Oriental cashew-nut*, known as *Anacardium orientale*, is the fruit of *Semecarpus Anacardium* L. or *Anacardium latifolium* Lam., a tall tree of India. The "nut" is about 25 Mm. (1 In.) long, nearly heart-shaped, flattish, obtuse, smooth, glossy, and nearly black. The pericarp and cotyledons have the same properties, and probably the same constituents, as the preceding; but Basiner (1881) ascertained that the brown oil of the mesocarp dissolved in potassa with a green color, and its alcoholic solution turns black with basic lead acetate.

The mango (from *Mangifera Indica* L.) is one of the most important fruits of the world, taking the place in the tropics which the peach occupies in temperate regions, and presenting about as many cultivated varieties. Its seed is used as an anthelmintic, the juice of its trunk as an antisyphilitic, and its bark and leaves as astringents. The fruits of *M. laurina* Bl. (the *Monkey mango*), *M. Taipon* Ham., and *M. Utana* Ham., are similarly eaten, but to a less extent.

ANDROPOGON.

(Fam. *Gramineæ*.)

This genus is treated in the most diverse ways by different authors. As regarded by Engler and Prantl, who are here followed, it contains nearly 200 species and represents a number of subgenera which are held as distinct genera by other authors. The species are mostly tropic, and are especially abundant in India and other parts of the old world. The subgenus *sorghum* will be considered under Saccharum. From *A. annulatus*, widely distributed in the old world, is obtained a manna containing 75 per cent of mannite (*Baker and*

Smith). The chief importance of the genus is owing to the presence of volatile oils in a large number of its species, these being coarse, tufted grasses, on which account many are extensively used in domestic and native practice as aromatics and stimulants. Some of the oils are distilled and are important articles of commerce (see Oils of Citronella, Lemon, Geranium, Vetivert, etc.).

Vetivert or *Vetiver* (*Cus-cus, Khas, Bala, Vala, Varelu, Baladvery, Panni, Usira, Virana*, etc.) is the rhizome and roots of *A. squarrosus* L. (*A. muricatus* Retz., *Anatherum m.* Retz., *Vetiveria odorato* Virey), of the East Indies, and cultivated in various parts of tropical America. It occurs as a dense, matted, reddish-brown, fibrous mass, having a somewhat aromatic odor and an aromatic, rather pungent taste. It has been considerably employed as an aromatic, carminative, and diaphoretic. In the same way are used the similar rhizomes and roots of *A. bicorne* L., *A. densiflorus* Steud., and *A. spatiflorus* Kunth., all of Brazil, and *A. laniger* Desf. (*Fœnum Camellorum*), of Persia. *Radix Ivarancusæ*, also an article of commerce, is the similar rhizome and roots of *A. Ivarancusa* Roxb., of India.

ANETHI FRUCTUS, *Br.*—Anethum.

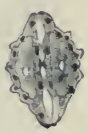
Dill, G.; *Aneth, Fenouil puant*, Fr.; *Eneldo*, Sp.

The fruit of *Anethum graveolens* L. (*Peucedanum g.* B. et H.—Fam. *Umbelliferæ*), a small yellow-flowered annual of southern Europe and adjacent Asia, and widely cultivated. The plant is sometimes used as a kitchen vegetable.

The fruit is oval, about 3 to 5 Mm. ($\frac{1}{8}$ to $\frac{1}{5}$ In.) long, dorsally compressed, of a brown color, and separates when ripe into 2 mericarps, which are flat upon the face and somewhat convex upon the back, the 3 dorsal ribs filiform and rather sharply keeled, while the 2 lateral ones are extended into a broad light-colored membranous margin; oil-tubes 6; odor and taste strong, resembling those of caraway.

Fig. 22. Fig. 23.

Indian anethum (×6).



German anethum: cross-section (×5).

The Indian variety, by some regarded as a distinct species (*A. Sowa* Roxb.), is here figured. The European variety is much broader in proportion to its length, and is also thinner and less rounded on the back, and usually darker colored than the Indian, which is more frequently stalked and with the mericarps united. The active constituent of dill is its 3 to 4 per cent. of volatile oil (see Oleum Anethi). It has the properties and uses of that oil, medicinally, and is very extensively used as a flavoring and condiment, especially by bakers and picklers.

Pharmaceutical Preparation.—Dill Water, Br. P.

Action and Uses.—Anethum is stimulant, aromatic, and carminative. It is rarely employed in America, but may be used in the treatment of flatulent colic, gastric indigestion, and hiccough. The fruit may be given in substance in the dose of from 15 grains to 1 drachm (1–4 Gm.). The usual dose of the volatile oil is from 2 to 5 minims (0.10–0.30 Cc.). An infusion, made with 1 ounce (30 Gm.) of the fruit and 1 pint (480 Cc.) of boiling water, may be administered in doses of from 1 to 2 fluidounces (30–60 Cc.).

ANGELICA.

Angélique, Fr.; *Angelica*, Sp., It.

Under this name are used various parts of a number of the highly aromatic species of the genus *Angelica* L. (Fam. *Umbelliferæ*), of which there are some 50, widely distributed through temperate and subtropical regions. The name is commonly, and officially in some pharmacopœias, construed as the roots of 2 species, as follows:

European Angelica (*Garden angelica, Arkangel, Holy ghost root, Angelicawurzel, Enelwurz*), the root of *A. Archangelica* L. (*A. officinalis* Moench, *Archangelica o.* Hoffm.). A stout perennial herb, about 2 M. (6 Ft.) high, native of northern Europe and extensively cultivated, especially in Germany, for the root, which is wholly produced from the cultivated variety, regarded by some botanists as a distinct species (*A. sativa* Fries).

Description.—European or garden angelica root (Fig. 29) consists of a short, thick rootstock, which is closely annulated above, and below abruptly divided into a large number of

nearly simple branches, which are about 6 Mm. (¼ In.) thick and 15 Cm. (6 In.) or more long, longitudinally wrinkled, of a dark-brown color externally, yellowish inside, with a spongy, radiated meditullium and numerous shining resin-cells in the thick bark. It has a strong aromatic odor and a sweetish, pungently aromatic and bitter taste, and breaks with a smooth, somewhat waxy fracture. The roots frequently come braided into fanciful forms.

Fig. 24.

German angelica (½ Nat.).

All forms of angelica root are greatly subject to destruction by larvæ and have to be carefully preserved.

Constituents.—Angelica contains a white waxy matter, crystallizing in wart-like masses from hot alcohol; *angelicin*, which is a somewhat acrid acid resin, soluble in alkalies and crystallizing in colorless needles from alcohol; volatile angelic acid ($C_5H_8O_2$), which crystallizes in colorless prisms, melts at 45° C. (113° F.), boils at 190° C. (314° F.), has a peculiar aromatic odor and a strongly acid taste, and when melted with potassium hydroxide yields propionic and acetic acids; an amorphous bitter principle; a little tannin, pectin, etc. (*Buchner*). The important constituent is about 0.5 per cent. of volatile oil, which has been thoroughly studied (see Oleum Angelicæ).

American Angelica Root, from *A. atropurpurea* L. (*Archangelica a.* Hoffm., *A. triquinata* Mx.), the *great, high*, or *purple angelica*, common in the northeastern United States, is similar, but is well distinguished by its lighter gray-brown color, its fewer branches, usually smaller, fewer resin-dots in the bark and less strong aroma, which, though similar to that of the European, is sufficiently distinct. Its composition, properties, and uses are very similar.

Fig. 25.

American angelica (rhizome, ½ Nat; root, ¾ Nat.).

Wild Angelica (the roots of *A. sylvestris* L. of Europe) is of a light gray-yellow, white within and more woody. *Smaller angelica, Southern angelica*, or *Hairy angelica*, the root of *A. villosa* (Walt.) B. S. P., of the southern United States, is similarly used. The root of *A. refracta* Fr. Sch., of Japan, is there known as *Moshiu-kuna* or *Yakara-kuna*. At least half a dozen other species are similarly used. The properties and uses are not confined to the roots, all other parts of the plants, especially the fruits, being used, and the oil being distilled from them. The fresh stems are frequently candied and used as a confection.

Pharmaceutical Preparation.—Fluidextract of Angelica, N. F.

Action and Uses.—Angelica is not employed extensively in medicine, but has been used as a stimulant and tonic, and when administered in warm infusion as a diaphoretic and emetic. The drug has been recommended as a stimulating expectorant in chronic inflammation of the upper air-passages. In the treatment of the milder types of intermittent fever angelica has met with favor, but it is probably of no more value than any of the ordinary simple bitters. It was formerly employed in the nervous forms of enteric fever, but its use in this connection has been abandoned.

Angelica may be given in substance in the dose of from 10 to 30 grains (0.60–2 Gm.) in powdered form. An infusion (made with 1 ounce (30 Gm.) of the root and 1 pint (480 Cc.) of water) may be given in doses of from 1 to 2 fluidrachms (4–8 Cc.).

ANILINA.—Aniline.

Amidobenzene, *Phenylamine*, E.; *Aniline*, Fr.; *Anilin*, G.

Formula, C_6H_7N or $C_6H_5NH_2$. Molecular weight, 92.39.

Origin.—Aniline was discovered by Unverdorben (1826) among the products of the dry distillation of indigo, and was found by Runge (1833) in the heavy oil of coal-tar. Zinin (1842) introduced the method of preparing it from nitrobenzene by the action of hydrogen sulphide in the presence of alcohol and ammonia, and A. W. Hofmann (1845) by nascent hydrogen from the action of dilute sulphuric acid upon zinc. The name *aniline* (from *anil*, the Portuguese name for indigo) was proposed by Fritzsche (1841). Aniline has been variously called by its discoverers in different substances, as *krystallin* by Unverdorben, *kyanol* by Runge, *benzidam* by Zinin, and the identity of these as aniline was finally established by Hofmann in 1845. It came into commercial use through the discovery of *mauve violet* by Perkins in 1856.

Preparation.—Aniline is prepared from nitrobenzene by the reducing action of nascent hydrogen, by digesting with a mixture of iron filings and acetic acid, as suggested by Béchamp, in which case the deoxidizing action of ferrous acetate, $Fe(C_2H_3O_2)_2$, first produced, materially assists the change. Nitrobenzene is thereby converted into aniline and water: $C_6H_5(NO_2) + 3H_2$ yields $C_6H_5NH_2 + 2H_2O$. The acetic acid has been replaced, by Brimmeyr, by hydrochloric acid. When, after several days, the reaction is completed, milk of lime is added and the aniline is distilled off, the receiver being changed toward the close of the distillation; the temperature then rises, and a red oil, *azobenzid*, $C_{12}H_{10}O_2$, passes over, which congeals to a crystalline mass. The separation of aniline from the heavy oil of coal-tar is effected by a complicated process depending upon its solubility in hydrochloric acid, the insolubility of this compound in ether, the liberation of the bases by an alkali, and their separation from each other by fractional distillation. Pure aniline is now prepared mostly from benzene as the starting-point.

Properties.—Aniline is a colorless, limpid, oily, strongly refractive, inflammable liquid, of a peculiar wine-like odor and burning aromatic taste. It has the specific gravity 1.0265 at 15° C. (59° F.), congeals at a low temperature, melts at —8° C. (17.6 F.), boils at 184.5° C. (364.1° F.), acquires in contact with air a yellow and brown color, is sparingly soluble in cold water (33 parts) and in all proportions of wood-spirit, alcohol, ether, aldehyde, acetone, and fixed and volatile oils. It dissolves phosphorus, camphor, several resins, and by the aid of heat much sulphur; coagulates albumin; precipitates the salts of iron, zinc, and aluminum; and unites with acids to form salts, which are mostly crystallizable, readily soluble in water, inodorous and colorless, but acquire a red color in contact with the air; alkalies decompose them, with the separation of aniline. Commercial pure aniline usually contains about 1 per cent. of toluidine; other grades contain more of this base, and are named mostly according to the colors to be made from the same. "Aniline for blue," next to pure aniline, is the purest commercial variety. "Aniline for red" and "aniline for safranin" are mixtures of aniline, orthotoluidine, and paratoluidine. *Toluidine* or *amidotoluene*, C_7H_9N or $C_6H_4CH_3NH_2$, exists in 3 modifications, of which 2 are present in the product of the above process. *Paratoluidine* forms colorless tabular crystals, melts at 45° C. (113° F.), and boils at 198° C. (288.4° F.). *Orthotoluidine* or *pseudotoluidine* is a colorless liquid of the same density as water at 15° C. (59° F.), boiling at 199.5° C. (390.2° F.), and not solidifying at —20° C. (—4° F.).

Tests.—Aniline should have the specific gravity and boiling-point above stated, and dissolve clear in 2 volumes of hydrochloric acid, the solution to remain clear on further dilution. Its aqueous solution on the addition of solution of chlorinated lime, or hypochlorite, develops a *violet* color (distinction from toluidine, which develops a reddish color). Acidulated with sulphuric acid the aqueous solution develops, after some time, a green to black color with potassium dichromate; or, if contained in a platinum receptacle and touched with the negative pole of a galvanic battery (Letheby), a transient play of colors from blue, through violet to pink, results.

Action and Uses.—The inhalation of fumes of aniline and the ingestion of large amounts of the drug itself produce alarming symptoms, which have been frequently followed by a fatal issue. When either inhaled or ingested in large amount, the drug produces weakness of the lower extremities with sometimes complete prostration, more or less cyanosis, headache, vertigo, lancinating pains, with nausea and vomiting. Reflex and

pupillary action are abolished, voluntary movement is held in abeyance, circulation is impaired, respiration becomes rapid and irregular, and bronchial irritation and cutaneous eruptions manifest themselves. Epileptiform convulsions and coma rapidly ensue, and if the patient survives hæmoglobinuria and jaundice become marked. There is a great reduction in the red blood-corpuscles, and the spectroscope gives the characteristic band of methæmoglobin. When locally applied, the drug sometimes causes cutaneous eruptions, eczematous or even gangrenous in character, which, however, may be due to contamination with arsenic. Aniline itself is rarely employed in medicine, but some of its derivatives have been quite largely used in antiseptic practice, and a few have been given internally in the treatment of disease. The drug itself has been recommended in the treatment of chorea, in daily doses of from 3 to 5 grains (0.20–0.30 Gm.), and while seemingly successful in a few cases, it has not given good results in others. Aniline camphorate is said to possess antispasmodic properties, and it too has been employed in chorea and other conditions attended with minor spasm, but it has never gained the confidence of physicians. The dose is stated to be from 5 to 10 grains (0.30–0.60 Gm.). Aniline sulphate has been given as a nervine and antispasmodic in doses of from ½ to 5 grains (0.025–0.30 Gm.), but is rarely if ever employed at the present time. Fuchsin was formerly considered as a possible remedy in the treatment of albuminuria and scarlatinous dropsy resulting from parenchymatous nephritis, but for these conditions it is now practically abandoned. Among the various derivatives of this drug which have been employed in antiseptic practice, methyl-violet stands preëminent. In the strength of 1 : 1000 it destroys the ordinary micro-organisms which produce pus, and in stronger solution will kill anthrax bacilli. Its use, however, is gradually decreasing because of the stain which it leaves, and the fact that the older antiseptics are equally efficacious. Closely allied to this remedy is *safranine* and "yellow pyoktanin," both of which may be used interchangeably with methyl-violet. They have been recommended in the treatment of conjunctivitis, blepharitis, corneal ulcer, and eczema of the eyelids. Pyoktanin is probably of more value in the treatment of diseases of the lacrymal apparatus, and for this purpose it is still largely employed. It has been used with asserted success in purulent otitis, tubercular laryngitis, and in tubercular sinuses and fistulæ. A solution (1 : 500 water) filtered through hot asbestos has been employed in doses of from ½ to 3 fluidrachms (2–12 Cc.) hypodermically for the purpose of retarding the growth and relieving the pain of malignant neoplasms. Should it produce sloughing, the area should be dressed antiseptically. Practically all of the aniline dyes possess antiseptic properties, but they should be used guardedly because of their poisonous properties. A number of them are employed for staining tissues and bacteria, the most common being fuchsine, methylene-blue, gentian-violet, and malachite-green.

Derivative Products.—BROMAMIDUM. *Bromamide, Tribromaniline hydrobromide, Bromaniline hydrobromide,* E.; *Bromwasserstoffsaures, Tribromanilin, Bromamid,* G. $C_6H_2Br_3NH_2.HBr$. Molecular weight, 407.83. Contains 77.8 per cent. of bromine.—Bromamide is prepared by reducing nitro-tribromo-benzene with tin and sulphuric acid. The tin is precipitated with hydrogen sulphide, and the tribromaniline combined with hydrobromic acid. It occurs as colorless, odorless, tasteless needles, insoluble in water, sparingly soluble in cold but soluble in 16 parts of boiling alcohol, and soluble in ether, chloroform, and oils; melts at 117° C. (242.6° F.), and is volatile at about 150° C. (302° F.) without decomposition.

PHENYLHYDRAZINE.—$C_6H_5N_2H_3$ or $C_6H_5.NH.NH_2$.—This compound is not used in medicine, but is of considerable interest as a reagent for the purpose of identifying aldehydes ketones, etc., with which it forms both crystallizable and non-crystallizable compounds, known as phenylhydrazones. It is a monacid base forming well-crystallized salts, and possesses strong reducing properties. Phenylhydrazine may be obtained by dissolving 10 Gm. of aniline in 200 Gm. of strong hydrochloric acid, cooling the solution, and adding 7½ Gm. of sodium nitrite dissolved in about 50 Cc. of water. To this liquid, which contains diazobenzene chloride, is then added 45 Gm. of stannous chloride dissolved in an equal weight of hydrochloric acid The mixture soon sets into a white crystalline pulp of phenylhydrazine hydrochloride, from which the free base may be obtained by adding an excess of alkali and extracting with ether It occurs in monoclinic plates, which melt at 17.5° C. (63.5° F.), sparingly soluble in cold water, more soluble in hot water, and very readily in alcohol and in ether. Phenylhydrazine has been of great value in the study of the sugar group on account of its characteristic behavior toward these compounds. With glucose it forms a well-defined yellow crystalline compound known as glucosazone, $C_6H_{10}O_4(N_2H.C_6H_5)_2$, which melts between 204° and 205° C. (399.2° and 401° F.), and hence has been recommended as a delicate test for sugar in urine. Phenylhydrazine is also used in the manufacture of antipyrine.

By action of acetic anhydride, phenylhydrazine is converted into acetylphenylhydrazine, $C_6H_5.NH.NH(C_2H_3O)$, also known as *hydracetin* or *pyrodin*, which forms colorless hexagonal prisms, melting at 128.5° C. (263.3° F.), and difficultly soluble in cold water and ether, but readily soluble in hot water and in alcohol.

DIPHENYLAMINE.—$NH(C_6H_5)_2$.—A weak base, formed by heating aniline hydrochloride with aniline to 240° C. (464° F.). It occurs in the form of grayish-white or colorless monoclinic crystals, melting at 54° C. (129.2° F.), slightly soluble in water, and having a pleasant faint odor. It is a very delicate reagent for nitric acid and for chlorine, and is used both in the dry state and in solution. Diphenylamine test-solution is made by dissolving 0.1 Gm. of diphenylamine in 50 Cc. of diluted sulphuric acid. To test a solution for the presence of nitric acid, a small portion of it is mixed with 1 or 2 drops of diphenylamine test-solution, and then concentrated sulphuric acid, free from compounds of nitrogen, is poured in so as to form a layer beneath the solution, when the presence of nitric acid is shown by a deep-blue color at the zone of contact.

Under the name *sulphaminol*, thiooxydiphenylamine has been introduced into medicine as an antiseptic. It is a yellow, odorless, and tasteless powder.

SALTS OF ANILINE.

Anilinæ Camphoras; *Anilinum camphoricum; Aniline camphorate; Kamphersaures Anilin*, G. $(C_6H_5NH_2)_2C_{10}H_{16}O_4$. Molecular weight, 383.40.—Crystals soluble in water (30 parts), in glycerin (10 parts), and readily in alcohol or ether.

Anilinæ Hydrochloridum; *Anilinum hydrochloricum; Aniline hydrochloride; Aniline salt; Salzsaures Anilin*, G. $C_6H_5NH_2.HCl$. Molecular weight, 128.57.—Prepared by mixing 100 parts of pure aniline with 160 parts of pure hydrochloric acid of 1.123 specific gravity, and crystallizing. The crystals are colorless needles, easily soluble in water and alcohol. Melting-point 192° C. (377.6° F.). Used principally as a basis for various aniline dyes.

Anilinæ Sulphas; *Anilinum sulfuricum; Aniline sulphate; Schwefelsaures Anilin*, G. $(C_6H_5NH_2)_2.H_2SO_4$. Molecular weight, 282.13.—Prepared by mixing an alcoholic (600 parts) solution of pure aniline (100 parts) with a fresh and cold solution of concentrated sulphuric acid (55 parts) in alcohol (150 parts). After allowing the mixture to stand, 400 parts of ether are added, and the resulting crystals separated by filtering the liquid through asbestos. The crystals are colorless needles, easily soluble in water or diluted alcohol, less readily soluble in alcohol, and quite insoluble in ether.

ANILINE DYES.

The manufacture of aniline colors has grown into a most important chemical industry. Nearly all the aniline dyes used in the United States are imported from Europe; the importations having increased from 210,500 pounds in 1877 to 1,103,864 pounds in 1882, and to 3,072,915 pounds in 1896. The value of aniline colors imported during the 11 months ending May 31, 1902, was $4,596,727. The known varieties of the dyes number in the thousands.

Aniline colors are much used in the preparation of inks: 1 to 2 parts of the desired color with an equal weight of sugar or gum arabic are dissolved in 60 to 150 parts of water; and for copying-inks the water is reduced to one-half the amount.

A few of the more commonly used aniline dyes are:

Aniline Black, $(C_6H_5N)_n.2HCl$, is the hydrochloride of a base termed nigraniline, and is produced by the oxidation of aniline in acid solution with dichromate, chlorates with salts of a metal (copper and particularly vanadium), or electrolytic oxygen. It may be obtained by heating to 60° C. (140° F.) a solution of 4 parts of aniline hydrochloride, 4 parts of cupric sulphate, 2 parts of potassium chlorate, 1.6 parts of ammonium chloride, dissolved in 50 parts of water. In dyeing, owing to its insolubility, it is usually formed direct on the fibre. It is a black compound turned greenish by acids, but when sufficiently oxidized with dichromate the black is permanent and unaffected by acids or alkalies. It is insoluble in water, alcohol, acids, or alkalies. Strong oxidizing agents convert it to *quinone*, and heated with aniline acetate *induline* is formed.

Nigrosine, a sulphonated induline, occurs as a black powder, soluble in water with a bluish-violet, and in alcohol with a blue color.

Aniline Blue; *Rosaniline blue* and *Spirit blue* are salts of two series of triphenyl derivatives of the colorless bases *rosaniline*, $C_{20}H_{16}(C_6H_5)_3N_3$, and *pararosaniline*, $C_{19}H_{14}(C_6H_5)_3N_3$, yielding respectively the dyes *rosaniline blue, spirit blue, Paris blue*, and *para-rosaniline blue, diphenylamine blue, azuline, azurine*. These dyes are marked by their excellent dyeing qualities. They are sparingly soluble in water, but soluble in alcohol. By sulphonating water-soluble dyes are produced, the respective rosaniline derivatives being commercially represented by the sodium monosulphonate salt, as Nicholson's blue, alkali blue, soluble blue, and the para-rosaniline by *alkali blue* D. The depth of the blue dyeing properties is closely proportional to the number of phenyl radicles (C_6H_5) substituted for hydrogen in the base. By treatment with iodide of methyl or ethyl, and similar compounds, a large variety of blue, violet, and green (iodine-green, methyl-green, etc.) dyes are obtained.

Aniline Red, Magenta, Fuchsine, etc., is formed by heating to about 180° C. (356° F.) a mixture of aniline and toluidine with mercuric nitrate, arsenic acid, or nitrobenzene. It is a salt of *rosaniline*, $C_{20}H_{19}N_3$. Magenta was formerly the acetate, *roseine* (French) the hydro-

chloride, and *rubein* and *azaleine* the nitrate of the same colorless base rosaniline. The hydrochloride, $C_{20}H_{19}N_3.HCl$, which as commercial magenta and fuchsine, has superseded the others, occurs as bright-greenish iridescent crystals, sparingly soluble in water to a crimson solution, soluble in amyl alcohol, in 10 parts of alcohol, insoluble in essential oils and ether, and exhibits characteristic absorption spectra between the Fraunhöfer lines D and E. Its solutions readily dye silk or wool without a mordant. Alkalies decompose and decolorize its solutions by liberating the free base.

Aniline Yellow, $C_6H_5N_2C_6H_4NH_2.HCl$, *Spirit yellow*, is used principally as the basis for manufacturing more permanent aniline colors. It occurs as bright bluish-violet needle-shaped crystals. Chrysoidine, $C_6H_5.N_2.C_6H_3(NH_2)_2.HCl$, the hydrochloride of diamido-azobenzene, occurs as a reddish-brown powder or violet-colored crystals. Its aqueous solutions are brown to orange colored, and are turned red by mineral acids. Much used in conjunction with safranine to produce scarlets on cotton.

Methyl-blue.—This compound is the sodium salt of triphenylpararosaniline-trisulphonic acid, $C_{19}H_{11}(C_6H_5)_3N_3(SO_3H)_3$, which latter is made by treating pararosaniline with aniline and the resulting product with sulphuric acid. It should not be confounded with methylene-blue, which is used medicinally, and from which it can be distinguished by adding sodium hydroxide to a solution, which changes the color of methyl-blue to reddish-brown and that of methylene-blue to violet.

Pyoktanin.—Two varieties, yellow and blue pyoktanin, have been brought to notice, the latter intended for general surgery, the former more especially for ophthalmic practice. *Yellow pyoktanin*, also known as *apyonin* and *benzophenoneid*, is the hydrochloride of imido-tetramethyldi-p-amidodiphenylmethane, $C_{17}H_{23}N_3OHCl$, and is obtained by heating tetramethyldiamidobenzophenone with ammonium chloride and zinc chloride. It belongs to the group of aniline dyes known as auramines.

Blue pyoktanin, also called methyl-violet, is of variable composition, and consists chiefly of the hydrochlorides of penta- and hexamethylpararosaniline. It is a blue crystalline powder which dissolves in water and in alcohol, forming intensely blue-violet colored solutions.

Safranine, $C_{21}H_{20}N_4$, is a red basic compound obtained from aniline containing toluidine by treatment with nitrous and arsenic acids, or commercially by conversion into amido-azo compounds and subsequent oxidation. As a monacid salt *safranine, aniline pink*, is a reddish-brown powder, soluble in water and alcohol, and readily dyes animal fibres in alkaline solution.

ANISUM, *U. S.*—Anise.

Anisi fructus, Br.; *Anise fruit* (incorrectly "*Aniseseed*"), *Sweet cumin, Aneys, Anny, Annyle*, E.; *Anis* (incorrectly "*Anissamen*"), G.; *Anis vert*, Fr.; *Harva doce, Anicetum*, Port.; *Anace*, It.; *Ch'uen Kiang, Hwai Hiang*, Chin.

The dried ripe fruit of *Pimpinella Anisum* L. (*Anisum vulgare* Moench—Fam. *Umbelliferæ*).

Description.—Consisting of 2 carpels, mostly united and stalked, about 4 to 5 Mm. ($\frac{1}{6}$ to $\frac{1}{5}$ In.) long, ovate, tapering upward toward the thick stylopode, grayish or greenish-gray, each with 5 light-colored nearly entire ribs, the intervening spaces bristly-hairy; carpels not grooved on the face; oil-tubes 12 to 20; odor characteristic; taste sweet and aromatic.

Conium fruit is frequently admixed, occasionally in poisonous quantity. Its presence in the entire or powdered state, even in so small amount as 1 per cent., can be readily detected by the mousey odor developed on soaking it for an hour in water, especially if a little potassium hydroxide be added. Fruits from which the oil has been partially distilled may be distinguished by their shrivelled appearance.

FIG. 26. FIG. 27.

Anise: dorsal and lateral view (× 6), transverse section (× 8).

The powder is of a green-brown color, and shows hairs and crystals. The presence in it of star-anise may be distinguished by the peculiar sclerotic cells figured under Illicium. Much earthy matter is frequently present, and can be estimated on separation by stirring the anise in strong brine, when the latter will float, the former sink.

The largest and handsomest anise for pharmaceutical purposes is that grown in the Mediterranean region, but a large portion of distillers' anise comes from Russia. "Australian Anise," so-called, is the fruit of *Seseli Harveyanum* F. v. M., but it rarely if ever gets into commerce.

With 3 or 4 per cent. of fixed oil, some gum, sugar, resin, malates, and inorganic substances, the active constituent is about 3 per cent. of volatile oil (see OLEUM ANISI).

Action and Uses.—Anise is an aromatic stimulant and carminative. It has been used as a condiment, and is said to assist in the digestion of food. The infusion (anise, 50 Gm.; boiling water, 1000 Cc.) has been recommended in infantile diarrhœa of a subacute or chronic type. Like other aromatics, it may be employed in the relief of flatulence and intestinal colic, and when combined with purgative drugs prevents to a certain extent their tendency to gripe. The drug has been recommended as a stimulating expectorant in chronic inflammations of the respiratory tract. It probably does not increase the secretion of milk in nursing women, but sometimes imparts to the milk a disagreeable taste. The drug when powdered is given in substance in the dose of from 10 to 20 grains (0.60–1.30 Gm.).

The fruits of *P. Peregrina* L. and *P. aromatica* M. Bieb., both of Europe, are used as anise.

Allied Drugs.—The roots of several species of *Pimpinella*, especially *P. Saxifraga* L. and *P. magna* L., *Radix Pimpinellæ* (P. G.), *Pimpernel, Burnet Saxifrage, Bennet, Bidernell, Grand Bocage* (Fr.), of Europe, and *P. Panatjan* L., the *Panatjan* of Java, have a similar composition and use with those of the fruit.

ANONACEÆ.—The Custard Apple Family.

About 50 genera and some 400 species, almost all tropical shrubs and trees, inhabiting both continents. The chief economic properties, in their order of importance, are edible fruits, aromatics, bitters, and antiperiodics.

The *Cherimolia* or *Chirimoya*, from *Anona Cherimolia* Mill. (*A. tripetala* Ait.), of Peru, is one of the two or three most delicious of known fruits. The fruit of the same name (also called *Gandhagatra, Ata Lundu, Sitapunda*, etc., in India, and *Fan-lih-chi* in China, from *A. squamosa* L., cultivated in all tropical countries, is only a little less delicious. The *Soursop*, from *A. muricata* L., of tropical America, is also a very important fruit. A half-dozen or more other species of *Anona* yield edible fruits, as do *Rollinia Siberi* DC., of tropical America, *Polyalthia cerasoides* Benth., of India, *Unona Musaria* Dun., of Malabar, a number of species of *Uvaria*, and *Asimina triloba* Dun., of the central and southern United States, our *Paw-paw* (not *Papaw*).

Aromatic principles may exist in any of the plant-parts. The precious volatile oil *ylang-ylang* is distilled from the flowers of *Artabotrys odoratissima* R. Br. (*non L.*) and that known as *Minjah henangam* from *A. intermedia* Hook., of Java. The leaves of the last-named are used as an insecticide, as are the seeds of *Anona squamosa*. The aromatic fruits of several species of *Xylopia* are used as condiments, especially those of *X. sericea* St. Hil., the *Embira* or *Pinduiba* of Brazil, *X. aromatica* Aubl. (*Unona a.* Dun.), the *Meleguetta pepper* of Guinea, *X. Brasiliensis* Mart., used like cubeb, and *X. Æthiopica* A. Rich. (*Unona piperita* Afzel). The seed of *Unona ligularia* Dun. is used in perfumery, the leaves and seeds of *U. Narum* A. DC., of India, as carminatives and anthelmintics. Many other of the barks and seeds are in domestic use as aromatics.

Bitters, frequently used as antiperiodics, are yielded by the seeds of *Xylopia salicifolia* Kunth., and the bark and seed of *X. glabra* L., and the bark and leaves of *Guatteria sempervirens* Dun., the seed of the ylang-ylang plant and the fruit of *X. longifolia* A. DC. (*Fruta del burro*), of tropical America. The bark of *Cœlocline polycarpa* A. DC. (*Unona p.* DC.) is used similarly in Africa, as well as for dyeing, under the name of *Berberin tree* or *Yellow dye-tree* of Soudan. It contains berberine.

Tannin is rather abundant in various parts of many species, especially in the unripe *Anona* and other fruits.

Miscellaneous mention may be made of the anthelmintic uses of the leaves of *A. reticulata, A. muricata*, and *A. palustris* L.; of fish poisons yielded by the leaves of the last-named, by the root of *A. muricata* and by the fruit of *A. spinescens* Mart., of Brazil; of the drastic properties of the bark of *A. squamosa;* the emetico-cathartic properties of the roasted seeds of the *Cherimolia;* the emetic properties of the alkaloidal seed of *Asimina triloba*, the abortifacient properties of the root of *Goniothalmus macrophyllus* Hook., the *Aku-sinderah* of Java; of the properties, antidotal to curare, of *Guatteria laurifolia* Dun., *G. Ouregu* Dun., and *G. venificum* Mart., and of an arrow poison said to be made from the leaves of *Unona lucidula* Oliv. A tragacanth-like gum is obtained in India from *Saccopetalum tomentosum* Hook. f. et. Th. and a yellow dye-stuff from the leaves of *Porcelia nitidifolia* R. et P., of Peru. The seed of *Monodora Myristica* is said to be exported from Camaroons, to be sold as nutmeg.

ANTHEMIS, *U. S.*—Chamomile.

English, Garden, Low, Roman, or White chamomile or camomile, Camomile, Camil, Whig-plant, Camooyne, E.; *Flores Chamomillæ Romanæ.—Anthemidis Flores*, Br.; *Römische Kamille*, G.; *Camomille Romaine*, Fr.; *Camomilla dos Franceses, Macella Dourada*, Port.; *Manzanilla Romana*, Sp.; *Camomilla Ingleses*, It.

The dried flower-heads of *Anthemis nobilis* L. (*Chamomilla nobilis* Godr.—Fam. *Compositæ*), collected from cultivated plants.

The Br. P. definition requires that the flowers should be expanded before being collected. Specification of cultivated plants as the source, is in order to insure the "double

Fig. 28.

Anthemis nobilis L.: *a*, section through single flower-head (Nat.); *b* and *c*, ray- and disk-floret (mag. 4 diam.).

Fig. 29.

Anthemis cotula L.: *d*, leaf (reduced); *e*, flower-head (Nat.).

flowers"—that is, those in which most or all of the tubular or disk flowers have been substituted by ligulate or ray flowers, a result which follows upon high cultivation. Such flowers are more highly and more finely aromatic, and their flavor is less rankly and disagreeably bitter.

Origin.—The chamomile plant is a low, somewhat hairy perennial, native, and is very extensively cultivated in Europe and to a small extent in other temperate regions. The stems are slender and semi-prostrate, the leaves twice or thrice pinnately divided, their segments linear and acute.

Description.—Roughly and irregularly globose and scaly, 12.7 to 25 Mm. (½ to 1 In.) broad, white or cream-colored, yellow to brown when long kept; involucre green, saucer-shaped to nearly hemispherical, 6 to 9 Mm. (¼ to ⅜ In.) broad, the scales in several series, closely appressed, with scarious margins, the outer somewhat shorter; ray-flowers crowded in many series, recurved and often concealing the involucre, white, stiff, and somewhat papery, oblong, blunt, slightly 3-toothed or entire, 3-nerved, pistillate, fertile or neutral; disk-flowers few, yellow, tubular, 5-toothed, the upper half abruptly twice as broad as the lower, perfect, without pappus; receptacle conical, solid, densely chaffy, the chaff scarious, shining, obovate, blunt with erose margins; strongly aromatic and bitter.

Substitutes and Adulterants.—All are readily distinguished by their single circle of ray-flowers, except *Chrysanthemum Parthenium* (L.) Pers. (*Matricaria P.* L., *Pyrethrum P.* Smith), the *Feverfew, Featherfew, Fetter-foe, Febrifuge plant, Bertram, Whitewort, Mutterkraut* (G.), *Matricaire* (Fr. Cod.), and *Achillea Ptarmica* L., the *White* or *Sneezewort tansy, Goose-tongue, Bertramgarbe* (G.), *Herbe à Eternuér* (Fr.), which, though double, are much smaller, especially the latter. *Anthemis Cotula* L. (*Maruta C.* DC.), the *May weed, Dogs' camomile* or *Stinking camomile, Dog daisy, Horse daisy,* or *Poison daisy, Balders, Dog finkel, Jay weed,* and known by many other common names, very abundant as a roadside weed throughout the United States and nearly all other temperate zone countries, has like properties and is similarly used, as is *A. arvensis* L., the European *corn camomile,* rather commonly naturalized in the United States (see also Matricaria).

Constituents.—About 1 per cent. of volatile oil (see Oleum Anthemidis), 5.25 per cent. of resin, 1.50 per cent. of nearly white, bitter, crystalline wax, a bitter crystalline substance of glucosidal nature, a small quantity of an organic acid, possibly anthemic acid, a red-brown volatile liquid alkaloid (Dohme) with a characteristic odor and taste, a trace of tannin, fat, glucose, and 6 per cent. of ash are contained.

Pharmaceutical Preparation.—Extract of Anthemis, Br. P.

Action and Uses.—Anthemis, because of its volatile oil, possesses stimulant and antispasmodic properties. On account of its bitter principle it acts as a simple tonic. When administered in very large amount in warm infusion the drug produces emesis. Full doses may occasion purging, pain, and vertigo.

Chamomile has been employed as a carminative in flatulent colic and in the summer diarrhœas of children, and has met with favor when given in tepid infusion in the treatment of periodical sick headaches and the milder forms of intermittent fever, and as an emmenagogue. As a simple bitter, the cold infusion has been recommended in anorexia during convalescence from acute febrile conditions and in various other debilitated conditions attended with loss of appetite.

Hot fomentations, made with the flowers and water or vinegar, may be employed with advantage as stimulants to old and sluggish ulcers and for the relief of pain occasioned by deep-seated inflammatory conditions, as, for example, earache and rheumatism.

Anthemis may be given in substance in the dose of from ½ to 1 drachm (2–4 Cc.).

The Extractum Anthemidis, Br. P., is given in the dose of 3 grains (0.20 Gm.); the Tinctura Anthemidis, in the dose of from 3 to 10 minims (2–0.60 Cc.). The infusion is made with chamomile flowers (30 Gm.) in boiling water (1000 Cc.), and given in doses of from 1 to 2 fluidounces (30–60 Cc.).

ANTIARIS, *Fr., G.*—Upas; Antiar.

A gum-resinous exudation from *Antiaris toxicaria*, Leschenault (Fam. *Moraceæ*), a very large milky-juiced tree of the East India islands.

The exudation is white or nearly so upon exuding from the wounded bark, but quickly turns yellowish and finally reddish-brown. Its consistency is waxy, the taste very bitter and somewhat acrid. It is partly soluble in alcohol and ether.

Constituents.—It contains (Kiliani) *antiarol* ($C_9H_{12}O_4$), neutral, soluble in alcohol, sparingly in cold water, crystallizing in long needles and quadratic or rhombic plates; *antiarin* ($C_{27}H_{42}O_{10}$, $4H_2O$), a glucoside crystallizing in long silky needles and yielding *antiarigenin* ($C_{22}H_{30}O_5$); a third crystalline body with formula $C_{27}H_{36}O$. Betlink found also two other active constituents, *oepain* and *toxicarine*. Gum, sugar, wax, and resin also exist.

Action and Uses.—Antiaris is one of the East Indian arrow poisons, and there appears to be no record of its employment in medicine. When injected into the body, it causes paralysis by depressing the motor nerve-trunks. Apparently it has little effect upon the central nervous system. The drug acts as a paralyzing depressant poison upon the heart, vasomotor centers, and voluntary muscles. When administered in large amounts, muscular relaxation, involuntary evacuations, great prostration, a feeble, irregular pulse, and finally death by paralysis of the cardiac muscle result.

ANTIMONII ET POTASSII TARTRAS, *U. S.*—Antimony and Potassium Tartrate.

Antimonium tartaratum, Br.; *Tartarus stibiatus*, P. G.—*Tartarated antimony, Tartar emetic, Antimonyl potassium tartrate, Potassio-tartrate of antimony*, E.; *Tartrate de potasse et d'antimoine, Emétique, Tartre stibié*, Fr.; *Brechweinstein*, G.; *Tartrato di antimonio e di potassio*, F. It.; *Tartrato de potassa y antimonio*, Sp.

Formula, $2K(SbO)C_4H_4O_6 + H_2O$. Molecular weight, 659.80.

It should contain not less than 99.5 per cent. of pure antimony and potassium tartrate, and should be kept in well-stoppered bottles.—U. S.

Origin.—A process for the preparation of tartar emetic from cream of tartar and crocus of antimony was first published in 1631 by Adrian van Mynsicht. Glauber (1648) used flowers of antimony or antimonial glass. At present the salt is generally prepared from pure oxide of antimony.

Preparation.—Tartar emetic, like many other chemicals, is best made on the large scale, and different methods, as to details, are employed by different manufacturers. Essentially, however, all processes consist in the action of acid potassium tartrate on antimonous oxide, whereby the free acid hydrogen atom of the tartrate is replaced by the antimonyl group (SbO); thus, $Sb_2O_3 + 2KHC_4H_4O_6 = 2K(SbO)C_4H_4O_6 + H_2O$. On the large scale impure oxide of antimony is used, such as antimony ash, and the product purified by crystallization, as the gain in cheaper raw materials offsets the loss in the waste of the impure mother-liquors. For the pharmacist, it is more advantageous to use pure materials, since with proper and careful manipulation the entire solution may be made to crystallize. The present U. S. Pharmacopœia gives no process and the British gives only outlines of one. The method formerly recognized by the U. S. P.

was practically as follows: 4 parts of oxide of antimony and 5 parts of acid potassium tartrate, both in fine powder, were added to 36 parts of water boiled for some time (1 hour). The liquid was filtered hot, concentrated, and set aside to cool and crystallize. The crystals should be dried on filter-paper in the air.

The former British method was this: 5 ounces of oxide of antimony were mixed with 6 ounces of finely powdered acid potassium tartrate and sufficient water to form a paste, and set aside for 24 hours. Then 2 pints of distilled water were added and boiled for a quarter of an hour, with frequent stirring, the solution was filtered and set aside to crystallize. The mother-liquor was concentrated, whereby a second crop of crystals may be obtained.

In the U. S. process, the long boiling is apt to produce a change whereby the liquid becomes colored and an uncrystallizable compound is produced. In the British process long boiling is avoided, the combination taking place mainly in the cold, while the subsequent boiling is intended merely to bring into solution the tartar emetic already formed. It is of importance that the antimonous oxide should be free from oxychloride, otherwise the mother-liquor will become acid, and more or less of the salt will be lost by refusing to crystallize. The acid potassium tartrate should be free from calcium tartrate, which would contaminate the crystals of tartar emetic, necessitating their recrystallization, and thus occasioning loss. The oxide of antimony should be in slight excess, as otherwise if the acid tartrate is in excess the latter will crystallize out with the tartar emetic.

Berzelius and later Henry used the oxychloride of antimony (powder of Algaroth) to prepare tartar emetic.

Properties.—Antimony and potassium tartrate forms colorless transparent crystals, which have the shape of a rhombic octahedron, become white and opaque on exposure to the air, and have a sweetish, afterward disagreeable, strongly metallic taste. In commerce it is usually seen in the form of a white finely granular powder. Heated to 110° C. (230° F.), the salt loses its water of crystallization, 2.71 per cent.; at 200° C. (392° F.) it parts with more water, and is converted into metatartrate; at a higher heat it decomposes, becomes brown and black, giving off empyreumatic products having the odor of burning sugar, and finally leaves a black or gray residue having an alkaline reaction. Tartar emetic is soluble in 15.5 parts of water at 25° C. (77° F.) and 3 parts of boiling water (U. S.); in 15 parts of water at 15.5° C. (60° F.) (Br.).

The aqueous solution is precipitated on the addition of alcohol in the form of a crystalline powder; in this manner a pure powder of tartar emetic is readily and most advantageously obtained for pharmaceutical purposes. The solution yields with hydrochloric and other mineral acids a white precipitate of an oxy-salt of antimony, which is soluble in hydrochloric acid, and does not occur if tartaric acid has been previously added to the solution. The aqueous solution, even if largely diluted, at once becomes turbid on the addition of a little potassium carbonate. Hydrogen sulphide causes an orange-red precipitate, which, when obtained from 2 Gm. of the salt after washing and drying at 100° C. (212° F.), weighs 1.012 Gm. A solution of tartar emetic which is not too dilute produces a flocculent precipitate on the addition of infusion of galls; an excess of the latter redissolves the precipitate. The salts of most metals and earths, being precipitated by normal tartrates, are incompatible with tartar emetic; also the alkalies, tannin, and tinctures containing tannin.

Tests.—Chlorides and sulphates, if present, are detected in the solution, previously acidulated with acetic acid, by silver nitrate and barium chloride, calcium by ammonium oxalate, and copper, iron, and other metals by potassium ferrocyanide. A 1 per cent. solution of the salt should not be clouded by the addition of a few drops of the reagents named.—U. S. Arsenic may be detected by carefully heating 20 or 30 grains of the salt until a black residue remains; on gradually increasing the temperature to redness a garlic-like odor will be evolved. More delicate tests are the following: If 2 Gm. of the salt be dissolved, with the aid of heat, in hydrochloric acid, and to this solution 1 Cc. of test-solution of stannous chloride be added, no turbidity or coloration should ensue within 1 hour (limit of arsenic).—U. S. If 1 Gm. of tartar emetic, in powder, be shaken with 3 Cc. of solution of stannous chloride, no coloration should ensue within 1 hour.—P. G. The impurity which is likely to be met with in consequence of faulty preparation is cream of tartar, the presence of which cannot be detected by its behavior to test-paper, since the solution of tartar emetic has an acid reaction; but a permanent

precipitate will not appear with potassium carbonate until after this impurity has been neutralized. By dissolving 24 grains of the salt in a fluidounce of warm water and cooling the solution to 10° C. (50° F.) it should remain clear. A crystalline deposit will occur if more than 8 per cent. of cream of tartar is present. The U. S. P. demands that if sodium carbonate (bicarbonate, Br.) solution be added to crushed crystals of tartar emetic, no effervescence should take place, to show absence of this impurity. A more delicate test, which, however, does not indicate the nature of the impurity, consists in preparing antimony sulphide from a given weight of the salt, as stated above. If to a 5 per cent. solution of the salt just sufficient sodium hydroxide test-solution be added to redissolve the precipitate formed, and if to this solution an equal volume of a fresh hydrogen sulphide test-solution be added, no coloration should be noticeable after standing in a warm place for half an hour when viewed by reflected light against a white surface (absence of heavy metals). If 1 Gm. of the salt be dissolved in water to 100 Cc., then 33 (32.99) Cc. of this solution should, after the addition of 20 Cc. of a cold saturated solution of sodium bicarbonate and a little test-solution of starch, require not less than 19.9 Cc. of decinormal iodine solution to produce a permanent blue color (corresponding to 99.5 per cent. of the pure salt).—U. S. Each Gm. should require between 60.2 and 60.7 Cc. of iodine solution, corresponding to 99.2–100 per cent., Br.; 0.2 Gm. should require 12 Cc. of iodine solution, corresponding to 99.66 per cent., P. G. The following equation will explain the reaction taking place in the test: $2(KSbOC_4H_4O_6).H_2O + 8NaHCO_3 + I_4 = 2NaSbO_3$ (meta-antimonate) $+ 4NaI + 2KNaC_4H_4O_6 + 8CO_2 + 6H_2O$. Now, since 503.6 ($125.9 \times 4$) parts of iodine are necessary to oxidize completely the antimony contained in 659.80 parts of crystallized tartar emetic, it follows that 19.9 Cc. of decinormal iodine solution, representing 0.250541 Gm. of iodine, are required for 0.32835 (0.33 at 99.5 per cent.) Gm. of the salt, for 659.8 : 503.6 :: 0.32835 : 0.2506. Titration should begin immediately after the addition of the sodium bicarbonate solution.

Action and Uses.—Tartar emetic was at one time largely employed as an expectorant, diaphoretic, emetic, sedative, antiphlogistic, and counterirritant, but at present its use has become greatly limited. When locally applied to mucous membranes, it causes a sensation of burning, which is followed by vesication if the contact be sufficiently prolonged. Upon the skin it acts as a rubefacient and irritant, and its continuous application causes a pustular eruption followed by deep sloughing. The surrounding tissue becomes devitalized and the resulting ulcer heals very slowly. Antimony depresses the sensory side of the spinal cord, and in poisonous dose paralyzes both the sensory and the motor centers in the cord. It lowers both the pulse-rate and pulse-force. The heart muscle is directly depressed by small amounts, and large doses probably depress the peripheral vagus nerves. Blood-pressure is lowered first, because of the depressed heart's action, and second, because of depression of the vasomotor system. The depression of the vasomotor system may be in part centric, but it is certainly due also to depression peripherally. The convulsions sometimes seen are due to circulatory depression with anæmia of the base of the brain. Moderate amounts do not affect the respiratory function, but lethal doses depress the respiratory center and the vagus nerves supplying the lungs, produce pulmonary congestion resulting from cardiac failure, and cause a large outpouring of mucus into the bronchial tubes. Tartar emetic, especially when assisted by copious draughts of water and diaphoretics, stimulates the secretion of the skin to a very marked degree. It is an irritant to the stomach and intestines, and in toxic dose produces violent gastro-enteritis. It causes vomiting by stimulating the vomiting center in the medulla and by irritating the gastric mucosa. The purging following overdose of this drug is an effort made by the intestines to eliminate the poison, and is due also to the intense intestinal inflammation. Antimony is very slowly absorbed from the stomach and intestines, and is slowly eliminated by all the secretions and by the bowels.

Tartar emetic may be employed as a circulatory depressant in all sthenic inflammatory conditions, as, for example, in the very early stages of bronchitis and pneumonia, for aborting beginning colds and other localized inflammations. It should never be employed in adynamic conditions where the heart's action is feeble, and little or no excess of temperature is present. As an expectorant, it is useful especially when combined with other drugs in the beginning stages of acute bronchitis. It is also useful in the above-named conditions for its diaphoretic properties. Minute doses of this drug may be used in the treatment of vomiting resulting from depression, but never when the

vomiting is occasioned by gastric irritation. Doses of $\frac{1}{60}$ grain (0.001 Gm.) may be used successfully in treating the acute gastric catarrh of children when associated with fever. As an emetic, it causes great prostration and muscular relaxation, and before the introduction of anæsthetics advantage of this fact was taken in order to reduce dislocations and strangulated hernias and to dilate the os uteri. It is too slow and prolonged in its action to render much service as an emetic in the treatment either of disease or of poisoning by other remedies. Locally the plaster or ointment (see Emplastrum Antimonii and Unguentum Antimonii) may be used in the treatment of chronically enlarged joints, and formerly was applied to the back of the neck for the cure of epilepsy, meningitis, and other cerebral lesions.

Antimony is badly borne by children, by the aged, and by those who are enfeebled by disease. It should never be employed when gastro-intestinal irritation or inflammation is present.

Poisonous doses of tartar emetic depress the circulation, cause muscular relaxation, copious sweating, severe nausea, and gastro-intestinal pain. Violent vomiting and hiccough with copious watery stools resembling those of Asiatic cholera are present. The temperature becomes subnormal, the pulse running, rapid, and thready, the face pinched and livid, the body covered with a cold, clammy sweat, and the respirations faint and shallow. Cramps in the calves of the legs usually follow abstraction of fluids from the tissues by the excessive purging. Cutaneous eruptions, partial anæsthesia, fainting, loss of sensation, and convulsions sometimes intervene before death occurs.

The treatment of tartar emetic poisoning consists, first, in the application of external heat and irrigation of the stomach with a solution of tannic acid. The employment of morphine hypodermically for the relief of pain, and the use of respiratory and circulatory stimulants, such as alcohol, strychnine, atropine, and digitalis, should not be forgotten.

Patients recovering from the acute symptoms of this poisoning frequently die subsequently from fatty degeneration of the viscera. Chronic poisoning sometimes results from the frequent administration of this drug, The principal symptoms are nausea, vomiting, purging, cachexia, and death from exhaustion. Fatty degeneration is frequently found after death as well as intense venous congestion, dark fluid blood, and pulmonary congestion and gastro-intestinal irritation.

As a circulatory quieter, tartar emetic is given in doses of from $\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003–0.005 Gm.); as an expectorant and diaphoretic, from $\frac{1}{12}$ to $\frac{1}{8}$ grain (0.002–0.008 Gm.), every 3 or 4 hours. As an emetic, the dose is from $\frac{1}{2}$ to 1 grain (0.03–0.06 Gm.), every 15 minutes, until several doses are taken or until emesis occurs.

ANTIMONII OXIDUM, *Br.*—Antimony Oxide.

Stibium oxydatum.—Antimony Trioxide, Antimonous oxide, E.; *Oxyde d'antimoine,* Fr.; *Antimonoxyd,* G.; *Oxido de antimonio,* Sp.

Formula, $Sb_2O_3(Sb_4O_6)$. Molecular weight, 286.24.

Origin.—Oxide of antimony in an impure form was known to the alchemists of the Middle Ages. The term *flores antimonii* was at first chiefly applied to the product obtained by the burning of the black sulphide, but subsequently to the purer white powder resulting from the burning of metallic antimony in air. The mineral *valentinite* or *white antimony* consists of this oxide; *antimony ochre* or *cervantite* is antimonous-antimonic oxide.

Preparation.—The process as outlined in the British Pharmacopœia is, to pour a solution of antimonous chloride into a large bulk of water, thus forming the oxychloride or powder of Algaroth, $4SbCl_3 + 5H_2O = Sb_4O_5Cl_2 + 10HCl$, and to decompose the oxychloride with sodium carbonate.

The process formerly official in the U. S. (1870) was essentially the same as the above, except that directions were also given for preparing a solution of antimonous chloride by digesting 4 parts of black antimony sulphide with 18 parts of hydrochloric acid: $Sb_2S_3 + 6HCl = 2SbCl_3 + 3H_2S$. The oxychloride formed by decomposition was decomposed by ammonia water. The resulting antimonous oxide must be dried at not too elevated a temperature, to avoid the formation of higher oxides of antimony. A contamination with arsenous acid, resulting from the arsenic sulphide frequently present in the black antimony, need not be apprehended; the greater part of it will be expelled

during the first part of the operation as arsenic chloride, and what little may be left in the liquid will remain in solution on precipitating with water. The large quantity of noxious gases given off renders it necessary to operate under a hood or to dispose of the gases by consuming them in a furnace.

On heating metallic antimony in a loosely covered crucible the metal burns at a red heat when in contact with air to antimonous oxide, and this sublimes in glossy, transparent, or white needles, intermixed with octahedrons; this product was formerly distinguished as *flores antimonii (flowers of antimony)*. The oxide was dropped in the U. S., 1900.

Properties.—Antimonous oxide is a dense white or grayish-white powder, which is very sparingly soluble in water, insoluble in alcohol, ether, and nitric acid, but dissolves readily in hydrochloric acid; it is also soluble in a warm solution of tartaric acid or in a boiling solution of acid potassium tartrate. It is without odor and taste, and melts at a dull-red heat to a yellowish liquid, and at a full-red heat sublimes in crystals, as stated above; slow sublimation gives mainly octahedrons, while rhombic prisms are obtained by rapid heating. When the oxide is slowly heated in contact with air, it is converted into grayish, infusible, and non-volatile tetroxide, or *antimonous-antimonic oxide*, Sb_2O_4 or $Sb_2O_3.Sb_2O_5$. When heated with sodium hydroxide upon charcoal by means of the blowpipe, very brittle metallic globules are obtained. Its solution in hydrochloric acid dropped into water yields a white precipitate, and this is at once changed to orange-red by hydrogen sulphide.

Tests.—A solution of antimony oxide in hydrochloric acid, diluted with water to incipient permanent turbidity, will yield with hydrogen sulphide a precipitate which when thoroughly washed should be perfectly soluble in ammonium sulphide solution, to indicate the absence of lead and copper. In a dilute (1 per cent.) aqueous solution made with aid of tartaric acid, sulphates would be detected by barium chloride solution, chlorides by silver nitrate, and iron and other metals by potassium ferrocyanide. Arsenic may be detected by adding 1 Cc. of stannous chloride test-solution to a solution of 1 Gm. of the oxide in hydrochloric acid; no turbidity or coloration should ensue within 1 hour. 0.5 Gm. dissolved in 1 Gm. of cream of tartar in hot solution and then made alkaline with 3 Gm. of sodium bicarbonate, should require 70 Cc. of iodine solution for titration, corresponding to 100 per cent. (Br.).

Action and Uses.—Oxide of antimony is said to possess the general properties of other antimonial preparations, but because of its inferior solubility is less liable to produce nausea and vomiting. It is rarely employed in medicine, but may be given in doses of from 2 to 4 grains (0.12–0.25 Gm.).

ANTIMONII SULPHIDUM.—Antimony Sulphide.

Stibium sulfuratum nigrum, P. G.; *Antimonium crudum—Black (crude) antimony, Antimony trisulphide, Antimonous sulphide*, E.; *Sulfure d'antimoine, Antimoine cru, A. sulfuré*, Fr.; *Schwefelspiessglanz, Spiessglanz, Schwefelantimon*, G.; *Trisulfuro di antimonio*, F. It.; *Sulfuro de antimonio*, Sp.

Formula, Sb_2S_3. Molecular weight, 334.09.

It is found native as *stibnite*, gray antimony ore, or black antimony, and associated with galena, iron pyrites, quartz, and heavy spar, in various parts of Europe, Borneo, New Brunswick, Nevada, and in Sevier Co., Ark. It was known to the ancients as "stimmi," and was early employed as an external remedy in cutaneous diseases and for darkening the eyebrows and eyelashes. From the infusible ores with which it is associated it is freed by fusion in pots arranged in such a manner that the fused sulphide runs off into earthen vessels, where it cools. It is afterward powdered. Antimony trisulphide, being the commonest and cheapest antimony ore, is employed for preparing the metal and as the source of all compounds of antimony.

Properties.—Thus purified, it is known in commerce as crude antimony, and contains variable small quantities of iron, and often traces of arsenic, lead, and copper, all in the state of sulphides. It is steel-gray, of a metallic luster and a radiated crystalline texture, friable, soft, and leaving a black mark upon harder bodies. Its specific gravity varies between 4.6 and 4.7, it being but little lighter than black oxide of manganese, from which it is readily distinguished by the ready fusibility of splinters of antimony sulphide when held in the flame of a candle. It is inodorous and tasteless, and insoluble in simple solvents. At a temperature below a red heat it fuses to a dark-brown liquid. It is

frequently seen as a heavy black or grayish-black and somewhat shining powder. This when boiled with 10 parts of hydrochloric acid, dissolves without leaving more than 1 per cent. of residue. The solution, completely deprived of hydrogen sulphide by boiling, when added to water gives a white precipitate which is soluble in a solution of tartaric acid. After separation of the precipitate by filtration the filtrate gives an orange-red precipitate with hydrogen sulphide test-solution.—U. S., 1890.

Action and Uses.—Because of its uncertain physiological action, this preparation should not be employed in general medicine. It has been recommended as a diaphoretic, alterative, and cathartic in the treatment of strumous, scrofulous, and syphilitic conditions. In America it is occasionally employed in veterinary practice. The dose is stated to be from 5 to 15 grains (0.30–1 Gm.), either in powder or pill.

ANTIMONII SULPHIDUM PURIFICATUM.—Purified Antimony Sulphide.

Antimonium nigrum purificatum, Br.; *Purified black antimony*, E.; *Sulfure d'antimoine depuré*, Fr.; *Gereinigtes Schwefelantimon*, G.

Formula, Sb_2S_3. Molecular weight, 334.09.

Preparation.—Very finely divided antimony sulphide is macerated during 5 days, with frequent agitation, with half its weight of ammonia water, washed by repeated decantation with water, and dried by gentle heat. The object of this treatment is to remove arsenic, etc. The Br. process is practically identical with the above. Garot has shown that the ammoniacal liquid, when evaporated, leaves a red residue which contains very little arsenic. Arsenous sulphide is, however, freely soluble in *ammonium carbonate*, which dissolves but little antimonous sulphide. The process devised by Hager is as follows: Mix in a high vessel 1000 parts of levigated antimony sulphide with 100 parts of ammonia water, specific gravity 0.960, and sufficient warm water to permit the mixture being readily stirred; digest for a day at between 30° and 40° C. (86° and 104° F.), add 50 parts of official ammonium carbonate, again digest with frequent agitation for 48 hours, then dilute with water, and wash thoroughly. It forms a dark-gray or grayish-black lusterless powder having the properties mentioned under Antimony Sulphide. This as well as the crude sulphide were dropped in the U. S., 1900.

Tests.—Commercial antimony sulphide is sometimes adulterated with coal-dust, or mixtures of powdered coal and chalk are sold in place of it. The latter effervesce briskly with dilute hydrochloric acid, forming a solution containing calcium chloride. If 2 Gm. of the sulphide be mixed and cautiously ignited in a porcelain crucible with 8 Gm. of pure sodium nitrate, and the fused mass boiled with 25 Cc. of water, there will remain a residue which should be white or nearly so, and not yellowish nor brownish (absence of other metallic sulphides). On boiling the filtrate with an excess of nitric acid until no more nitrous vapors are evolved, then dissolving in it 0.1 Gm. of silver nitrate, filtering again if necessary, and cautiously pouring a few drops of ammonia water on top, not more than a white cloud, but no red nor reddish precipitate, should appear at the line of contact of the two liquids (absence of more than about 0.1 per cent. of arsenic).—U. S., 1890.

Action and Uses.—Purified sulphide of antimony is employed for the same purposes as sulphide of antimony (see ANTIMONII SULPHIDUM).

ANTIMONIUM.—ANTIMONY.

Stibium.—Antimoine, Fr.; *Antimon, Spiessglanzmetal*, G.

Symbol, Sb. Atomic weight, 119.3.

Antimony occurs in several mineral forms, but principally as trisulphide, known as *stibnite* or *antimony blende*, which occurs in large crystals of great beauty, especially in Japan. The sulphide was used in early times as a toilet article for darkening eyebrows. The metal was prepared as early as 1000 B. C. by the Chaldeans (W. Black). Its compounds were especially studied by Basil Valentine in the fifteenth and by Proust and Berzelius in the nineteenth century. France and Germany produce the bulk of antimony on the market. The best quality, in planoconvex cakes, comes from France. English and Spanish antimony comes in cones and pigs, respectively. The metal is obtained by heating the crude oxide (obtained by roasting the sulphide) with potassium hydroxide and charcoal. Such antimony is always impure, containing small amounts of iron, lead,

arsenic, and sulphur. Arsenic is removed by melting the metal repeatedly with $\frac{1}{10}$ its weight of niter, whereby potassium arsenate is formed in the slag. It is a hard, brittle, easily fusible, bluish-white metal of high luster and specific gravity 6.7. It is unaffected in air at ordinary temperature, but burns at a high temperature to the oxide, $Sb_2O_3(Sb_4O_6)$. The proper solvent for antimony is *aqua regia*. Sulphur, halogens, phosphorus, and arsenic unite with it directly in the cold or on heating. It enters into many alloys, 2 of which are *type-metal* and *Britannia metal*. In its chemical behavior it resembles phosphorus and arsenic very much, the 3 elements forming a natural group.

Action and Uses.—Antimony is never employed in medicine, and its various oxides, as a rule, should not be. For action and uses of antimony arsenate, see ARSENI TRIOXIDUM.

Oxides.—Antimony forms three oxides, $Sb_2O_3(Sb_4O_6)$, Sb_2O_4, and Sb_2O_5.

Antimonous Oxide, Sb_2O_3, or more properly, Sb_4O_6, has been described. It is a weak acid anhydride, and with alkalies gives salts of metantimonous acid or metantimonites, $KSbO_2$, but it acts more commonly as a basic oxide, giving salts with acids.

Antimony Tetroxide, Sb_2O_4, is formed when either antimony, the trioxide, or the pentoxide, is heated in the air at a dull-red heat for a long time. Phosphorus and arsenic do not behave thus. It is non-volatile.

Antimony Pentoxide, Sb_2O_5, formed by treating antimony or the preceding oxides, with concentrated nitric acid. It is a lemon-yellow powder insoluble in water. As in the case of phosphorus pentoxide, 3 acids derived from Sb_2O_5 exist, namely, ortho-, meta-, and pyro-antimonic acid, or H_3SbO_4, $HSbO_3$, and $H_4Sb_2O_7$. These acids are sparingly soluble in water, but dissolve in alkalies, forming the corresponding salts. One of these salts, $Na_2H_2Sb_2O_7$, acid sodium pyroantimonate, is interesting because of its insolubility; the corresponding potassium salt is soluble, $K_2H_2Sb_2O_7$.

Other oxides of antimony, more or less pure or combined with antimony sulphide, were formerly employed in medicine, and are occasionally, though very rarely, called for. When black antimony sulphide is gradually heated to redness in contact with the air, it is partly oxidized to antimonous antimonate, $Sb_2O_3Sb_2O_5$, and constitutes then an ash-gray powder known as *cinis antimonii* (*antimony ash*). When this is fused with a little black antimony, a transparent garnet-red mass, known as *vitrum antimonii* (*antimonial glass*), is obtained. When a mixture of equal parts of black antimony and potassium nitrate is deflagrated by igniting it in small quantities, it yields *hepar antimonii* (*liver of antimony*); and when this is exhausted with water to remove potassium sulphate and sulphantimonate, *crocus of antimony* is left, which is mainly a mixture of antimony oxide and sulphide. *Antimonium diaphoreticum* (*diaphoretic antimony*) is prepared like liver of antimony, except that more (2 parts) of potassium nitrate is used, so that the preparation contains, besides antimony oxide, antimonate, sulphate, nitrate, and nitrite of potassium in varying proportions. By washing this with water the residue consists mainly of *potassium antimonate*, which is recognized by the French Codex.

Antimony Trichloride, *Butter of antimony*. $SbCl_3$.—Formed by the action of chlorine on excess of antimony, by distilling a mixture of antimony and mercuric chloride, or by dissolving antimony trisulphide in hydrochloric acid, then concentrated solution of the chloride, usually colored by iron, and finally pure chloride, solidifying in fine white crystals, pass over into the condenser in succession. The crystals attract moisture and pass into a soft, butter-like mass; it is corrosive. Water breaks it down into an oxychloride (*powder of Algaroth*), and finally into the oxide, Sb_2O_3. It was recognized in the Br. P. of 1885 as Liquor Antimonii Chloridi, but has been dropped from the 1898 pharmacopœia.

Antimony Triiodide, SbI_3.—Obtained by heating antimony and iodine in a flask in the proportion of 3 atoms of iodine to 1 of antimony, cooling, and powdering the mass. A dark orange-red powder, decomposed by water.

Antimony Arsenate.—A heavy snow-white powder, said to be used in Russia as an alterative, 4 times daily in doses of $\frac{1}{50}$ grain (0.0012 Gm.). It contains 44 per cent. of arsenic acid.

For Antimonetted Hydrogen, SbH_3, and tests for antimony, see under ARSENI TRIOXIDUM.

ANTIMONIUM SULPHURATUM, *Br.*—Sulphurated Antimony.

Kermes mineral, E.; *Sulfure d'antimoine précipité*, Fr.; *Gefälltes Schwefelantimon*, G.; *Sulfuro de antimonio hidratado*, Sp.

Chiefly antimonous sulphide (Sb_2S_3; 335.14), with a very small amount of antimonous oxide (U. S., 1890). This preparation has been dropped in the U. S., 1900.

According to the Br. P., it is a mixture of antimonous sulphide and oxide, antimonic sulphide and oxide, and sulphur.

Origin.—Both antimonial kermes and golden sulphur appear to have been first obtained by Basilius Valentinus in the fifteenth century. The latter was called *sulphur*

auratum by Quercetanus (1603). The former was prepared by Glauber by dissolving black antimony in potassium hydroxide solution and cooling, and was lauded by Simon (1719) under the name of *alkermes minerale.* Numerous processes for obtaining these preparations have been published, nearly all of them resulting in mixtures of one or both sulphides of antimony with more or less antimonous oxide. The German Pharmacopœia recognizes only pure Sb_2S_5 under the title Stibium sulphuratum aurantiacum (Goldschwefel). See Antimonii Pentasulphidum, page 191.

Preparation.—Purified antimony sulphide in very fine powder, 100 Gm.; solution of sodium hydroxide, 1200 Cc.; distilled water, diluted sulphuric acid, each a sufficient quantity. Mix the antimony sulphide with the solution of sodium hydroxide and 3000 Cc. of distilled water, and boil the mixture over a gentle fire for 2 hours, constantly stirring, and occasionally adding distilled water so as to preserve the same measure. Strain the liquid immediately through a double muslin strainer, and drop into it, while yet hot, diluted sulphuric acid so long as it produces a precipitate. Wash the precipitate with hot distilled water until the washings are at most but very slightly clouded by test-solution of barium chloride, then dry the precipitate and rub it to a fine powder.—U. S., 1890. If avoirdupois weight be used, $3\frac{1}{3}$ ounces of antimony sulphide will require $40\frac{1}{2}$ fluidounces of solution of sodium hydroxide and $6\frac{1}{2}$ pints of distilled water.

The British process is as follows: 2 parts of *antimonous sulphide,* 2 parts of sublimed sulphur, and 1 part of commercial caustic soda are boiled together for 2 hours in 20 parts of water, then diluted while hot with 36 parts of hot water, filtered, and acidified before cooling with sulphuric acid. The precipitate is filtered, washed free from sulphates, and dried at not above 100° C. (212° F.). The changes here are approximately expressed thus: $Sb_2S_3 + 3Na_2S + S_2 = 2Na_3SbS_4$. The sodium sulphide, Na_2S, is formed by the action of S on NaOH. Na_3SbS_4, sodium sulphantimonate, is also known as *Schlippe's salt.* The acid added acts thus: $2Na_3SbS_4 + 3H_2SO_4 = Sb_2S_5 + 3H_2S + 3Na_2SO_4$. The pentasulphide, Sb_2S_5, is not pure, but contains some oxides and trisulphide, due to the presence of antimonite, antimonate, and sulphantimonite of sodium.

In the former U. S. P. process the solution contains both sulphantimonite and antimonite of the alkali, the formation of which is seen from the following equation: $Sb_2S_3 + 4NaOH = NaSbO_2$ (meta-antimonite) $+ Na_3SbS_3$ (ortho-sulphantimonite). On adding sulphuric acid, both the compounds named are decomposed and antimonous sulphide is precipitated without the evolution of hydrogen sulphide: $NaSbO_2 + Na_3SbS_3 + 2H_2SO_4 = Sb_2S_3 + 2Na_2SO_4 + 2H_2O$. The precipitate, however, is likely to retain a portion of undecomposed antimonite, which, if remaining in the hot acidulated liquid, is gradually decomposed; to insure this decomposition, Liebig suggested to pour the hot alkaline solution into an excess of diluted sulphuric acid, and to boil the moist precipitate with a fresh portion of such acid.

Properties and Tests.—Sulphurated antimony is a reddish-brown (dull-red, Br.) powder, without odor or taste, and insoluble in water and other simple solvents. Heated in a dry test-tube, it emits moisture and leaves a black residue. When heated with 10 times its weight of official hydrochloric acid it is nearly all dissolved, with evolution of hydrogen sulphide. The residue, after having been washed and dried, burns with the characteristic flame of sulphur and leaves a scanty ash. The solution in hydrochloric acid, when added to water, deposits a white powder. The liquid filtered from this powder yields an orange-red precipitate with hydrogen sulphide. Water in which the preparation has been boiled should not yield a white precipitate with ammonium oxalate (absence of calcium). A mixture of 1 part of sulphurated antimony and 20 parts of hot water, well shaken, should yield a filtrate which is neutral to test-paper, and which should not be rendered more than slightly opalescent by barium chloride test-solution (limit of sulphate) or silver nitrate test-solution (limit of chloride).—U. S., 1890. The limit allowed by the U. S., 1890, for arsenic is the same as prescribed in the case of purified black antimony (which see). Boiled in water with acid potassium tartrate, the resulting solution is precipitated orange red with hydrogen sulphide, thus showing the presence of antimonous oxide. Oxidized with nitric acid, 3 Gm. give a white residue of 2 Gm. when dried and heated to redness (Br.).

Action and Uses.—Kermes mineral is rarely employed in medicine at the present time. It was formerly largely used as an alterative, diuretic, and emetic, but at present other more potent remedies are used in its place. The dose is from 1 to 2 grains

(0.05–0.10 Gm.), twice daily as an alterative, and from 5 to 20 grains (0.30–1.3 Gm.) as an emetic.

Allied Compounds.—Antimonii Oxysulphuretum, U. S., 1870.—*Stibium sulfuratum rubrum*, P. G., 1872, *Sulphur stibiatum rubrum, Kermes minerale, Kermes aurificum minerale.—Oxysulphuret of antimony, Kermes mineral*, E.; *Sulfure d'antimoine hydraté, Kermès minéral, Poudre des Chartreux*, Fr.; *Mineralkermes*, G.—The name "Kermes" mineral was applied by the U. S. P., 1890, to the sulphurated antimony (see above). Composition, a mixture of Sb_2S_3 and Sb_2O_3. This was prepared by boiling for 1 hour 1 part of black antimony with 250 parts of water containing 23 parts of sodium carbonate, filtering and cooling; after 24 hours the precipitate was collected, washed with cold water previously boiled, and dried. The reaction is similar to that described above, except that carbon dioxide is given off. On cooling, a mixture of Sb_2S_3 and Sb_2O_3 is deposited, varying with the relative proportion of the sulphide and carbonate, and with the concentration of the liquid.

Antimonii Pentasulphidum.—*Antimonii sulphuretum aureum s. præcipitatum, Stibium sulfuratum aurantiacum*, P. G.; *Sulphur stibiatum aurantiacum, Sulphur auratum antimonii.—Antimonic sulphide, Golden sulphuret of antimony, Golden sulphur*, E.; *Soufre doré antimoine*, Fr.; *Goldschwefel, Sulfaurat*, G.—This was originally prepared by precipitating an aqueous solution of liver of antimony with an acid, and contained, besides Sb_2S_5, also variable amounts of Sb_2S_3 and Sb_2O_3. Instead of such mixtures, the German and other pharmacopœias now recognize the pure antimonic sulphide, which is prepared as follows: A solution of 70 parts of crystallized sodium carbonate in 250 parts of water is boiled, and mixed with milk of lime containing 26 parts of lime and 80 parts of water. 36 parts of levigated antimony sulphide and 7 parts of sublimed sulphur are added, and the whole boiled until the gray color has disappeared, when the liquid is filtered and crystallized. 24 parts of these crystals, which, from the discoverer, Schlippe (1821), are known as *Schlippe's Salt*, and have the composition $Na_3SbS_4 + 9H_2O$, are dissolved in 700 parts of water, and added to a mixture of 9 parts of sulphuric acid and 200 parts of water. The precipitate, having the composition Sb_2S_5, is washed and dried. The reactions involved in this process may be illustrated by the following equations: (1) $4Sb_2S_3 + 9(Na_2CO_3 10H_2O) + S_8 + 9CaO = 5(Na_3SbS_4 9H_2O) + 3(NaSbO_3) + 9CaCO_3 + 45H_2O$. (2) $2(Na_3SbS_4 9H_2O) + 3H_2SO_4 = Sb_2S_5 + 3(Na_2SO_4) + 3H_2S + 18H_2O$. It is an orange-colored, inodorous, and tasteless powder, which, on being slowly heated in a test-tube, gives a sublimate of sulphur, leaving a residue of black antimonous sulphide; at a red heat it is completely volatilized. Arsenic is tested for by treating 0.5 Gm. of the powder with 5 Cc. of a saturated solution of ammonium carbonate at a temperature of 50°–60° C. (122°–140° F.) with repeated shaking. On acidifying the filtrate with hydrochloric acid, no yellow precipitate should occur within 6 hours. The limits of sulphate and chloride are tested for by adding silver nitrate and barium nitrate solutions, respectively, to water which has been shaken with the powder; no turbidity should occur immediately.—P. G.

ANTIPYRINA, *U. S.*—Antipyrine.

Phenazonum, Br.; *Pyrazolonum phenyldimethylicum*, P. G.; *Analgésine*, Fr. Cod.; *Phenazone, Methozine, Analgesine, Dimethyl-phenyl-iso-pyrazolone, Dehydrodimethyl-phenylpyrazine*, E.; *Antipyrine, Anodynine, Parodyne*, Fr.; *Antipyrin, Phenyldimethyl-pyrazolon*, G.

Formula, $C_{11}H_{12}N_2O$ or $C_3HN_2O(CH_3)_2.C_6H_5$ or $C_6H_5N.CO.CH:C(CH_3).N(CH_3)$. Molecular weight, 186.75.

Origin and Preparation.—Antipyrine was first prepared by L. Knorr (1883), and afterward introduced to the medical profession by Filehne. Several processes are in use for the manufacture of antipyrine, of which the following is probably the best known: Phenylhydrazine, $C_6H_5HN.NH_2$, is heated with aceto-acetic ether, $CH_3CO.CH_2O.OC_2H_5$, whereby phenylmethylisopyrazolone, $C_6H_5N.CO.CH:C(CH_3).NH$, is produced. If this compound be dissolved in methyl alcohol and treated with methyl iodide, the latter unites with it to form an addition-compound, which when further treated with a solution of sodium hydroxide splits off hydriodic acid and separates antipyrine in the form of a heavy oil. The latter may then be crystallized from toluene or ether. Antipyrine may also be obtained direct by heating methylphenylhydrazine with aceto-acetic ether, water and alcohol being split off; thus, $C_6H_5HN.NHCH_3 + CH_3CO.CH_2CO.OC_2H_5 = C_6H_5N.CO.CH:C(CH_3).N(CH_3) + H_2O + C_2H_5OH$.

Properties and Tests.—Antipyrine crystallizes readily in laminæ, or from water in rhombic prisms. The commercial article is a voluminous crystalline white or whitish powder; it is almost inodorous, and has a mild bitter taste. At 25° C. (77° F.) it dissolves in less than 1 part of water, in about 1 part of alcohol or chloroform, and in about 30 (40, Br.) parts of ether, and is freely soluble in benzene, but slightly soluble in benzin. 2 Cc. of a 1 per cent. solution acquire with 2 drops of fuming nitric

acid a green color, changing to red on the addition of another drop of the acid to the previously boiled liquid. 1 drop of ferric chloride solution, added to 2 Cc. of a 0.1 per cent. solution of antipyrine, causes a deep-red color, changing to pale yellow on the addition of 10 drops of sulphuric acid. A solution of tannic acid added to a 1 per cent. aqueous solution of antipyrine causes a copious white precipitate of antipyrine tannate. The solution of antipyrine in water should have a neutral reaction, should be colorless, should not have an acrid taste, and should not be affected by hydrogen sulphide. It should volatilize completely when heated. On warming 0.1 Gm. of antipyrine with sodium hydroxide test-solution, and again warming after the addition of chloroform, the disagreeable odor of phenyl isocyanide should not be developed (absence of acetanilide). 0.1 Gm. of sodium nitrite and 12 Cc. of a 1 per cent. aqueous solution of antipyrine yield a nearly colorless liquid which turns deep green on addition of 1 Cc. of diluted sulphuric acid, due to formation of isonitroso-antipyrine. An aqueous solution of the same strength mixed with an equal volume of nitric acid assumes a yellow color, passing to crimson on warming (distinction from acetanilide and acetphenetidin).—U. S. 0.2 Cc. of a 1 per cent. aqueous solution should be colored green by 2 drops of fuming nitric acid, and the color should be changed to red by boiling with an additional 3 or 4 drops of the acid. A 5 per cent. aqueous solution gives with mercuric chloride test-solution a white precipitate which disappears on boiling, but reappears as the liquid cools.—Br.

Antipyrine melts at 113° C. (235.4° F.), and when further heated turns red, then brown, and acquires an empyreumatic odor resembling oil of amber, the residue being soluble in alcohol, and with a red color in chloroform. The powder as well as the solution should carefully be protected from contact with iron compounds.

Acetanilide has been found mixed with antipyrine; its detection is easy, for although both compounds have approximate melting-points (113° C., 235.4° F.), a mixture of equal parts melts at 45° C. (113° F.) (Helbing). Antipyrine is a well-characterized base, and forms salts with acids by direct addition. Many drugs have been found incompatible with it, among which may be mentioned sodium bicarbonate and salicylate in solid form, chloral hydrate and butylchloral hydrate, hydrocyanic acid, ferrous sulphate, carbolic acid, mercuric and mercurous chlorides, and all nitrites in acid solution.

Action and Uses.—Antipyrine was first introduced and indiscriminately employed in medicine for the reduction of high fevers, but because of the untoward symptoms which it frequently causes, and the fact that it in no way shortens the course or modifies the other symptoms of infectious febrile conditions, it has largely fallen into disuse. While it has been fully established that antipyrine is not a remedy to be employed in the routine treatment of febrile diseases, it has been definitely ascertained that its properties as an analgesic are equal to those of any other drug, with the exception of opium, and as such it is now very largely employed. Medicinal amounts have little or no effect upon the cerebral cortex, but overdoses cause tetanic and epileptiform convulsions while consciousness is preserved. Its primary action upon the cord is that of a stimulant, but later it depresses especially its sensory portions, and decreases reflex activity. Antipyrine depresses the sensory nerves and, to some extent, both the motor nerves and the muscles. Locally applied to mucous membrane, or when injected subcutaneously, it produces local anæsthesia which lasts for several days. In medicinal amounts phenazone, as it is sometimes called, has practically no influence upon the circulation, unless it has been already enfeebled by previous disease. It may be looked upon as a cardiac depressant, however, rather than as a stimulant, but it is probably true that many cases of so-called circulatory failure following its administration have been collapse resulting from the great lowering of temperature rather than from any direct effect of the drug upon the heart. Very large doses and toxic amounts do decrease arterial tension, unless convulsions occur, when it is raised. The lowering of blood-pressure is probably due both to its action upon the heart muscle and upon the bloodvessels. No material changes occur in the blood from medicinal doses of this drug, but where idiosyncrasy exists cyanosis may come on. Toxic amounts decrease the oxygen-carrying power of the blood, reduce the oxyhæmoglobin to methæmoglobin, cause shrivelling of the red blood-corpuscles, and the appearance of hæmatin in the urine. Small doses of the drug have no effect upon respiration, but very full doses increase its rapidity, while lethal amounts cause death by respiratory paralysis. In fevered states antipyrine acts as a fairly constant antipyretic by increasing the elim-

ination and decreasing the production of bodily heat. In the healthy individual it has little or no effect upon temperature unless given in toxic amounts, when it acts as a depressant. Phenazone is absorbed and eliminated rapidly. Its elimination takes place chiefly by the kidneys, but it has been found in the salivary secretion and in the milk of nursing women. It acts as a conservator of tissue, and decreases both the watery and nitrogenous portions of the urine. This drug is also antiseptic, and small quantities prevent fermentation and putrefaction, while larger amounts will destroy micro-organisms.

It is now generally conceded that antipyrine is not a drug to employ in the routine treatment of fevers. It may be an advisable remedy to use in the hyperpyrexia occasionally seen in scarlet fever, smallpox, pneumonia, and other dynamic states, but the condition of the circulation frequently contraindicates its use, especially in pneumonia. When employed for this purpose, it should usually be given in one or two full doses, and not in small ones frequently repeated. The application of cold (see Cold Water) is a much better routine treatment, as it not only reduces temperature, but also stimulates all the vital functions of the organism, while this drug as a rule depresses them. It is inadvisable to use antipyrine in enteric fever and other typhoid conditions, as it acts as a depressant and in its elimination increases the work of the kidneys, which are already burdened by the toxins which they excrete. It is not advisable to employ this drug either in sunstroke or in pulmonary tuberculosis, for in the former it frequently fails to reduce the temperature, and in the latter it commonly increases the night-sweats and sometimes causes collapse. In the various forms of nerve pain antipyrine is the peer of all other drugs, but it is valueless in pain resulting from disease of the internal organs, surgical operations, or inflammations. It is remarkably efficient in the treatment of migraine, the lancinating pains of locomotor ataxia, in sciatica, and in various neuralgias resulting from nervous depression or antecedent disease. It relieves the pain of gout and rheumatism, and is said to shorten the course of the latter condition; but as it frequently increases the sweating in acute rheumatism, it should be given guardedly. It has been recommended to palliate the pains of labor and to relieve dysmenorrhœa, but its employment in these conditions is not attended with marked success. Diabetes mellitus, depending upon a gouty diathesis, is said to have been cured by its administration. While it controls in a marked degree the febrile paroxysms of malaria, it in no way acts as an antiperiodic. Antipyrine is serviceable in the treatment of minor spasmodic conditions depending upon nervous irritability. It is the best remedy to employ in whooping-cough, and spasmodic croup and laryngeal spasm are said to have been relieved by it. It is beneficial in epileptic convulsions resulting from reflex irritation, such as that caused by intestinal worms or dysmenorrhœa, and is occasionally serviceable in idiopathic epilepsy, and especially so when combined with the bromides.

Local applications of a 4 per cent. solution are valuable in the treatment of acute coryza and in congestions of the larynx and pharynx. As these applications are quite painful, they should be preceded by one of cocaine. They relieve the congestion by contracting the capillaries with which they come in contact. Hypodermically, a solution may be injected into the region of a hypersensitive nerve, as in sciatica, for the purpose of causing local anæsthesia, but the pain immediately following is usually severe. Because of its power of constringing bloodvessels, antipyrin has been employed in 4 per cent. solution as a hæmostatic agent, and is of service in the treatment of epistaxis and other similar hemorrhages.

Medicinal amounts of antipyrine sometimes cause duskiness of the face, coldness of the extremities, sweating of the face, and tingling of the skin. Various skin eruptions, such as erythematous patches, pemphigus-like spots, urticaria, dermatitis, and large bullæ, have been noted. These symptoms are usually of sudden onset, and disappear within a few hours. Poisonous doses, in addition to the above symptoms, occasion headache, vertigo, tremors, dyspnœa, excessive sweating, a rapid running pulse, lowering of the temperature, collapse, convulsions, and death from respiratory failure. This condition is treated by the application of external warmth to maintain bodily heat, and the use of respiratory and circulatory stimulants, such as strychnine, atropine, and digitalis. Oxygen inhalations may be given with benefit if cyanosis is marked.

The ordinary dose is from 3 to 5 grains (0.20–0.30 Gm.), either in powder, syrup, or aromatic water. As much as 20 grains (1.3 Gm.) may be given without detriment.

Derivatives of Antipyrine.—ACETOPYRINE.—This name is applied to a recent compound of antipyrine and aspirin (acetyl-salicylic acid). It occurs as a white crystalline powder, having a faint acetous odor and melting at 64°–65° C. (147.2°–148° F.). It is sparingly soluble in cold, but more soluble in hot water, and is readily dissolved by alcohol and chloroform; almost insoluble in ether.

ANTIPYRINE BENZOATE, known also as BENZOPYRINE. $C_{11}H_{12}N_2O.HC_6H_5O_2$.—It may be obtained by adding antipyrine to a boiling solution of benzoic acid. It is a yellow liquid which solidifies to a crystalline mass. Almost insoluble in hot and cold water, but soluble in alcohol and ether.

ANTIPYRINE-CAFFEINE CITRATE, *Migrainin.*—Obtained by fusing on a water-bath a mixture of 85 parts of antipyrine, 9 parts of caffeine, and 6 parts of citric acid. Upon cooling, the mass solidifies and is reduced to powder. Simple mixture of the ingredients by trituration will not answer, as it becomes pasty. It occurs as a colorless hygroscopic powder. As its name implies, migrainin is used in the treatment of migraine and other forms of headache. The dose is from 5 to 15 grains (0.30–1 Gm.).

ANTIPYRINE MANDELATE, *Tussol.* $C_{11}H_{12}N_2O.C_8H_8O_3$.—Prepared by heating a mixture of 188 parts of antipyrine and 152 parts of mandelic acid on a steam-bath, cooling the liquid mass, and crystallizing from alcohol. Colorless crystals, soluble in water and alcohol, having a bitter taste, and melting at 52°–53° C. (125.6°–126.4° F.). At higher temperatures it is decomposed, giving off an odor of oil of bitter almond, and finally burns without leaving a residue. A 5 per cent. aqueous solution is colored green by addition of a few drops of fuming nitric acid, and blood-red by addition of ferric chloride solution. If mixed with milk, the salt is decomposed. Tussol is recommended in the treatment of whooping-cough. The dose is from ½ to 10 grains (0.025–0.60 Gm.), varying with the age of the patient.

ANTIPYRINE SALICYLATE, *Salipyrine, Salazolon, Salipyrazolin.* $C_{11}H_{12}N_2O.HC_7H_5O_3$.—Obtained by heating on a water-bath a mixture of 57.7 parts of antipyrine and 42.3 parts of salicylic acid. An oily liquid results, which congeals on cooling and may be crystallized from alcohol. A colorless, odorless, crystalline powder of acid reaction and having a sweetish-bitter taste. It is soluble in 200 parts of cold and 25 parts of boiling water; also soluble in alcohol, ether, and chloroform. It melts at 92° C. (197.6° F.). Addition of ferric chloride solution to an aqueous solution of the salt causes the violet coloration characteristic of salicylic acid. Salipyrine possesses the combined properties of salicylic acid and antipyrine. Doses of 15 to 30 grains (1–2 Gm.) have been employed in rheumatic fever, chronic rheumatism, tonsillitis, and influenza.

ANTIPYRINE SALICYL-ACETATE, *Pyrosal.*—This compound was introduced by J. D. Riedel. Process of manufacture not given. It contains 50 per cent. of antipyrine and 37 per cent. of salicylic acid, and occurs in colorless leaflets or needles. It is sparingly soluble in water, and has a sour but not bitter taste. Pyrosal is analgesic, antipyretic, and antirheumatic. It has been recommended in the treatment of rheumatism in doses of 5 to 10 grains (0.30–0.60 Gm.) several times daily.

BUTYLCHLORAL-ANTIPYRINE. $C_{11}H_{12}N_2O.C_4H_5Cl_3O + H_2O$.—This compound is obtained by triturating together 188 parts of antipyrine and 193.5 parts of butylchloral hydrate until the mixture liquefies, dissolving the oily liquid in hot water, and setting aside to crystallize. It occurs in colorless needles, which melt at 70° C. (158° F.) and are soluble in 30 parts of water at ordinary temperature. Butylchloral-antipyrine is employed for the same purposes and in the same dose as hypnal.

CHLORAL-ANTIPYRINE.—Two combinations of hydrated chloral and antipyrine have been introduced into medicine. Of these,

MONOCHLORAL-ANTIPYRINE or HYPNAL is best known. It is made exactly like the preceding preparation, except that 165.5 parts of hydrated chloral are used in place of the butylchloral hydrate. Its composition is expressed by the formula: $C_{11}H_{12}N_2O.CCl_3CH(OH)_2$. It occurs in colorless octahedral crystals, which melt at 67°–68° C. (152.6°–153.4° F.) and are soluble in 30 parts of cold water. Hypnal is analgesic and hypnotic. It is employed in neuralgic insomnia and in that arising from the excessive cough of tuberculosis and bronchitis, in doses of 5 to 20 grains (0.30–1.30 Gm.).

DICHLORAL-ANTIPYRINE, $C_{11}H_{12}N_2O.[CCl_3CH(OH)_2]_2$, differs from the other compound in containing an additional molecule of hydrated chloral. It is made by the same process, except that only 94 parts of antipyrine are used with 165.5 parts of hydrated chloral. Dichloral-antipyrine is used for the same purposes and in the same doses as hypnal.

DIMETHYLAMIDO-ANTIPYRINE, *Pyramidon.* $C_{13}H_{17}N_3O$.—Prepared by reducing an acetic acid solution of isonitroso-antipyrine in alcohol to amido-antipyrine, and treating the latter with methyl chloride or iodine. It occurs as a crystalline powder of yellowish-white color and almost free from taste. It melts at 108° C. (226.4° F.) and is soluble in 10 parts of water. Pyramidon is readily distinguished from antipyrine by the following color reactions: If to an aqueous solution ferric chloride solution, nitrous acid, or fuming nitric acid be added, a fugitive violet-blue color will be produced in each case, instead of the respective red and green colorations as in the case of antipyrine. Pyramidon is said to possess the same physiological action as antipyrine, but its effect upon the nervous system is more powerful and more lasting than that of the latter remedy. It has been recommended in tuberculosis in doses not exceeding 8 grains (0.5 Gm.).

FERRIPYRINE. $(C_{11}H_{12}N_2O)_3Fe_2Cl_6$.—It is made by adding a solution of 5 parts of crystallized ferric chloride in 10 parts of 96 per cent. alcohol to a solution of 5 parts of antipyrine in 10 parts of alcohol and 50 parts of ether. The resulting orange-red precipitate is collected on a filter, washed with ether, and dried on porous tiles at 40° C. (104° F.). The compound occurs as a permanent, orange-red fine powder, containing 64 per cent. of antipyrine and 36 cent. of anhydrous ferric chloride, which is soluble in 5 parts of cold and 9 parts of boiling water. Upon heating a cold saturated solution ruby-red leaflets are separated, which melt at 225° C. (437° F.). It is insoluble in ether, but soluble in alcohol and benzene, and can be crystallized from its solution in methyl acohol. If alkali carbonates or bicarbonates be added to an aqueous solution of ferripyrine, ferric hydroxide is precipitated. Ferripyrine should be protected against light. Ferripyrine is employed both locally and in internal medicine. A 20 per cent. solution is recommended as a hæmostatic. It is usually employed upon cotton tampons. In doses of 5 to 10 grains (0.30–0.60 Gm.) it is said to be of value in the treatment of headache and neuralgia dependent upon anæmia.

FORMOPYRINE, *Methylenediantipyrine.* $(C_{11}H_{12}N_2O)_2CH_2.H_2O$.—Prepared by heating 5 parts of antipyrine with 4 parts of formalin (40 per cent. solution of formaldehyde) for 4–6 hours at a temperature of 120° C. (248° F.). Upon cooling, the resulting crystals are washed with water, dried, and recrystallized from benzene. The hydrated crystals melt at 156° C. (312.8° F.), but if anhydrous, at 177° C. (350.6° F.). It is insoluble in cold and sparingly soluble in hot water, but readily soluble in alcohol.

IODOPYRINE. $C_{11}H_{11}IN_2O$.—May be prepared by mixing 127 parts of iodine dissolved in 1500 parts of alcohol with a solution of 188 parts of antipyrine dissolved in 750 parts of alcohol, the mixture after several days separating crystals of iodopyrine, which consist of colorless silky prismatic needles, only slightly soluble in cold and readily soluble in hot water, and practically free from odor and taste. Iodopyrine melts at 160° C. (320° F.). Iodopyrine presents the combined physiological action of iodine and an antipyretic, and has been recommended in bronchial asthma and tertiary syphilis. The dose is from 10 to 20 grains (0.60–1.3 Gm.). After its administration the characteristic reaction of iodine may be found in the urine.

ANTITOXINS.

Since the antitoxins are the direct result of bacteriological research, it will afford a clearer understanding of the properties of these substances if a few paragraphs are devoted to a general consideration of the principles of bacteriology before dealing with the individual members of the group.

Bacteria were discovered by Leeuwenhoek more than 200 years ago, and were believed to be animalculæ until very recent years, when the researches of bacteriologists and botanists showed conclusively that they were minute unicellular plants closely related to the algæ, moulds, yeasts, etc., which undoubtedly belong to the vegetable kingdom. Bacteria are probably the most minute organisms in existence—indeed, they may be compared to atoms. Budjwid estimated that eight billions of pus germs would weigh but a single milligram.

Many methods of classifying bacteria have been proposed: as chromogenic or non-chromogenic, depending upon the formation of coloring-matter; pathogenic (disease-producing) and non-pathogenic, etc. The most important classification, and one that has generally been accepted, is based upon form. This classification gives us the micrococci, bacilli, and spirilla. The micrococci are spherical, and may have more comprehensive names denoting the grouping of the organisms: thus when occurring in irregular masses they are called staphylococci—*e. g.*, the ordinary pus germ, Staphylococcus pyogenes aureus; when two occur together, they are termed diplococci—*e. g.*, diplococcus of pneumonia; when a number of micrococci form long chains, they are spoken of as streptococci, as the streptococcus of erysipelas, tonsillitis, etc. The second class, bacilli (the word "bacillus" meaning a small rod), may occur in dense masses or singly, as the Bacillus tuberculosis, bacillus of typhoid fever, and many of the other common pathogenic bacteria, or these may form long threads, as in the case of anthrax. The third class, but a few species of which have been studied, are the spirilla, which, when occurring singly, have a comma or bent-rod shape. When several elements grow into long threads, spirals are formed, as in the case of the spirillum of Asiatic cholera.

No hard-and-fast lines can be laid down, as all these forms merge gradually one into another, in some cases a bacillus being so short as to be mistaken for a coccus. The grouping and shape of bacteria depend to a considerable extent upon environment; especially do variations of temperature, food, etc., produce changes. In many instances cultures when exposed to detrimental influences will change in a marked degree, involution-forms being produced which vary greatly from normal types—especially is this noticeable in cultures of diphtheria.

Some bacteria develop spores corresponding to the seeds of higher plants. The loca-

tion of these spores in the body of the organism may give the germ an atypical appearance. A good illustration is that of the tetanus germ, which, since the spore occurs at one end of the bacillus, presents the appearance of a short pin.

One of the most important properties of bacteria is the facility with which their protoplasm combines with the basic aniline dyes, which enables the observer to study with great accuracy variations in form, size, etc., and often to determine characteristics of the organism which would not be possible in unstained specimens.

Little is known relative to the structure of bacteria, notwithstanding the great amount of work devoted to this phase of the subject. They may be regarded as small bits of protoplasm with a transparent enveloping membrane. In some cases minute granules, especially in stained specimens, may be noted in the protoplasm. Bacteria probably, like other cells, contain a nucleus.

Many forms of bacteria possess the power of spontaneous motion, owing to the development of one or more whips or vibrios. The bacillus of typhoid fever is one of the best illustrations.

Bacteria usually multiply by fission, a constriction appearing in the middle of the organism, which gradually deepens until division takes place at that point. When the division is incomplete, chains are formed, as in the bacillus of anthrax. Under favorable conditions, since bacteria may divide once every 15 minutes, an incomprehensible number of germs may be produced in a short time.

The progeny of each different germ, when grown upon the surface of solid culture-media, usually forms a small round or nearly round speck, which is called a colony. Bacteria can grow only in the presence of moisture when supplied with proper food. Many of them, usually those producing diseases in animals, will multiply only when kept at the temperature of the animal body in which they occur. Since bacteria do not contain chlorophyll, they cannot assimilate carbon dioxide as do the higher plants; light hinders their growth to a considerable extent, hence the prevalence of disease in dark, damp localities. Most forms of bacteria require oxygen, and obtain it from the air. However, some germs, as the bacillus of tetanus, will not grow if oxygen be present; consequently in cultivating them artificially in the laboratory it is necessary to exclude air and supply hydrogen or some other gas to take the place of air in the containers in which they are grown.

Bacteria are not destroyed by extreme cold, but nearly all kinds are killed at a temperature of 100° C. (212° F.), if maintained for a considerable length of time.

Pathogenic bacteria require almost invariably neutral or slightly alkaline substances for food, since the animal tissues in which they occur are alkaline; while certain other germs thrive in a slightly acid medium.

In order to obtain a definite knowledge of the biological characteristics of bacteria, they must be grown in various ways. A great variety of substances have been employed as food; some of these are natural, others artificial. Of the natural varieties of pabulum, the most important is blood-serum obtained under aseptic conditions from the blood of slaughtered animals. This serum may be coagulated by heat (Koch's blood-serum), or when a small per cent. of beef bouillon is added before coagulation it is known as Loeffler's blood-serum, and is employed very generally for the cultivation of diphtheria germs. Potatoes, tuberous roots, milk, cooked fish, and various other substances may be employed. Usually, however, for laboratory purposes, culture-media having as a basis beef bouillon containiug 1 to 2 per cent. of peptone and 0.5 per cent. of sodium chloride are employed. The cultures of bacteria, which produce the substances employed for the production of the antitoxins, are usually grown in the bouillon itself. For solid and semisolid media, substances are added to the beef bouillon, such as gelatin, agar-agar, etc. In all cases it is necessary that extreme care be taken to supply each particular kind of bacteria with that culture-medium which allows growth to occur with the greatest rapidity and certainty. The artificial or natural culture-material, before it can be employed for experimental purposes, must be placed in suitable containers, usually test-tubes or flasks, the necks of which are plugged with cotton to prevent the entrance and exit of bacteria, and still allow air to pass in and out. The contents of the containers are rendered sterile by heating repeatedly on successive days in a steam sterilizer or autoclave.

Bacteria play a very important part in the cycle of life in splitting up complex organic substances into simpler ones. In the words of Pasteur, "putrefaction is a phe-

nomenon correlative of life, not of death." Carbon dioxide, alcohol, gases of the methane series, etc., are some of the products that may be formed during the disintegration of the carbohydrates. Proteids give origin to a still greater number of compounds before being returned to plants, as ammonia, nitrous acid, and other organic constituents. Many of the intermediate products may be of synthetic origin, as bacterial cells may elaborate organic compounds as well as the cells of the higher plants and animals. Many of these intermediate products are of the greatest practical importance to mankind. Ptomaines, bearing such a striking resemblance to the alkaloids of higher plants, are perhaps the best known, as many have been isolated. Still more poisonous than the ptomaines are the toxalbumins, many behaving chemically like albumins, others like globulins, belonging to the same class of poisons as the deadly ricin of the castor-oil bean, possibly also the venom of snakes; but the most toxic substances elaborated by bacteria do not give the reaction of proteids, and do not react in a characteristic manner to alkaloidal reagents, but are many times more poisonous than either. These substances, which have not been isolated in a pure state, are called toxins. It has been estimated that $\frac{1}{250}$ grain of impure tetanus toxin is sufficient to kill a full-grown man. One minim of a bouillon toxin of diphtheria has killed a horse weighing more than half a ton.

Many of the facts of immunity have been known since the earliest time. That individuals or races are less susceptible to certain diseases than others, has been the cause of inquiry as to the meaning of disease by physicians in all ages. Likewise, it has been the universal observation that one attack of an infectious disease renders a person immune to subsequent attacks of the same disease, or at least a second attack does not recur for some time after the patient has recovered.

Jenner, more than a hundred years ago, showed that the inoculation of cowpox virus would prevent smallpox.

Raynaud, in 1877, successfully protected a calf against cowpox by injecting it with blood from a calf that had been vaccinated.

Pasteur, in 1880 and subsequently, successfully prepared vaccines against some of the animal diseases by attenuating cultures with heat, and declared: "It is possible for man to eradicate every contagious disease from off the face of the earth."

In 1886, Salmon and Smith immunized pigeons against hog cholera by the previous injection of sterilized cultures of the bacteria producing this disease.

Roux, likewise, accomplished similar results by the use of attenuated anthrax and symptomatic anthrax cultures.

Loeffler immunized guinea-pigs against diphtheria by inoculating them with weakened cultures.

C. Fraenkel, in 1890, likewise published methods for producing immunity in animals against diphtheria.

Behring and Kitasato, one day later, published their method for immunizing against diphtheria and tetanus.

In 1891, Klempler brothers reported similar results with pneumonia.

It has been a long-observed fact that carnivorous animals that thrive on putrid flesh and decomposing substances are immune to many of the diseases that attack other types of animals.

In 1887, Sewell immunized pigeons against the venom of rattlesnakes. Hericourt and Richet, the same year, found that the blood from dogs treated with tubercle germs would protect unimmunized dogs.

Ogata and Jasuhara prevented the development of anthrax in mice by previous inoculations of blood from an animal immune to anthrax.

Behring and Kitasato, a little later, showed "that the blood of an animal, which had an acquired immunity against tetanus or diphtheria when added to a virulent culture of one or the other of these germs, neutralizes the pathogenic power of such cultures, as shown by inoculation of susceptible animals." Likewise, they showed that the filtrate obtained from bouillon cultures of diphtheria and tetanus could be rendered harmless by adding to them blood from an immune animal.

Ehrlich assisted greatly in this work by showing that rabbits could be immunized against the poisons abrin and ricin.

Nearly every prominent bacteriologist in Europe and America during the period from 1890 to 1894 was engaged in research which bore directly or indirectly upon the possibility of producing antitoxins. At the International Congress of Hygiene which met in October of that year at Budapest, Roux and Behring presented papers on the production

of immunity against diphtheria, on obtaining the curative serum, and clinical data that convinced the medical world that it was possible, by artificial means, to produce nature's remedy for the cure and prevention of diphtheria.

Many unsuccessful attempts have been made to isolate the antitoxins from the blood-serum and to determine their chemical composition. They are fairly stable bodies, since the serum may be heated to nearly the coagulation-point without destroying them. Various preservatives, as trikresol, phenol, etc., do not destroy them, and they remain active for many months. The antitoxins are removed from the serum by precipitation of the proteids, and nearly all the antitoxic strength disappears from the serum when the globulins are extracted, while the globulins are found to possess nearly as great antitoxic strength as the serum from which they were obtained.

A number of workers have contended that the antitoxins were toxins that had become altered by passage through the animal body, but this belief has been contradicted by Roux and others. The belief that antitoxin is an enzyme likewise remains to be established as a fact. Ehrlich's "lateral chain theory" has been most generally accepted as the best explanation. According to this view, the animal cells are regarded as very complex molecular bodies, having many "lateral chains" of different combining powers. These cells, when stimulated by various substances of animal, vegetable, or bacterial origin, which may be introduced into the animal body by artificial or natural means (as when they are produced by bacteria during the progress of disease) form an excess of these combining affinities.

Behring, Ehrlich, and others believe that the antitoxins are neutralized in vitro by the addition of the toxins, in much the same way as an acid is neutralized by an alkali, while Roux, Metschnikoff, Calmette, and other workers do not believe the reaction is so simple, and are of the opinion that the mediation of the living cells of the animal body is necessary to bring about neutralization. It may be possible that the phenomenon is due to ferment action of the antitoxin or some substance produced by the cells of the body when the antitoxins are administered. It seems quite probable that an antitoxin produced by the administration of cultures of bacteria possesses considerable bactericidal action, while a serum obtained by the use of toxin has strong antitoxic properties and weaker bactericidal action.

Diphtheria Antitoxin.—*Antidiphtheritic Serum; Diphtherie-Heilserum,* G.; *Serum antidiphthérique,* Fr.; *Siero Antidifterico,* It.

Definition.—Diphtheria antitoxin is the serum obtained from the blood of animals that have been rendered immune to cultures of diphtheria or the toxic products produced by diphtheria germs by the subcutaneous or intravenous injection of repeated, gradually increasing doses of these substances, and possesses the property, when injected subcutaneously, of conferring immunity to susceptible animals or human beings against infection from diphtheria or curing the disease after it has become established.

History.—As already stated, the discovery of diphtheria antitoxin should be credited to numerous persons working on the subject at about the same time. Convincing proof of the therapeutic importance of diphtheria antitoxin was shown by Roux and Behring in papers presented at the International Congress of Hygiene which met in Budapest in October, 1894. Immediately after this meeting, so conclusive were the results obtained by these observers and so closely did they coincide with the results to be expected from the laboratory experiments that had been made in all parts of the world, that the manufacture of diphtheria antitoxin was undertaken on a large scale in nearly every civilized country.

Preparation.—The preparation of diphtheria antitoxin may be divided into three stages:

1. Toxin.—Cultures are made from the throats of patients suffering from diphtheria by applying to the diseased tissue a pledget of sterilized absorbent cotton, and then rubbing the infected cotton over the surface of coagulated Loeffler's blood-serum, etc., contained in test-tubes of suitable size, which are then placed in the incubator, kept at the body temperature, and allowed to remain for from 12 to 24 hours, at the end of which time examination will show numerous, roundish, pin-point colonies upon the surface. Some of these colonies, if the plants were made from a case of genuine diphtheria, will be found to be pure cultures of the Klebs-Loeffler diphtheria germ. Usually, there will be several varieties of bacteria found upon the surface of the culture-medium, since normally in the mouth and throat there are many different kinds of bacteria

always present. Microscopic examination shows whether the case is one of true diphtheria. A number of colonies are taken from the culture-medium with a sterilized platinum wire, and transferred to fresh tubes of blood-serum. Again the inoculated tubes are placed in the incubator, and allowed to remain until the cultures develop, and are then examined. One or more of the tubes will be found to contain pure cultures of Klebs-Loeffler diphtheria germs. From these pure cultures other tubes are planted, which, after growing 24 hours, serve for inoculating the large flasks of beef bouillon in which the diphtheria toxins are grown, for immunizing the animals that are to produce the antitoxin. Great care should be exercised in planting the flasks, in order that they do not become accidentally contaminated by dust or other means. The planted flasks are then placed in the incubator, and allowed to remain for several days, at the end of which time the clear, transparent bouillon has been changed to a turbid, unsightly looking mixture from the presence of countless millions of diphtheria germs. If microscopic examination shows the presence of only Klebs-Loeffler diphtheria germs, the culture is filtered through unglazed porcelain, which removes all bacteria, and gives the clear, transparent beef bouillon in which are contained the soluble products elaborated by the growing and multiplying germs. The chemical nature of these products has not been satisfactorily determined. For the sake of convenience, this beef bouillon, which contains many other substances besides the toxins, which may or may not be of value in immunizing the animals, is called diphtheria toxin. Before employing the toxin for injection into the animals that are to produce the diphtheria antitoxin, it is necessary to determine the minimum lethal dose for half-grown guinea-pigs which produces death within 4 days. This serves as a basis for the calculation of the quantity needed to immunize larger animals.

2. Immunizing the Animals.—Various animals, such as horses, mules, and donkeys, have been employed for the preparation of diphtheria antitoxin, the former being generally preferred, owing to the ease with which they can be handled, the large quantity of available blood, and the readiness with which they can be immunized against diphtheria. Only young horses, which have been subjected to the Mallein test, and passed a searching physical examination by a veterinarian, should be employed for the production of antitoxin. The individual resistance of horses varies considerably; in some instances very minute amounts of the diphtheria toxin are sufficient to produce alarming symptoms of intoxication and sometimes paralysis. In commencing the treatment, 0.1 Cc. of a toxin of such strength that $\frac{1}{200}$ Cc. will kill test guinea-pigs is quite sufficient for the first injection. The toxins or cultures may be injected subcutaneously or intravenously, the former method being generally preferred; in either case careful aseptic and antiseptic precautions should be observed. Soon after the subcutaneous administration of the toxins the pulse becomes accelerated, the temperature elevated, there is loss of appetite, and more or less swelling occurs at the point of injection—in fact, the symptoms are much the same as those observed in the early stages of diphtheria in human beings. This condition continues for a variable number of hours or days, after which the animal recovers, when a second and larger injection is made, and the same disturbances are noted as after the first dose. Thus the injections are repeated as often as deemed necessary, the quantity being increased in proportion to the resistance of the animal until extremely large amounts of the cultures or toxins can be given without producing alarming symptoms. When the horse has become immune to these doses, the treatment is discontinued for a period of 10 days to 2 weeks, when small amounts of blood are taken for test-purposes by plunging a trocar directly into the jugular vein under antiseptic and aseptic precautions. The blood is set aside and allowed to coagulate, the clot contracts, and the fluid portion of the blood, the serum, which contains the antitoxin in solution, separates as a nearly transparent, straw-colored fluid at the top of the container. This serum, containing the antitoxin in solution, is usually called antitoxin, although it contains various organic and inorganic substances besides. The serum is then tested for its immunizing properties to determine whether the horse is in fit condition to allow a large bleeding to be made for obtaining the antitoxin for commercial purposes. (For the method of testing this serum, see paragraph entitled *Tests.*)

3. Preparation of the Antitoxin.—If the antitoxin from the test-drawing of blood contains a sufficient number of immunizing units per Cc., 5 to 10 liters of blood are drawn, clotting allowed to occur, the antitoxin collected into sterile containers, some preservative, as 0.5 per cent. carbolic acid, 0.4 per cent. trikresol, etc., added, and the fluid set aside for some weeks, during which time more or less precipitate is formed, which

is removed by filtration through sterile filters, tested for strength, asepsis, etc. (see *Tests*), and is finally bottled for the market. The greatest care should be exercised to keep the animals and stables in the best possible condition, and to conduct all operations with the most minute attention to aseptic and antiseptic precautions.

Physical Properties and Tests.—Diphtheria antitoxin is a nearly transparent, straw-colored fluid, which may become slightly turbid on standing from the chemical precipitation of organic or inorganic substances. The serum, as it is obtained from the blood, has a specific gravity of 1.017 to 1.032; average of 10 samples, 1.0262. Total solids, 7.8 to 11.18 per cent.; average of 44 samples, 9.65 per cent. Artificial concentration of the serum, which sometimes is practised surreptitiously, increases the specific gravity and total solids. Various preservatives are generally present, as trikresol (0.4 per cent.), phenol (0.5 per cent.), camphor, etc.

The physiological activity of antitoxin is determined by the number of immunity units contained in each Cc. An immunity unit may be defined as the amount of antitoxin which will neutralize 100 times the minimum fatal dose of a test toxin when the two are mixed together and immediately injected subcutaneously into a standard test guinea-pig (250 Gm. body weight). Several methods have been employed for finding the number of units in a given sample of antitoxin, but most of the serum now appearing on the market is assayed according to Ehrlich's method, which may be briefly stated as follows: A test diphtheria toxin is prepared according to the method already given; and since an antitoxin unit neutralizes the action of 100 times the minimum lethal dose of toxin, the quantity of the test toxin which will exactly neutralize 1 unit of Ehrlich's standard test antitoxin is found by measuring out, with specially graduated pipettes, into several small glass capsules, an amount of Ehrlich's test antitoxin, properly diluted, which contains exactly 1 antitoxic unit, and then adding to each capsule varying quantities of the diphtheria test toxin, and injecting each of the several portions of toxin and antitoxin into a test guinea-pig (250 Gm. body weight). If the toxin is a virulent one, several of the animals will die within 4 days. The smallest quantity of the toxin which neutralizes 1 unit of the antitoxin, and still kills the test animal, is called the L+ dose of toxin, and is employed for assaying any given sample of antitoxin. In determining the strength of a given antitoxin, an L+ dose of toxin is measured out with the special pipette as before into several small glass capsules. To each of these measured portions of toxin are then added various quantities of the diphtheria antitoxin to be tested, the mixture being diluted to 1 Cc. by the addition of a suitable quantity of 0.6 per cent. salt solution. Each portion of the mixture of toxin and antitoxin is injected subcutaneously into a test guinea-pig. One or more of the animals will die within 4 days from the time of the injection. The smallest quantity of serum preventing the death of a test guinea-pig contains 1 antitoxin unit, consequently, if 0.002 of a given sample of serum contains 1 unit, 1 Cc. of the serum will contain 500 units. In testing a given sample of antitoxin as it appears on the market, it will first be necessary to determine the exact quantity of serum in the container, and to divide the entire number of units given on the label by this number, the quotient being the number of units which should be present in each Cc. A comparison of this number of units with the number of units found in each Cc., determined according to Ehrlich's method, will show whether it is up to standard or not.

Several grades of antitoxin appear on the market which differ from each other according to the number of immunity units contained in each Cc. The more concentrated the serum, the greater the cost of production. The poorest grade of serum contains 200 or less units per Cc.; very little of this grade is now sold. The second grade, the product most often employed, contains over 200 units per Cc. The serum is put up sometimes in bottles, preferably in the United States in sealed glass bulbs, each containing a single dose of 500, 1000, 1500, 2000, 3000, or 4000 units.

The injection of small quantities of serum into healthy guinea-pigs, mice, etc., should not produce much local or general disturbance. It should not be possible to obtain aërobic or anaërobic cultures from the serum. Diphtheria and other antitoxins should be kept in a cool dark place. The containers are generally broken by freezing.

The German Pharmacopœia recognizes diphtheria antitoxin both in the fluid and solid form, which are not allowed to be offered for sale or use until they have been examined and sealed at the Royal Institute for Experimental Therapy at Frankfort-on-the-Main. The dry antitoxin is obtained by carefully drying in vacuo high-grade fluid

antitoxic serum, and is free from antiseptic and other preservatives. It occurs in the form of yellow transparent lamellæ or a yellowish-white powder, 1 Gm. of which contains 5000 immunizing units, and is intended for preparing the fluid antitoxin extemporaneously in the original glass-stoppered vials in which it is sold, by addition of the prescribed quantity of sterilized distilled water. It is, however, a fact that dried serum has not proved popular, because of the great difficulty of getting it into solution and the great danger of accidental infection.

Action and Uses.—Diphtheria antitoxin is a specific remedy for the treatment of, or an immunizing agent against, diphtheria. It is usually administered hypodermically, deep injections being made in any part of the body where there is plenty of subcutaneous tissue, as in the abdominal wall or flank. A few reports would indicate that the serum may be followed by satisfactory results when given per stomach or per rectum, but the action is slow and uncertain when given in this way. Opinions vary as to the quantity of antitoxin, or, more properly speaking, the number of immunity units that should be given, some authorities preferring to give several thousands of units at the first injection, repeating them if necessary, while equally good observers claim that just as satisfactory results may be obtained by injecting much smaller quantities and repeating within a few hours if improvement does not quickly follow. Fortunately, unlike most remedies, the exhibition of large doses is not followed by harmful results, as the antitoxin is usually harmless in quantities many times larger than are really necessary to control the disease. Experience proves that the earlier treatment is commenced, the more prompt and certain the cure. In cases in which the disease is merely suspected, antitoxin should be given at once, as it usually does no harm, and may prevent serious developments. For the purpose of preventing the disease in exposed persons, 1000 units are usually sufficient; mild cases treated within 24 hours of the onset of the symptoms require 2000 to 3000 units; in late, severe, or laryngeal cases, 3000 to 4000 or more units may be necessary. In all cases, and whatever the dose, it should be promptly repeated in 6 to 12 hours if improvement does not occur. The age of the patient, contrary to the general rule, need not be considered, except in rare cases, owing to the harmlessness of the remedy. The greater the number of units per Cc., the less is the distention of the tissues at the point of injection, but it is advisable that the specific gravity of the serum should be as nearly as possible that of the serum of the normal body.

Results.—As pointed out by Virchow, "the brute force of figures" is overwhelmingly in favor of the use of diphtheria antitoxin. No remedy has ever become so universally recognized as a specific agent in any disease as has the use of antitoxin in diphtheria. The death-rate in Baltimore (Board of Health report) from diphtheria without antitoxin in 1896 was 51.87 per cent.; in 1898, with the serum, 5.73 per cent. New York, Chicago, and many other American cities show similar reports. The reports from foreign municipalities, hospitals, etc., all proclaim the same verdict. Where 1000 immunity units of antitoxin are injected as a prophylactic after exposure to the disease, almost certain immunity is produced.

Streptococcus Antitoxin.—*Antistreptococcic serum; Streptococcus-Heilserum*, G., *Serum antistreptococcique*, Fr.; *Siero Antistreptococco*, It.—This antitoxin is obtained from the blood of horses that have been immunized against cultures of Streptococcus pyogenes, obtained from cases of erysipelas, puerperal fever, etc. It possesses the same chemical and physical properties as diphtheria antitoxin.

The same tests are applied for determining its purity and sterility. No suitable method has been devised for standardizing it.

Streptococcus antitoxin is employed for the treatment of all infections due to the Streptococcus pyogenes; especially have beneficial results followed its use in erysipelas, puerperal fever, etc. It should be employed in very large doses; 10 Cc. or more every 6 hours should be injected unless the symptoms improve.

Tetanus Antitoxin.—*Antitetanic serum; Tetanus-Heilserum*, G.; *Serum antitetanique*, Fr.; *Siero Antitetanico*, It.—This antitoxin was the first of the antitoxins to be discovered. It is obtained from the blood of horses that have been immunized to the toxins of pure cultures of the tetanus bacillus. The tetanus toxins are the most virulent poisons thus far discovered, consequently great care must be exercised in immunizing the animals.

Tetanus antitoxin has the same physical and chemical properties as diphtheria antitoxin. It is amenable to the same tests for purity and sterility. No method of assay has been generally accepted.

Tetanus antitoxin is of greatest value as a prophylactic administered as soon as possible after infection has taken place, injected in 10 Cc. doses. When employed as a treatment for tetanus, it should be given in extremely large doses, 10 Cc. or more every 6 hours, and continued for a number of days unless the symptoms improve. Sometimes in tetanus the skull is trephined and the antitoxin injected directly into the brain substance in doses of 1 to 3 Cc., but statistics do not show that the serum acts with greater certainty. Since tetanus usually follows infection through a puncture wound, especially in the sole of the foot, it is always best in addition to the serum treatment to enlarge the wound, remove any foreign substances present, and treat it according to the best surgical methods.

Tubercle Antitoxin.—*Antitubercle serum.*—This serum is prepared from the blood of horses immunized to the toxic products of the tubercle bacillus. It has the same chemical and physical properties as the other antitoxins, but appears to be of less value than any of them.

APOCYNACEÆ.—The Dog-bane Family.

Genera about 130, species more than 1000, very abundant in most tropical countries, thence decreasing, rare in temperate regions. So numerous and abundant are these plants in nearly all warm countries, and so generally and intensely poisonous are they, that the following botanical characters should be recognized by everyone: Trees or erect or climbing shrubs, rarely perennial herbs, the juice milky, the leaves almost always opposite and without stipules, the flowers regular, hermaphrodite, the corolla gamopetalous, usually more or less (often very long-) tubular, the stamens 5 (rarely 4) adnate to the corolla at the base, or higher, the anthers usually adherent in a cone-shaped body to the stigma, the pistils superior, variously 2-carpelled, but with a single style, and variously annulate toward the summit, the stigma 2-lobed or cleft, the fruit usually a follicle, and the seed commonly plumose at one or both ends.

In habits, foliage, and inflorescence, these plants are among the handsomest, and many of them among the most fragrant, in the vegetable kingdom, and are largely used for decoration. Otherwise, except for a few edible fruits, and the rubber-yielding species (see Elastica), interest is almost entirely in the medicinal and poisonous properties.

Carissa Carandas L. (*Karonda, Karinda, Karanada, Kalaka*, etc.), of the East Indies, *C. edulis* Vahl (the *Natal plum*), of eastern Africa, *Willughbeia edulis* Roxb., of India, *Hancornia speciosa* Gomez (Manguba), of Brazil, *Carpodium acida* G. Don, of Sierra Leone, *Tabernæmontana dichotoma* Roxb. (the East Indian Apple of Eve), *Melodinus monogynus* Roxb., *Oncinus Cochinchinensis* Lour., and *Plumiera obtusa* L., of India, are the principal edible fruit-yielding species.

Probably no other family possesses alkaloids and glucosides so generally distributed among its members. Active constituents may be encountered in any of the plant-parts, but are especially common and abundant in the barks and seeds. These are very common agents of criminal, military, ordeal, and legal poisoning among savages, and accidental poisoning by them is not infrequent. Very many are utilized as domestic or native remedies, and a number (see Apocynum, Strophanthus, Alstonia, and Acocanthera—under Curare) have been found useful in professional medicine. An enumeration of all those used as medicines or poisons, or known to be actively medicinal or poisonous, would exceed our space-limits, and only the most important will be considered.

Holarrhena antidysenterica Wall. yields the *East Indian Conessi* or *Tellicherry bark* or *Écorcé de Codagapala, Kura, Kurchi, Kuda*, etc. (for an elaborate account see Dymock and Hooper, *Pharm'g'a'. Ind.*, ii. 391), which has very important uses, especially as an antidysenteric (the seeds for headache). The active constituent appears to be the alkaloid *conessine* or *wrightine* ($C_{24}H_{40}N_2$, a yellowish powder, anthelmintic and astringent). The genuine bark, experimented with in Europe, was found to be very active and useful, but fell into disrepute, it is said, because of the common substitution of the nearly inert bark and seeds of *Wrightia tinctoria* Br., which seeds are not bitter and which bark is of a much darker color and not exfoliating in patches, as well as that of *W. tomentosa*, which may be similarly distinguished. The bark of *H. Codago* G. Don and *H. pubescens* Wall., both of India, are very largely used, the seeds as anthelmintics, the roots for toothache, angina, bleeding piles, etc.

Carissa.—Various species are active, apparently due to the presence of glucosides similar to *carissin*, which occurs in *C. ovata stolonifera* F. M. Bailey, of Australia, a powerful heart poison. A similar heart poison, *ouabain*, is yielded by *Acokanthera Schimperi* B. et H. (*C. Schimperi* A. DC.), used as an arrow poison by the Somalis.

Cerbera.—The bark of *C. Tanghinia* Hook. (*Tanghinia Madagascarensis* Pet. Th.) contains the glucoside *tanghinin*, a powerful heart poison. Very similar in activity are the glucosides *cerberid* and *thevetosin*, yielded by *Thevetia Yccotli* DC. (*Gerbera thevetioides* H. et B.), the *Yccotlo* of Mexico. Other species of the genus act similarly and doubtless have similar constituents.

Oleander.—The bark and leaves of the common oleander (*Nerium Oleander* L.), native of southern Europe and adjacent Asia, are actively poisonous. They contain the glucosides *oleandrin* (*pseudocurarin*, very similar to digitalin) and *neriin*.

The root-bark of *N. odoratum* Lam., of the East Indies, called *Kaner*, *Alari*, *Svetapushpa*, etc., acts similarly and contains the highly poisonous glucosides (?) *neriodorin* and *neriodorein* (Greenish, *Pharm. Jour.*, April 23, 1881).

Plumiera.—This genus is rich in native remedies. The bark of *P. lancifolia major* Müll. Arg., of Brazil, containing the glucoside *agoniadin* (contained also in *P. Sucuuba* Spruce), and that of *P. acutifolia* Poir, the *Dolochapo* of India, *Sanbodja* of Japan, or *Ki-tau-hwa* of China, containing *plumierid*, are used in intermittents, etc. The root of the last is also purgative. The milk-juice of *P. retusa* Lam., of Madagascar, is caustic, that of *P. drastica* Mart., the *Tiborna* of Brazil, is a drastic, and that (poisonous) of *P. phagedænica* Mart., the *Sebuii-iiga* of Brazil, is used as an anthelmintic, etc. The bark and root of *P. rubra* L., of the West Indies, and the leaves and bark of *P. Agoniada* Peck., are used as purgatives.

Alkaloids occur in the bark and seed of *Calicarpum albiflorum* T. et B. and of *C. Roxburghii* Don (tetanus-producing), both of India, in the bark of *Ochrosia Ackeringiæ* Miq., *O. coccineus* Miq., *O. elliptica* Lab., and probably in other species of this genus which are used medicinally; in the bark, leaves, and seeds of *Kopsia flavida* Bl., in the leaves and bark of *Hunteria Sundana* Miq., *H. corymbosa* Roxb., *Balberopus villosus* Miq., *Cercocomus macrantha* F. et B., *Conemorpha macrophylla* Don, and *Pseudochrosia glomerata* Bl., all of Java, in various species of *Cyrtosiphonia* and *Vallesia*, the last used as an antiperiodic, *ophioxyline* and *pseudobrucine* in the root of *Ophioxylon serpentinum* W. (*Rauwolfia s.* Benth.), the *Chundra*, *Harkai*, etc., of India, used as an anthelmintic, febrifuge, and oxytocic, the same probably existing also in *O. trifoliatum* Gærtn., of Java, and in *Voacanga fœtida* Thou., of Java. In several species of *Tabernæmontana* occur one or more alkaloids very similar to *buxine*. One of these barks, known as *Johimbehe-bark*, of Camaroons, is used as an aphrodisiac, another in the treatment of elephantiasis. The root-bark of *T. coronana* (L.) W. (*Nerium c.* L.), the *Tagar* or *Nandibattal* of India, and many other species, have more or less important local medicinal uses. The antiperiodic alkaloids *vellosine* (*pereirine*) and *geissospermine* occur in the bark of *Geissosperma Vellozii* Fr. All. (*Tabernæmontana lævis* Vell.), the *Pao Pereiro* of Brazil. The first-named alkaloid exists also in the fruit and leaves.

In the poisonous seeds of *Cerbera Odallam* Gærtn. (*Tanghinia o.*) and in the leaves and bark, as also in those of *C. ladoria* Ham., used as a purgative, occurs the poisonous amaroid *cerberin*.

Arrow poisons are yielded by *Urechites suberecta* Jacq., *Malouetia nitida* Spruce, which acts like curare, and which has caused various cases of accidental poisoning, and by the juice of *Echites venenosa* Mart. (*Caminhoa*), all of tropical America. At least half a dozen other species of *Echites* are used in native medicine. The root of *E. Chilensis* A. DC. is a commercial article in Chile under the name *Quilmey*.

Vinca minor L., *Sinngrün*, contains the principle *vincin*, probably a glucoside, and finds many minor and indefinite uses in domestic medicine.

Fish poisons are yielded by the seeds of *Thevetia Ahouai* DC., and of *T. neriifolia* Juss., both of Brazil, the latter at least containing the glucoside *thevetin*, the bark of *Melodinus Monogynus* Roxb. (*Wrightia piscidia* Don, *Nerium p.* Roxb.), and the leaves and twigs of *Kamettia Malabarica* Kostl., of India.

Unstudied bitter principles exist in the following, leading to their use as antiperiodics or simple bitters: *Cerbera oppositifolia* Lam., of southeastern Asia, the bark of *Continia illustris* Vell. (*Quina de Camanu*), used as a cinchona substitute in Brazil, the wood of *Carissa Xylopicron* Pet. Th., of Bourbon, the barks of *Gonioma Kamassi* E. Mey., used as an angustura substitute at the Cape, and *Alyxia stellata* R. et S., of the East Indies, the latter, as well as probably that of other species of the genus, yielding coumarin.

The following are employed as purgatives: the roots of *Dipladenia pastoreum* A. DC. and *Odontadenia speciosa* Benth., of Brazil, *Echites alexicaca* Mart. (*Purga de Campo*), *E. Cururu* Mart., of Brazil, the root, leaves, and seeds of *Allamanda cathartica* L. (*A. Linnei* Pohl, *A. Aubletii* Pohl, *A. grandiflora* Lam., *Orelia g.*, Aubl.), of tropical America and widely cultivated, *Jahara Sontakha* or *Arasin* of the East Indies, an emetico-cathartic, of special use in lead colic, also other species of *Allamanda*, the fruit of *Pacourea Guyanensis* Aubl., and the milk-juices of various species of *Rauwolfia*, that of *R. canescens* W. vesicant and said to contain an alkaloid.

The following are used as anthelmintics: the milk-juices of *Kickxia Africana* Benth., *Callophora utilis* Mart., of Brazil, the bark of *Echites pubescens* Buch, of the East Indies, also used as an antiperiodic, and the root of *Wrightia Ceylonica* R. Br., the seed of which yields 30 per cent. of oil.

The root and herbage of *Echites longiflora* Desf., the *Flor de Babado* of Brazil, are used for hemorrhoids, the roots of *Ichnocarpus frutescens* R. Br., the *Sarifa*, *Syamalata*, etc., of the East Indies, are used like sarsaparilla, the juice from the bark of *Parameria vulneraria* Radlk., *Tagulaway Balsam* of southeastern Asia, is used as a vulnerary. The entire plant *Wrightia tinctoria* R. Br., the *Kala-Koora* of the East Indies, yields a blue coloring-matter, substituting indigo.

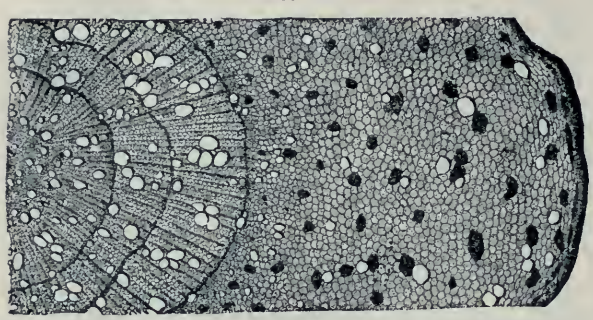
APOCYNUM, *U. S.*

Canadian hemp, *Black Indian hemp* (often called, incorrectly, "Indian Hemp"), E.; *Canadische Hanfwurzel*, G.; *Chanvre du Canada*, Fr.

The dried rhizome and roots of *Apocynum cannabinum* L., or of closely allied species of *Apocynum* (Fam. *Apocynaceæ*).

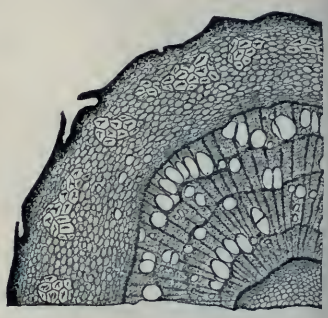
Origin.—We are in complete ignorance as to the species of *Apocynum* which should yield this drug. Up to a very recent period, 5 or more distinct species were included

Fig. 30.



Apocynum cannabinum: transverse section; magnified 25 diameters.

Fig. 31.



Apocynum androsæmifolium: transverse section; magnified 25 diameters.

under the name *A. cannabinum*, even in our standard botanical works, and the plants themselves were not distinguished. It is therefore impossible to ascertain which species yields the different drugs whose actions have been reported upon under that name. This fact doubtless explains, in great part, the conflicting testimony regarding the medicinal activity of the drug. The real *A. cannabinum* is a perennial milky-juiced herb growing throughout the most of North America. The species is probably always glabrous, although present limitations allow of some pubescence on the lower leaf surfaces. The stem is 1 to 2 M. (about 3 to 6 Ft.) high, slender, branched, erect or strongly ascending. The opposite, entire leaves are shortly and stoutly petioled, the blades 5 to 10

Fig. 32.

Apocynum cannabinum (½ Nat.).

Cm. (2 to 4 In.) long and 0.3 to 2.5 Cm. ($\frac{1}{8}$ to 1 In.) broad, ranging from oblong or lance-oblong to broader, just how much broader being as yet uncertain, rounded to narrowed at the base, mucronate at the summit, rather thin and bright-green. A form with broadly ovate, cordate leaves is also referred to this species. A small, dense, and

contracted cyme of greenish-white flowers terminates the stem, the lateral branches quickly surpassing it and producing similar cymes. The flowers are strictly erect, and all those of one cyme mature pretty much at the same time. Their size and structure are determined best from reference to the accompanying illustration. The fruit is a slenderly cylindraceous, tapering, and acute follicle, 15 to 20 Cm. (6 to 8 In.) long, and about 3 or 4 Mm. ($\frac{1}{8}$ to $\frac{1}{6}$ In.) thick. The rhizome is horizontal and somewhat branched, usually more deeply buried than in most other species.

Its nearest relative is *A. album* Greene, with white flowers and relatively narrower leaves. It is readily distinguished by its sprawling. habit, the branches being at their lower portions horizontal or usually deflexed, the terminal portions erect. The plant is perfectly glabrous. It grows in moist and usually sandy soil. The species which most resembles *A. cannabinum*, and which is probably the most common and abundant of the genus, is *A. medium* Greene. The corolla averages about a half larger, is open-campanulate, with the margin somewhat recurved, and white or commonly pinkish. The flowers mature and fall away successively upon the branchlets, and when fully mature they are slightly recurved or sub-pendulous. All the other species at all common in the Northeast have the flowers campanulate like that last described. Southward and westward, *A. pubescens* R. Br., the *Velvety dogbane*, is common. It is readily recognized by its velvety surface throughout. It is not improbable that this species yields the drug that has been so favorably reported upon.

Description.—The following description applies to the drug of commerce, the characters of the different species not having been differentiated.

Of indefinite length, 3 to 8 Mm. ($\frac{1}{8}$ to $\frac{1}{3}$ In.) thick, cylindrical or with a few obscure angles produced by drying, lightly longitudinally wrinkled, and usually more or less transversely fissured; orange-brown, becoming gray-brown upon keeping; fracture weak, brittle, sharply transverse, exhibiting a thin, corky brown layer, the remainder of the bark about as thick as the wood, white or sometimes pinkish, starchy, containing laticiferous ducts, the wood yellowish, of several rings, finely radiate and very coarsely porous, and enclosing a very thin white pith; almost inodorous, the taste starchy, afterward becoming bitter and somewhat acrid.

Constituents.—The active constituents are the bitter glucosides apocynin and apocynein, with which are resin, starch, gum, sugar, a little wax, and tannin. *Apocynin* is amorphous, resin-like, soluble in alcohol and ether, not in water, its activity destroyed by boiling with HCl. *Apocynein* is yellowish, soluble in alcohol and water, not in ether.

Pharmaceutical Preparation.—Fluidextract of Apocynum, U. S. P.

Action and Uses.—In moderate dose apocynum is considered an excellent diuretic. Overdoses produce vomiting and purging, which are due to the gastro-intestinal inflammation which its excessive administration causes. Its employment is said also to promote expectoration and sweating. It stimulates the heart muscle, the vagus nerves, and the vasomotor center, thus slowing the pulse and increasing arterial tension. Its effects are similar to those of digitalis. Because of its diuretic properties, apocynum has been employed in the treatment of cardiac and renal dropsy. Its bitter principle is also said to be tonic and antiperiodic, and for this reason it has been recommended in the treatment of mild cases of malarial fever and in various atonic conditions of the stomach following the acute infectious diseases. It is also said to destroy intestinal worms, but is rarely employed for this purpose at the present time.

The dose of apocynum is from 1 to 5 grains (0.06–0.30 Gm.), but as much as 20 grains (1.3 Gm.) have been employed. An infusion made with $\frac{1}{2}$ ounce (16 Gm.) of the drug in 1 pint (480 Cc.) of water is given in doses of 1 or 2 fluidounces (30–60 Cc.). The dose of the fluidextract is from 1 to 5 minims (0.05–0.30 Cc.); of the tincture, from 5 to 20 minims (0.30–1.30 Cc.), several times daily. *Apocynum adrosæmifolium* has been used for the same purposes, but is practically of no value.

Allied Drugs.—The rhizome of *A. androsæmifolium* L. (*Dog's-bane, Bitter-root, Wild ipecac, Wandering milkweed*) is also used. The plant has a similar range to the other. It is smooth, much lower, and its branches are widely spreading. Its broad and thin leaves, at least the lower ones, are strongly deflexed and its corollas are large, rosy-white, broader than long, and the border strongly recurved. The rhizome is only about half as thick, is tougher, and its bark relatively very much thinner. Its constituents have not been investigated, but it contains glucosides similar to, if not identical with, those of the last.

APOMORPHINÆ HYDROCHLORIDUM, *U. S., Br.*—Apomorphine Hydrochloride.

Apomorphinum hydrochloricum, P. G.—*Chlorhydrate d'apomorphine*, Fr.; *Apomorphinhydrochlorid*, G.; *Chloridrato di apomorfina*, F. It.

Formula, $C_{17}H_{17}NO_2.HCl$. Molecular weight, 301.34.

The hydrochloride of an artificial alkaloid prepared from morphine or codeine.

Preparation.—Morphine and concentrated hydrochloric acid in the ratio of 1 to 20 are introduced into a strong glass tube, securely sealed, and then heated to 140°–150° C. (284°–302° F.) for 3 hours. After cooling, the contents of the tube are diluted with air-free distilled water, supersaturated with sodium bicarbonate, filtered, and the apomorphine extracted with chloroform or ether, from which, upon the addition of hydrochloric acid, the apomorphine hydrochloride may then be obtained in crystalline form. The salt, as well as the alkaloid, should be rapidly dried under a bell jar and protected from moisture and light. Apomorphine may also be prepared from morphine hydrochloride by the process of Mayer (1871), by heating morphine hydrochloride for 1½ to 2 hours to 120° C. (248° F.) with a solution of zinc chloride of such strength that its boiling-point is at 200° C. (392° F.). Matthiessen and Wright, who discovered apomorphine, also obtained it by heating codeine with hydrochloric acid, *chlorocodid*, $C_{13}H_{20}ClNO_2$, being first formed, and which on further heating splits into methyl chloride, CH_3Cl, and apomorphine, $C_{17}H_{17}NO_2$.

Properties.—Apomorphine hydrochloride occurs in minute monoclinic prisms, grayish-white in color, glistening, odorless, having a slightly bitter taste, and acquiring a greenish tint upon exposure to light and air. It is soluble at 25° C. (77° F.) in 39.5 parts (at 15° C. (59° F.) in 40 parts, P. G., in 50 parts, Br.) of water, 38.2 parts of alcohol, 1864 parts of ether, and in 3800 parts of chloroform. The salt decomposes between 200° and 210° C. (392° and 410° F.), and fuses at 263.8° C. (507° F.). The aqueous solution shows a neutral (or very feebly acid, Br.) reaction to litmus-paper. Apomorphine hydrochloride is not colored when treated with sulphuric acid; with nitric acid a deep purple color fading to orange is produced; with sulphuric acid containing a trace of selenious acid, a dark blue color, fading to violet, and then turning black; with sulphuric acid containing a trace of nitric acid, a blood-red color, fading to orange; with sulphuric acid containing a trace of ferric chloride, a pale-blue color; with sulphuric acid containing a trace of ammonium vanadate, a violet-blue color, changing to deep greenish blue; with sulphuric acid containing a little paraldehyde, a green color, fading to reddish brown; with sulphuric acid containing potassium iodate, a black color, changing to brown, and finally to pale brown. If sulphuric acid be added to a crystal of apomorphine hydrochloride and a crystal of potassium nitrate, the latter is colored red, and on stirring with a glass rod the solution becomes green, then blue, then purple, and finally cherry red. Acetic acid dissolves the salt without color, but on adding a trace of potassium iodate, the solution turns blood red, changes to purple, and on adding a little ether and shaking, the latter assumes a blue color (U. S.). Apomorphine is slowly decomposed in boiling water or boiling alcohol. With nitric acid a blood-red color results. With solution of sodium or potassium hydroxide a purple color develops upon exposure to air, gradually changing to black. Dissolved in ammonium hydroxide solution a purple color develops. Sodium bicarbonate added to an aqueous solution throws down an amorphous precipitate of apomorphine, which rapidly turns green and forms a bluish-green solution with alcohol, a purple one with ether or benzene, and a violet-blue one with chloroform.

Tests.—Gold chloride test-solution produces a reddish-purple precipitate in a solution of apomorphine hydrochloride. Diluted ferric chloride test-solution colors a solution of the salt red (distinction from morphine, which, under the same test, is colored blue). If the salt imparts at once an emerald-green color to 100 parts of water on being shaken with it a few times in a test-tube, it should be rejected.

Silver nitrate test-solution added to the aqueous solution of the salt throws down a white precipitate, insoluble in nitric acid, soon turning black by reduction to metallic silver, and instantly reduced by addition of ammonia-water. If 0.05 Gm. be shaken with a solution made by dissolving 0.05 Gm. of ferrous sulphate in 10 Cc. of water, the solution will gradually turn blue and then black; on the addition of some alcohol, the solution resumes its blue color (absence of codeine, morphine, narceine, and narcotine). —U. S.

Apomorphine hydrochloride should be kept in small non-actinic glass vials. It is always dispensed in the form of aqueous solutions, and amber-colored vials should be used for the same; the gradual green coloration of the solution can be prevented by addition of a few drops of hydrochloric or acetic acid.

Action and Uses.—Either because of some idiosyncrasy of the individual or because of the employment of an impure article, a number of untoward symptoms have followed the administration of moderate doses of apomorphine. Nervous irritation, hyperæsthesia, depression of the circulation, shallow, irregular respiration, convulsions, and collapse have been noted.

In moderate amounts apomorphine stimulates the motor centers of the brain and increases the force and rapidity of the pulse by stimulating the accelerator nerves of the heart and the vasomotor center. Poisonous amounts depress the circulation and produce tetanic convulsions which are probably of spinal origin. The motor and sensory nerves and muscles also are depressed by overdoses of this drug. It has little or no effect upon respiration unless given in poisonous doses, when it causes the breathing to become rapid and irregular. Apomorphine increases the secretion of mucous membranes and stimulates the vomiting center in the medulla, thereby causing emesis.

Apomorphine is employed as a sedative expectorant in the treatment of acute bronchitis, when the air-passages are inflamed and the secretion scanty. It is probably the most useful emetic which we have, and may be employed as such in the treatment of narcotic poisoning, in chronic catarrh of the stomach and air-passages, and in dislodging foreign bodies from the bronchi or œsophagus. It has also been used with success in treating spasmodic asthma and spasmodic croup. Choreic movements and hiccough are also said to have been relieved by its administration. Apomorphine has been used in small non-emetic doses as a valuable nervous sedative in delirium tremens.

As an expectorant, apomorphine is given by the mouth in doses of from $\frac{1}{40}$ to $\frac{1}{25}$ of a grain (0.0015–0.0025 Gm.). As an emetic, $\frac{1}{20}$ of a grain (0.003 Gm.) is usually sufficient, but as much as $\frac{1}{5}$ of a grain (0.01 Gm.) may be given to very robust patients. The last amount should be given with care, however, as it may occasion great depression or collapse.

AQUA, *U. S.*—Water.

Eau, Fr.; *Wasser*, G.; *Agua*, Sp.; *Acqua*, It.

Potable water in its purest attainable state (U. S.). Aqua was dropped from the last Br. P.

Formula, H_2O. Molecular weight, 17.88.

Properties.—Water is often combined in nature, as in many crystalline compounds, and is very abundant in the free state. Natural water is an excellent solvent for most gases and many salts, but it is rarely found pure; B. M. Brackenridge and E. Stieren observed (1860) chemically pure water in the spring of a ravine known as "the Dark Hollow," in Allegheny County, Pa. With few exceptions, *spring water* contains carbon dioxide in solution, and by its agency dissolves calcium carbonate and sulphate and magnesium carbonate from the soil. Such water precipitates an insoluble lime-soap from solution of ordinary soap, and is called *hard*. Hardness is of two kinds, *temporary* and *permanent*. The temporary hardness is due to dissolved carbonates of calcium and magnesium, which are precipitated on boiling the water, by which the solvent carbon dioxide is driven out and the water is thus made soft to a great extent. The permanent hardness is due to magnesium and calcium sulphates, which cannot be removed by boiling. Clark's method for removing hardness from waters consists in adding lime water in sufficient quantity to the water, by which the bicarbonates of calcium and magnesium are converted into insoluble carbonates and precipitated. Hardness is expressed in degrees: 1 degree represents 7 parts of calcium oxide (German) or calcium carbonate (French) in 100,000 parts of water.

A precipitation takes place in rivers, from the water of which, owing to its extended surface, the carbon dioxide is mostly given off; hence *river water* is usually soft. Both spring and river waters contain variable quantities of salts of alkalies in solution, of which they cannot be deprived except by distillation.

Rain water and *snow water* are free from such saline compounds, except the portions falling first; these contain particles of dust and various organic and inorganic matters which had been suspended or dissolved in the air. Among them, ammonia, iodine, chlorine, and

nitric acid have been found, the latter more particularly during a thunder-storm, the former two elements occasionally, while ammonia or allied compounds are always present in inhabited regions. It is advisable, therefore, to collect rain water only some time after the rain has commenced falling, and as far removed from dwellings as possible; it will then contain a little carbon dioxide, which has been dissolved from the air.

The purity of running and well-water is affected by the nature of the surrounding soil and the proximity of decaying animal or vegetable matter, the decomposition-products of which may find an outlet into the former by natural drainage, sometimes from a considerable distance, and render such water unwholesome and unfit for many purposes. The refreshing taste of spring water is mainly due to the carbon dioxide dissolved therein. Of secondary importance is the small quantity of saline compounds contained in it. When the latter is permanently increased beyond a certain quantity, the spring is called a *mineral spring* (see AQUÆ MINERALES).

Most spring waters are unfit for chemical and pharmaceutical uses, but may often become adapted therefor after boiling and filtering. River water, if not naturally bright and transparent, is improved by filtration through sand and charcoal, and may then be employed if nearly free from organic matter, the amount of which may be approximately ascertained by a dilute solution of potassium permanganate, which will permanently impart its color to the water as soon as the organic matter and other deoxidizing agents accidentally present have been destroyed or oxidized. But distilled water is best for all the purposes indicated. Its taste is insipid, owing to the absence of carbon dioxide or to the minute quantity of this gas absorbed by contact with air.

Water may often be purified sufficiently for manufacturing purposes by treating it with alum, 2 grains to a gallon; and letting it stand 48 hours or longer, until the impurities settle. Gelatinous aluminum hydroxide gradually forms, which carries down mechanically as well as by occlusion most of the impurities present.

Pure water in contact with untarnished surfaces of lead becomes contaminated; the dissolved oxygen and carbon dioxide in the water convert the lead into carbonate, which goes into solution. Such water may give rise to lead-poisoning. Pure water or soft waters are more apt to be contaminated than hard waters, as the salts in the latter soon give rise to a protective film over the surface of lead.

There is little danger of lead-poisoning in the use of lead pipes and connections in water-supplies to houses, as the pipes soon become coated with an insoluble film. Water that has been standing for some time in hydrant pipes should be allowed to run off before using the water for drinking.

When water has been contaminated by organic matter, especially animal, it is dangerous for drinking-purposes. Such water responds strongly to tests for ammonia both free and "albuminoid," and for nitrites and nitrates which result from oxidation of the ammonia. Ammonia is determined by means of the exceedingly delicate Nessler's Solution (double potassium-mercuric iodide in strong solution of caustic potash).

Free ammonia should not exceed 0.08 part per million of water, and albuminoid ammonia not more than 0.15 part per million, otherwise the water should be regarded with suspicion for drinking-purposes. The presence of undue amounts of nitrite and nitrate and chlorine points to contamination with animal matter, as urine or sewage.

The reader is referred to special works on water analysis for discussions as to what constitutes a good drinking-water, how the constituents are determined quantitatively, and how they are to be judged. Descriptions of methods for purifying water for large cities, etc., by filtration and chemical treatment may be found in comprehensive works on chemistry or technology.

It has been found by experiments that water has a corrosive action on lead when it contains free acid or alkalies, oxygen, nitrates, chlorides, and sulphates. This corrosive effect is neutralized by such compounds as calcium carbonate, sodium bicarbonate, ammonium carbonate, calcium silicate, silica, and soluble phosphates.

At the temperature of 0° C. (32° F.) water freezes, forming transparent crystals of ice; if entirely undisturbed, it may be cooled to several degrees below this point without freezing, and if now slightly agitated it will at once congeal, the temperature rising to the freezing-point in consequence of the liberation of latent heat. Water impregnated with salts, particularly such as are readily soluble in it, freezes at a lower temperature, the ice being free from the compounds which were dissolved in the water. Hence, water equal in purity to distilled water may be obtained by melting perfectly clear and transparent

ice under conditions which preclude the admixture of dust and other impurities. *Sea water*, which has the specific gravity 1.027 and contains about 3½ per cent. of salts, yields ice of as great purity as river water.

The boiling-point of water is 100° C. (212° F.) at normal barometric pressure (760 Mm.), and rises beyond this temperature if notable quantities of salts, etc., are dissolved in it or if the pressure is increased; on the reduction of pressure water boils at a lower temperature.

The density of distilled water at 15° C. (59° F.) or at 15.5° C. (60° F.) is by general consent regarded as the unit by which the density of liquid and solid bodies is measured. In Europe, however, this unit is sometimes taken from water at its greatest density, and several of the tables published in the U. S. Pharmacopœia (1880) are based upon this unit. The specific gravity of water decreases with the rise of temperature, and increases gradually as the temperature is lowered until 4° C. (39° F.) is reached, when it has its maximum density, becomes lighter again toward the freezing-point, and expands very considerably when passing into the solid state, ice having the specific gravity 0.916. When converted into vapor at 100° C. (212° F.), water expands to nearly seventeen hundred times in bulk, and forms a transparent and colorless gas having the specific gravity 0.455; it has therefore less than one-half the density of atmospheric air. When mixed with air, it condenses into minute drops, to which the opaqueness of steam is due; the oversaturation of air with aqueous vapor causes a similar condensation in the atmosphere, hence the appearance of clouds.

Tests of Purity.—A colorless, limpid liquid, without odor or taste at ordinary temperatures, and odorless when heated. Water should be perfectly neutral to litmus-paper, and 10 Cc. contained in a test-tube of about 40 Cc. capacity, when acidulated with 1 Cc. of diluted hydrochloric acid and warmed to about 50° C. (122° F.), should not be colored or rendered turbid by addition of an equal volume of freshly prepared hydrogen sulphide test-solution after standing, well stoppered, in a warm place—35° C. (95° F.)—for at least half an hour, nor should the further addition of ammonia-water to this solution cause a coloration or turbidity therein (showing the absence of heavy metals). On evaporating 1000 Cc. of water on a bath of boiling water, it should not leave a residue weighing more than 0.5 Gm. (limit of soluble salts), and this residue, when ignited, should not carbonize nor evolve ammoniacal or acid vapors. If 200 Cc. of water be acidulated with hydrochloric acid and heated to boiling, and 0.5 Cc. of barium chloride test-solution added, the liquid, when cooled and filtered, should give no further precipitate on the addition of a few drops of barium chloride test-solution, even on standing (limit of sulphates). If 200 Cc. of water be acidulated with nitric acid and heated to boiling, and 0.5 Cc. of tenth-normal silver nitrate solution added, the liquid, when cooled and filtered, should not be affected by the subsequent addition of a few drops of silver nitrate test-solution (limit of chlorides). If 10 Cc. of water mixed with a few drops of diphenylamine test-solution be carefully poured upon about 3 Cc. of sulphuric acid free from nitrous compounds, contained in a test-tube, so as to form a separate layer, no blue color should be formed at the line of contact of the two liquids (limit of nitrates). If to 50 Cc. of water contained in a glass cylinder 2 Cc. each of sulphanilic acid test-solution and naphthylamine acetate test-solution are added, and the solution well mixed, no distinct pink coloration should appear within 5 minutes, when viewed from above and placed upon a white surface (limit of nitrites). If to 50 Cc. of water contained in a glass cylinder 2 Cc. of alkaline mercuric potassium iodide test-solution (Nessler's solution) be added and thoroughly mixed, no yellow or brownish tint should be produced immediately; the cylinder should be viewed from above and placed upon a white surface. On heating to boiling, 100 Cc. of water, acidulated with 10 Cc. of diluted sulphuric acid, and subsequently adding 0.5 Cc. of tenth-normal potassium permanganate solution, the color of the liquid should not be completely destroyed after it has been boiled for 10 minutes (limit of organic or other oxidizable substances).—U. S.

Action and Uses.—From a medicinal point of view, water is used internally in large quantities for the purpose not only of allaying thirst, but of increasing the ability of the kidneys to eliminate impurities from the body. While it cannot be truly said to possess medicinal properties, it is nevertheless a fact that the drinking of pure water exercises a distinct medicinal influence in gouty, rheumatic, and other affections depending upon perverted metabolism.

Used externally water is chiefly employed for the purpose of bathing, and in most instances where baths are employed for medicinal purposes the water is more or less strongly impregnated with mineral substances (see AQUÆ MINERALES).

Pure water, at varying temperatures, is constantly employed in medicine for the purpose of soothing irritation of the peripheral nerves, modifying the condition of the general circulatory system, and increasing the excretive activity of the skin.

Used externally at temperatures varying from that of the body to 70° or even 65° F., water is employed for the purpose of relieving fever and the nervous irritation often associated with this symptom of disease.

There is not space in this volume to discuss thoroughly the subject of hydrotherapy, and the reader must refer to special works for directions as to the various means by which water at different temperatures can be employed as a powerful and valuable remedial agent (see Baruch's *Hydrotherapy*). Much depends upon the manner of its employment. Perhaps the most noteworthy use of water in the bath is in the so-called Brand treatment of typhoid fever, which consists in immersing the patient in a tub of water at about 65° to 70° F., rubbing his body actively while he is in the water, with the object of not only reducing his temperature, but, more important, of increasing the elimination of toxic materials from his body by the skin and kidneys, equalizing the circulation, thereby overcoming conditions of stasis and anæmia in various portions of the body, and in addition stimulating the nervous system so that it is not overwhelmed by the toxæmia of the disease.

AQUA AMMONIÆ, *U. S.*—Ammonia Water.

Liquor ammoniæ, Br.; *Liquor ammonii caustici*, P. G.; *Spiritus salis ammoniaci causticus, Ammonia aqua soluta.—Ammoniaque liquide, Eau (Solution, Liqueur) d'ammoniaque*, Fr.; *Salmiakgeist, Aetzammoniak, Ammoniak-Flüssigkeit*, G.; *Ammoniaca*, F. It.; *Amoniaco liquido*, Sp.

An aqueous solution of ammonia containing 10 per cent. by weight of gaseous ammonia.—U. S.

Formula of ammonia gas, NH_3. Molecular weight, 16.93.

Origin.—Ammonia is produced during the putrefaction of all organisms and of many organic compounds containing nitrogen; it exists in the air and in the soil, mostly in combination with acids in the air, as carbonate and nitrite. Ammoniacal salts are met with in most plants and animals. The products of the dry distillation of many nitrogenated compounds contain ammonia, and it is from such a source—namely, from the so-called gas-liquor, a by-product of the manufacture of illuminating-gas—that ammoniacal salts are principally obtained (see Ammonii Chloridum and Ammonii Sulphas).

Preparation.—AMMONIA WATER. The U. S. Pharmacopœia of 1900, like its predecessor, not stating an official method for preparing ammonia water, the method of 1870 is here given; it will be found to yield an excellent product on a small scale: Take of ammonium chloride in small pieces, lime, each, 12 troy ounces; water, 6 pints; distilled water a sufficient quantity. Pour a pint of the water upon the lime in a convenient vessel, and after it has slaked stir the mixture so as to bring it to the consistence of a smooth paste. Then add the remainder of the water and mix the whole thoroughly together. Decant the milky liquid from the gritty sediment into a glass retort of the capacity of 16 pints, and add the ammonium chloride. Place the retort on a sand-bath, adapt to it an empty wash-bottle, and connect the latter with a 2-pint bottle containing a pint of distilled water, by a glass tube reaching nearly to the bottom. Surround the last-named bottle with ice-cold water and apply heat to the sand-bath, gradually increasing it until ammonia ceases to come over. Remove the liquid from the bottle, and add to it sufficient distilled water to raise its specific gravity to 0.960. Lastly, keep the liquid in small bottles, well stopped.

According to the British Pharmacopœia, 1 pint of strong solution of ammonia is mixed with 2 pints of distilled water.

When ammonium salts are treated with the hydroxide of a metal of the alkalies or alkaline earths, the corresponding salts of the metals are formed and ammonia and water are set free; thus, $2NH_4Cl + Ca(OH)_2$ yields $CaCl_2 + 2NH_3 + 2H_2O$. It is important to heat the mixture gradually, so that much of the gas may be given off before the boiling temperature is reached. A rapid heating is apt to cause the extrication of the gas with such violence that the contents of the retort will boil over. In preparing

ammonia on the large scale, it is advantageous to connect the wash-bottle with a series of stoneware receivers shaped like Woulf's bottles, so that the gas which is not absorbed in the first will pass into the second receiver, and so on.

The employment of a considerable excess of calcium hydroxide has been found advantageous to insure the complete decomposition of the ammonium salt. On account of this excess the residue in the retort will contain a basic calcium chloride having the composition $CaCl_2 3CaO$, which, after having been filtered from the lime, may be neutralized by hydrochloric acid and evaporated to dryness, to be utilized as calcium chloride.

On the large scale ammonia water is usually made with common water, the natural impurities of which it contains, together, frequently, with notable quantities of iron derived from the iron delivery-tubes employed. Chemically pure ammonia water may be obtained from this by heating it, or, preferably, the commercial stronger ammonia water, in a glass flask or retort, and conducting the gas, a considerable amount of which is evolved below the boiling-point of water, by means of glass tubes, into distilled water.

Gaseous ammonia is obtained by passing the gaseous products in the above processes over dry caustic potash or calcium chloride.

Properties.—Gaseous Ammonia.—Ammonia is a colorless gas having a strong, penetrating odor and an acrid, alkaline taste. In pure oxygen it burns, forming water and free nitrogen. It has the specific gravity 0.593. By a pressure of 7 atmospheres at 15° C. (59° F.), or when cooled to —40° C. (—40° F.) at the ordinary atmospheric pressure, it condenses into a colorless liquid much lighter than water, which boils a few degrees above this temperature and crystallizes when placed in a mixture of solid carbon dioxide and ether at about —75° C. (—103° F.). Water dissolves about 727 times its volume of ammonia gas at 15° C. (59° F.).

Liquid ammonia is sold in iron cylinders, and is extensively used in the manufacture of ice; liquid ammonia in evaporating produces a low temperature, by which water is made to freeze. Over five million pounds of liquid ammonia are manufactured in the United States annually, of which The National Ammonia Company, of St. Louis, Mo., produces more than 75 per cent.

Ammonia gas unites with acids directly to form salts which resemble the alkali salts in all respects. It is highly probable that in these salts there is a group of atoms (NH_4) which has received the name "Ammonium," and corresponds to the metals potassium, sodium, etc. Thus, $NH_3 + HCl = (NH_4)Cl$. The nitrogen changes apparently from the trivalent state in NH_3 to the pentavalent state in $(NH_4)Cl$. The group (NH_4) cannot be obtained free; it exists only in the salts. It is believed that when ammonia gas is passed into water a hydroxide of ammonium is formed—thus, $NH_3 + H_2O = NH_4OH$—corresponding to KOH or NaOH. This is easily broken down into NH_3 and water.

Ammonia-water.—The official solution of ammonia constitutes a colorless, transparent liquid possessing the odor and taste of the gas, being lighter and having a lower freezing-point than distilled water. It has a specific gravity of 0.958 at 25° C. (77° F.), 0.959, Br., 0.960, P. G., at 15° C. (59° F.), and imparts a brown color to turmeric paper, a blue color to litmus-paper, and a green color to the juice of violet-flowers. It evolves dense white fumes when a glass rod moistened with hydrochloric or acetic acid is held over the liquid. Sometimes commercial ammonia-water, when carelessly prepared, shows a rose tint when acidified, especially by nitric acid, due to such impurities as pyrrol, aniline, naphthalene, and pyridine, which are derived from the gas-liquor. Ammonia neutralizes all acids, forming salts which are mostly colorless and crystallizable, possess a sharp, saline taste, and when heated to redness are entirely volatilized without residue, unless the acid be non-volatile; even the solutions of most ammonium salts, when evaporated or heated to boiling, lose a portion of the ammonia.

Tests.—Ammonia-water should evaporate at the temperature of boiling water without residue (salts). On slightly supersaturating 10 Cc. of ammonia-water with diluted sulphuric acid, no empyreumatic odor or red color should be developed, and if to this liquid 1 Cc. of centinormal potassium permanganate solution be added, the pink color should not be completely destroyed within 10 minutes (absence of readily oxidizable matters). If ammonia-water be mixed with four times its volume of lime-water, it should not afford an immediate turbidity (only minute traces of carbon dioxide); and if it be diluted with twice its volume of water, it should not be affected by ammonium oxalate test-solution (absence of calcium), nor should it be affected by hydrogen sulphide test-

solution either before or after neutralization with hydrochloric acid (absence of metallic impurities). If ammonia-water be slightly supersaturated with nitric acid, it should not be affected by barium chloride test-solution (absence of sulphates), nor by silver nitrate test-solution (chloride); and if a third portion of the acidulated liquid be evaporated on a water-bath to dryness, it should afford a colorless residue, which, on ignition, should be completely volatilized (absence of coal-tar bases and of fixed impurities). If 10 Gm. (10.42 Cc.) of ammonia-water be diluted with distilled water to measure 100 Cc., then 34 Cc. of this solution should require for neutralization not less than 20 Cc. of normal sulphuric acid, litmus being used as indicator (each Cc. corresponding to 0.5 per cent. of ammonia).—U. S. The Br. P. requires for each Gm. of ammonia-water 5.9 Cc. of volumetric sulphuric acid, and the P. G. for 5 Cc. of ammonia-water 28 to 28.2 of normal hydrochloric acid.

The solutions of ammonium salts yield orange-colored crystalline precipitates with platinum chloride and sodium cobaltic nitrite, and, if not too dilute, white ones with tartaric acid or acid sodium tartrate. The most delicate tests for ammonia are those of Einbrodt (1852) and of Nessler (1856). *Einbrodt's reagent* is an aqueous solution of mercuric chloride rendered slightly alkaline by the addition of a minute quantity of potassium carbonate. The test is applied to an alkaline solution, or if the solution has an acid reaction, it should be rendered faintly alkaline by the addition of potassium or sodium hydroxide, when the test-liquid will produce a white cloudiness if only $\frac{1}{5000000}$ of ammonium is contained in the solution.

Nessler's reagent is a solution of potassium-mercuric iodide, made either by saturating a solution of potassium iodide with mercuric iodide, and rendering this alkaline by potassium hydroxide, or it is prepared from potassium iodide and mercuric chloride (see Hydrargyri Iodidum Rubrum). With solutions of ammonia or ammoniacal salts it gives a brown-red precipitate, or if very dilute an orange color. It may be used for the quantitative determination of minute quantities of ammonia by diluting the liquid until with Nessler's Solution only an orange tint is produced, which is compared with that obtained from a solution of ammonium chloride of known strength by diluting the latter until the same coloration is produced with the test-liquid.

Action and Uses.—Ammonia water is used chiefly for its cleansing properties when added to ordinary water. It is very rarely used medicinally (see below).

AQUA AMMONIÆ FORTIOR, *U. S.*—Stronger Water of Ammonia.

Liquor ammoniæ fortis, Br.; *Strong solution of ammonia*, E.; *Eau d'ammoniaque forte*, Fr.; *Starker Salmiakgeist*, G.

This solution differs from ordinary ammonia water chiefly in the proportion of ammonia gas held in solution, and contains 28 per cent. (U. S.) or 32.5 (Br.) by weight of the gas. It has the specific gravity 0.897 at 25° C. (77° F.) (U. S.) or 0.891 (Br.), and is prepared on a large scale by distilling ammonium chloride or sulphate, obtained from gas-liquor, with milk of lime, purifying the gas by passing it over quicklime, and passing the gas into a series of vessels filled about three-fourths with water until saturation is reached.

Stronger ammonia water is a colorless, transparent liquid, with an excessively pungent odor, very acrid, alkaline taste, and a strongly alkaline reaction. If it be diluted with twice its volume of water, it should respond to the reactions and tests named under Ammonia Water. 23 Cc. of normal sulphuric acid should be required to neutralize 1.7 Gm. of stronger ammonia water (U. S.) or 19.1 Cc. of normal acid for 1 Gm. (Br.), rosolic acid being used as indicator.

Great care should be taken in opening bottles containing stronger ammonia water, lest the vapor of ammonia frequently collected in the upper part of the bottle should blow out the stopper and cause injury to the eyes or mucous membranes of the nose and throat by inhalation.

Action and Uses.—The medicinal properties of ammonia as an internal remedy will be discussed under Spiritus Ammoniæ Aromaticus. The stronger ammonia-water is never employed in internal medicine. The 10 per cent. preparation may be given internally or injected intravenously when a powerful and rapidly acting circulatory stimulant is required, but in either case it should be largely diluted. When applied to the skin in concentrated form ammonia causes reddening of the tissue followed by burn-

ing pain, and if the contact be sufficiently long an escharotic action is obtained. Weaker solutions act as rubefacients and are frequently employed in the preparation of stimulating liniments. When an escharotic action follows its use, the ulcer resulting is painful and very slow to heal. When employed intravenously ½ drachm (2 Cc.) should be diluted with 1 ounce (30 Cc.) of water, and very slowly injected into a vein of the leg. If given in too concentrated a form, it may produce immediate cardiac arrest. Abscesses almost invariably result from its hypodermic use, and for this reason it should not, as a rule, be so used. As a vesicating agent, a few drops may be placed near the painful area and covered with a watch crystal. The time required for producing a blister rarely exceeds ten or fifteen minutes when the stronger water is used, but somewhat longer when the 10 per cent. preparation is employed. Poisoning from the inhalation of ammonia gas or the drinking of either of the ammonia waters is not an uncommon occurrence. If a sufficient amount of the gas be inhaled, death may take place rapidly, resulting from spasm or œdema of the glottis; the same occurrence may also result from drinking the ammoniacal water. Inhalation of moderate amounts causes severe bronchitis and at times œdema of the glottis and lungs. The buccal and nasal mucous membranes are also irritated and at times partially destroyed. When taken internally, if death is not immediate, the symptoms of severe gastro-enteritis ensue. Violent abdominal pain and spasm, accompanied by either delirium or stupor, passing into collapse, coma and death result. This condition is met by the prompt administration of vegetable acids, such as vinegar and lemon juice, demulcents and opium for the relief of pain, and supporting treatment as the symptoms require.

As a vesicant, ammonia water may be used in the various conditions in which blistering is beneficial, as in obstinate neuralgias, inflamed joints, and in suppression of urine. As a stimulating lotion, it may be used when diluted in various rheumatic, gouty, neuralgic, and spasmodic conditions. It can be applied also with benefit when diluted to the spot stung by insects, such as bees, spiders, and mosquitoes.

The internal dose of the 10 per cent. preparation is from 10 to 30 minims (0.6–2 Cc.), largely diluted with water.

AQUA AMYGDALÆ AMARÆ, *U. S.*—Bitter-almond Water.

Aqua amygdalarum amararum, P. G.—*Eau d'amandes amères*, Fr.; *Bittermandelwasser*, G.; *Acqua distillata di mandorle amare*, F. It.

Preparation.—Oil of bitter almonds, 1 Cc.; distilled water, 999 Cc. Dissolve the oil in the distilled water by agitation and filter through a well-wetted filter.—U. S. (16 minims of oil of bitter almonds, dissolved in 33¼ fluidounces of distilled water, will yield a preparation of the same strength.)

Made by this process, bitter-almond water is a very unreliable preparation, owing to the variable amount of hydrocyanic acid contained in the oil of bitter almonds, and if the latter has been deprived of its hydrocyanic acid, the bitter-almond water prepared from it will possess no virtue except for imparting flavor.

Bruise bitter almonds 12 parts, and express as much fixed oil as possible without the aid of heat. Powder the press-cake, mix it thoroughly with water 20 parts, and distil off 9 parts into a receiver containing alcohol 3 parts, determine the amount of hydrocyanic acid in the distillate, and then dilute with a mixture of alcohol 1 part and distilled water 3 parts, so that 1000 parts of the mixture contain 1 part of hydrocyanic acid. Thus prepared, bitter-almond water is nearly clear, and has a strong odor of hydrocyanic acid and oil of bitter almonds, the latter remaining after the hydrocyanic acid has been removed by means of silver nitrate.—P. G.

In making bitter-almond water by the latter process the fixed oil is removed, because it hinders the reaction between the amygdalin and emulsin, to complete which maceration of the expressed almonds with water for about 10 or 12 hours is advisable at a temperature of about 30° or 35° C. (86° or 95° F.). The almond mixture is then placed upon a perforated diaphragm and heat applied to the still.

When the requisite quantity of water has distilled over, 27 Gm. of the distillate are diluted with 54 Gm. of distilled water, mixed with sufficient magnesia, previously rubbed with water to render it milky, and with a few drops of solution of potassium chromate; decinormal (volumetric) solution of silver nitrate is then added until the red color produced by the latter ceases to disappear on stirring; each Cc. of the silver solu-

tion represents 0.01 per cent. of HCN. A bitter-almond water containing 0.1 per cent. of hydrocyanic acid will require 10 Cc. of the silver solution. The strength may also be determined gravimetrically by adding to 1000 grains of the water first a little ammonia, then a slight excess of nitric acid, and finally solution of silver nitrate until a precipitate ceases to appear; this, when washed and dried, should weigh exactly 5 grains.

Action and Uses.—Bitter-almond water is a preparation which cannot be highly recommended. Any medicinal properties which it possesses depend upon the hydrocyanic acid which it contains, and this varies greatly in quantity.

The dose of bitter-almond water is 3 to 4 teaspoonfuls (12–16 Cc.).

AQUA ANETHI, *Br.*—Dill Water.

Eau d'aneth, Fr.; *Dillwasser*, G.

Preparation.—Take of dill fruit bruised, 1 pound (or 500 Gm.); water, 2 gallons (or 10 liters); distil one-half.—Br.

The water, which is at first slightly milky if prepared by this process, possesses the odor and taste of dill fruit.

Action and Uses.—Dill water is sometimes given to nursing mothers with the idea that the drug will be eliminated in the milk and so relieve infantile colic. It has no special advantages over other official waters which are used as vehicles, and is very rarely employed.

AQUA ANISI, *U. S., Br.*—Anise Water.

Eau d'anis, Fr.; *Aniswasser*, G.; *Acqua distillata di anice*, F. It.

Preparation.—Oil of anise, 2 Cc.; purified talc, 15 Gm.; distilled water, a sufficient quantity to make 1000 Cc. Triturate the oil with the purified talc, add the water gradually with continued trituration; filter, and pass the filtrate through the filter repeatedly until the anise-water is perfectly clear.—U. S.

(32 minims of oil of anise may be triturated with 240 grains of purified talc, and will require 2 pints of distilled water.)

Anise-fruit bruised, 1 pound (or 500 Gm.); water, 2 gallons (or 10 liters). Distil one-half.—Br. Distilled from the fruit, anise water has a more pleasant odor and taste than that made from the oil.

Action and Uses.—Anise water is a useful vehicle for medicines which are intended to expel flatus from the gastro-intestinal tract, and is sometimes added to laxative mixtures to prevent griping.

AQUA AURANTII FLORUM, *U. S.*—Orange-flower Water.

Aqua Aurantii floris, Br.; *Aqua florum naphæ.—Eau (Hydrolat) de fleur d'oranger, Eau de naphe*, Fr.; *Orangenblüthenwasser*, G.; *Acqua distillata di arancio*, F. It.; *Agua de azahar*, Sp.

Preparation.—Stronger orange-flower water, distilled water, of each, 1 volume. Mix them immediately before use.—U. S. It is used as a vehicle.

The British Pharmacopœia directs that the distilled orange-flower water of commerce shall be mixed with twice its volume of distilled water immediately before use.

AQUA AURANTII FLORUM FORTIOR, *U. S.*—Stronger Orange-flower Water; Triple Orange-flower Water.

Water saturated with the volatile oil of fresh orange-flowers, obtained as a by-product in the distillation of the oil of orange-flowers. It should be kept in bottles loosely stoppered with a pledget of purified cotton and in a dark place.—U. S.

The French Codex directs the distillation, by means of steam, of twice the weight of the fresh orange-flowers used. Thus prepared, it is called in commerce *double orange-flower water*, and if it is diluted with an equal weight of distilled water it is known as *simple orange-flower water*. The so-called *triple* and *quadruple orange-flower waters* are also met with in commerce, the former being obtained by distilling 3 parts, the latter by distilling 2 parts, of water from 2 parts of fresh orange-flowers.

Distilled orange-flower water is a clear and colorless or slightly opalescent liquid of a very agreeable odor and aromatic taste, which cannot be imitated by preparing the water from the oil of orange-flowers (neroli). As distilled from the flowers, it possibly contains some volatile ethers, which are freely soluble in water and not contained in the volatile oil. Occasionally, commercial orange-flower water separates mucilaginous flocks, which may be removed by agitation with powdered kaolin and filtration. If it has acquired an acid reaction, it is advisable to distil it over magnesia. The total absence of metallic salts, resulting from the use of a metallic condenser or from keeping the water in metallic vessels, is proved by its remaining unaffected by hydrogen sulphide and by ammonium sulphide. Occasionally, distilled orange-flower water has been met with which acquires a red color on the addition of an acid; the cause of this abnormal behavior has not been ascertained, but may perhaps be due to accidental impurity.

Action and Uses.—Orange-flower water is used as a pleasant lotion and vehicle for other drugs.

AQUA CAMPHORÆ, *U. S., Br.*—Camphor Water.

Aqua camphorata.—Eau camphrée, Fr.; *Kampherwasser*, G.; *Aqua alcanforada*, Sp.

Preparation.—Camphor, 8 Gm.; alcohol, 8 Cc.; purified talc, 15 Gm.; distilled water, a sufficient quantity to make 1000 Cc. Dissolve the camphor in the alcohol, triturate the solution with the purified talc, and, after allowing the greater part of the alcohol to evaporate spontaneously, continue the trituration with the water, gradually added; then pour the mixture upon a well-wetted filter, and pass the filtrate through the filter repeatedly until the camphor-water is perfectly clear.—U. S.

(120 grains of camphor, 120 minims of alcohol, and 240 grains of purified talc may be used in making 2 pints of camphor-water.)

The British Pharmacopœia directs that 70 grains (or 5 Gm.) of camphor be dissolved in sufficient alcohol (90 per cent.) to form ½ fluidounce (or 15 Cc.) of solution, which is then added in successive portions to 1 gallon, Imperial measure (or 5 liters), of distilled water, shaking after each addition and finally shaking until all camphor is dissolved. This preparation contains only about ¼ as much camphor as that of the United States Pharmacopœia, which latter aims to produce a saturated solution, for which purpose cold water only should be used. Saturated camphor water contains about 2 grains of camphor in each fluidounce, or 0.004 Gm. in each Cc.

Action and Uses.—See CAMPHORA.

AQUA CARUI, *Br.*—Caraway Water.

Aqua carui.—Eau distillée de carvi, Fr.; *Kümmelwasser*, G.

Preparation.—Take of caraway fruit bruised, 1 pound (or 500 Gm.); water, 2 gallons (or 10 liters). Distil one-half.—Br.

This water has the flavor of the fruit in a marked degree.

Action and Uses.—Caraway water is used as a vehicle to carry more potent drugs.

AQUA CHLORATA, *P. G.*—Chlorine Water.

Aqua chlori, U. S., 1890; *Chlorum solutum, Aqua oxymuriatica.—Solution of chlorine*, E.; *Eau chlorée, Chlore liquide*, Fr.; *Chlorwasser*, G.; *Acqua di cloro*, F. It.

An aqueous solution of chlorine containing at least 0.4 to 0.5 per cent. of the gas.—P. G.

Symbol, Cl. Atomicity univalent. Atomic weight, 35.18.

Origin.—Chlorine was discovered by Scheele (1774), and was first called dephlogisticated muriatic acid, afterward *oxymuriatic acid*, under the supposition that it was a compound of muriatic acid with oxygen. Gay-Lussac and Thénard (1809) showed that from its behavior it might be regarded as an element, a view which was strengthened by the researches of Humphry Davy (1810), who called it chloric gas, which name was changed to chlorine by Gay-Lussac (1813). Chlorine is widely distributed in nature, but owing to its affinity for other elements it is never found in the isolated state. It exists in many minerals, in most spring waters, in sea water, in plants, and in animals, and is liberated from the chlorides by the combined action of sulphuric action and an oxidizing agent.

Preparation.—Chlorine-water may be prepared by generating chlorine gas from a mixture of 35 Cc. of hydrochloric acid and 25 Cc. of water with 10 Gm. of manganese dioxide, in lumps of about the size of filberts, the whole being heated moderately to facilitate reaction. The gas is conducted through a wash-bottle containing 50 Cc. of water and then into a bottle of 1000 Cc. capacity containing 400 Cc. of previously boiled and cooled distilled water. The temperature best suited for dissolving the chlorine in water is 10° C. (50° F.), at which temperature water, according to Schoenfeld, dissolves 2.585 times its volume of the gas, the degree of solubility becoming gradually less as the temperature rises. The action of the acid on the manganese results in the liberation of chlorine and water, while manganese chloride is formed at the same time and remains in solution. When the air has been entirely displaced by the gas, disconnect the bottle from the apparatus, and, having inserted the stopper, shake the bottle, loosening the stopper from time to time, until the gas ceases to be absorbed. If necessary, reconnect the bottle with the apparatus, and continue passing the gas and agitating until the distilled water is saturated. Finally, pour the chlorine-water into small, dark amber-colored, glass-stoppered bottles, which should be completely filled therewith, and keep them in a dark and cool place. Chlorine-water, even when kept from light and air, is apt to deteriorate. When it is required of full strength, it should be freshly prepared.

During the preparation and handling of chlorine-water the operator should be careful not to inhale the gas, on account of its irritating and poisonous properties. Should its effects be perceived, it is advisable to inhale carefully a little ammonium sulphide, which is decomposed by the chlorine into ammonium chloride and sulphur. It should, however, be cautiously used, since an excess of this compound is likewise poisonous. A little ammonia, sufficiently diluted, may also be taken with advantage.

For the preparation of chlorine on the large scale, as in the manufacture of chlorinated lime, sulphuric acid is sometimes used in addition to the manganese dioxide and hydrochloric acid, when all the chlorine contained in the latter is obtained and manganous sulphate is left in solution. Or the generation of hydrochloric acid and of chlorine is effected in one operation by the use of sulphuric acid, sodium chloride, and manganese dioxide, in which case the sulphates of sodium and of manganese remain behind.

For special purposes chlorine may be prepared by the action of hydrochloric acid upon potassium dichromate: $14HCl + K_2Cr_2O_7$ yield $3Cl_2 + 2KCl + Cr_2Cl_6 + 7H_2O$, the result being chlorine, potassium chloride, chromium chloride, and water. Or potassium chlorate may be decomposed by hydrochloric acid, with the formation of chlorine, potassium chloride, and water: $6HCl + KClO_3$ yield $3Cl_2 + KCl + 3H_2O$, but the gas is in this case apt to be contaminated with hypochlorous acid. At present much of the chlorine made on the large scale is obtained by the electrolysis of a solution of potassium chloride, which yields chlorine at the positive pole or anode and caustic potash and hydrogen at the negative pole or kathode: $2KCl + 2H_2O = 2KOH + H_2 + Cl_2$. It is obtained also as a by-product in the electrolysis of sodium chloride, magnesium chloride, and zinc chloride for the respective metals: $2NaCl = 2Na + 2Cl$. Most of the chlorine obtained thus is converted into bleaching-powder (Calx chlorata).

Properties.—Chlorine is a greenish-yellow, irrespirable, corrosive gas, having the specific gravity 2.45 as compared with air, and becoming liquid at 0° C. (32° F.) under a pressure of 6 atmospheres. Liquid chlorine is yellow, congeals at —102° C. (—151.6° F.), and boils at —33.6° C. (—28.48° F.). Chlorine is not inflammable, but is capable of supporting combustion.

Chlorine water is a clear, greenish-yellow liquid possessing the suffocating odor and acrid, irritating taste of chlorine, evaporating without residue, but separating crystals of chlorine hydrate when cooled to the freezing-point of water. Its specific gravity is 1.003 when saturated at 6° C. (42.8° F.) (Berthollet). It instantly discharges the color of diluted solutions of indigo and litmus, and bleaches vegetable coloring-matters generally. Exposed to light, it is decomposed into hydrochloric acid and oxygen. It is a powerful oxidizing agent, and this property serves to readily ascertain its strength. A fluidounce of it, mixed with a solution of 14 grains of pure ferrous sulphate, does not produce a blue precipitate with potassium ferricyanide, indicating that the salt has been completely oxidized to ferric sulphate, and proving that the water contains 0.4 per cent. of chlorine.

Tests.—Chlorine water should evaporate without residue. Agitated with an excess of mercury until the odor of chlorine has disappeared, the remaining liquid

reddens litmus-paper but faintly, if at all (limit of hydrochloric acid). The German Pharmacopœia requires that 28.2 to 35.3 Cc. of tenth-normal sodium thiosulphate solution shall be required to decolorize the deep-red liquid obtained by adding 25 Gm. of chlorine-water to a solution of 1 Gm. of potassium iodide in 5 Cc. of water.

The volumetric determination of the chlorine is indirectly accomplished, and is based upon the fact that chlorine is capable of displacing iodine and bromine in equivalent proportions; thus, $2KI + Cl_2 = 2KCl + I_2$. Each Cc. of tenth-normal sodium thiosulphate solution corresponds to 0.003518 Gm. of chlorine.

Action and Uses.—Chlorine water diluted one-third to one-half with pure water, or used even in its pure state, is employed locally as a stimulant and disinfectant upon superficial ulcers, and depends for its therapeutic power, of course, upon the chlorine gas which it contains. It has been employed as a gastro-intestinal antiseptic, in small doses well diluted, in such diseases as typhus and typhoid fever and in scarlet fever and diphtheria. But in none of these diseases is it a remedy to be depended upon. Probably its best use is as a gargle in cases of septic sore throat, diluted one-half with water.

AQUA CHLOROFORMI, *U. S., Br.*—Chloroform Water.

Eau de chloroforme, Fr.; *Chloroformwasser*. G.

Preparation.—Add enough chloroform to a convenient quantity of distilled water, contained in a dark amber-colored bottle, to maintain a slight excess of the former after the contents have been repeatedly and thoroughly agitated.

When chloroform water is required for use, pour off a sufficient quantity of the solution, refill the bottle with distilled water, and saturate it by thorough agitation, taking care that there be always an excess of chloroform present.—U. S.

Take of chloroform, 30 minims (or 2.5 Cc.); distilled water, 25 fluidounces (or 1000 Cc.). Shake together until the chloroform is entirely dissolved in the water.—Br.

Both pharmacopœias aim to produce a saturated aqueous solution of chloroform, the solubility of the latter substance in water being considered as about 1 in 200.

Action and Uses.—Chloroform water has been used as a gargle in sore throat, and internally in cases of neuralgia of the stomach and of gastro-intestinal flatulence. It is a moderately active antiseptic when used internally, and may be employed as a vehicle for organic substances which are apt to undergo fermentation or decomposition. Usually it is better to employ spirit of chloroform in internal medicine (see SPIRITUS CHLOROFORMI).

AQUA CINNAMOMI, *U. S., Br., P. G.*—Cinnamon Water.

Eau de canelle, Fr.; *Zimmtwasser*, G.; *Acqua distillata di cannella*, F. It., Sp.

Preparation.—Oil of cinnamon, 2 Cc.; purified talc, 15 Gm.; distilled water, a sufficient quantity to make 1000 Cc. Triturate the oil with the purified talc, add the water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the cinnamon-water is perfectly clear.—U. S.

(32 minims of oil of cinnamon may be triturated with 240 grains of purified talc, and will require 2 pints of distilled water.)

The British Pharmacopœia directs the distillation of 1 Imperial gallon (or 5 liters) of cinnamon water from 20 ounces (or 500 Gm.) of bruised Ceylon cinnamon. The German Pharmacopœia recognizes as *Aqua cinnamomi* a distilled water formerly called *Aqua cinnamomi spirituosa* (*s. vinosa*), and made by distilling 10 parts from a mixture of sufficient water, 1 part of alcohol (90 per cent.), and 1 part of Chinese cinnamon.

Made from the oil, cinnamon water has the odor and a somewhat harsh taste of cinnamon; but if distilled from the bark, its odor is more fragrant and its taste decidedly sweet. Cinnamon water made with magnesia has a yellowish color. In contact with the air the volatile oil is oxidized, and crystals of cinnamic acid and small particles of a brownish resin are sometimes separated.

Action and Uses.—Cinnamon water possesses slight stimulant and carminative properties, but is seldom used except as a vehicle for other medicines. It finds its most common employment in mixtures for flatulent colic and diarrhœa combined with such remedies as chalk, astringents, and opium. Its dose is 1 to 4 drachms (4–16 Cc.).

AQUA CREOSOTI, *U. S.*—Creosote Water.

Eau créosotée, Fr.; *Kreosotwasser*, G.

Preparation.—Creosote, 10 Cc.; distilled water, 990 Cc.; to make 1000 Cc. Agitate the creosote with the distilled water until dissolved, and filter through a well-wetted filter. Creosote-water should be freshly prepared when dispensed.—U. S.

(1 fluidrachm of creosote agitated with 99 fluidrachms of distilled water, and filtered, will furnish 12½ fluidounces of official creosote-water.)

Action and Uses.—Creosote-water has been used as a local application in cases of leucorrhœa and to ulcers. It is rarely used, but is sometimes of value to allay nausea. The dose is from 1 to 2 drachms (4–8 Cc.).

AQUA CRESOLICA, *P. G.*—Cresolated Water.

Kresolwasser, G.

Preparation.—Solution of cresol soap, 1 part; water, 9 parts.—P. G.

The German Pharmacopœia directs that distilled water shall be used if the preparation be intended for surgical purposes, in which case a yellowish clear solution will result. If cresolated water be prepared with ordinary water, it is likely to be turbid, but oily drops should not float on the surface. Cresolated water contains 5 per cent. of crude cresol and resembles carbolated water in odor.

Solution of cresol soap, Liquor Cresoli Saponatus, of the German Pharmacopœia is made by melting official soft soap on a water-bath, adding an equal weight of crude cresol and heating the mixture until a clear yellowish-brown solution results.

AQUA DESTILLATA, *U. S., Br., P. G.*—Distilled Water.

Eau distillée, Hydrolat simple, Fr.; *Destillirtes Wasser*, G.

Composition, H_2O. Molecular weight, 17.96.

Preparation.—Water, 1000 volumes; to make 800 volumes. Distil the water from a suitable apparatus provided with a block-tin or glass condenser. Collect the first 100 volumes and throw them away. Then collect 800 volumes, and keep the distilled water in glass-stoppered bottles, rinsed with hot distilled water immediately before being filled.—U. S.

When ordinary water is heated to ebullition, the gases and volatile compounds dissolved therein are also vaporized and carried off with the vapors of the water, which, if condensed, would then be more highly charged with these volatile compounds; hence the necessity of rejecting the first portion of the distillate, as directed by the pharmacopœias. On the other hand, if the distillation is continued until all the water is vaporized from the still, the last portions are apt to be contaminated with volatile products resulting from the decomposition of ammonia compounds and organic matter. The pharmacopœias avoid this possibility by discontinuing the distillation when 15 per cent. of the water is left in the still.

The material of which the distillatory apparatus used for this purpose is constructed is of considerable importance, but more particularly in relation to the condenser. Iron, copper, and lead condensers should not be used, since the water corrodes these metals, traces and sometimes larger quantities of which will always be found in the distillate. Where a glass condenser is available, it may be regarded as the most desirable, apparatus made of metals (silver and platinum) which are not in the least corroded during distillation being too costly for general use. The material best adapted for practical purposes is block-tin, of which the condenser and all those portions of the apparatus should be made from which the vapors are made to descend. A minute quantity of tin is nearly always dissolved, but separates again on standing for a few days in contact with the air. The occasional appearance of confervæ in distilled water depends upon its direct contact with the air, and may be prevented by keeping it in vessels arranged in such a manner that the air can enter only after having passed through a layer of cotton, by which the spores are retained.

Distilled water as ordinarily prepared always contains a minute quantity of ammonia, but for some purposes it is necessary to have ammonia-free water. In such cases, carefully distilled water is redistilled with addition of acid potassium sulphate or a

little dilute sulphuric acid. Traces of ammonia are detected by Nessler's reagent (see AQUA AMMONIÆ).

Properties and Tests.—Distilled water is a colorless, limpid liquid, without odor or taste, and of a neutral reaction. On evaporating 1 liter of distilled water on a water-bath to dryness, not more than 0.075 Gm. of residue should remain. The transparency or color of distilled water should not be affected by hydrogen sulphide or ammonium sulphide (absence of metals), by test-solutions of barium chloride (sulphate), silver nitrate (chloride), ammonium oxalate (calcium), or mercuric chloride, with or without the subsequent addition of potassium carbonate (ammonia and ammonium salts). On heating 100 Cc. of distilled water acidulated with 10 Cc. of diluted sulphuric acid to boiling, and adding 1 Cc. of tenth-normal solution of potassium permanganate, the color of the liquid should not be entirely destroyed by boiling for 10 minutes, nor by afterward setting the vessel aside well covered for 10 hours (absence of organic or other oxidizable matters). Distilled water should not be affected when mixed with twice its volume of lime-water (absence of carbonic acid).—U. S. On continued exposure to the air distilled water will dissolve carbonic-acid gas, and then become cloudy with clear lime-water.

AQUA FŒNICULI, *U. S., Br., P. G.*—Fennel Water.

Eau de Fenouil, Fr.; *Fenchelwasser*, G.; *Acqua distillata di finocchio*, F. It.

Preparation.—Oil of fennel, 2 Cc.; purified talc, 15 Gm.; distilled water, a sufficient quantity to make 1000 Cc. Triturate the oil with the purified talc, add the water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the fennel water is perfectly clear.—U. S.

(32 minims of oil of fennel may be triturated with 240 grains of purified talc, and will require 2 pints of distilled water.)

Take of bruised fennel, 1 pound av. (or 500 Gm.); water, 1 gallon Imperial measure (or 10 liters). Distil one-half.—Br. The P. G. directs that 30 parts of distillate are to be collected for each part of fennel used. If good fennel be employed, the water last mentioned separates a small portion of oil on standing, and is therefore a saturated solution.

Action and Uses.—Fennel water, in combination with other remedies which are more powerful for this purpose, is used to expel flatus from the gastro-intestinal tract. Its dose is a teaspoonful (4 Cc.) or more as needed.

AQUA HAMAMELIDIS, *U. S.*—Hamamelis Water.

Liquor Hamamelidis—*Solution of Hamamelis*, Br.—*Witchhazel water, Witchhazel extract*, E.; *Eau de hamamelis*, Fr.; *Hamameliswasser*, G.

Preparation.—Take of hamamelis bark, 10,000 Gm.; water, 20,000 Cc.; alcohol, 1500 Cc. Macerate the hamamelis bark in the water during 24 hours; then distil until 8500 Cc. of distillate are obtained, add the alcohol, and mix thoroughly.—U. S.

This preparation should be made only from the fresh young twigs of hamamelis, collected for this purpose, preferably, when the plant is in flower, in the late autumn of the year. (See HAMAMELIS.) The addition of alcohol is partly for better preservation and partly perhaps to aid as a stimulant when the preparation is locally used.

The Br. P. directs that the preparation be made from fresh hamamelis leaves by macerating 1000 Gm. for 24 hours in a still with a mixture of 2000 Cc. of water and 200 Cc. of 90 per cent. alcohol, and then distilling one-half.

Hamamelis water is a clear colorless liquid having a peculiar odor, which to some persons is quite unpleasant. The U. S. P. requires that if 1 Cc. of hamamelis-water be added to 5 Cc. of sulphuric acid, containing a little salicylic acid in solution, no red color should appear (absence of formaldehyde).

Action and Uses.—For the action and uses of Aqua Hamamelidis, see HAMAMELIDIS FOLIA.

AQUA HYDROGENII DIOXIDI, *U. S.*—Solution of Hydrogen Dioxide.

Liquor Hydrogenii Peroxidi, Br.; *Solution of Hydrogen Peroxide*, E.; *Soluté de peroxide d'hydrogen*, Fr.; *Wasserstoff hyperoxidlösung*, G.; *Acqua ossigenata*, F. It.

A slightly acid aqueous solution of hydrogen dioxide, containing, when freshly prepared, about 3 per cent. by weight of the pure dioxide, corresponding to about 10

volumes of available oxygen. It should be kept in a cool place. Upon removing the stopper from the bottle not more than a slight pressure should be observed.—U. S.

Formula, H_2O_2. Molecular weight, 33.76.

History and Occurrence.—Thénard (1818) discovered hydrogen dioxide, which has also been called *oxygenated water* and *oxygen hydrate*, by acting with dilute acids upon barium peroxide.

It occurs in minute quantity in the atmosphere after storms and heavy snowfalls, and is formed in many oxidation processes that take place in the presence of water. It is also formed whenever ozone is generated in the presence of water, as ozone easily breaks down with water into hydrogen peroxide, for example, when terpenes are brought in contact with water and air. It is formed in solution whenever certain peroxides—for example, Na_2O_2, K_2O_2, BaO_2—are treated with dilute acids, such as HCl, H_2SO_4, HF: $Na_2O_2 + 2HCl = 2NaCl + H_2O_2$. The reaction is exactly analogous to that which takes place when an oxide and an acid react; thus, $Na_2O + 2HCl = 2NaCl + H_2O$; but in the latter case, water or *hydrogen monoxide* is formed, while in the former case *hydrogen dioxide* is obtained.

On the large scale barium dioxide is used, and such acid is chosen as will give with barium an insoluble compound, thus leaving an approximately pure aqueous solution of the hydrogen peroxide. Sulphuric or hydrofluoric acid is used, giving in the one case insoluble barium sulphate and in the other insoluble barium fluoride, which are removed by filtration from the solution of hydrogen dioxide. Barium dioxide may also be decomposed by suspending it in water and passing carbon dioxide through the mixture: $BaO_2 + CO_2 + H_2O = BaCO_3 + H_2O_2$, insoluble barium carbonate being formed. In all methods of preparation the temperature should be kept down nearly to 0° C. (32° F.), to avoid decomposition of the dioxide.

Preparation.—The U. S. P., 1890, gave the following process: Barium dioxide, about 10½ avoirdupois ounces (300 Gm.); phosphoric acid, diluted sulphuric acid, distilled water, of each a sufficient quantity. Pour about 16 fluidounces (500 Cc.) of cold distilled water into a suitable bottle, add to it the barium dioxide in such a way that it does not form lumps, and shake vigorously, so that a uniform mixture may result. Provide suitable means of refrigeration, so that the bottle and its contents may be kept at a temperature below 10° C. (50° F.), and shake it thoroughly every few minutes during half an hour. Afterward, continuing the refrigeration, shake it occasionally, but vigorously, until the dioxide has become fully hydrated, which may be recognized from the fact that only a small portion of the water separates from it on standing, and that it may be mixed with the separated water without great effort by shaking. Having introduced about 3¼ fluidounces (96 Cc.) of phosphoric acid into a bottle having the capacity of about 67 fluidounces (about 2000 Cc.), add to it about 10¾ fluidounces (320 Cc.) of distilled water, cool the mixture and remove about 1⅔ fluidounces (50 Cc.) as a reserved portion. Now add the well-mixed magma to the acid liquid, and mix them intimately by frequent stirring and shaking, cooling the bottle if necessary. From time to time test the reaction of the liquid, and, when it becomes alkaline, add to it, cautiously, a little of the reserved phosphoric acid, until the liquid has again acquired an acid reaction. Repeat the agitation or stirring from time to time, and also the cautious addition of phosphoric acid, until the liquid, after standing for some time, no longer is alkaline, and at most is only slightly acid. Having finally shaken the bottle again thoroughly, set it aside until the precipitate occupies only about one-third of the volume of the contents, and pour the supernatant liquid upon a wetted, double, rapidly acting white filter, of a diameter of 30 Cm. Then transfer the semi-liquid precipitate to the filter, rinse the bottle with about 3½ fluidounces (100 Cc.) of distilled water, transfer this to the filter, and when the liquid has drained off wash the barium phosphate on the filter with distilled water until the filtrate measures about 34 fluidounces (1000 Cc.). Now add to it, first, 20 drops, and afterward, if necessary, smaller quantities of diluted sulphuric acid, until a small portion of the liquid, after filtration (which may be assisted by a little starch), is no longer rendered cloudy by diluted sulphuric acid. Mix the cloudy liquid with 150 grains (about 10 Gm.) of starch by agitation, so that the starch may be thoroughly distributed throughout the liquid, and then filter it through a well-wetted white filter of a diameter of 25 Cm., returning the first portions until the filtrate is clear. When all the liquid has passed, ascertain the percentage of hydrogen dioxide contained in it by the method of assay given below and dilute the remaining liquid if necessary, so that it will contain 3 per cent of absolute hydrogen dioxide. Keep the product in loosely stoppered bottles, in a cool place.

Since solution of hydrogen dioxide will gradually diminish in strength, even when carefully kept, it should either be freshly made when wanted or kept on hand only in such quantity as will probably be consumed within a short time.

Properties.—Solution of hydrogen dioxide is a colorless, odorless liquid, having at 15° C. (59° F.) a specific gravity of 1.006 to 1.012. It has a slightly acidulous taste,

and produces a peculiar sensation and soapy froth in the mouth. Its acid reaction is due to the small amount of acid purposely added for preservation. It decomposes by age, exposure to heat, and protracted agitation, into water and free oxygen. Exposed to the air or cautiously heated on a water-bath to a temperature not above 60° C. (140° F.), it loses chiefly water; but if rapidly heated, it is apt to decompose with explosive violence. If a few Cc. of ether be poured upon a mixture of 10 Cc. of distilled water, 1 drop of potassium chromate test-solution, and 10 drops of diluted sulphuric acid, a blue color will appear at the line of contact upon addition of a few drops of hydrogen dioxide solution. After shaking, the ethereal layer will separate with a blue color.

Absolute hydrogen dioxide has been prepared by evaporating a dilute solution on a water-bath at a temperature not above 75° C. (167° F.) till it reaches about 50 per cent. and then distilling in a vacuum, when water comes over first, and finally nearly pure dioxide. By repeated fractionation in this manner, a dioxide containing 99.1 per cent. has been obtained. It is a thick, oily, colorless liquid, specific gravity 1.499, and boiling at 69° C. (156.2° F.) under a pressure of 26 Mm. It does not congeal at —30° C. (—22° F.). It volatilizes slowly in vacuo and without decomposition at ordinary temperatures. When exposed to sunlight, or when heated, or when brought into contact with charcoal, silver, gold, the platinum metals, the oxides of manganese, alkalies, or various other compounds, the dioxide is decomposed, often with explosive violence, and in presence of the oxides of the metals mentioned these are reduced to the metallic state. A number of other bodies act less energetically and are oxidized. Litmus- and turmeric-paper are gradually bleached. The dioxide is odorless and has a harsh and bitter taste; applied externally, it colors the skin white and causes violent itching. Because of its instability and liberation of oxygen, it is a very powerful and useful oxidizing agent. It liberates iodine from iodides, and converts arsenous and sulphurous into arsenic and sulphuric acids. Many organic substances are decomposed by it, as blood, pus, etc. In some instances it acts as a reducing agent. Easily reducible oxides, as those of silver, gold, and platinum, are reduced to metal; thus, $Ag_2O + H_2O_2 = 2Ag + H_2O + 2O$. Chromic acid and permanganic acid are reduced by it, with escape of oxygen gas; also hypochlorites.

Many practical uses are made of hydrogen dioxide solution. It is largely used as a bleaching agent, especially for delicate objects, as, for example, Tussah silk, ostrich feathers, ivory, human hair, old engravings, and paintings. It is used in textile industries to bleach, and also to decompose hypochlorites and sulphites, which cling tenaciously to fabrics. It is also an excellent antiseptic.

Tests.—If to 25 Cc. of the solution 5 Cc. of tenth-normal potassium hydroxide solution be added, and the mixture evaporated to about 10 Cc., and 3 drops of phenolphthalein added, not less than 35 Cc. of tenth-normal sulphuric acid should be required to discharge the red color of the solution after continued boiling (limit of free acids). If 20 Cc. of the solution be evaporated to dryness upon a bath of boiling water, and the drying completed at 120° C. (248° F.), not more than 0.03 Gm. of solid residue should remain (limit of total solids). If to 1 Cc. of the solution 1 Cc. of ammonia-water be added, and the solution evaporated to dryness upon a bath of boiling water, the residue should not respond to the modified Gutzeit's test for arsenic (see ARSENI TRIOXIDUM). If to 1 Cc. of the solution 1 Cc. of ammonia-water be added and evaporated to dryness upon a bath of boiling water, the residue, when dissolved in 10 Cc. of distilled water containing 1 Cc. of diluted hydrochloric acid and warmed to about 50° C. (122° F.), should not be colored or rendered turbid by the addition of an equal volume of freshly prepared hydrogen sulphide solution after standing, well stoppered, in a warm place—35° C. (95° F.)—for at least half an hour, nor should the further addition of ammonia-water to this solution cause a coloration or turbidity therein (absence of heavy metals). Upon evaporating 50 Cc. of the solution, previously rendered alkaline by sodium hydroxide test-solution, to dryness upon a water-bath, transferring the dry residue to a watch-glass, moistening it with sulphuric acid, and setting the glass in a moderately warm place for a few hours, the surface of the glass, after being washed, should exhibit no sign of corrosion (absence of hydrofluoric acid). The addition of a few drops of diluted sulphuric acid to 10 Cc. of the solution should produce no turbidity or precipitate (absence of barium).—U. S.

The Pharmacopœia gives the following method for ascertaining the strength of a solution of hydrogen dioxide: Dilute 10 Cc. of the solution with distilled water sufficient

to measure 100 Cc. Transfer 16.9 Cc. of this liquid (containing 1.69 Cc. of the solution) to a beaker, add 5 Cc. of diluted sulphuric acid, and then, from a burette, slowly add, with constant stirring, tenth-normal potassium permanganate solution until the liquid just retains a faint pink tint. Each Cc. of tenth-normal potassium permanganate solution consumed corresponds to 0.1 per cent. of absolute hydrogen dioxide, or 0.329 volumes of oxygen.

To express the strength in *percentage (by weight) of absolute hydrogen dioxide*, multiply the number of Cc. of tenth-normal potassium permanganate solution decolorized by 1 Cc. of it by 0.169, or divide the number of Cc. of tenth-normal potassium permanganate solution decolorized by 1.69 Cc. of it by 10.

The Br. P. requires 1 volume of solution to yield 18–22 volumes of oxygen gas when assayed by means of an acidified solution of permanganate of potassium in a nitrometer filled with brine, corresponding to a 9–11 volume solution.

Action and Uses.—Hydrogen peroxide is used for the purpose of cleansing ulcerating surfaces, for the removal of the false membrane of diphtheria and of the exudate in tonsillitis, and it is sometimes applied to the skin for the purpose of removing discolorations by virtue of its bleaching powers. There is no local application which compares with the peroxide of hydrogen for the removal of the false membrane of diphtheria. When it comes in contact with blood, pus, or other organic material, it sets free a very considerable portion of its oxygen and active effervescence ensues. Applied to ulcers, it speedily softens and removes pus and inflammatory exudates, and leaves a cleansed surface, which may be adequately treated by the application of such substances as are needed in the acceleration of healing.

Peroxide of hydrogen ought never to be injected into body cavities unless the opening in the cavity is large enough to admit of the ready escape of the gas which is set free; for if the gas is imprisoned, it forces apart the inflammatory exudate which is protecting the surrounding parts from infection, and so tends to increase the area of disease. This is particularly important in cases of fistula in ano, and in sinuses which communicate with dead bone. Peroxide of hydrogen has been administered internally as a gastric antiseptic, but is probably of little value, and its internal use, with the idea that it will give off oxygen which can be absorbed into the blood and utilized by the system, is based upon a lack of knowledge of its composition and physiological action. If any oxygen is absorbed from it when it enters the stomach, the amount is so infinitesimal as to be without effect.

When hydrogen peroxide is applied to the throat in diphtheria or in tonsillitis, it should be used in an atomizer made of glass or hard rubber, or applied by means of a piece of cotton on an applicator. It has been used as a gargle in septic sore throat, but it is apt to exert an effect upon metallic fillings in teeth, and if it comes in contact with a carious spot in a tooth may produce a great deal of pain.

Allied Compounds.—It has been known since 1858 that acid esters of hydrogen dioxide could be obtained by the action of acetyl or benzoyl chloride, or acetic or benzoic anhydride, on barium dioxide, and in 1896 Vanino and Thiele published methods for preparing benzoyl dioxide from sodium dioxide by action of benzoyl chloride (*Ber. d. d. chem. Gesellsch.*, 1896, p. 1724). Later Drs. Freer and Novy of the University of Michigan prepared benzoyl-acetyl dioxide and named it benzozone, which name was afterward changed to

Acetozone.—This compound, $(C_6H_5CO.COCH_3)O_2$, resembles hydrogen dioxide in structure, and occurs in crystals which melt at about 36.6° C. (98° F.). It is soluble in water in proportion of 1 part in 1000 to 10,000 parts, according to the temperature of the water; also soluble in 35 parts of oil, slightly soluble in alcohol, and fairly so in ether and chloroform. When dissolved in liquids other than neutral petroleum oils it is gradually decomposed. Acetozone also decomposes in contact with alkalies, or when gradually heated. While not itself an oxidizing agent, its aqueous solutions, owing to slow hydrolysis, act as such.

Acetozone is highly recommended as an intestinal antiseptic in the treatment of typhoid fever, in which disease it is claimed to lessen the tendency to tympanites and diarrhœa, to destroy the offensive odor of the stools, to abate nervous symptoms, and to reduce temperature. At least 2 quarts of the 1 : 2000 solution should be drunk in 24 hours, the solution replacing all other liquids except milk. It is used also in diarrhœa, amœbic dysentery, Asiatic cholera, and other intestinal diseases, administered by the mouth and by high rectal injection. Its antiseptic power renders it an efficient application in tonsillitis and other throat affections, corneal ulcers, gonorrhœal urethritis and vaginitis, in abscesses, gangrene, and minor surgical cases. For these purposes it may be applied in powder, aqueous or oily solution or ointment. For internal administration acetozone is preferably dissolved in *warm* water in the proportion of 7½ grains to 1 quart (about 1 : 2000). If given in powder or cap-

sule it may irritate the stomach. Ointments of acetozone should be made with petrolatum and of the strength of $\frac{1}{10}$ to 1 per cent., while for use as a spray it may be dissolved in liquid petrolatum previously warmed to about 55° C. (131° F.). Commercial acetozone, as marketed by Parke Davis & Co., is in the form of powder, and is said by the manufacturers to be a mixture of equal weights of pure acetozone and an inert absorbent substance.

GLYCOZONE.—This is claimed by the manufacturer, Marchand, to be a stable chemical compound resulting from the reaction taking place when chemically pure glycerin is treated with 15 times its own volume of ozone. It has a pleasant sweet acidulous taste and absorbs moisture quite readily, hence must be kept in well-stoppered bottles to prevent deterioration. Glycozone is claimed by its manufacturer to give relief when given internally in catarrhal and in inflammatory conditions of the stomach, and in intestinal disorders, and when applied locally to stimulate healthy granulations in ulcers, etc.

HYDROZONE.—This name has been applied by Marchand to an aqueous solution of hydrogen peroxide about 3 times as strong as the official solution, yielding not less than 30 volumes of available nascent oxygen, and containing 9 per cent. of hydrogen dioxide. With ordinary care it is said not to lose more than $\frac{1}{10}$ of 1 volume of oxygen every 30 days, at a temperature not exceeding 21.1° C. (70° F.), and must, therefore, be considered as quite stable. Hydrozone is used for the same purposes as Aqua Hydrogenii Dioxidi.

AQUA LAUROCERASI, *Br.*—Cherry-laurel Water.

Eau distillée de laurier-cerise, Fr.; *Kirschlorbeerwasser*, G.

Preparation.—Take of fresh leaves of cherry laurel, 1 pound (or 320 Gm.); water, 2½ pints (or 1000 Cc.). Crush the leaves, introduce them with the water into a retort, and distil 1 pint of liquid (or 400 Cc.). Shake the product, filter through paper, and adjust the strength of the finished product either by addition of hydrocyanic acid or by diluting the filtrate with distilled water, so that 20 Gm. of it, tested as described under Hydrocyanic Acid, shall require 3.7 Cc. of the volumetric solution of silver nitrate to be added before a permanent precipitate begins to form, which corresponds to 0.1 per cent. of real hydrocyanic acid.—Br.

The distillate contains oil of bitter almond and hydrocyanic acid, and is similar to bitter-almond water.

Action and Uses.—Cherry-laurel water depends for its properties upon the small quantity of hydrocyanic acid which it contains, amounting to about $\frac{1}{10}$ of 1 per cent. Because of the volatility of its active principle it varies greatly in strength, sometimes producing effects which are excessive and at other times being almost devoid of influence. Like most medicinal waters, it is used chiefly as a vehicle because of its pleasant taste of bitter almond. Its dose is from ½ to 2 teaspoonfuls (2–8 Cc.), the latter dose being administered with caution.

AQUA MENTHÆ PIPERITÆ, *U. S., Br., P. G.*—Peppermint Water.

Eau de menthe poivrée, Fr.; *Pfefferminzwasser*, G.; *Acqua distillata di menta piperita*, F. It.

Preparation.—Oil of peppermint, 2 Cc.; purified talc, 15 Gm.; distilled water, a sufficient quantity to make 1000 Cc. Triturate the oil with the purified talc, add the water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the peppermint-water is perfectly clear.—U. S.

(32 minims of oil of peppermint may be triturated with 240 grains of purified talc, and will require 2 pints of distilled water.

Take of oil of peppermint, 77 minims (or 10 Cc.); water, 1½ gallons (or 15 liters). Distil two-thirds.—Br.

The German Pharmacopœia directs 10 parts of water to be distilled from 1 part of the herb; Fr. Cod., 1 part from 1 part of the fresh herb.

Action and Uses.—Peppermint water when freshly prepared has quite a strong odor and taste of peppermint, and is chiefly used as a vehicle in the administration of drugs which are designed to cure indigestion and to expel flatus from the gastro-intestinal tract. Peppermint water is sometimes given in the dose of from ½ to 1 teaspoonful (2–4 Cc.), pure or diluted with water, in the treatment of colic in children. It is also sometimes used with bicarbonate of sodium in the treatment of headache, hiccough, and cardiac palpitation dependent upon hyperacidity of the stomach.

AQUA MENTHÆ VIRIDIS, *U. S.*, *Br.*—Spearmint Water.

Eau de menthe verte, Fr.; *Römisch-Minzwasser*, G.; *Agua de yerba buena*, Sp.

Preparation.—Oil of spearmint, 2 Cc.; purified talc, 15 Gm.; distilled water, a sufficient quantity to make 1000 Cc. Triturate the oil with the purified talc, add the water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the spearmint-water is perfectly clear.—U. S.

(32 minims of oil of spearmint may be triturated with 240 grains of purified talc, and will require 2 pints of distilled water.)

Take of oil of spearmint, 77 minims (or 10 Cc.); water, $1\frac{1}{2}$ gallons (or 15 liters). Distil two-thirds.—Br.

On the continent of Europe curled mint-water is used instead. *Aqua menthæ crispæ* is prepared by mixing curled mint-leaves, 1 part, with sufficient water, and distilling 10 parts.

Action and Uses.—Spearmint is used in cases of infantile colic with bicarbonate of sodium, in the dose of a teaspoonful, for the expulsion of flatus from the gastro-intestinal tract, and as a vehicle for other drugs. Its dose is from $\frac{1}{2}$ to 4 teaspoonfuls (2–8 Cc.).

AQUA PICIS, *P. G.*—Tar Water.

Theerwasser, G.; *Acqua di catrame*, F. It.; *Agua de alquibran*, Sp.

Preparation.—1 part of tar is mixed with 3 parts of powdered pumice-stone which has been previously washed with water and dried, and of this mixture 2 parts are added to 5 parts of water, well shaken for 5 minutes, and filtered.—P. G. Tar, 1 part; water, 46 parts.—F. It.

Tar water should be clear, of yellowish or brownish-yellow color, and possess the odor and taste of tar. It is best prepared fresh when wanted.

Action and Uses.—Tar water is sometimes used in cases of intestinal catarrh and of bronchitis in its chronic forms.

Aqua Picis Concentrata.—*Concentrated tar water*, E.; *Starkes Theerwasser*, G.—250 parts of tar are mixed with 15 parts of sodium bicarbonate and 1000 parts of water, and warmed in a closed vessel on a water-bath for 3 hours. When cool, the mixture is filtered.

AQUA PIMENTÆ, *Br.*—Pimento Water.

Eau de piment de la Jamaïque, Fr.; *Nelkenpfeffer-Wasser*, G.

Preparation.—Take of pimento, bruised, 8 ounces (or 250 Gm.); water, 2 gallons (or 10 liters). Distil one-half.—Br.

On standing, it separates a brownish resin.

Action and Uses.—Pimento water has been used for wind colic and as a vehicle.

AQUA ROSÆ, *U. S.*, *Br.*, *P. G.*—Rose Water.

Aqua Rosarum.—Eau distillée de rose, Fr.; *Rosenwasser*, G.; *Acqua distillata di rose*, F. It.; *Agua rosada*, Sp.

Preparation.—Stronger rose water, distilled water, of each, 1 volume. Mix them immediately before use.—U. S.

The British Pharmacopœia directs that rose water shall be prepared by mixing the distilled rose water of commerce with twice its volume of distilled water immediately before use.

Add 4 drops of oil of rose to 1000 Cc. (about 34 fluidounces) of lukewarm water, agitate for some time, and filter.—P. G.

Action and Uses.—Rose water is used as a vehicle.

AQUA ROSÆ FORTIOR, *U. S.*—Stronger Rose Water.

Triple rose-water, E.; *Stärkeres Rosenwasser*, G.

Water saturated with volatile oil of rose petals, obtained as a by-product in the distillation of oil of rose.

Strong rose water should be kept in well-stoppered bottles, in a dark place.—U. S.

Like orange-flower water, the finest rose water is obtained by distillation of the fresh

petals; it should be clear and colorless, not mucilaginous, and free from metallic impurities, which latter may be detected by hydrogen sulphide and ammonium sulphide, neither of which should produce turbidity in the water.

AQUA SAMBUCI, *Br.*—Elderflower Water.

Eau distillée de sureau, Fr.; *Fliederblumen- (Hollunderblüthen-) Wasser*, G.

Preparation.—Take of fresh elderflowers, separated from the stalks, 10 pounds (or 5000 Gm.) (or an equivalent quantity of the flowers preserved while fresh with common salt); water, 5 gallons (or 25 liters). Distil one-fifth.—Br.

On standing, it is inclined to separate a mucilaginous sediment, which should be removed by filtration.

AQUÆ MEDICATÆ.—Medicated Waters.

Aquæ destillatæ, P. G.; *Aquæ stillatitiæ.—Distilled waters*, E.; *Eaux distillées, Hydrolats*, Fr.; *Destillirte Wässer*, G.; *Acquæ distillate*, F. It.

Preparation and Properties.—The above names are applied to waters which have been impregnated with volatile substances. All odorous plants and parts of plants impart their odor, and to a certain extent also their taste, to water which is distilled therefrom. This is due to a considerable extent to the volatile oils passing over with the vapor of water; but in many instances the flavor of such distilled waters differs more or less from that of the aqueous solutions of the corresponding volatile oils, and we may therefore assume that besides the volatile oils and other volatile compounds, acids, and probably ethers, pass over and remain dissolved in the water, whereby the flavor is modified and nearly always becomes more agreeable. In preparing medicated waters distillation should be resorted to whenever practicable.

The drugs are preferably used in the fresh state if they can be thus obtained, since during the drying process more or less of the volatile constituents are lost by evaporation, and, in common with the others, often modified in composition. In some cases where the oil-cells are well protected, as in cinnamon bark, or the oil is produced only by contact with water, as in bitter almond, the material may be preserved in the dry state for a long time without deterioration. In all cases where the oil-cells are not situated on the surface, as they are in many leaves, the drug should be suitably comminuted, so that it may be easily penetrated by the hot water and the oil-cells ruptured.

In distilling medicated waters over a naked fire great care should be taken to prevent the material from being burned, otherwise an empyreumatic odor and taste will be imparted to the distillate; this is obviated by placing the drug upon a diaphragm, or setting within the still another vessel perforated on the sides and bottom, so that the vapors will pass through it without unnecessary obstruction. If steam is used, the danger of burning is avoided; in this case a jet of steam may be conducted to the bottom of the still, the contents of which are thereby heated to the boiling-point. If dry material is used, allowance should be made for its swelling on becoming thoroughly permeated by the water, as it might otherwise fill the still and pass into the condenser. Some materials when boiled in water foam considerably, and portions of the decoction are then apt to be carried over mechanically, rendering the distillate colored and otherwise impure. This tendency to foam over will be lessened by adding to the contents of the retort a small quantity of a fixed oil.

The rapidity with which medicated waters are distilled is of importance, since it has a considerable influence on their flavor and stability. In all cases the waters should be rapidly and thoroughly cooled in the condenser, to prevent the action upon the tin of the hot water and of the acids which are frequently present, and to avoid changes in the volatile oil which, in its finely divided condition, are apt to occur. Waters which have been insufficiently cooled very frequently become ropy in keeping. It is advisable, therefore, to distil them slowly, and to cool the condenser well with a sufficient supply of water.

A peculiar odor is observed in some waters immediately after they have been distilled from tin vessels or condensed in tin worms, but not when glass vessels have been used. If the waters are exposed to the air in loosely closed vessels for a few days, this still-odor disappears and the natural odor of the water becomes apparent.

Distilled waters which, like orange-flower and rose-water, are not completely saturated with volatile oil, are advantageously prepared of double or triple strength, either by distilling off only one-half or one-third of the necessary quantity of water, or by having recourse to the process of cohobation, in which case the proper quantity of water is distilled off and a second or third time distilled from fresh portions of the same material. When wanted for use, they are diluted with distilled water in the proper proportions.

Distilled waters are best preserved in well-corked bottles, which should be completely filled and protected from the light. Exposed to air and light, they gradually turn sour and lose their agreeable odor.

The U. S. Pharmacopœia directs most medicated waters to be prepared by dissolving the volatile oil in distilled water, the intention being to produce, as nearly as possible, saturated solutions, which must be clear and free from solid impurities. To facilitate solution, the oils are now directed to be triturated with about 8 times their weight of purified talc, after which the distilled water is gradually added with continued trituration; the mixture is finally filtered through paper. Thorough trituration with an insoluble powder causes division of the oils into minute particles, in which condition they are more readily dissolved by water. It is important that the purified talc be not used in the form of an impalpable powder, as this is apt to pass through the filter and necessitate frequent refiltration, but a coarser powder, about No. 60 or No. 80, should be employed. Permission is also given in the Pharmacopœia to effect solution of the volatile oil by replacing the purified talc by pulped or shredded filter-paper, or by the addition of oils to hot water and separation of the excess of the former after active agitation and subsequent cooling of the mixture, or by distillation of the drug or oil with water. When shredded filter-paper is used, the best plan is to drop the oil upon the shredded paper, add this to the hot distilled water contained in a strong bottle or jug, and shake actively until the liquid is cold, after which a perfectly clear solution may be obtained by simple filtration. In our experience this method produces excellent results with little labor. The use of alcohol for the purpose of facilitating solution of the oil in the water must be condemned as liable to cause trouble, the very weak alcoholic liquid having a tendency to become sour through oxidation under favorable conditions. Calcium phosphate, directed in the U. S. P., 1890, is not a good medium for division of the oils, and is frequently found impure from contamination with soluble matter. Magnesium carbonate, at one time largely used, is not desirable, as it is not wholly insoluble, and this fact has often given rise to trouble, as in the case of cinnamon-water, which invariably has a yellow color when made with this agent, and in the case of mixtures of medicated waters with lime-water, producing turbidity.

Tests for Purity.—Medicated waters should evaporate in a clean porcelain capsule without appreciable residue. The water should not acquire a brown or black color by ammonium sulphide or hydrogen sulphide (metals), nor yield with the former a white sediment after having been previously rendered alkaline by the addition of ammonia (zinc).

Action and Uses.—Medicated waters are employed almost exclusively as vehicles for more powerful drugs which are dissolved in them. Very few of them are administered for their own medicinal properties. Statements in regard to the therapeutic uses of each of these will be found under their appropriate headings.

AQUÆ MINERALES.—Mineral Waters.

Eaux minérales, Eaux médicinales, Fr.; *Mineralwässer,* G.

These are spring waters which are charged with certain gases or salts to such a degree that they are unfit for ordinary use, having a noticeable taste and appreciable effect on the animal organism. If the temperature of the water is higher than that of the atmosphere, the springs are known as *thermal,* or *hot,* otherwise they are called *cold springs.*

According to the predominant constituent present, the springs are divided into the following classes:

1. Sulphuretted Waters contain sulphides and hydrogen sulphide, in consequence of which they possess a more or less fetid odor. Some of them are colored or yield a colored deposit, from which fact they have received such names as white (deposit of sulphur), red (iron oxide), blue (from slate), or yellow (due to polysulphides). In this country many sulphur springs exist, the following being some of the most noted:

Cold.—Olympian, Paroquet, Big Bone, Upper and Lower Blue Lick, all of Kentucky; Columbia, Massena Sharon, Clifton, and Chittenango, of New York; White, Red, and Blue Sulphur, Greenbrier White Sulphur, Yellow Sulphur, of Virginia; Salt Sulphur, Red Sulphur, and Borden Spring, of West Virginia.

Thermal.—Santa Barbara (15.5°–54.4° C., 60°–130° F.), Paso Robles (44.4°-50° C., 112°–122° F.), Calistoga, of California; Warm Springs (36° C., 97° F.), of Virginia and of Georgia (32° C., 89.6° F.); Warm Sulphur Springs (35.5°–40° C., 96°–104° F.) of Colorado; Warm Sulphur Springs (35.5°–40° C., 96°–104° F.) of Alaska.

The chief springs in Europe are—

Cold.—Harrowgate, Old Sulphur Well (England); Montmorency (France); Weinberg. Nenndorf, Langenbrücken (Germany).

Thermal.—Barèges, St. Sauveur, Eaux-Chaudes, in France; Baden, in Austria; Aix-la-Chapelle, Aix-les-Bains (Savoy).

2. Alkaline Waters, in which sodium carbonate predominates and free carbonic acid is often present in considerable quantity. Potassium and magnesium carbonates are also present. The following are a few noted springs: Ems, Salzbrunn, Fachingen, in Germany; Vichy, Carnares, in France; Bristol and Buxton, in England; Bladon Springs, in Alabama; Gettysburg Spring, in Pennsylvania.

3. Saline Waters contain various salts of alkalies and alkaline earths, occasionally bromides and iodides. The most common salts are sulphates, carbonates, and chlorides, the latter being the principal one. The following are American springs:

Saratoga, Ballston Spa, Albany Artesian Wells, of New York; Hot Springs, of Virginia; Sweet Springs, of West Virginia; Yellow Springs, Ohio; Bethesda, Wisconsin.

Celebrated European springs are: Selters, Apollinaris, of Germany; Bath, Cheltenham Royal Old Wells, of England; Carlsbad, of Bohemia; Plombières, of France.

4. Purgative Waters, so named because of a purgative action due to sulphates of the alkalies and magnesium, and called by the Germans *Bitterwasser*. Some of them contain iron compounds.

Some American waters are: Bedford Springs, of Pennsylvania; Estile, Crab Orchard, and Harrodsburg Springs, of Kentucky.

European Springs are: Friedrichshall, in Saxe-Meiningen; Seidlitz; Hunyadi János, Ivanda Pullna, of Austria; Kissingen, of Germany; Epsom, of England.

5. Chalybeate Waters, embracing those springs which contain iron in sufficient quantity to impart to them a ferruginous taste. The iron is present either as sulphate or frequently as ferrous carbonate, held in solution by excess of carbonic acid. Hydrogen sulphide is present in some of these springs. Iron being found in several of the waters named above in larger quantities than mere traces, it is evident that the classification must be somewhat arbitrary.

Spa, Pyrmont, Schwalbach, Homburg, are in Germany; Brighton, Cheltenham (chalybeate), Tunbridge Wells, in England; Anderson's Spring, Pa.; Rawley Springs, Va.; Cooper's Well, Miss.; Ballston Spa, New York.

6. Thermal Springs.—Their temperature is above that of the locality in which they are situated, and they serve an important use for baths, although most of these waters are also used internally. The following are some of the best known:

Carlsbad, 73.5° C. (172.4° F.); the temperature of 8 other hot springs ranges between 60.2° and 40° C. (140.4° and 109.4° F.) (Austria). Wiesbaden (Kochbrunnen), 68.8° C. (155.8° F.) (Germany). Baden-Baden, the temperature of 9 springs ranges between 68.63° and 44.4° C. (156° and 112° F.) (Germany). Hot Springs, Arkansas, the 57 springs range in temperature between 65.5° and 33.9° C. (157° and 76° F.). Mention should also be made of the Hot Springs of South Dakota, temperature 36.6° C. (98° F.), and at Glenwood, Colorado, temperature 51.11° C. (124° F.). Aix-la-Chapelle (Aachen), 4 springs ranging between 55° and 45.4° C. (131° and 113.7° F.) (Germany). Bath (King's Spring), 46.2° C. (115° F.) (England). Gastein (Wildbad), 49° to 25° C. (120.2° to 77° F.) (Austria). Ems, 13 springs, ranging between 46.6° and 27.9° C. (116° and 82.2° F.) (Germany). Idaho Springs, Colorado, 46.1° to 29.5° C. (115° to 85° F.). Vichy, 8 springs, 43.5° to 22° C. (108.5° to 71.6° F.) (see under Alkaline Waters). Hot Springs, Virginia, 43.3° to 25.5° C. (110° to 78° F.). Plombières, 51.6° C. (125° F.) (France). Teplitz, 48.8° C. (120° F.) (Bohemia).

Artificial Mineral Waters have been manufactured and used for many years both in Europe and the United States; many of these are close imitations of the natural waters and are extensively sold.

Action and Uses.—Spring water when pure is often taken in large quantities for the purpose of flushing the kidneys and the bladder and aiding in the elimination of impurities from the body. Often its therapeutic effect can be changed or modified by its being taken either hot or cold. In the case of those waters which are alkaline and contain a considerable quantity of bicarbonate of sodium or other saline materials of a closely related character, we find that they are particularly useful in the treatment of gouty and rheumatic affections; that waters containing sulphur in its various forms are useful in many acneiform and scaly eruptions of the skin and in catarrhal states of the alimentary and other mucous membranes; that ferruginous or iron waters are valuable in cases of anæmia, while those waters which contain as their chief ingredients sulphate of magnesium and sulphate of sodium are of value in chronic dyspepsia, gastro-intestinal catarrh with constipation, and for the relief of hemorrhoids. The saline waters with purgative properties are increased in their efficacy, as a rule, if they are taken hot. Some instances of diarrhœa can be much benefited by the use of waters containing iron and alum. So, too, patients suffering from catarrh of the bile-ducts, or from gallstone colic, are often benefited by a prolonged course of alkaline or purgative saline waters.

In cases of irritability of the bladder depending upon excessive acidity of the urine, which often is scanty in quantity, the alkaline waters are of great value, since they not only cause a free flow of urine, thereby diluting it, and carrying out of the bladder various excretory matters, but also render the urine alkaline, so that the bladder is no longer irritated by acid substances. When an excess of phosphates is present and the urine is very alkaline, the use of waters containing sodium bicarbonate is inadvisable. The most celebrated springs containing bicarbonate of sodium are those of Vichy, in France; while the best known mildly alkaline springs in North America are at Saratoga.

The waters of most of the thermal springs do not possess any therapeutic properties apart from their heat. This factor is, however, an important one in aiding in the absorption and elimination of drugs and poisons.

For a description of the various medicinal springs of North America and Europe, and their therapeutic application, see Crook's *Mineral Waters of the United States*, and Hayem's *Physical and Natural Therapeutics.*

ARACEÆ.—The Arum Family.

Genera more than 100, species nearly 1000, mostly tropical, many marsh or water plants, others (which is much the same thing in the humid tropics) at least partially epiphytic. On account of their starch, the rhizomes and bulbs of many species are used as foods or the starches are extracted. Even those which are poisonous may be thus employed, since cooking usually destroys their toxicity. Mere drying partially destroys the toxicity and acridity. Hydrocyanic acid, which exists uncombined, can often be distilled, but the chief toxicity is not due to this. The acridity is partly due to soluble substances and partly to the mechanical effect of needle-shaped crystals. Tannin is not common or abundant.

The most important edible product is the corm of *Calocasia Calocasia* (L.) Lyons (*Arum C.* L.; *C. antiquorum* Schott; *C. esculenta* Schott; *Caladium e.* Vent.; *Arum e.* L.), the *Taro*, *Kalo*, *Cocco*, *Cocoe*, *Tanya*, *Eddoes*, *Eddas*, *Edders*, *Yo-tao*, *Sato-imo*, *Oto*, or *Kalkas*, which is one of the most largely used of tropical foods. Other species of this genus are similarly used, as are *Alocasia Indica* Schott, *A. mucronata* Schott, *Caladium violaceum* Desf., *Xanthosoma edule* Schott, *X. sagittæfolium* Schott, *Amorphophallus giganteus* Bl., *A. sativus* Bl., and *Schismatiglottis calyptrata* Zoll. et Moc. *Monstera deliciosa* yields an edible fruit.

Irritant or stimulant members of the family are so numerous that only a few of the better known are here named.

The juice of the root of *Dieffenbachia Seguina* Schott, of the West Indies, is very acrid and poisonous; its tincture is employed in *pruritus vulvæ*. The rhizome of *Monstera perpusa* Schott is used as a rubefacient and powerful diuretic. *Lagenandra toxicaria* Dalz., or *Vutsusap*, is very poisonous. We have seen the rhizome of a Bolivian species of *Anthurium* in use as a poison by the Indians. The roots and seeds of *Orontium aquaticum* L., the *Golden club*, or *Tawkin*, as well as the seeds of *Peltandra*, the *Arrow-head*, and of *Skunk's cabbage*, all of the United States, are highly acrid and used as antispasmodics, though edible when thoroughly cooked. As antispasmodics, are also used the leaves of *Syngonium Vellozianum* Schott, the *Espirito Santo* (for asthma), *Richardia Africana* Kth. (flatulence), *Homalomena aromaticum* Schott (aphrodisiac), *H. cordata* Schott, *H. rubescens* Kth., *H. alba* Hassk., the latter also a starch-yielder, and various species of the genus *Pothos*. Various species of the genus *Philodendron* have been used as counter-irritants, one of them especially in orchitis.

Anthelmintics are less numerous. They include several species of *Caladium*, the seed of *Philodendron bipinnatifidum* Schott, *Montrichardia aculeata* Crueg., *Scindapsus officinalis* Schott, the *Gaya-pipal*, *Thora-pimpali*, *Vashira*, etc., of India, *Epipremum mirabile* Schott, and *Rhaphidophora lacera* Hassk., one of the ingredients of the *Tonga* of the Fiji Islanders. It is said to contain a volatile alkaloid, *tonghine*.

Synantheris silvaticus Schott, the *Jangli-soorum*, *Madan-must*, or *Kunmar-kas*, is used as a bitter. *Spathyphyllum Humboltii* Schott, of South America, is used as a vanilla substitute.

ARALIA.

A genus of some 25 species of the family *Araliaceæ*, and sharing in its generally aromatic properties. A number of species have enjoyed an extensive use as drugs, and the two following are worthy of special notice:

ARALIA NUDICAULIS L.—*False or Wild sarsaparilla, Small spikenard, Wild liquorice*, E.; *Nackte Aralienwurzel*, G.; *Aralie à tige nue, Petit nard*, Fr.—It is a perennial plant indigeneous to Canada and the United States, where it grows in rich and rocky woodlands as far south as Carolina and Tennessee, and west to the Rocky Mountains. The rhizome sends up a single petiole about 30 Cm. (12 In.) long, and 3-parted at the summit, each division bearing 5 ovate or oval, serrate, and subsessile leaflets. The scape is divided into 3 to 5 peduncles, each bearing a globose loose umbel of many greenish flowers. The rhizome, which is the part employed, is several feet long, horizontal, with some slender branches, and sparingly beset with a few roots. The internodes are indistinct and the undeveloped buds alternate. The dry rhizome is about 6 Mm. (¼ In.) in diameter; the few scape-scars are shallowly cup-shaped, and approximate at the upper annulated end of the branches; the bark is longitudinally wrinkled, of a somewhat glossy pale brownish-gray color externally, the corky layer being easily removed from the white inner bark, which does not firmly adhere to the cylindrical wood. The latter is about 3 Mm. (⅛ In.) in diameter, of a yellowish color, and encloses a spongy white amylaceous pith. The rhizome breaks with a short fracture, and is somewhat aromatic, has a mawkish taste, and contains a little volatile oil, resin, sugar, pectin, and starch.

ARALIA RACEMOSA L.—*American spikenard, Spignet, Pettymorrel*, E.; *Amerikanische Narde*, G.; *Nard américain*, Fr.—This plant grows in similar localities as the preceding, but is found southward to Georgia. It has an herbaceous stem about 1 M. (40 In.) high, and ternately and quinately divided leaves with ovate or heart-ovate doubly serrate leaflets. The flowers are in small umbels arranged in ample branching racemes. The rhizome is oblique, 10 to 15 Cm. (4–6 In.) long, and half as thick; the nodes are approximate, and the stem-scars prominent, about 25 to 38 Mm. (1–1½ In.) in diameter, the older ones deeply concave. The roots are numerous, from 50 to 75 Cm. (20–30 In.) long, about 25 Mm. (1 In.) thick near the rhizome, and little branched below. It has a stronger aromatic odor and taste than the preceding, and has similar constituents.

Pharmaceutical Preparation.—FLUIDEXTRACT OF ARALIA, N. F.

The California spikenard, *Aralia Californica* Watson, resembles *Aralia racemosa*, but the plant and the root are much larger.

ARALIA EDULIS Siebold is indigenous to Japan and cultivated there. In appearance and size the rhizome resembles Solomon's seal, but the circular stem-scars are somewhat spirally arranged, about ½ inch apart, and the wood is in radiating bundles.

ARALIA PAPYRIFERA Hook., indigenous to Formosa, contains a thick white pith, which, cut into thin layers, constitutes part of the so-called Chinese *rice-paper*.

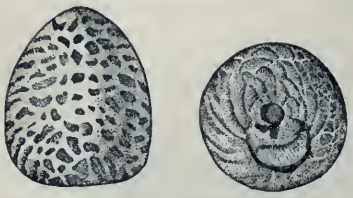
Action and Uses.—*Aralia nudicaulis* and *Aralia racemosa* are employed by the laity as stimulants, diaphoretics, and alteratives. An infusion or decoction (℥j to Oj) is said to possess value in the treatment of syphilis, chronic rheumatism, and chronic cutaneous affections. When locally applied, the decoction is said to be valuable also as a stimulant to sluggish ulcers. California spikenard may be employed for the same purposes as the other varieties.

The *Ariliaceæ*, or *Ivy Family*, is in all ways closely related to the *Umbelliferæ*, comprising more than 50 genera and nearly 400 species, distributed through subtropical and warm-temperate regions, especially in the South American Andes, southern and southeastern Asia and the adjacent islands; in foliage and frequently in inflorescence-habits, highly ornamental, though the individual flowers are not showy; other economic properties, except medicinal, unimportant. Chinese rice-paper is made from *Tetrapanax Papyrifer* (Hook.) K. Koch and some other species. The foliage of a few species is used in salads and as potherbs. Volatile oils similar to those of the *Umbelliferæ* impart aromatic properties to most of the species, especially of *Aralia* and *Panax* (which see), which have rendered them famous in unlearned medical practice, though little esteemed in scientific circles. *Fatsia payrifera* (Hook.) B. et H., *T'ung oh-muh* or *T'ung-ts'au* of China, *Dendropanax arboreum* Dec. et Pl., of tropical America, *Didymopanax Morototoni* Decne, of South America, and *Brassiopsis Haimla* Seem (*Hedera scandens* DC.), may be specially mentioned in this connection. The wood of *Bolyscias nodosa* Forst. (*Aralia n.* Bl., *Hedera n.* Hassk.), of the East Indies, is used as a fish poison. *Hedera Helix* L., the common ivy of Europe, has an ancient medical history. All parts of the plant have been used. The leaves possess mild aromatic properties, differing little from others of the class. Besides *Carotin*, contained also in carrot, they contain the glucoside *helixin* ($C_{32}H_{52}O_{10} + 2H_2O$). The fruit is reputed poisonous, but there appears no evidence that this is true.

ARECA.—Areca-nut.

Semen Arecae.—Betel-nut, E.; *Arekanuss, Betelnuss*, G.; *Noix d'arec*, Fr.
The seed of *Areca Catechu* L. (Fam. *Palmaceæ*), a handsome tall palm, native and very largely cultivated in the East Indies.

FIG. 33.



Areca: lateral and basal surfaces (Nat.).

Description.—1 inch (25 Mm.) or less in length, bluntly conical or strawberry-shaped, the depressed base bearing short fibrous remains of the pericarp; light gray-brown with numerous broad, interrupted reddish veins winding spirally from base to apex; internally ruminated with similar veins, the small embryo near the base; heavy, hard, faintly aromatic, astringent and slightly acrid. The inner layers of the testa and the internal veins contain tannin, and the principal alkaloid, *arecoline*, is contained in or near the latter.

By imperfect drying, a fungous growth is sometimes caused to grow within the tissues.

The areca fruit is a 1-seeded drupe, somewhat resembling a small apple in form and size, the surface orange-yellow, smooth and shining, and the thick mesocarp tough-fibrous. The fruits are husked, boiled, and dried to prepare them for the market. So prepared, they are a highly prized and largely used masticatory in the Orient. Three varieties of the product are recognized; *Chilkin*, made from the unripe, *Betta*, from the moderately ripe, and *Gotu*, from the dead-ripe, fruits.

The leaves of the tree yield a volatile oil.

Constituents.—Johns has found 4 alkaloids. *Arecoline* ($C_8H_{13}NO_2$), 0.07–0.1 per cent., is a colorless oily liquid, chemically resembling *pelletierine* and miscible in all proportions with water, alcohol, ether, and chloroform. Its salts are crystalline and hygroscopic, except the hydrobromide, which is non-hygroscopic. *Arecaine* ($C_7H_{11}NO_2.H_2O$), 0.1 per cent., is a betaine-like body, in colorless crystals, soluble in water, scarcely so in alcohol, chloroform, or ether, and forming crystalline salts of acid reaction. *Arecaidine* ($C_7H_{11}NO_2.H_2O$) is an isomer of arecaine, crystallizing in colorless plates and soluble in water and dilute alcohol. *Guvacine* ($C_6H_9NO_2$) is soluble in water and dilute alcohol, forms small lustrous scales, and yields soluble salts of acid reaction. Arecoline is methyl-arecaidine, and is easily converted into arecaidine and the latter into arecoline. Areca yields also 14 per cent. of tannic acid resembling catechutannic acid, gallic acid, 14 per cent. of fat and oil, gum, and areca-red (a dye). It contains no catechin.

Of the 4 alkaloids found in areca-nut, only arecoline is said to be of importance; the other 3 being considered as possessing no medicinal value. For the purpose of extracting the alkaloids, coarsely powdered areca-nut is exhausted by means of cold water acidulated with sulphuric acid, the infusion being concentrated and precipitated with potassium-bismuth iodide. The resulting crystalline red precipitate is thoroughly washed and boiled with a mixture of barium carbonate and water, which causes the alkaloids to go into solution. After concentration of the solution, barium hydroxide is added in excess, and the mixture immediately shaken out with ether, which takes up the arecoline, but leaves the other alkaloids in the aqueous liquid. The German Pharmacopœia recognizes arecoline hydrobromide.

Arecolinum Hydrobromicum, P. G.—*Arecolinæ Hydrobromidum.—Arecoline hydrobromide*, E.; *Arekolinhydrobromid, Bromwasserstoffsaueres Arekolin*, G. Formula, $C_8H_{13}NO_2HBr$. Molecular weight, 234.33.—This salt occurs in the form of colorless anhydrous needle-shaped prisms, which are crystallized from a hot alcoholic solution. It is readily soluble in water and in alcohol, but difficultly soluble in ether and chloroform. The crystals melt at 167°–168° C. (332.6°–334° F.). An aqueous 5 per cent. solution is not precipitated by potassium hydroxide solution, nor by solutions of platinum chloride, mercuric chloride, or tannic acid, but addition of iodine solution, bromine water, and silver nitrate solution causes respectively a brown, yellow, and pale-yellow precipitate.

Action and Uses.—Areca-nut has been largely employed in its native country for the expulsion of tapeworms, and its efficacy has been confirmed by many practitioners. The freshly grated nut may also be used for the removal of round worms. Its alkaloid, arecoline, slows the pulse, and purges by notably increasing intestinal peristalsis. In over-

dose it occasionally produces tetanic convulsions. Poisonous amounts of arecoline cause respiratory and cardiac depression, and prove fatal through arrest of the respiratory function.

The dose of the powdered drug is from 2 to 4 drachms (8–16 Gm.), usually administered in syrup.

ARGENTI CYANIDUM, *U. S.*—Silver Cyanide.

Argentum cyanatum.—Cyanure d'argent, Fr.; *Silbercyanid, Cyansilber.*

Formula, AgCN. Molecular weight, 132.96.

It should not contain less than 99.9 per cent. of pure silver cyanide corresponding to 80.48 per cent. of metallic silver, and should be kept in dark amber-colored bottles, protected from light.—U. S.

Preparation.—Silver cyanide may be prepared by distilling hydrocyanic acid from a retort by the action of sulphuric acid on potassium ferrocyanide, into a receiver containing a solution of silver nitrate in water. The precipitated silver cyanide is filtered out, washed, and dried. The reaction occurring is explained by the following equation: $HCN + AgNO_3 = AgCN + HNO_3$.

Silver cyanide may also be conveniently prepared by adding a solution of silver nitrate to a solution of pure potassium cyanide as long as a precipitate continues to be formed, and then filtering and washing the precipitate well with distilled water. When silver nitrate solution is first added, no precipitation occurs, owing to the formation of a soluble compound, $KAg(CN)_2$; but this is decomposed by further addition of the silver solution, and silver cyanide is then precipitated. About 17 Gm. of silver nitrate will require 6.5 Gm. of potassium cyanide, producing about 13.3 Gm. of silver cyanide, the two reactions taking place being as follows: (1) $2KCN + AgNO_3 = KAg(CN)_2 + KNO_3$; (2) $KAg(CN)_2 + AgNO_3 = 2AgCN + KNO_3$.

Properties.—Silver cyanide is a white powder, without odor or taste, permanent in dry air, but gradually turning brown on exposure to light. It is insoluble in water, alcohol, or cold nitric acid, but soluble in boiling nitric acid with evolution of hydrocyanic acid; also soluble in ammonia-water, sodium thiosulphate test-solution, and potassium cyanide test-solution. When heated in a porcelain crucible the salt fuses, gives off cyanogen gas, and, on ignition, leaves a residue of metallic silver amounting to 80.48 per cent. of its original weight.—U. S.

Action and Uses.—Silver cyanide is rarely employed in medicine, but is used in pharmacy for the preparation of diluted hydrocyanic acid.

ARGENTI NITRAS, *U. S., Br.*—Silver Nitrate.

Argentum nitricum crystallisatum, P. G.—*Nitrate (Azotate) d'argent, Nitre lunaire*, Fr.; *Silbernitrat, Salpetersaures Silberoxyd, Silbersalpeter*, G.; *Nitrato di plata*, Sp.; *Nitrato di argento crystallizzato*, F. It.

Formula, $AgNO_3$. Melecular weight, 168.69.

It should contain not less than 99.9 per cent. of pure silver nitrate, and should be kept in dark amber-colored vials, protected from light.—U. S.

Preparation.—Silver as free as possible from other metals is dissolved in pure nitric acid diluted with about an equal bulk of water. The chemical change is represented thus: $3Ag + 4HNO_3 = 3AgNO_3 + NO + 2H_2O$. The colorless nitric oxide NO, on coming in contact with oxygen of the air, combines with it; thus, $NO + O = NO_2$, forming reddish fumes of nitrogen tetroxide. The solution of silver nitrate is evaporated to the crystallizing-point and set aside in a cool place. The crystals are drained off in a funnel and the mother-liquor further evaporated and set aside to crystallize. Contact of organic substances with silver nitrate should be avoided.

If pure silver and pure nitric acid are taken, the crystals of silver nitrate need no purification, but if small quantities of copper and other metals are present purification is necessary. This may be done by recrystallization, or the solution may be evaporated to dryness, and the salt carefully heated in a porcelain dish until it is in quiet fusion and colored acid fumes cease to come off. The nitrates of copper and other metals are decomposed into their oxides and the fused mass acquires a more or less dark-gray color. The cooled mass is digested with water, the silver nitrate passes into solution while the

impurities are left behind, being insoluble. The solution is evaporated to crystallization with addition of a little nitric acid.

If considerable copper is present in the silver, it is advisable to purify the silver by one of the methods given elsewhere (see Argentum). None of the pharmacopœias give an official method for preparing silver nitrate.

When silver nitrate is required in sticks or pencils, it is fused in a porcelain vessel and stirred until uniform, and then poured into silver- or gold-lined iron or steel moulds, where it hardens. Care must be taken to avoid overheating and contact with organic substances and dust, else the sticks will have a gray appearance and turn darker in the light. Although pure silver nitrate is unaffected by light, it is well to preserve it in dark bottles with glass stoppers. The fused nitrate is known as *Lapis infernalis* and *Höllenstein* (G.).

Properties.—Silver nitrate exists in colorless shining tabular crystals of the rhombic system, which are inodorous and have a caustic and strongly metallic taste and a neutral reaction. It is soluble at 25° C. (77° F.) in 0.54 part of water and in 24 parts of alcohol (U. S.); in 0.6 part of water and in .10 parts of alcohol, specific gravity 0.832 (P. G.); also in 0.1 part of boiling water and in 5 parts of boiling alcohol (U. S.). It is likewise, though less freely, soluble in ordinary ether, but nearly insoluble in absolute ether, freely soluble in diluted, but sparingly soluble in strong nitric acid. It melts at 200° C. (392° F.) to a faintly yellow liquid, and on cooling congeals to a white crystalline mass; at a higher temperature nitrous vapors are given off, leaving silver oxide and nitrate; heated to a dull-red heat, metallic silver is left. The crystals and the aqueous solution are permanent in the air and light, except in the presence of organic matter, whereby they acquire a dark color. The alcoholic solution when exposed to the light is gradually reduced, silver being separated. Hydrochloric acid produces in the solution a white curdy precipitate of silver chloride, which is insoluble in dilute nitric acid, but dissolves readily in ammonia. Stains produced by silver nitrate upon the skin are removed by rubbing them with a strong solution of potassium cyanide, or by moistening them first with a solution of iodine and afterward with sodium thiosulphate. The solution of silver nitrate acidulated with nitric acid and heated with alcohol produces the violently explosive compound known as *fulminating silver*. Silver nitrate contains no water of crystallization.

Tests.—1 Gm. of silver nitrate yields 0.843 Gm. of chloride.—Br. The salt should yield with ammonia a clear and colorless solution (absence of copper, lead, etc.), and its aqueous solution, when precipitated by an excess of hydrochloric acid, should yield a filtrate which when evaporated leaves no residue (absence of other salts). A 10 per cent. aqueous solution, mixed with 4 times its volume of diluted sulphuric acid and heated to boiling, should not become turbid.—U. S. This test indicates the absence of lead, the sulphate of which is insoluble, while silver sulphate is soluble in 68.6 parts of boiling water. If 0.5 Gm. of silver nitrate, dissolved in 10 Cc. of water, be mixed with 30 Cc. of tenth-normal sodium chloride solution and 3 drops of potassium chromate test-solution, not more than 0.4 Cc. of tenth-normal silver nitrate solution should be required to impart a permanent red color.—U. S. Each Cc. of sodium chloride solution corresponds to 0.016869 Gm. of $AgNO_3$, hence 29.6 (30–0.4) Cc. corresponds to 0.4993 Gm., or 99.86 per cent.—U. S.

Action and Uses.—The pure crystals of silver nitrate are usually employed in internal medicine; solutions of the crystals as well as of the moulded nitrate of silver and of mitigated caustic are frequently employed locally. The two last forms are also used in the solid stick for escharotic purposes. The action and uses of all three are practically the same.

When nitrate of silver is locally applied either to the skin or mucous membrane, it produces burning pain with superficial destruction of the tissue. A white eschar is at first formed, which in a short time becomes of a brown or black color, due to the oxidation of the silver. The albumin of the tissue is coagulated, thereby forming a barrier to the silver salt, and for this reason deep destruction of the part is prevented. When taken internally, its action upon the various vital functions of the organism is not thoroughly understood, but its effect upon respiration and circulation bears no relation to its use in practical medicine. When administered internally in overdose, silver nitrate rapidly produces a violent gastro-enteritis attended with excessive abdominal pain, vomiting, and purging. The vomitus is frequently white and curdy, but may be brownish

in color. The lips are stained first white, and later brown. The face is pinched and covered with perspiration. Occasionally delirium, coma, and epileptiform convulsions are present. Death results either from collapse occasioned by the severe pain or by paralysis of the respiratory center accompanied by exudation of mucus into the bronchial tubes.

The treatment of acute poisoning with nitrate of silver consists in the employment of sodium chloride as the chemical antidote. The application of external warmth to maintain bodily heat, and the administration of opium or morphine and bland draughts, such as milk or emulsions of bland oils, to relieve pain and irritation, should be resorted to. Large draughts of water or soapsuds may be given to dilute the poison. Stimulants such as strychnine, alcohol, and atropine should be employed as necessity demands.

Chronic silver-poisoning, or "argyria," is a condition following the continued administration of silver nitrate, and is characterized especially by the peculiar slate-blue color of the skin and the livid, cadaveric appearance of the individual. This results from a deposition of the salt in the tissues, and is usually first seen in the conjunctiva or the inner surface of the lips. As a rule, argyria is not curable so far as restoration of normal color is concerned. It may be treated by the administration of potassium iodide to aid in the elimination of the drug.

Internally when combined with extract of hyoscyamus or opium silver nitrate is the best drug to employ in the treatment of gastric ulcer. Its administration is also beneficial in treating subacute gastritis, chronic gastric catarrh, chronic diarrhœa, and catarrhal inflammation of the gall-ducts. The drug has been employed in the treatment of intestinal ulcerations attending enteric fever, and in many cases its success has been apparent. In a few instances it has cured tabes dorsalis and anterior spinal sclerosis, but in most cases it has failed to influence the progress of these diseases. Epilepsy was formerly treated by its administration, but this practice is now largely abandoned. Acute and chronic dysentery and ulcerations of the large intestine may be cured by irrigation with a solution of silver nitrate. The bowel should first be emptied, and thoroughly washed out with warm water. If the ulceration is high up in the bowel, 1 drachm (4 Gm.) of the salt in 3 pints (1440 Cc.) of warm water should be injected; if in the rectum, 3 to 5 grains (0.20–0.30 Gm.) in 4 ounces (120 Cc.) of warm water may be used. Should this irrigation prove very painful, relief may be obtained by a second injection of salt solution (℈j to pint j). A 5 per cent. solution has been recommended to prevent the spread of erysipelatous inflammation and the pitting of smallpox. Orchitis and epididymitis in their incipiency may be aborted by painting the scrotum with a 20 per cent. solution of the drug in water. Inflammation of the pharynx and larynx is frequently relieved by the application of a 1.5 per cent. solution, and a spray containing 2 grains (0.12 Gm.) to the ounce (30 Cc.) has been employed in the treatment of laryngeal tuberculosis and whooping-cough. A solution containing $\frac{1}{8}$ of 1 per cent. of the salt is useful as an injection in chronic gonorrhœa, and one containing 1 part of the salt in 5000 parts of water is frequently employed in the treatment of cystitis. Gonorrhœal ophthalmia in all its stages is benefited by the application of silver nitrate.

Leucorrhœa resulting from cervical congestion or uterine ulceration may be cured by the application of the solid stick, and exuberant granulations, venereal excrescences, warts, and chancroids may be destroyed by its use.

A strong solution painted around the edges of the inflamed zone has been used to abort boils, felons, and bedsores. Strong solutions were formerly employed in the abortive treatment of specific urethritis, but this treatment is now practically abandoned, as it frequently increases the intensity of the disease, and often fails to cure.

The dose of silver nitrate is from $\frac{1}{8}$ to $\frac{1}{4}$ of a grain (0.001–0.0015 Gm.) in pill form. When employed for ulcer of the stomach or other gastric disease, it should be administered upon an empty stomach.

ARGENTI NITRAS FUSUS, *U. S.*—Molded Silver Nitrate.

Argenti nitras induratus, Br.—*Toughened caustic*, E.; *Azotate d'argent fondu*, Fr.; *Gehärteter Höllenstein*, G.

It should contain not less than 94.8 per cent. of pure silver nitrate.—U. S.

Preparation.—Silver nitrate, 100 Gm.; hydrochloric acid, 4 Gm. To the silver nitrate contained in a porcelain capsule add the hydrochloric acid, and melt the mixture at as low a temperature as possible. Stir well, and pour the melted mass into suitable

moulds. Keep the product in dark, amber-colored vials, protected from light.—U. S. Fuse and thoroughly mix 95 Gm. of silver nitrate and 5 Gm. of potassium nitrate, and pour into moulds.—Br.

The reasons for the cautious application of heat when fusing silver nitrate have been pointed out above (see Argenti Nitras). The salt being decomposed by nearly all the metals when heated with them, capsules of platinum or of the best porcelain are the only vessels suitable for this operation. When fused, it has the appearance of a colorless, transparent, oily liquid, and is then ready to be poured into the moulds, which should be faced with pure silver. Brass moulds are sometimes used, but they are liable to contaminate the product with copper. Steel or porcelain moulds may be used after they have been rubbed with powdered French chalk, which prevents the fused salt from adhering to the mould. If the moulds have been previously warmed to about 40° or 50° C. (104° or 122° F.), the fused mass will not congeal too rapidly. Oiling the moulds should be avoided, lest a reduction of the salt should take place.

Properties.—Moulded *pure* silver nitrate is met with in nearly colorless thin cylinders or pointed cones, which when broken show a crystalline texture upon the fractured surface; in solubility, chemical behavior, and composition it agrees with the crystallized nitrate. It is not affected by light unless it has been partly reduced by too high a heat to silver nitrite or been in contact with organic matter; wrapping the sticks in paper or handling them with the fingers should therefore be avoided. The pencils are rather brittle, but the addition of a little silver chloride, as proposed by Dr. Squibb (1858), renders the sticks more opaque and tough. This is now recognized by the U. S. P. Oxide or metallic silver in very fine division is occasionally present, either in consequence of too high a heat having been employed or because the sticks have been in contact with organic matter; it is left as a black powder on treating the sticks with distilled water. If 0.50 Gm. of molded silver nitrate, dissolved as completely as possible in 10 Cc. of water, be mixed with 30 Cc. of decinormal sodium chloride solution, and then a few drops of potassium chromate test-solution added, not more than 1 to 9 Cc. of decinormal silver nitrate solution should be required to impart to the liquid a permanent red color (corresponding to 94.8 per cent. of pure silver nitrate).—U. S. 1 Gm. should yield 0.8 Gm. of silver chloride.—Br.

Action and Uses.—Molded nitrate of silver is rarely employed in solution, but it may be locally used instead of the pure crystals. It is never given internally, because of the impurities which it frequently contains. Lunar caustic is employed for the removal of venereal warts, excessive granulations, and diphtheritic exudations. Its solution is employed for the same purpose and in the same strength as that made from the pure crystals (see Argenti Nitras).

ARGENTI NITRAS MITIGATUS, *U. S., Br.*—Mitigated Silver Nitrate.

Argenti nitras dilutus, U. S., 1890; *Argentum nitricum cum kalio nitrico*, P. G.; *Lapis infernalis nitratus.—Diluted silver nitrate, Mitigated caustic, Nitrate of silver and potassium*, E.; *Azotate d'argent mitigé, Pierre infernale diluée*, Fr.; *Salpeterhaltiges Silbernitrat, Salpeterhaltiger Höllenstein*, G.

It should contain not less than 33.3 per cent. of pure silver nitrate.—U. S.

Preparation.—Silver nitrate, 30 Gm.; potassium nitrate, 60 Gm. Melt the salts together in a porcelain crucible at as low a temperature as possible, stirring the melted mass well until it flows smoothly. Then cast it in suitable moulds. Keep the product in dark, amber-colored vials, protected from light.—U. S.

Silver nitrate, 1 part; potassium nitrate, 2 parts.—P. G., Br.

Properties.—A white, hard solid, generally in the form of pencils or cones, of a finely granular fracture, becoming gray or grayish-black on exposure to light in presence of organic matter; odorless, having a caustic metallic taste and a neutral reaction. Each of its constituents retains the solubility in water and in alcohol, mentioned respectively under Argenti Nitras and Potassii Nitras.—U. S. The pencils are less fragile and more opaque than those made of pure silver nitrate. They will contain silver nitrite, and blacken on exposure to light if the salts have been melted at too high a heat. If made with sodium nitrate, they become superficially moist in a damp atmosphere.

Tests.—An aqueous solution of mitigated silver nitrate yields, with a slight excess of hydrochloric acid, a white precipitate, which is readily soluble in ammonia-water.

The filtrate from the precipitate, when evaporated to dryness, yields a white residue which is completely soluble in water, and this solution affords a yellow crystalline precipitate with platinic chloride test-solution, and a white crystalline precipitate with sodium bitartrate test-solution. If to an aqueous solution of mitigated silver nitrate a slight excess of ammonia-water be added, it should neither assume a blue color (absence of copper) nor show turbidity (absence of lead and bismuth). If 1 Gm. of mitigated silver nitrate, dissolved in 10 Cc. of water, be mixed with 20 Cc. of tenth-normal sodium chloride solution, and then a few drops of potassium chromate solution added, not more than 0.3 Cc. of tenth-normal silver nitrate solution should be required to impart to the liquid a permanent red color (corresponding to at least 33.23 per cent. of pure silver nitrate).—U. S. 3 Gm. should yield 0.843 Gm. of AgCl.—Br.

Action and Uses.—This is merely a mitigated form of molded silver nitrate, and may sometimes be found convenient when a slight caustic action is intended.

ARGENTI OXIDUM, *U. S., Br.*—Silver Oxide.

Argentum oxydatum.—Argentic oxide, E.; *Oxyde d'argent,* Fr.; *Silberoxyd,* G.

Formula, Ag_2O. Molecular weight, 230.12.

Silver oxide should be kept in dark amber-colored vials, protected from light. It should not be triturated with readily oxidizable or combustible substances, and should not be brought in contact with ammonia. It should contain 99.8 per cent. of pure oxide, corresponding to not less than 92.9 per cent. of pure metallic silver.—U. S.

Preparation.—It was formerly prepared by precipitating silver nitrate by potassium hydroxide (U. S. 1870). The Br. P. directs the use of lime water. The reaction is $2AgNO_3 + 2KOH = 2KNO_3 + H_2O + Ag_2O$. The oxide is filtered, washed, and dried at a temperature not above 100° C. (212° F.). The caustic alkali should be free from chloride and carbonate, to avoid formation of silver chloride and carbonate along with the oxide. It may also be prepared by boiling silver chloride (moist) with strong potassium hydroxide solution, until a portion of the sediment is completely soluble in nitric acid.

Properties.—Argentic oxide is an olive-brown or blackish powder, soluble in 3000 parts of water with alkaline reaction. When moist it attracts carbon dioxide. It is reduced by the action of light, also decomposed at 250°–300° C. (482°–572° F.) into silver and oxygen; it should therefore be well dried and kept in dark, amber-colored bottles, protected from light. Freshly prepared silver oxide is wholly soluble in ammonia water, after drying and keeping only partly, leaving a black powder, *Berthollet's fulminating silver,* and the solution depositing black crystals of the same compound, which is violently explosive. The oxide, moistened with creosote or when mixed with tannin, amorphous phosphorus, precipitated sulphur, the sulphides of arsenic and antimony, or with other readily oxidizable or combustible substances, renders these spontaneously inflammable.

Tests.—Silver oxide should be completely dissolved without effervescence in dilute nitric acid (absence of carbonate or chloride), and the colorless solution should respond to the reactions and tests stated under Argenti Nitras. 0.5 Gm. of the oxide when ignited in a porcelain crucible should yield not less than 0.464 Gm. (or 92.9 per cent.) of metallic silver.—U. S. 1 Gm. should yield 1.237 Gm. of AgCl when dissolved in nitric acid and precipitated with hydrochloric acid.—Br.

Action and Uses.—Silver oxide may be employed in internal medicine for the same conditions in which silver nitrate is used, but because of its slight solubility is probably of less benefit than the latter salt (see Argenti Nitras). For local application solutions of silver nitrate are always to be employed.

Silver oxide is given in doses of from ½ to 2 grains (0.03–0.12 Gm.), 3 times daily.

ARGENTUM.—Silver.

Argentum purificatum.—Refined silver, E.; *Argent, Argent raffiné,* Fr.; *Silber, Raffinirtes Silber,* G.; *Argento,* F. It.

Symbol, Ag. Atomicity univalent. Atomic weight, 107.12.

Origin.—This metal was known and in use in the earliest historic period, and was

called *Luna* or *Diana* by the alchemists. It is found free and in combination with various metals, and with sulphur, chlorine, bromine, iodine, etc., the richest silver ores being in the western United States, Mexico, Peru, Norway, Russia, Germany, and Spain.

Preparation.—The extraction of the metal is effected by different processes, the details varying considerably with the richness and the composition of the ore. The process of *amalgamation* is based upon the formation of an alloy between metallic mercury and silver. The finely powdered ore is intimately mixed with sodium chloride and then roasted, when the mass contains, besides metallic silver, its chloride, the latter being converted to the metallic state by agitation in a revolving cylinder with water and iron. Mercury is now added and the agitation continued, when the silver, gold, and copper unite with the mercury, the amalgam being obtained by subsidence and washing, and afterward separated into a liquid and a solid portion by subjecting it to pressure in strong linen or leather bags. By distilling the solid portion, the mercury is volatilized and recovered, while the silver remains, containing copper and gold.

In the process of *cupellation* galena (lead sulphide) containing silver is first reduced and the metallic lead allowed to cool slowly, when almost pure lead crystallizes, and is removed by means of a ladle or by carefully draining off the liquid portion, which is rich in silver. This is exposed to a red heat, and air directed upon it by means of a blast, whereby the lead is oxidized and the litharge blown off, leaving silver containing some lead. This is now transferred to a dish made of bone-ash and heated to redness; the plumbic oxide formed is absorbed by the porous vessel, and finally almost chemically pure silver is left.

By the careful roasting of the ore containing the metals as sulphides these are converted into sulphates, which are treated with hot water; from this solution the silver is precipitated by metallic copper, the latter being subsequently recovered by precipitation with iron.

Many modifications of these and other processes are employed, the silver obtained on the large scale always retaining a small portion of other metals.

Chemically pure silver is obtained in various ways from the chloride, which is readily prepared free from other chlorides by precipitating the solution in nitric acid with hydrochloric acid and washing it thoroughly with water. The silver chloride is then reduced by boiling it with glucose and sodium carbonate; the powdered silver thus obtained is well washed with acetic acid and water and then fused. Or the chloride is mixed with acidulated water and a rod of zinc introduced, the silver being afterward fused with borax and saltpeter. Or a mixture of the chloride with sodium and potassium carbonate is heated, whereby silver, alkali chlorides, carbon dioxide, and oxygen are formed: $2AgCl + KNaCO_3$ yields $Ag_2 + KCl + NaCl + CO_2 + O$.

For the technical preparation of pure silver, only two processes, in the main, are employed at present, namely, the sulphuric acid and the electrolytic method. In the former, the granulated silver is boiled with concentrated sulphuric acid, and the silver sulphate brought into solution with much hot water. From this solution the silver is precipitated by iron, the fine powder is pressed into bricks and melted in crucibles. In the electrolytic process the silver in the form of plates is hung as the anode in a bath of silver nitrate and copper nitrate, from which it is carried by the electric current to the cathode, which is made of thin silver plates, where it deposits in large pure crystals. By washing and drying these, they are ready for the market.

Properties.—Silver is a brilliant white metal, very ductile and malleable, having the specific gravity 10.47 when obtained by fusion; the pressed and the distilled silver have a density of 10.57. It may be drawn into very fine wire and beaten into very thin *silver-leaf, Argentum foliatum* (P. G.). It melts at about 1000° C. (1832° F.), absorbs oxygen, which on cooling is again given off, but it does not oxidize in contact with the air at a red or white heat, and distils at the heat of the oxyhydrogen flame. It is tarnished superficially by the hydrogen sulphide contained in the atmosphere. It dissolves completely in diluted nitric acid and hot concentrated sulphuric acid, but is insoluble in hydrochloric acid and dilute sulphuric acid. Pure silver is too soft for coins, utensils, etc., and therefore copper is added to it to make it harder and more durable. Silver is unaffected by fused alkalies or alkali nitrates, and hence silver crucibles and spatulas are used in the laboratory for such fusions. Silver forms a greater number of insoluble or difficultly soluble salts than any other metal. The nitrate is the most important silver salt.

Various allotropic modifications of metallic silver have been obtained by treating solutions of silver salts with different reducing agents; some of these have been found soluble in water, and nearly all of them can be reduced to powder by moderate trituration. The particular allotropic form appears to depend upon the reducing agent employed and the conditions under which reduction takes place; thus blue, lilac, green, gold-colored, and reddish-brown silver have been obtained. The usual methods followed are (1) reduction of silver citrate or tartrate by ferrous citrate or tartrate; (2) action of dextrin and fixed alkali hydroxides on silver nitrate or oxide; (3) action of tannin and fixed alkali carbonates on silver nitrate or carbonate. More complete accounts of this interesting subject will be found in the papers by M. Carey Lea (see *Proc. Am. Pharm. Assoc.*, for 1890, 1891, 1892).

Argentum Colloidale.—*Argentum solubile, Collargolum.—Colloidal or soluble silver*, E.; *Colloidales Silber, Credésches Silber*, G.—This preparation may be obtained by adding to 500 Cc. of a 10 per cent. silver nitrate solution, while stirring, a mixture composed of a solution of 280 Gm. of crystallized sodium citrate in 500 Cc. of water and 500 Cc. of a 30 per cent. solution of crystallized ferrous sulphate. The resulting precipitate is washed by decantation with dilute sodium citrate solution, dissolved in water, and reprecipitated by addition of absolute alcohol. In its moist state colloidal silver appears as a pale lilac, blue, or green-colored mass, which is soluble in 50 parts of water, forming a deep-red liquid. The addition of hydrochloric acid to this solution precipitates a spongy mass, consisting of silver chloride and metallic silver. Colloidal silver is also soluble in 500 parts of alcohol. While looked upon as an allotropic modification of silver, it contains but 97 per cent. of pure metal. Its chief use is in the preparation of Credé's Ointment (*Unguentum argenti colloidalis*, Credé), which is composed of colloidal silver 15 parts, water 5 parts, white wax 10 parts, and benzoinated lard 70 parts.

Tests.—The solution of chemically pure silver in hot diluted nitric acid, when precipitated by hydrochloric acid, yields a filtrate which is not darkened by hydrogen sulphide, and on evaporation to dryness leaves no residue.

Action and Uses.—Metallic silver is not employed in medicine as such, but because of its tendency to oxidation and its antiseptic properties it has been largely used in surgery, especially in the form of wire and plates.

Colloidal silver or Unguentum Credé has been introduced into medicine in the treatment of various forms of septic infection. Infectious pneumonia, pyæmia, septicæmia, peritonitis, pelvic abscess, and cystitis are said to be benefited by its use. It may either be given by intravenous injection, the dose being from $\frac{1}{2}$ to 1 grain (0.03–0.06 Gm.) in a 1 to 100 solution; or by inunction, the amount employed being from 20 to 40 grains (1.3–2.6 Gm.). The injection may be repeated daily if the nature of the case requires. The intravenous injection of this substance is not uncommonly followed either by a distinct chill or a chilly sensation in from 2 to 4 hours.

SILVER SALTS.

Argentaminum. *Argentamine, Ethylenediamine silver phosphate.*—Made by dissolving 10 parts of ethylenediamine and 10 parts of silver phosphate in 100 parts of water. A colorless alkaline solution, not precipitated by chlorides or albumin. It should be protected from light. An antiseptic, used in gonorrhœa.

Argenti Acetas. *Silver acetate.* $C_2H_3O_2Ag$.—Obtained by action of sodium acetate on silver nitrate. White minute crystals, of a disagreeable metallic taste, soluble in 100 parts of cold and 15 parts of boiling water, slightly soluble in alcohol. It is affected by light. Used as a reagent.

Argenti Chloridum. *Silver chloride.* AgCl.—Obtained by precipitation of silver nitrate by sodium chloride or hydrochloric acid. When wet, a white curdy, agglutinating substance, which darkens in light. Decomposed by caustic alkalies to oxide. Native chloride is known as *horn silver*. Silver chloride is soluble in ammonia water, cyanides, thiosulphates insoluble in water and dilute acids. It melts at 260° C. (500° F.) to a yellow liquid which solidifies into a colorless translucent horny mass (horn silver). Formerly often used as a substitute for silver nitrate in many affections.

Argenti Citras. *Silver citrate, Itrol.* $C_6H_5O_7Ag_3$.—Obtained by precipitating a solution of silver nitrate with a solution of citric acid neutralized by sodium bicarbonate, filtering, washing, and drying the precipitate on porous plates, without access of light. It is a white, odorless, heavy powder, moderately sensitive to light, soluble in 3800 parts of water. It is a non-corrosive antiseptic, used dry or in solution.

Argenti Fluoridum. *Silver fluoride.* AgF.—A very hygroscopic mass left on dissolving oxide or carbonate of silver in hydrofluoric acid and evaporating to dryness. It has antiseptic properties.

Argenti Iodas. *Silver iodate.* $AgIO_3$.—A white crystalline difficultly soluble powder obtained by precipitating silver nitrate with potassium iodate solution; used externally and internally.

Argenti Iodidum. *Silver Iodide.* AgI.—This salt was dropped in U. S., 1900. It may be obtained by adding a solution of silver nitrate to a solution of potassium iodide, while stirring, filtering and washing the precipitate on a filter. Silver chloride, due to impurity of chloride in potassium iodide, may be removed by washing the precipitated silver iodide with dilute ammonia-water by decantation before filtering. It is a heavy, light-yellow, tasteless powder, unaltered by light if pure, insoluble in water, alcohol, or dilute acids, soluble in 2500 parts of stronger ammonia-water, and in potassium cyanide solution and sodium thiosulphate. The presence of chloride or bromide in silver iodide is detected by digesting it successively with a solution of ammonium carbonate and ammonia-water and acidifying the respective filtrates with nitric acid, when more than a slight opalescence indicates, in the first case, chloride, in the second, bromide. If a small quantity of chlorine-water be agitated with an excess of the salt, the filtrate acquires a dark-blue color on the addition of starch paste. Iodide of silver is practically never employed in medicine at the present time. It was formerly used in the treatment of syphilis, asthma, chorea, and pertussis. The dose is stated to be from ½ to 2 grains (0.03–0.12 Gm.).

Argenti Lactas. *Silver lactate, Actol.* $C_3H_5O_3Ag + H_2O$.—Obtained by dissolving silver carbonate (by precipitating silver nitrate with sodium carbonate) in diluted lactic acid (8 parts of 75 per cent. acid to 80 parts of water) and evaporating to crystallization. All work should be done in a dark room. Colorless needles easily affected by light, soluble in 15 parts of water. The salt is usually brown and gives a brownish or reddish solution. An aqueous solution of 1 : 300 to 1 : 500 is equivalent to a 0.1 per cent. mercuric chloride solution in disinfecting properties. The dry salt is irritating to wounds. Actol tablets are on the market, containing 0.2 Gm. of actol, each of which will make ½–1 liter of solution, which is used in place of mercuric chloride. Silk catgut and drains are made antiseptic by impregnation with actol solution, washing, and exposing to light until dark-brown.

Argenti Phosphas. *Silver phosphate.* Ag_3PO_4.—A yellow amorphous powder, obtained by the action of sodium phosphate on silver nitrate. It is insoluble in water, soluble in nitric acid and ammonia water.

Argenti Quinaseptolas. *Silver quinaseptolate, Silver oxyquinoline-sulphonate, Argentol.* $C_9H_5N(OH)SO_3Ag$.—Obtained by interaction between silver nitrate and sodium quinaseptolate. A yellow powder, difficultly soluble in cold water, alcohol, and ether, more soluble in hot water. Used as substitute for iodoform for wounds, and skin diseases, either as ointment (1–2 : 100) or solution (1 : 300–1000). It is decomposed by septic matter into silver and oxyquinoline. It should be protected from light.

Argenti Sulphas. *Silver sulphate.* Ag_2SO_4.—Formed by action of sodium sulphate on strong solution of silver nitrate, whereby a colorless crystalline powder is obtained, which is filtered, washed first with a little cold water and then diluted alcohol. It is soluble in 200 parts of cold, 70 parts of hot water. It is not particularly sensitive to light. Used as a reagent in chemistry.

Argenti Sulphophenas. *Argenti sulphocarbolas, Silver sulphocarbolate, Silver phenolsulphonate.* $C_6H_4(OH)SO_3Ag$.—Obtained by dissolving silver carbonate in paraphenolsulphonic acid and evaporating to crystallization in the dark. Colorless, odorless prismatic needles, of a metallic taste, soluble in 3 parts of water and 60 parts of alcohol; insoluble in ether, chloroform, or carbon disulphide. It is decomposed by light and when heated to 120° C. (248° F.). The aqueous solution is neutral, and gives a dark precipitate with an alkali and a white one (AgCl) with chlorides or hydrochloric acid. Antiseptic, used like itrol and argonin in eye diseases and wounds, and preferred to silver nitrate because non-corrosive.

Argonin. *Silver sodio-caseinate.*—Prepared by adding silver nitrate solution to the sodium compound of casein and precipitating by alcohol. The precipitate is washed with dilute alcohol and dried. It contains about 4 per cent. of silver. It is a fine white powder, difficultly soluble in cold, but easily soluble in hot water. Acids split it up into its components. Neither albumin nor sodium chloride is precipitated by it. It should be free from acid (HNO_3) or alkali and preserved in the dark. It is a non-irritant antiseptic, used in gonorrhœa, etc., in the form of a 0.5 per cent. solution.

Argyrol, chemically silver vitellin, is a proteid salt of silver introduced early in 1902, and occurs in black hygroscopic scales containing 30 per cent. of metallic silver. It is soluble in all proportions of water, the solutions keeping well without deteriorating. Argyrol solutions do not coagulate albumin or precipitate chlorides. It is not precipitated by alkalies, but is precipitated from the solution by zinc sulphate, lead acetate, liquor hydrastis, and by strong acids. *Action and Uses.*—Argyrol may be used locally in acute inflammations in as strong as 50 per cent. solution without producing pain or irritation. *Methods of Use.*—In acute gonorrhœa, as an abortive measure, injections of 2 drachms of 20 per cent. solution, every three hours, held in the urethra ten minutes. For regular treatment of acute gonorrhœa injections three times daily of 5 per cent. solution retained in urethra ten minutes. During the second week (after disappearance of gonococci) injections of 5 per cent. argyrol solution are alternated with

injections of astringents (zinc, lead, hydrastis, etc.). Chronic posterior urethritis, hand injections of 5 to 10 per cent. solutions; deep, instillation of 25 per cent. solution; irrigation with 1 to 1000 solution. Cystitis, injection of 1 ounce of 10 per cent. solution, which is allowed to remain in the bladder. The same method is also applicable in infection of the prostatic follicles. Purulent conjunctivitis (gonorhœal, neonatorum, etc.), flushing the conjunctiva with 25 to 50 per cent. solutions every three hours. Catarrhal conjunctivitis, free instillation of 5 to 20 per cent. solutions three times daily. Dacrocystitis and tracoma, 25 per cent. solution. Acute and chronic rhinitis, pharyngitis, laryngitis, otitis media, application (with swab or nebulizer) of 25 to 50 per cent. solutions once daily. Vaginitis, endometritis, cervical ulcerations, 50 per cent. solution by means of swab or tampons. Fissure and fistula of the anus, proctitis, inflamed hemorrhoids, suppositories of 10 to 25 per cent. argyrol in cacao butter. *Internal Administration.*—Argyrol is non-toxic and is not absorbed. 5 to 10 grains in capsules three times daily in gastric ulcer, gastritis, and gastro-enteritis. As an irrigating fluid, from 1 to 4 pints of 1 to 1000 solution by high rectal injection, twice daily in dysentery, ulcerative enteritis, mucous colitis, cholera infantum. Argyrol should be dispensed in aqueous solutions only, never in combination with other drugs. Argyrol stains on linen, hands, etc., may be immediately and completely removed by immersing in a 1 to 500 bichloride of mercury solution.

Nargol is a true chemical combination of silver in the strength of 10 per cent. with nucleinic acid derived from yeast. It is rapidly soluble in water, and is said to have a greater penetrating power than silver nitrate. It is also less irritating to mucous membranes. Nargol has been employed with great success in the treatment of gonorrhœa and in inflammation of the conjunctiva. It may be employed in solution or in the form of an ointment to old ulcers and suppurating wounds which need stimulation, and in which irritation is to be avoided. For conjunctivitis the solution should be from 2 to 5 per cent. strength; for gonorrhœal irrigations, 0.25 to 1 per cent. strength, or even as strong as 5 per cent. in very chronic cases.

Protargolum. *Protargol.*—A compound of albumin and silver. A yellowish powder, of weak metallic taste, soluble in 1 part of water. Solution is best effected by sprinkling the powder on the water and agitating or stirring in a beaker or dish. The solutions are brown in color and are not precipitated by alkalies, alkali sulphides, sodium chloride, albumin, or heat. Picric acid causes a yellow precipitate. The dry salt as well as the solution should be protected from light. It is an excellent non-irritant bactericide. A 5 per cent. solution may be used in the eye with scarcely any burning pain. A ¼–2 per cent. solution is used in acute gonorrhœa of men. In urethritis of women, 5–10 per cent. solutions may be used without irritation.

ARMORACIÆ RADIX, *Br.*—Horseradish Root.

Meerrettig, G.; *Raifort, Cram de Bretagne, Moutarde des moines*, Fr. Cod.; *Rabano rusticano*, Sp.

The fresh root of *Roripa Armoracia* (L.) Hitchcock (*Cochlearia A.* L.; *Nasturtium A.* Fries; *Cochlearia rusticana* Lam.; *Armoracia r.* Gærtn.; *A. sativa* Bernh.—Fam. *Cruciferæ*).

Origin.—A large perennial herb of eastern Europe, almost everywhere cultivated and commonly naturalized in North America and other countries. The grated and pickled root is a well-known condiment.

Description.—From 3 to 7 Dm. (1 to 2½ Ft.) long, and occasionally reaching 5 Cm. (2 In.) or more in thickness, cylindraceous, somewhat annulate above upon the one to several short crowns; externally light yellowish-brown, internally white and fleshy, the fracture short and sharp; transverse section exhibiting a thin bark, containing a number of prominent yellow thick-walled cells, a dark-colored cambium line, and a slightly radiate meditullium. The crowns show a large central pith; when bruised or broken, it exhales a very pungent odor; it has a sharply biting and acrid taste.

Constituents.—The pungent principle originates, as in mustard, through the decomposition of a glucoside, under the influence of water and a special enzyme. This oil is produced to the extent of about 0.05 per cent., and is almost identical with the volatile oil of mustard, having the same composition, but differing slightly in odor. In the raw condition it has a slight yellow coloration, which is removed by rectification, after which it becomes dark-colored with age. Its specific gravity is 1.01. The drug contains also a little bitter resin, with ordinary plant constituents. Mutschler found the fresh root to lose about 83 per cent. on drying, the ash amounting to 11.75 per cent. of this dried portion and consisting mainly of potassium and calcium salts.

Action and Uses.—Horseradish, in the fresh state or pickled, has a very pungent and acrid taste, irritates the fauces and the nostrils, and causes a flow of tears. It is a familiar condiment, especially for beef. It excites a sense of warmth in the stomach, stimulates the appetite, and promotes digestion. In excessive doses it occasions burning at the epigastrium, nausea, and vomiting. It augments the urine, and probably the

perspiration also, and gives to the former a peculiar odor. Externally applied, it reddens and sometimes blisters the skin. These qualities depend upon its volatile oil, which has at first a sweetish and then an extremely acrid taste and a pungent and very diffusive odor. Horseradish has had great renown as a remedy for scurvy, and the resemblance of its taste to that of scurvy-grass (*Cochlearia officinalis*) is noteworthy. It is advantageous as a condiment in many cases of dyspepsia with feeble appetite, oppression after eating, and flatulence, and in gastric debility attended with vomiting even when excited by reflex irritation. As a local irritant it is sometimes used to relieve toothache, to stimulate the fauces, to correct relaxed states of the mucous membranes, and to remove the hoarseness produced by congestion of the larynx. For these purposes it may be employed as a masticatory, or a strong infusion of it may be used as a gargle. It may be resorted to as a counterirritant in all the cases in which mustard is appropriate, to arouse sensibility, to relieve pain, excite motility, etc.

Cochlearia (*Scurvy-grass, Spoonwort*, E.; *Herba cochleariæ*, P. G.; *Löffelkraut*, G.; *Cochlearia, Herbe au scorbut*, Fr.; *Cochlearia*, F. It., Sp.) is the herb *Cochlearia officinalis* L. (*C. oblongifolia* DC.). The German Pharmacopœia defines it as the dried herb. It is a native of Europe, and is occasionally cultivated there and in other countries. The radical leaves are roundish-cordate to subreniform, obtuse, nearly entire; stem leaves ovate, sparingly angularly toothed, the lower petioled, the upper sessile and clasping; flowers in terminal racemes, white, cruciferous; pods globular-ovate, ascending, slightly laterally flattened, containing 4 red-brown seeds in each of the 2 cells; pungent, acrid, and bitterish, much of the pungency lost on drying. It contains, besides tannin and a bitter principle, a volatile oil similar to that of horseradish, according to Hoffman butylsulphocyanide ($CSN.C_4H_9$), its ammonia compound melting at 135° C. (275° F.). An oil obtained synthetically from butylamine had the composition of oil of scurvy-grass, but a different odor, and yielded an ammonia compound fusing at 90° C. (192° F.). The uses of scurvy-grass are precisely those of horseradish, its action being only slightly modified by the presence of the bitter constituent.

ARNICA, *U. S.*—Arnica Flowers.

Leopard's-bane, Mountain tobacco, Wolf's-bane, E.; *Arnika, Blutblume, Fallkraut, Gemsblume*, G.; *Arnique*, Fr.

The dried flower-heads of *Arnica montana* L. (*Doronicum Arnica* H. Br.—Fam. *Compositæ*).

Official in most pharmacopœias (not Br.). Most require the florets only, by the rejection of the involucre, which necessarily involves that of the receptacle also.

Fig. 34.

Arnica: *a*, involucre; *b*, receptacle; *c*, ray-floret; *d*, disk-floret (× 1½).

The arnica plant is native of Europe, growing chiefly in Germany, Switzerland, and northward. The genus contains a large number of species, which have been much confused, so that the range-limits are somewhat in doubt. It probably does not grow in any part of America. It is a perennial, a foot or two high, the leaves chiefly radical and the flower-heads few, terminating long peduncles.

Description.—Heads about 2 Cm. (¾ In.) long; involucre campanulate-turbinate, ⅔ the length of the head, 1.2 to 2 Cm. (½ to ¾ In.) broad, the scales 1- to 2-serialled, appressed, green,

shortly and sparsely gray-hairy, oblong, obtusish; receptacle slightly convex, densely short-hairy and pitted; rays about 16, spreading or reflexed, bright-yellow, the ligulate portion 2 to 2.5 Cm. (¾ to 1 In.) long, nearly 0.6 Cm. (¼ In.) broad, oblong, 3-toothed, 7- to 9-nerved, pistillate, fertile; disk-flowers perfect, tubular, 5-toothed, of a deeper yellow, their akenes nearly 0.6 Cm. (¼ In.) long, slender, tapering sharply to the base, flattened, 5-ribbed, pubescent, the pappus nearly a half longer than the akene, a little shorter than the corolla, of a single circle of nearly white, barbellate bristles; anthers not tailed at the base.

This drug has been subject to extensive adulteration. *Inula*, of several species, has the involucral scales in several or many series, the receptacle not hairy, the anther-bases long-tailed. *Doronicum* (including *Aronicum*) has the receptacle naked and the rays only 4- or 5-nerved. The receptacles, when present, are very liable to be infested with larvæ. Collected in the early stage of flowering, a little preceding full expansion, the drug is not only more active, but is also less liable to the presence of the larvæ.

Constituents.—The active constituents are 4 per cent. of *arnicin* (see Arnicæ Radix) and 0.04–0.07 per cent. of a butyraceous volatile oil, distinct from that of the rhizome. The bitter alkaloid *arnicine*, with crystallizable salts, was reported by Bastick in 1851, but has not since been reported.

Pharmaceutical Preparations.—Fluidextract of Arnica Flowers, N. F.; Tincture of Arnica, U. S. P.

Action and Uses.—When locally applied, arnica flowers produce a sensation of warmth. If the skin be delicate, they cause more or less irritation and at times an extensive dermatitis. Given internally in moderate amount, arnica slows the heart and increases arterial tension. In large amounts it depresses the vagus nerve, increases the rapidity of the pulse, and causes diuresis and diaphoresis. In overdose the drug causes irritation of the throat, burning pain in the stomach, nausea, vomiting, frontal headache, vertigo, and insomnia. Both the pulse and respiration are accelerated. Later, exhaustion, more or less sweating, dilatation of the pupils, occasionally muscular spasms, cold extremities, and an irregular and infrequent pulse result. Death may occur if 3 or more ounces are swallowed. The nauseating and irritating properties of arnica flowers probably depend upon the eggs and larvæ of the *Atheris Maculatus*, which is commonly found admixed with them.

Locally the drug is employed in the treatment of sprains, bruises, abraded surfaces, and local paralyses. It is rarely employed internally in this country, but has been recommended in dysentery, gout, rheumatism, intermittent fever, secondary anæmias, and various nervous affections.

Arnica is usually administered in the form of a tincture in the dose of from 15 to 30 minims (1–2 Cc.). A decoction may be made with 50 Gm. of the drug and 1000 Cc. of water, and given in the dose of 1 to 2 tablespoonfuls (16–30 Cc.). The dose of the drug in substance is 10 to 30 grains (0.6–2 Gm.).

ARNICÆ RADIX.—Arnica Root.

The dried rhizome and roots of *Arnica montana* L. (Fam. *Compositæ*). Official in most pharmacopœias.

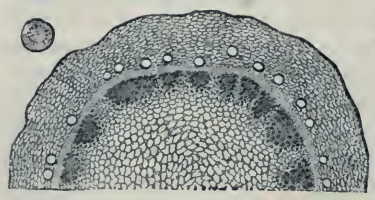
Description.—Rhizome oblique, about 5 Cm. (2 In.) long and 3 or 4 Mm. (⅛ In.) thick, often bearing hairy remains of petioles and stem-base at one end; externally reddish-brown, broadly annulate with the scars of amplexicaul leaves; under surface supplied with numerous rather coarse roots; internally whitish, with a rather thick bark, containing a circle of large distant resin-cells surrounding the short yellowish wood-wedges; pith large and spongy. Roots brittle, lighter than the rhizome, with a thick bark containing a circle of resin-cells. Odor somewhat aromatic; taste pungently aromatic and bitter.

The powder contains neither starch-grains nor crystals of calcium oxalate.

Various adulterants of, or accidental admixtures with, arnica root have been reported, but none of them, excepting possibly other species of Arnica, possess the rings, the circle of large resin-cells, or the peculiar aroma, while starch-grains are present in most of them.

Constituents.—Arnica root contains 10 per cent. of inulin, with gum, wax, salts, 0.5 to 1 per cent. of volatile oil, and arnicin. The volatile oil is yellowish, has a radish-like odor, and consists chiefly of the methyl-ether of hydrothymoquinone and isobutyric acid phlorylester (*Sigel*). *Arnicin* ($C_{20}H_{30}O_4$ or $C_{35}H_{54}O_7$), an amorphous, terebinthinate, bitter, non-volatile principle, is soluble in alcohol, ether, and alkalies, almost insoluble in water, and is precipitated by tannin. Pavesi's arnicin is a mixture,

Fig. 35.

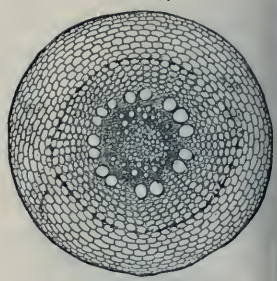


Arnica: transverse section of rhizome, magnified.

Fig. 36.

Arnica rhizome (somewhat reduced).

Fig. 37.



Arnica: section through root, magnified 25 diam.

Action and Uses.—Arnica root possesses the same action as that of the flowers. It is devoid of the irritating principle contained in the larvæ which accompany the flowers, and for this reason is a better drug for internal administration. It is given in substance in the dose of 10 to 30 grains (0.60–2 Gm.). The dose of the tincture is 15 to 30 minims (1–2 Cc.); of the fluid extract, 5 to 10 minims (0.3–0.6 Cc.); of the extract, 3 to 5 grains (0.20–0.30 Cc.).

ARNOTTA.—Annota; Annatto.

Orellana, Orleana.—Orlean, G.; *Rocou, Terre de la Nouvelle-Orléans*, F.; *Achiote, Achiotillo*, Sp.

A coloring-matter obtained from the seeds of *Bixa Orellana* L. (Fam. *Bixaceæ*).

This is a rather small tree, in habit somewhat resembling a very large plum tree, native of tropical America, and very extensively cultivated there and in other tropical countries for the sake of this product. The capsules, about as large as hen's eggs and somewhat resembling gigantic beech-nut capsules, are short-ovoid, with impressed base, and spinose-tuberculate. The numerous seeds, whitish but apparently red from the pulpy covering, are angularly obovoid and about 3 Mm. ($\frac{1}{8}$ In.) long. There are various methods for extracting and preparing the arnotta, some of them extremely filthy, but in general the seeds are soaked or allowed to ferment in water, rubbed between the hands and upon a sieve, crushed, and finally completely mashed and again washed with water. The coloring-matter subsides and is formed into cakes; the water likewise contains a coloring-matter. The cakes are either plastic or hard, of a nearly blood-red color, red-brown on exposure, of a peculiar odor and a disagreeable saline and bitter taste. Arnotta is nearly insoluble in water, coloring it yellow, but dissolves almost completely in alcohol, ether, fixed oils, and alkalies, with an orange-red or dark-red color.

The substance is enormously adulterated. Earthy matters of various kinds are readily separated by their insolubility in hot alcohol, while metallic salts are detected by appropriate chemical tests. Damaged flour, from various grains, and other vegetable dualterants are readily recognized by an examination of their starch-grains, those of arnotta being very few and small, with an elongated and stellate hilum, much resembling those of peas and beans.

Arnotta contains a fatty acid, a turpentine-like body, and *bixin* ($C_{28}H_{34}O_5$), which forms glistening red crystals. *Orellin*, a yellow coloring-matter, has also been described, but Zwick failed to find it. The air-dried seeds yield 5.15 per cent. of ash, chiefly phosphate of potassium and silica.

Action and Uses.—Arnotta was at one time employed in medicine to a limited extent, but its use has now been abandoned. It finds some use in pharmacy as a coloring for plasters and ointments, and in the arts as a yellow dye for silks and other fabrics. It is the chief constituent of the butter and cheese coloring preparations and of the various polishes for russet leather. Butter color may be prepared by digesting arnotta with twice its weight of alcohol until it is completely disintegrated, and then mixing with 5 times its weight of olive oil and heating until the alcohol is evaporated, or it may be made by dissolving 1 part of extract of arnotta in 10 parts of olive oil.

ARSENI IODIDUM, *U. S.*—Arsenous Iodide.

Arsenii iodidum, Br.; *Arsenicum (Arsenum) jodatum.—Arsenious iodide*, E.; *Iodure d'arsenic*, Fr.; *Arsentrijodid*, G.

Formula, AsI_3. Molecular weight, 452.10.

It should contain not less than 82.7 per cent. of iodine, and 16.3 per cent. of metallic arsenic. It should be kept in amber-colored, glass-stoppered vials, in a cool place, carefully protected from light.—U. S.

Preparation.—According to the U. S. P. 1870, 75 parts of metallic arsenic and 380 parts of iodine are intimately triturated and then placed in a small flask and heated until liquefaction occurs. Any sublimed iodine is washed down by running the molten mass upon the sides of the flask. The mass is finally poured upon a porcelain slab and, when cold, broken into pieces and bottled. Although sufficiently pure for medicinal purposes, it is difficult to produce in this way a uniform chemical compound, which, according to Berzelius, is obtained on subjecting the mechanical mixture to sublimation from a retort the body of which is completely imbedded in sand. Or the iodine is dissolved in carbon disulphide; the solution is gently heated, and, after the gradual addition of the powdered arsenic, is digested until the purple color of free iodine has disappeared; the clear solution is decanted if necessary, and the solvent distilled or evaporated, when the arsenous iodide is obtained in crystals, and may be recrystallized from alcohol. Or, according to Bamberger and Phillip, it may be made by mixing a hot solution of arsenous acid in hydrochloric acid with a concentrated solution of potassium iodide, and washing the precipitate with hydrochloric acid, specific gravity 1.12.

Properties.—Obtained by fusion, arsenous iodide is a glossy orange-red crystalline mass; if made by sublimation or crystallization, it appears in shining brick-red or orange-red hexagonal scales. It has an iodine-like odor and taste, and slowly gives off iodine on exposure to the air. Its density is 4.39. It is soluble, with a neutral reaction and without decomposition, in water, alcohol, ether, and carbon disulphide, but is gradually decomposed on being boiled with water or alcohol. It is soluble in 12 parts of water and in 28 parts of alcohol at 25° Cc. (77° F.). It is difficultly soluble in hydrochloric acid. The aqueous solution has a yellow color, is neutral to litmus-paper, and on standing gradually decomposes into arsenous and hydriodic acids. On passing hydrogen sulphide through the solution a lemon-yellow precipitate is thrown down. If the salt be heated with diluted nitric acid, vapor of iodine is given off. No loss of iodine occurs when it is heated on a boiling water-bath, but at higher temperatures the salt is completely volatilized.—U. S.

Tests.—The purity is ascertained by the complete solubility of the salt in water and alcohol, and by its volatilizing without residue on the application of heat. If 0.5 Gm. of the salt and 2 Gm. of sodium bicarbonate be dissolved in 50 Cc. of water, not less than 21.5 Cc. of tenth-normal iodine solution should be required to impart a slight yellow tint to the solution.—U. S.

Action and Uses.—This compound in small doses is an alterative, and in large ones an irritant poison. Its dose is so small that the iodine contained in it fails to make any impression upon the organism. The remedy may be employed in all conditions for which arsenic trioxide is beneficial (see ARSENI TRIOXIDUM); but it has been especially recommended in psoriasis, lepra, chronic eczema, and lupus. The symptoms and treatment of poisoning by this drug are practically the same as those of arsenic trioxide. The dose is $\frac{1}{20}$ of a grain (0.003 Gm.), gradually increased until the effects of the remedy are apparent.

ARSENI TRIOXIDUM, *U. S.*—Arsenic Trioxide.

Acidum arsenosum, U. S., 1890; *Acidum arseniosum*, Br.; *Acidum arsenicosum*, P. G.; *Arsenicum album.—Arsenic, White arsenic, Arsenous acid, Arsenious anhydride*, E.; *Acide arsénieux, Arsenic blanc*, Fr. Cod.; *Arsenigesäure, Weisser Arsenik*, G.; *Arsenico bianco*, It.; *Arsenico blanco*, Sp.

Formula, As_2O_3. Molecular weight, 196.44.

It should contain not less than 99.8 per cent. of pure arsenic trioxide.—U. S.

The name *arsenous acid* is a misnomer, since the oxide is an acid anhydride and has no acid properties until it unites with water.

Vapor density determinations show that the formula of the oxide is As_4O_6 (Mitscherlich). At very high temperatures, 1700° C. (3092° F.), the molecule suffers dissociation, and the formula then is As_2O_3. However, it is customary and convenient to use the simpler formula As_2O_3 in reactions.

Occurrence and Preparation.—Arsenic trioxide appears to have been known since about the beginning of the Christian era, but was first distinguished from other arsenical compounds by Geber in the eighth century. It has been found in many mineral waters in minute proportion, and is obtained in large quantities as a by-product in roasting cobalt, nickel, tin, and even some silver ores, and particularly arsenical iron pyrites; the vapors are conducted through long tubes or chambers, where they are condensed in the form of a white powder, formerly called *flowers of arsenic*. This is not pure, but contains some metallic arsenic, arsenic sulphide, dirt, etc., from which it is purified by resublimation. That consumed in this country is imported mostly from Europe. The English product comes into the market as a finely ground crystalline powder.

Properties.—Arsenic trioxide occurs in heavy inodorous masses, which are at first glass-like, transparent, and have a conchoidal fracture, but become superficially white, opaque, and of a waxy lustre, the change penetrating gradually to the interior, so that ultimately the entire mass is converted into a porcelain-like mass, the formation of which is dependent upon a molecular change, the amorphous glass-like arsenic trioxide becoming indistinctly crystalline. The specific gravity of the vitreous variety is 3.7385, and of the opaque variety 3.699 (Guibourt). When heated in a sealed tube arsenic trioxide may be melted to a thick liquid, and again be obtained as a glass-like mass, or, when very slowly cooled, in crystals of different form. Heated in an open test-tube, the amorphous oxide melts at about 200° C. (392° F.) and volatilizes, while the crystalline variety volatilizes without melting. The vapor is condensed on the cool parts of the tube in minute crystals easily recognized under a lens as characteristic regular octahedra. When thrown upon burning charcoal, it is reduced to the metallic state and vaporized, arsenic trioxide again being produced and an alliaceous odor emitted. It does not readily mix with water; its solution has a slight but distinct metallic taste and a feeble acid reaction. The crystalline acid is less soluble than the amorphous, but one is under various circumstances converted into the other. At 25° C. (77° F.) the vitreous variety is soluble in about 30 parts of cold water, while the porcelain-like requires about 100 parts; both are slowly but completely soluble in 15 parts of boiling water (U. S.). According to the P. G., at 15° C. (59° F.) the vitreous oxide is soluble in 30 parts, the porcelain-like oxide in 80 parts of water, and both are soluble in 15 parts of boiling water. The acid does not volatilize with vapors of boiling water. The British Pharmacopœia says the trioxide is soluble in 100 parts of cold water and in 10 of boiling water. H. Erdmann (*Lehrbuch der Anorg. Chemie*, 1900) says that 1 Gm. of crystallized oxide is soluble in 355 Gm. of water at 15° C. (59° F.) and 46 Gm. of water at 100° C. (212° F.). 1 Gm. of amorphous oxide is soluble in 108 Gm. of water at 15° C. (59° F.) and in 30 Gm. of water at 100° C. (212° F.). There seems to be a lack of agreement in the statements of various writers in regard to the solubility of the oxide.

Solutions of both the amorphous and crystalline varieties pass readily through the septum of the dialyzer. By the aid of heat glycerin dissolves the oxide slowly but freely, and deposits again a portion of it on dilution with water. Oil of turpentine dissolves only the glassy variety. Arsenic trioxide is insoluble in ether and chloroform, quite sparingly soluble in alcohol, but combines with fixed oils when heated, forming a plaster-like mass; several acids increase its solubility in water, particularly hydrochloric and tartaric acids.

Powdered arsenic trioxide is often adulterated; hence it should not be employed for medicinal purposes unless its purity has previously been established. When rubbing the hard masses of vitreous or porcelain-like oxide to powder, sufficient alcohol should be sprinkled over it to prevent the dust from rising, and the mouth and nostrils should be protected by a moist sponge. When larger quantities are powdered, it is even advisable to protect the eyes and the bare hands.

Tests.—Arsenic trioxide is volatilized completely at a temperature of 200° C. (392° F.), U. S., 204.5° C. (400° F.), Br., and yields a white sublimate free from gray or orange-colored portions (absence of metallic arsenic and sulphides). 0.1 Gm. of the oxide dissolved with 1 Gm. of sodium bicarbonate in 20 Cc. of water by the aid of heat should decolorize not less than 20.32 Cc. of tenth-normal iodine solution, corresponding to

at least 99.8 per cent. of oxide.—U. S. The P. G. permits a 98.8 per cent. oxide. The British Pharmacopœia requirement is higher, since 0.25 Gm. of oxide must decolorize at least 50.8 Cc. of iodine solution, corresponding to at least 99.9 per cent. (H = 1; O = 15.88). The reaction occurring in this test is shown by the equation: $As_2O_3 + 5H_2O + 2I_2 = 2H_3AsO_4 + 4HI$; 1 molecular weight of arsenic trioxide is oxidized by 4 atomic weights of iodine, with the formation of 2 molecules of arsenic and 4 of hydriodic acid. The admixture of arsenic acid is detected by agitating an excess of the powder with cold alcohol, filtering, evaporating, and neutralizing with ammonia, when silver nitrate will produce a red-brown precipitate. Arsenic trioxide should be completely soluble in 10 parts of warm ammonia-water, forming a colorless solution, which should not be colored yellow nor produce a yellow precipitate upon addition of hydrochloric acid (absence of arsenic sulphide and other impurities).

A solution of arsenic trioxide gives with ammonio-silver nitrate (silver nitrate solution to which ammonia-water is added until the precipitate formed is just dissolved) a lemon-yellow precipitate, Ag_3AsO_3, soluble in nitric acid and also in excess of ammonia-water. The latter solution when heated deposits metallic silver (distinction from arsenic acid or its salts, which, moreover, give a reddish-brown silver arsenate, Ag_3AsO_4).

Ammonio-copper sulphate gives with a solution of the oxide a bright green precipitate of copper arsenite, $CuHAsO_3$ (Scheele's green), which is soluble in caustic alkali, giving a blue solution. On boiling this, red cuprous oxide is deposited and alkali arsenate is left in solution. This is a delicate test, and serves to distinguish quite sharply between arsenous and arsenic solutions, the latter giving a green precipitate, insoluble in alkalies and not precipitating red cuprous oxide on boiling.

Detection of Arsenic.—Several methods may be employed for detecting small quantities of arsenic, as, for example, in solutions, in which the tests described above are not sufficiently sensitive. Hydrogen sulphide precipitates a bright-yellow sulphide from *acidulated* solutions. In the case of *arsenous* compounds the precipitate forms immediately, but when arsenates are present the precipitate at first does not form at all in the cold; on standing for some time, it slowly forms. Warming the solution to 70° C. (158° F.) facilitates the precipitation, and yellow *pentasulphide* is obtained. If sulphurous acid is added to the solution of arsenate, the arsenic acid is reduced to arsenous acid, and hydrogen sulphide passed into such a solution precipitates yellow *arsenous* sulphide immediately. Neutral or alkaline solutions containing arsenic do not give a precipitate with hydrogen sulphide; they must first be acidulated with hydrochloric acid. For quantitative determination, hydrogen sulphide must be passed into the solution for about 10 hours, after which the solution is allowed to stand in a warm place 15 hours or more. If not mixed with other metals, the precipitate thus obtained is pretty characteristic, since only two other metals yield under the same circumstances precipitates of sulphides having a similar color, namely, *cadmium* and tin in *stannic* compounds. *Cadmium sulphide* has a bright lemon-yellow color, but is distinguished readily from the corresponding arsenic compound by being completely insoluble in potassium hydroxide, ammonia, and ammonium sulphide; on the other hand, cadmium sulphide dissolves completely in strong hydrochloric acid, forming cadmium chloride, and giving off hydrogen sulphide, while arsenic sulphide is insoluble in the acid mentioned. *Stannic sulphide* has a dusky-yellow color, and dissolves in potassium hydroxide, ammonia, and ammonium sulphide, but differs from arsenic sulphide not only in the shade of color, but also in its complete solubility in strong hydrochloric acid. If the precipitate is not a pure yellow, but seems to contain sulphides of other metals, the arsenic sulphide, together with any antimony or tin sulphide that may possibly be present, may be extracted by digesting the mixed sulphides with warm ammonium sulphide, filtering, and washing the residue with water. The filtrate will contain the three sulphides, which may be reprecipitated by acidulating with hydrochloric acid. Arsenic sulphide is separated from any possible antimony and tin sulphides by treatment with warm concentrated hydrochloric acid, which leaves the arsenic sulphide undissolved, while antimony and tin sulphides pass into solution.

In forensic cases, a better and surer proof of the presence of arsenic is the liberation of the metal itself, with subsequent conversion into the striking and characteristic octahedra and tetrahedra of arsenic trioxide. This is accomplished in the following manner: The arsenous sulphide, as obtained above, is treated with a little ammonia-water, to which are

added a few granules of sodium carbonate, and evaporated to dryness in a dish. The residue is mixed with about twelve times its bulk of *cyanide flux* (an intimate mixture of 1 part of potassium cyanide and 3 parts of anhydrous sodium carbonate) and introduced into the bulb of a Berzelius hard-glass reduction-tube (Fig. 38), where it is heated to

Fig. 38.

Reduction-tube of Berzelius.

redness. An iron-gray, metallic arsenic ring sublimes into the cooler part of the tube, accompanied by a garlic-like odor. The sublimate volatilizes on the application of heat, and condenses again in a cooler part of the tube, and, if atmospheric air has been admitted, is converted partly or entirely into minute brilliant octahedral crystals of arsenic trioxide (Fig. 40).

Arsenic trioxide, which is usually met with in cases of accidental or criminal poisoning, yields, if heated in a narrow tube (see Fig. 39), the crystalline sublimate described above; and if mixed with charcoal or cyanide flux, the sublimate will, as in the above case, con-

Fig. 39.

Reduction-tube with sublimate of arsenic trioxide.

sist of metallic arsenic, and this, on being sublimed in the presence of air, will yield the octahedral crystals of arsenic trioxide.

Fig. 40.

Sublimate of arsenic trioxide, magnified.

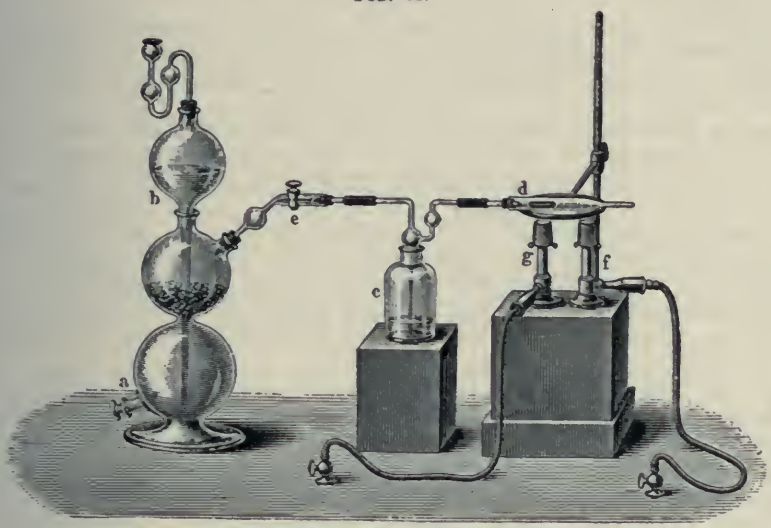
As it is often difficult or even impossible to obtain glass free from arsenic, Fresenius and v. Babo have modified the above method so as to be free from any error due to arsenic in glass. The mixture of arsenic sulphide and cyanide flux is heated in a small porcelain boat resting inside of a glass tube. Fig. 6 represents the apparatus: *a* is a carbon dioxide generator, and *d* a bottle containing the porcelain boat, which first is heated near the tapering end to low redness, and then under the boat metallic arsenic sublimes into the narrowed end in an atmosphere of carbon dioxide, which prevents oxidation to the oxide. In this form the test is extremely delicate. It will give a recognizable mirror with as little as $\frac{1}{6500}$ grain (0.00001 Gm.) of arsenic trioxide. It is simpler, cleaner, and superior to all other methods for producing metallic arsenic from the sulphide, for which it is especially adapted.

In the presence of much organic matter the detection of arsenic is a more complicated process, involving the separation of most of the organic matter, which Fresenius and v. Babo accomplished by heating the mass on a water-bath with hydrochloric acid, and adding to it potassium chlorate in small quantities until a thin liquid is produced; if the heat be not raised beyond the temperature of boiling water, no arsenic chloride will be volatilized, but the mixture becomes more liquid in proportion as the solid organic substances are destroyed. The liquid is then filtered, the clear filtrate saturated with hydrogen sulphide, and the precipitate, which contains organic matter, treated with strong nitric acid and subsequently fused with pure sodium nitrate, whereby the organic compounds are destroyed completely, and the antimony and arsenic are converted into soluble arsenate and insoluble antimonate of sodium. On mixing this residue intimately with about twelve times its weight of an exsiccated mixture composed of sodium carbonate 3 parts and potassium cyanide 1 part, the powder may be heated to redness in a reducing-tube in a current of dry carbon dioxide, when a mirror of metallic arsenic will be obtained, while the presence of antimony, tin, and other metals will not interfere with the result. The mass obtained after the destruction of the

organic matter and fusion with sodium nitrate may be dissolved in water, and this solution, after acidulation with hydrochloric acid, may then be treated again with hydrogen sulphide, or in Marsh's apparatus—in the latter case, after evaporation with an excess of sulphuric acid to expel the nitric acid.

The destruction of the organic matter, as described above, may in some cases be omitted, the material being boiled simply with water and the filtrate acidulated with hydrochloric acid, previous to passing hydrogen sulphide through it. A solution suitable for the purpose may likewise be obtained by the process of dialysis, whereby mucous, amylaceous, and albuminous substances are left behind, while the dialyzed liquid contains the arsenous acid, besides organic and inorganic salts.

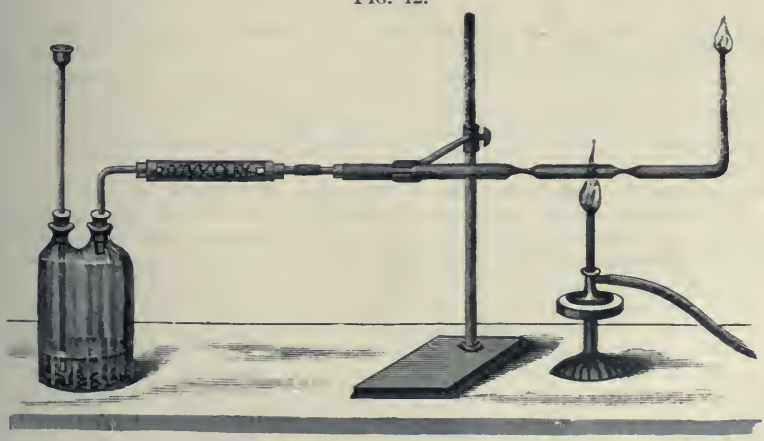
Fig. 41.



Apparatus for demonstrating Fresenius and v. Babo's test for arsenic.

Marsh's test depends upon the formation of hydrogen arsenide (arsine) by the action of nascent hydrogen upon the oxygen compounds of arsenic. A simple form of Marsh's apparatus is shown in Fig. 42. Hydrogen is liberated by zinc from an acid in a suitable flask and dried by conducting it through a tube filled with fragments of calcium chloride. After the air has been expelled completely and the apparatus filled with hydrogen, some of

Fig. 42.



Marsh's test for arsenic.

the liquid to be tested is introduced through the funnel-tube, and the escaping gas ignited. Upon holding a piece of porcelain in the flame, a brown-black spot of metallic arsenic will

be deposited, which will dissolve quickly on the addition of a little chlorinated lime or chlorinated soda (Bischoff, 1840). Antimony compounds will yield a similar spot, which, however, is not affected by the hypochlorites. When a dry beaker or test-tube is held over the jet, arsenic trioxide is deposited upon the inside, and may be recognized by its crystalline form; and after dissolving it in a little hot water a yellow precipitate will be obtained on the addition of solution of silver-ammonium nitrate. Antimony similarly treated gives no precipitate. The delivery-tube, which should be of hard glass, may be heated to redness in the flame of a gas-lamp, when the hydrogen arsenide will be decomposed, metallic arsenic being deposited. Antimony gives a similar reaction, but the two metals may be distinguished by heating the deposit in contact with air, when the arsenic will be converted into crystallized arsenic trioxide; or hydrogen sulphide may be passed through the tube and the deposit gently heated, when the arsenic will be converted into yellow sulphide and the antimony into orange sulphide. On now passing dry hydrochloric acid through the tube the antimony sulphide will disappear and the arsenic sulphide remain unaffected. (For the disturbing effect of selenium in the Marsh test, see Acidum Selenosum.)

On passing the hydrogen gas from the delivery-tube through lead acetate, to remove any H_2S, into a solution of silver nitrate, a black precipitate will be produced both by antimony and arsenic. If the former, the deposit will consist of a compound of antimony and silver; if the latter, metallic silver only is precipitated, while the solution contains the arsenic as arsenous acid mixed with the excess of silver salt, and on cautiously neutralizing with ammonia a yellow precipitate of silver arsenite is obtained.

Gutzeit's Test (*Phar. Zeitung*, 1879, p. 263).—Into a test-tube (about 6 by ½ inch) place a single piece of pure zinc (weighing about 1 Gm.), and add about 5 Cc. of pure 5 per cent. sulphuric acid; now add the liquid to be tested, which should not be alkaline nor materially increase the volume of the contents of the tube. At once fasten over the mouth of the test-tube a cap made of three thicknesses of pure filter-paper free from dust, and apply to the upper paper 1 drop of a saturated aqueous solution of silver nitrate containing about 1 per cent. of nitric acid. Place the tube at once in a box, rigidly excluding light, and examine the paper cap after a while. A bright-yellow stain will appear upon the paper—rapidly if the amount of arsenic be considerable, slowly if the amount be small; if the yellow stain be moistened with water, the color changes to brown or black. (Antimony colors the spot black or brown without a previous yellow coloration.) The action of hydrogen arsenide upon silver nitrate in the absence of water takes place with the formation of a yellow compound; thus, $AsH_3 + 6AgNO_3 = Ag_3As3(AgNO_3) + 3HNO_3$. When water is added, metallic silver is separated, showing a brown or black color: $Ag_3As3(AgNO_3) + 3H_2O = 6Ag + 3HNO_3 + H_3AsO_3$. Since hydrogen phosphide and hydrogen sulphide produce yellow-colored compounds under the conditions stated above, the zinc used in testing must be absolutely free from sulphur and phosphorus.

Modified Gutzeit's Test (U. S. P.).—The efficiency of this test depends upon a strict adherence to the conditions described below:

Reagents.—*Zinc.*—This should be in a granulated or fine mossy condition and free from arsenic, sulphur, and phosphorus, and should not contain more than 0.1 per cent. of iron. It should otherwise respond to all the tests given under zinc.

Hydrochloric Acid (8 per cent.).—Mix 18 Cc. of hydrochloric acid with water sufficient to measure 100 Cc.

Mercuric Chloride Test-paper.—By means of a glass rod transfer a drop of a saturated alcoholic solution of mercuric chloride to the centre of a piece of white filter-paper (preferably the kind used for quantitative analysis) of about 4 Cm. diameter; after drying, this paper is twice successively moistened with the reagent and dried. It is not necessary to moisten the paper with alcohol or the reagent while using it.

Lead Acetate Test-gauze.—A piece of cheese cloth, about 1 decimeter square, is thoroughly impregnated with lead acetate test-solution, and the excess of fluid removed by pressure.

Test-flask.—Select a flask of the capacity of about 60 to 75 Cc., with a neck of about 5 to 6 Cm. in length and about 1 Cm. in diameter.

Preparation of the Chemical to be Tested.—To 5 Cc. of the aqueous solution of the chemical (1 in 10) or to a solution in 5 Cc. of water of the residue remaining after undergoing special treatment, 1 Cc. of a mixture of equal parts of sulphuric acid and water is added, followed by 10 Cc. of a freshly prepared saturated solution of sulphurous acid. This solution, contained in a small beaker, is heated upon a bath of boiling water until free from excess of sulphurous acid, and its volume has been reduced to 5 Cc.

THE TEST.—Before applying this test for the presence of arsenic in chemicals, a preliminary blank test should be made as follows, in order to establish the freedom of the reagents from arsenic, sulphur, and phosphorus, or any interfering contaminations: Into the flask are introduced 2 Gm. of zinc, 20 Cc. of the diluted hydrochloric acid, and 5 Cc. of water; and into the neck of the flask is inserted the lead acetate test-gauze, pressed with sufficient firmness to retain its place. About 1 Cm. space should be allowed above the gauze; the lip of the flask, after careful cleansing, is securely covered by folding over it the mercuric chloride test-paper. The reaction is allowed to proceed until the greater portion of the zinc has dissolved, which may require from ½ to 2 hours, when, if no trace of a yellow to orange-colored deposit is distinguishable upon the inner surface of the paper test-cap, a direct test may be applied at once. If a black stain is produced, sulphur is present, which has escaped absorption by the lead acetate gauze, in which case the gauze should be remoistened with the test-solution. While the blank test is being carried out, another flask should be charged in a like manner with 2 Gm. of zinc and 20 Cc. of the diluted hydrochloric acid, followed by the 5 Cc. of the solution of the chemical (1 in 10) to be tested, which has undergone reduction as directed (under *Preparation of the Chemical*); the lead acetate gauze is then introduced, and after cleansing the lip of the flask the mercuric chloride cap is folded over the top. After the evolution of hydrogen has proceeded for 30 minutes, no distinct yellow stain should be visible upon the inner side of the mercuric chloride test-cap.

The presence of arsenic much in excess of the permissible limit (1 in 100,000) is manifested by the formation of a distinct yellow to orange spot, according to the quantity present. Antimony produces a dark-gray to brownish-black coloration.

Bettendorf's Test (1869).—On adding arsenical solution to a solution of stannous chloride in strong hydrochloric acid, specific gravity not less than 1.123, a gradual or, on heating, a somewhat rapid, reduction to metallic arsenic takes place, the deposit having a brown or black color according to quantity. Dilution with water and the presence of nitric acid or nitrates interfere with the reaction. Antimony is not reduced by this test.

The U. S. P. prescribes the following method of applying this test: To a solution of the prescribed quantity of the substance to be tested in 5 Cc. of pure concentrated hydrochloric acid and contained in a clean test-tube, 5 Cc. of a saturated solution of freshly prepared stannous chloride in pure concentrated hydrochloric acid are added; after heating for 15 minutes while immersed in a bath of boiling water, the tube is allowed to stand for 1 hour. Not the faintest brownish tint should become manifest when viewed by reflected light against a white surface, or viewed from above when placed over a pure white surface, and compared with a mixture of 5 Cc. each of pure concentrated hydrochloric acid and saturated solution of stannous chloride, prepared under like conditions, which should remain colorless.

Note.—It is absolutely necessary that the solution of stannous chloride be freshly prepared, and sulphates, sulphites, and sulphides be absent from the reagents and the chemicals being tested.

Reinsch's Test (1843).—If an arsenical solution is strongly acidulated with hydrochloric acid, and heated to boiling in the presence of a thin slip of bright copper—or, according to A. S. Taylor, preferably of finest copper gauze—the copper will become tarnished by the deposition upon it of metallic arsenic, the film having a bluish or iron-gray color according to quantity; the presence of nitric acid interferes with the reaction. The copper is washed with water, dried, and heated in a narrow test- or reduction-tube, when arsenic trioxide will be sublimed in the form of octahedral crystals. If the arsenic is present as arsenate, 2 volumes of concentrated hydrochloric acid must be added to make the test succeed. Antimony and other metals also give a dark coat on copper.

Fleitmann's Test, like the process of Marsh with its numerous modifications, depends upon the generation of hydrogen arsenide; instead of an acid, however, a strong solution of potassium or sodium hydroxide is employed, which has the advantage of preventing the formation of hydrogen antimonide If the gas is generated in a test-tube the orifice of which is covered with a piece of filter-paper moistened with a solution of silver nitrate, the appearance of a black spot will indicate the presence of arsenic. In applying this test, care must be taken to prevent the paper from coming in contact with the alkaline liquid, which would produce a similar color. A plug of cotton loosely inserted in the upper part of the tube will prevent any spirting of the liquid. A strip of paper moistened with solution of lead acetate, if colored brown or black by the gas, would prove the presence of hydrogen sulphide.

Johnson proposed aluminum in connection with potassium hydroxide solution for the

generation of hydrogen. In this, as in the preceding case, the metals employed are previously to be tested for the presence of arsenic.

Much simpler is the modification by E. W. Davy (1876), who employs an amalgam prepared by warming 8 or 10 parts of mercury, and dropping upon it gradually in small pieces 1 part of metallic sodium. The amalgam should be used only in a neutral or alkaline liquid; the gas is generated by the action of the sodium upon water, and the presence of arsenic in it is recognized with silver nitrate, as stated above.

According to Scherer (*Zeit. f. anal. Chem.*), the delicacies of the wet tests are as follows: $AgNO_3$ detects $\frac{1}{20000}$ part of As; $CuSO_4$, $\frac{1}{13500}$ part; H_2S, $\frac{1}{640000}$ part; Reinsch's test, $\frac{1}{120000}$ part, or after boiling one-quarter of an hour, $\frac{1}{250000}$ part.

Precautions.—It is scarcely necessary to remark that when testing for arsenic all the reagents must be absolutely free from that metal. The purity of sulphuric acid and hydrochloric acid is ascertained most conveniently by Bettendorf's or Reinsch's process, and the purity of zinc by that of Gutzeit. The use of copper for the purpose referred to is not, as a rule, interfered with by its containing arsenic, but the presence of the latter may readily be detected, according to Odling (1863), by heating it in a retort with 6 times its weight of ferric chloride and an excess of hydrochloric acid, when chloride of arsenic will distil over and give the usual reactions of arsenic compounds.

In forensic analysis it is required usually that the arsenic be separated in the metallic state, and that the quantity of the poison be estimated. The former is accomplished by the methods described above; the latter, by weighing the metal deposited in the heated delivery-tube of Marsh's apparatus, either upon the glass or upon platinum introduced for the purpose, or by estimating it in the form of magnesium pyro-arsenate.

Pharmaceutical Preparations.—Solution of Arsenous Acid; Solution of Potassium Arsenite.

Action and Uses.—Arsenic trioxide and its preparations in medicinal dose may be considered as indirect stimulants to the circulatory, respiratory, and nervous systems, inasmuch as they are stimulants to all nervous and muscle protoplasm and are said to have a selective action upon the trophic nerves. In poisonous dose the drug is a powerful depressant to the entire organism, slowing the heart, decreasing blood-pressure, lessening reflex action and sensation to pain produced by heat or pinching, and eventually causing motor paralysis. Arsenic trioxide is an irritant to mucous membranes, and when concentrated causes violent inflammation. Upon the normal, unbroken skin it has little or no effect; but applied to that tissue when abraded it acts as a powerful caustic and produces deep destruction. In small doses arsenic trioxide distinctly decreases tissue-waste, and in large amounts increases the percentage of nitrogenous elements in the urine. It is slowly absorbed, and is gradually eliminated by the skin, kidney, bowels, saliva, and in the milk of nursing women.

Given in ascending doses, arsenic trioxide in its various forms is probably the best drug we have for chorea, acting almost as a specific. It is of value in both primary and secondary anæmias, and has no equal in the treatment of pernicious anæmia, leukæmia, and pseudo-leukæmia. It is said to be useful as an antiperiodic in intermittent fever, and is commonly employed in chronic malaria, malarial cachexia, and rheumatoid arthritis. Amenorrhœa, dysmenorrhœa, menorrhagia, and leucorrhœa, especially when associated with anæmia, are frequently benefited by its use. The drug is employed with benefit in asthma when due to depraved conditions of the mucous membrane. In those individuals with phthisical tendencies who are readily susceptible to cold and who suffer with chronic winter cough it is of service, and in many cases of advanced tuberculosis it may be given with excellent result. It may be used with advantage in chronic nasal catarrh, early coryza, hay fever, cancrum oris, and sore throat. Arsenic is useful in the vomiting of pregnancy, morning vomiting of drunkards, and in atonic dyspepsia. It relieves the pain of gastric cancer and gastric ulcer, and frequently prevents the vomiting which occurs in these conditions. It is recommended in the chronic diarrhœa of children and in the chronic gastric catarrh of hand-fed babies. As a remedy in dry scaly skin diseases, for example, psoriasis, lichen, lepra, and pemphigus, arsenic stands first; but in those lesions characterized by a moist condition it is distinctly harmful and should not be employed. It may be given with advantage in intercostal, facial, and supra-orbital neuralgias, especially when associated with anæmia or dependent upon malaria.

Locally applied in solution, the drug is employed for the removal of warts, corns,

and other epithelial growths. In the form of an arsenical paste, such as that recommended by Marsden—arsenic trioxide and powdered acacia, each 1 oz. (30 Gm.), and water 3 fluidounces (90 Cc.)—it has been employed in the removal of epitheliomata. If used in this way, a large amount should be applied for a short time, in order that it may produce destruction of the tissue rather than absorption of the drug. As its application is very painful, its employment is gradually being abandoned.

When given in full dose, arsenic causes puffiness of the lower eyelids and a sensation of stiffness in the muscles of the face. There are some laxity of the bowels and slight pain in the intestines. In certain susceptible individuals the drug may produce dermatitis or some other skin lesion. It occasionally affects the mucous membrane, producing coryza and gastric disorders.

When habitually taken in small doses, a certain tolerance to the drug is established, and eventually large quantities may be ingested without detriment. The Styrian peasants and the inhabitants of the Tyrol are said to frequently resort to the internal use of the drug in this manner, claiming that it lessens the respiratory distress which usually occurs in mountain-climbing.

Poisonous doses of arsenic produce violent gastro-intestinal inflammation. The patient complains of pain in the œsophagus and abdomen, inability to swallow, and a feeling of constriction of the fauces. Excessive vomiting and purging ensue; the stools become profuse, serous in character, and closely resemble the rice-water passages of Asiatic cholera. The mucous membrane is stripped off the bowels and appears in the dejecta in shreds. On the third day, providing death has not occurred, various inflammatory conditions of the skin may be noticed, and a remission of all the symptoms takes place. The remission is followed in a few hours by a return of these symptoms, usually more aggravated than at first. Violent cramps occur, especially in the calves. The patient occasionally recovers, but usually passes into collapse and coma, which is followed by death on about the sixth day. The treatment of acute poisoning consists in giving emetics if seen early (apomorphine $\frac{1}{10}$ grain (0.005 Gm.) hypodermically), or in using the stomach-tube. The best chemical antidote is the *ferri oxidum hydratum cum magnesia*, as it not only antidotes the arsenic, but at the same time purges. If this antidote is inaccessible, any ferric solution may be diluted with an equal quantity of water, and ferric hydrate be precipitated by the addition of diluted water of ammonia. If made in this manner, it should be strained and the precipitate washed with pure water until the odor of ammonia has entirely disappeared. As the antidote is not poisonous, a large quantity may be given—as much as an ounce every few minutes if deemed advisable. Opium and demulcent drinks (milk, mucilage of acacia, or emulsion of almonds) may be used to relieve the pain. Body heat is to be maintained by the application of external heat, and circulatory and respiratory stimulants (digitalis, strychnine, or caffeine) are to be used if indicated. If collapse occurs, small doses of atropine will be of use. Large quantities of water are to be administered, to dilute the poison, to aid in its elimination, and to prevent as far as possible irritation of the kidneys.

Chronic arsenical poisoning presents a wide range of symptoms, the most common being as follows: asthma, resulting from irritation of the bronchial mucous membrane; multiple neuritis, producing symptoms resembling those of tabes dorsalis; pigmentation and irritation of the deeper layers of the skin; areas of anæsthesia; muscular atrophy and localized motor palsies, usually confined to the toes. It is treated by the removal of the patient from exposure to the drug, by the administration of potassium iodide to aid in elimination, suitable tonics to improve the general nutrition, and the application of electricity to combat the muscular atrophy.

The dose of arsenic trioxide is stated to be from $\frac{1}{30}$ to $\frac{1}{15}$ of a grain (0.002–0.004 Gm.). It should be given in gradually increasing doses until its physiological effects are observed or the symptoms of the disease for which it is employed are ameliorated. If given upon an empty stomach, it may produce gastric irritation.

ARSENUM.—Arsenic.

Arsenium, Arsenicum.—Arsenic, Fr.; *Arsen, Arsenik*, G.

Symbol, As. Atomicity trivalent and quinquivalent. Atomic weight, 74.4.

Origin.—Arsenic, which is classed by some chemists with the metals, by others with the non-metallic elements, is widely diffused in nature, but is found usually in small quantities. It exists in the uncombined state as *native arsenic*, known also under the name of *cobaltum* or *flystone*, but more frequently in combination with sulphur and sulphides, as *red orpiment* or *realgar*, As_2S_2; *yellow orpiment*, As_2S_3; *arsenical pyrites* or *mispickel*, $FeS_2.FeAs_2$; *cobalt-glance*, $CoS_2.CoAs_2$; *tin-white cobalt*, $CoAs_2$; and in other minerals. It was first obtained in the metallic state by Albertus Magnus in the thirteenth century, by heating together white arsenic and soap.

Preparation.—On heating arsenical pyrites in earthen cylinders most of the arsenic volatilizes and is collected in iron receivers, where it congeals. $FeS_2.FeAs_2$ yields $2As + 2FeS$. A portion of the arsenic remains behind with the iron sulphide, and may be recovered as arsenous acid by roasting. The crude metallic arsenic should be purified by mixing it with charcoal and subliming at the heat of a sand-bath. It is obtained on a small scale by mixing arsenous acid with half its weight of powdered charcoal, introducing the mixture into a crucible, covering it with a layer of granular charcoal 2 or 3 inches thick, and cementing over the crucible in an inverted position another one having a small hole drilled through the bottom; on heating the crucible the arsenous acid is reduced to arsenic, which sublimes, carbon monoxide escaping; $As_2O_3 + 3C$ yields $As_2 + 3CO$.

Properties.—It is a brittle, steel-gray, crystalline mass having a bright metallic luster, gradually changing on exposure to the air to a grayish-black color devoid of gloss. Its specific gravity is 5.73 to 5.96. Heated in a sealed tube, it fuses, but if heated in the open air it volatilizes, without melting, at a temperature of 180° C. (356° F.), a portion of it being oxidized to arsenous acid. Its vapor is colorless, has an unpleasant, garlic-like odor, and between 560° and 860° C. (1040°–1580° F.) possesses a density which shows that the molecule of arsenic contains 4 atoms. On suddenly cooling the vapor in the absence of light and air a yellow modification of arsenic is obtained, which is soluble in carbon disulphide and in strong light quickly reverts to ordinary arsenic. On immersing the metal in water, the air dissolved in the latter oxidizes a portion to arsenous oxide, which explains the use of cobaltum as a fly-poison. Metallic arsenic is insoluble in simple solvents, but dissolves on heating in some fixed oils, and unites readily with most of the metals, with sulphur, chlorine, iodine, and other elements. Hydrochloric acid scarcely affects arsenic, but nitric acid readily dissolves it, oxidizing it to arsenous or arsenic acid.

For action and uses, see ARSENI TRIOXIDUM.

Compounds of Arsenic.—HYDROGEN ARSENIDE or ARSINE, AsH_3, is a colorless gas with a garlic-like odor and the density 2.695, and when ignited burns with a bluish flame, yielding water and arsenous oxide; but on cooling the flame, by holding in it a piece of porcelain or glass, metallic arsenic is deposited. Arsenous hydride is generated whenever compounds of arsenic, especially the oxide, are present in a solution where nascent hydrogen is being generated. Marsh's test depends on this fact (see page 32). A solid hydride is also known, As_4H_2, which is brown. As_2H_4, which corresponds to the liquid phosphorus compound P_2H_4, is not known in the free state, but the methyl derivative $As_2(CH_3)_4$ is known, and is called *cacodyl* because of its disgusting odor.

OXIDES.—Arsenic when burned or roasted in the air forms the trioxide, As_2O_3. When this is oxidized with nitric acid, the solution evaporated to dryness, and the mass heated to low red heat, the pentoxide, As_2O_5, is left as a white mass which melts and decomposes at a higher heat into the arsenous oxide and oxygen. In damp air or in contact with water it deliquesces to an oily-looking liquid, which is a concentrated solution of *arsenic acid*, H_3AsO_4. This is poisonous, however, in a less degree than arsenous oxide; the concentrated solution is corrosive. It is much employed in the manufacture of certain aniline colors and for other purposes in the arts. *Pyro-arsenic* and *meta-arsenic acids* are analogous to the corresponding phosphoric acids, but on dissolving in water yield at once the above *ortho-arsenic acid*.

ARSENOUS CHLORIDE, $AsCl_3$, is a colorless, oily, very poisonous liquid, which has the specific gravity 2.205, boils at 134° C. (273.2° F.), and is decomposed by water into HCl and As_2O_3 (see LIQUOR ACIDI ARSENOSI).

ARSENOUS BROMIDE, $AsBr_3$, is formed from the two elements in the presence of carbon disulphide, like the iodide. It is colorless, crystalline, of a peculiar odor, has the density 3.86, melts at about 20° C. (68° F.), and boils at 202° C. (428° F.). It is deliquescent, and decomposed by water into As_2O_3 and HBr.

Three sulphides of arsenic are known, but the pentasulphide, As_2S_5, is of no practical importance.

Realgar or Red Orpiment, As_2S_2, is a mineral which consists of handsome orange-red scales. It is made by fusing together 5 parts of arsenous acid and 3 parts of sulphur, when sulphur dioxide is given off. It burns with a blue flame, but with a white flame when mixed with potassium nitrate; a mixture for fireworks and signal-lights consists of: red orpiment, 2 parts; sulphur, 7 parts; potassium nitrate, 24 to 26 parts.

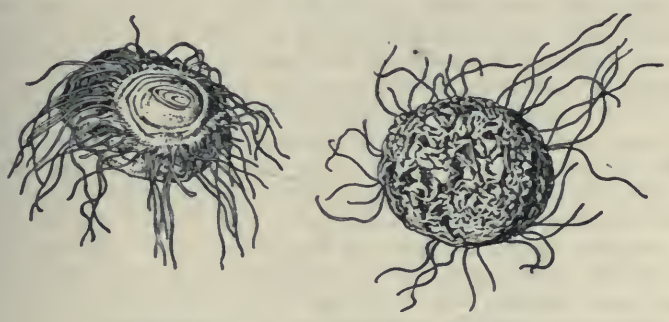
Orpiment, King's Yellow, or Auripigmentum, As_2S_3, is likewise a mineral, crystallizes in prisms or scales, and is artificially obtained by fusing together 5 parts of arsenous acid with 4 to 5 parts of sulphur. It was formerly much employed as a pigment; at present it is used in fireworks, and occasionally, mixed with considerable lime, as a depilatory.

ARUM.

This name has been applied to a number of plants of different genera in the family *Araceæ*. As commonly applied, it refers to the corm of *Arisæma triphyllum* (L.) Torr. (*Arum t.* L.), the American arum, and that of *Arum maculatum* L., the European arum. The former plant is very common in eastern North America, where it is known as *Indian turnip, Wild turnip, Jack-in-the-pulpit, Devil's ear, Pepper turnip, Wake-robin*, etc. It grows in rich soil, especially in moist places, to a height of from 0.3 to 1 M. (1 to 3 Ft.), has 1 or 2 long-petioled, broad, trifoliolate leaves, a green spathe, broadly striped with brown-purple, which arches over and encloses the spadix, the latter 5 to 8 Cm. (2 or 3 In.) in length and as thick as a small lead-pencil.

The corm is nearly lenticular in shape, 1.25 to 5 Cm. (½ to 2 In.) broad and about half as high, depressed in the summit, whence arise the stem and numerous coarse wavy roots, and coarsely reticulate-wrinkled on the evenly rounded brownish lower surface. Applied to the tongue, it is painfully and persistently acrid when fresh, losing this property when cooked or partially when dried. For market, it is transversely sliced and dried. These slices appear as nearly white circular disks with brownish edges, but little shrunken on the faces and of a starchy fracture. They are somewhat acrid.

Fig. 43.



American arum: upper and lower surfaces (½ Nat.).

The European arum plant is commonly known as *Spotted arum, Cocky-baby* or *Cuckoo-babies, Adder's-root, Bobbins, Friar's-cowl, Kings-and-queens, Bloody-man's-finger, Parson-and-clerk, Quakers, Pfaffenpint, Gefleckter Aronstab, Aronwurzel, Zehewurzel, Gouet, Pied-de-veau*, etc. The corm closely resembles the other, except that it is thicker in proportion to its breadth and generally larger, and that its roots proceed from the under surface. It is prepared in the same way and the slices are of similar appearance. If, however, one of the top slices be selected, the stem-depression is not found surrounded by the root-scars, as in the American species. Its composition is practically the same, if not identical.

Arum contains a volatile acrid principle, soluble in ether, much starch, gum, sugar, resin, fat, and numerous needle-shaped crystals of calcium oxalate. Enz claims to have obtained saponin, and Bird thinks there is a volatile alkaloid.

Action and Uses.—In the fresh state arum has an acrid, burning taste and acts as a severe irritant to mucous membranes with which it comes in contact. If given internally, it causes severe gastro-enteritis. The juice of the fresh plant when applied to the skin may even vesicate. The acrid principle is dissipated by drying or by heat, and the partially dried drug may be employed in doses of 10 grains (0.60 Gm.), 3 times daily, in

the treatment of chronic bronchitis, asthma, flatulent colic, and rheumatism. The juice of the fresh plant when incorporated with lard has been applied locally in the treatment of ringworm.

Other Arums.—The *Dragon arum* of the ancients was probably *Amorphophallus campanulatus* Bl., of the East Indies. Italian arum of southern Europe is from *A. Italicum* Mill. That of Asia Minor, with similar properties, is *A. dioscoridis* Sibth. et Sm. The *Pwan-hia* or *Sang-pwan-hia* of Asia is from *A. macrourum* Bunge. The arrow poison *Maschi* of Guiana, is supposed to come from a species of *Arum*.

ASAFŒTIDA, *U. S.*—Asafetida.

Asefétide, Assa fetida, Cibus Deorum, Stercus diaboli, E.; *Stinkasant, Teufelsdreck*, G.; *Asa fœtida*, Fr. and others; *Hing*, India; *Angusa-kema*, Afgh.

A gum-resin obtained from the rhizome of *Ferula fœtida* (Bunge) Regel (*Scorodosma f.* Bunge; *Ferula Scorodosma* B. et T.; *Ferula Narthex* W.—Fam. *Umbelliferæ*), and probably from other species of *Ferula*. Other species which are named by various pharmacopœias as sources of asafetida are *F. alliacea* Boiss.; *F. Asa fœtida* L. (*Asa fœtida Disgunensis* Kaempf.); *F. Narthex* Boiss. (*Narthex Asa fœtida* Falc.).

Asafetida is official in all pharmacopœias. The British and some others say "and probably some other species" than those named in their respective definitions, a wise provision, since it is pretty certain that several species yield it. In the *Pharm. Jour. and Trans.*, Ser. iii., 19: 21, 41, and 365, Mr. E. M. Holmes gives the most extensive and carefully digested account of the asafetida plants which has appeared, and he names the following as at least possible sources of the drug, in addition to those named above: *F. fœtidissima* Regel et Schmal, of Turkestan; *F. alliacea* Boiss.; *F. rubricaulis* Boiss.; *F. teterrima* Karel and Kiril; and *F. persica* W.

Origin.—The asafetida plants are natives of eastern Persia and western Afghanistan, and the principal point of export is Herat. It appears very probable that the product from different localities is obtained from different species, since the composition, even when pure, shows perceptible variations. The account furnished by Dr. J. E. F. Aitchison, who visited the Afghanistan deserts in 1885, of the plants and the method of collecting and preparing the asafœtida for market, may be taken as agreeing in the main with those of several other travellers who have furnished imperfect descriptions. He states that the plains are perfectly barren during the dry season, though a sea of vegetation quickly springs up from the perennial root-stocks of a number of umbelliferous plants, chiefly species of *Ferula* and *Dorema*, immediately upon the commencement of the rains. The immense interlacing leaves are 3 feet or more in length and almost as broad, while the flower-stems reach a height of from 6 to 12 feet, the growth being so dense as to seriously impede travel. At the season's close, this entire growth withers and disappears with surprising rapidity. The principal, if not the only asafetida-yielding species of that region appears to be *F. fœtida*. Only about 1 per cent. of the plants flower in any one season, the process commencing with the production of a large cabbage-like bud. These flowering plants are unfit for the collection of the drug, and the natives, who do not recognize them as being of the same species, eat the tender portions of the underground stem. The root-stock of the others is laid bare to a depth of a couple of inches and a slice cut from the top. A quantity of milky juice exudes, but is not at once collected. The exposed part is then covered by a domed structure, a few inches high, called a *khora*, formed of twigs and covered with clay, leaving an opening toward the north, thus protecting the exposed rhizome from the rays of the sun. The drug-collectors return after 5 or 6 weeks. A thick, gummy, not milky, reddish substance now appears, in more or less irregular lumps, upon the exposed surface, looking exactly like the ordinary asafetida of commerce, and is scraped off or removed along with a slice of the root, and placed at once in leather bags and conveyed to Herat, where it usually undergoes a process of adulteration with a red clay, *tawah*, and where it is sold to export traders, called *Kakri-log*, who convey it to India. We have it upon the authority of Kaempfer that plants under 4 years of age are not productive. A single plant produces a variable amount, according to size and other conditions, ranging from ½ ounce to 2 pounds. The rhizomes sometimes reach the thickness of a man's leg. The fruit is also said to be highly prized for its medicinal properties and is considerably used in India.

The very fine variety of tear asafetida which occurs in the Indian bazars under the

name of *Kandoharee hing* is said by Kaempfer to be obtained from the central portion of the rhizome.

Description.—Asafetida consists essentially of tears, occurring either (the "tear" form) separately or more or less agglutinated, or (the "lump" form) imbedded in a more or less soft and pasty, or, if adulterated, hard and earthy, matrix. The tears vary in size from 0.6 to 2.5 Cm. (¼ to about 1 In.) in diameter and are of irregular form, usually flattened, externally of a yellowish or reddish-brown color, internally whitish and shining, and changing upon exposure by fracture, first to pink, then red, finally to a yellow or brown much like the external color. Tears which exhibit a dingy-brown fracture are of little value. The fracture is toughish. The matrix of the lump form is of a variable shade of brown, usually made reddish by the foreign admixture. The odor is strongly garlicky and very penetrating and persistent, and, according to Kaempfer, is many times stronger in the fresh juice. The taste is persistently bitter and acrid. Asafetida is softened, but not melted by heat, and burns readily and even explosively. It yields a milky emulsion, which becomes yellowish on the addition of ammonia-water. Not less than 50 per cent. should dissolve in alcohol. The ash should not exceed 10 per cent. An understanding of the tests for identity and purity, and of standards of quality, is dependent upon the processes of collection and adulteration, which will be considered farther on.

Adulteration.—Adulteration has been practised upon a most extensive scale and in a variety of forms. The adulterants may be grouped under 4 principal heads: (*a*) the tissue substance of the plant itself; (*b*) other gums produced in the same locality; (*c*) earthy substances; (*d*) turpentine-products. Those of the first class are, of course, insoluble in alcohol, and are to be found in the residue after the use of this solvent, but do not materially increase the yield of ash. Those of the second class have not been investigated, nor have we any precise methods for determining them. Those of the third class represent by far the greater bulk, and are to be determined by the alcohol-insoluble residue, or chiefly by incineration. From 1 to 2 per cent. of ash is a normal constituent of even the purest tear asafetida, partly a natural constituent and partly unavoidable impurity. An allowance of 5 per cent. of ash is ample for a fairly pure article, but different amounts, up to 10 per cent., are allowed by the different pharmacopœias. The best commercial samples of the United States market rarely reach this standard. Our commercial asafetida contains usually from 20 to 40 per cent., frequently more, of ash. It even appears that such matter is sometimes added even after the drug reaches Europe. Importations from Sweden into Hamburg have been reported which consisted almost exclusively of pieces of gypsum thinly coated with asafetida, the latter amounting to not more than 5 per cent. Earthy adulterations consist chiefly of chalky matters, as is indicated by effervescence with hydrochloric or nitric acid.

Tests for the relative quality of asafetida have been confined chiefly to the determination of the alcohol-soluble portion, which, in the best tear forms, reaches to 76 per cent., and which, in a good commercial sample, should reach 60 per cent., as required by the pharmacopœia. Here again, however, we find such a grade of the drug practically wanting in our market, the amount falling frequently to about 10 per cent. The best method of treating this situation has given rise to wide discussion. The claim that adulteration at the point of production is necessary to facilitate transportation, appears to be disposed of by the statement of Aitchison, that the drug is transported over the most difficult part of its journey before the adulteration occurs, as well as by the frequent occurrence of lots not so adulterated. In any case, we may consider an article yielding 60 per cent. of alcohol-soluble matter as easily producible. A more reasonable claim is that the methods of producing asafetida are not subject to our control by means of any regulations or requirements which we may impose. While it might be assumed that the persistent rejection of an adulterated article would result in reforming the collectors' methods, there appears to be no tendency in this direction, notwithstanding that the exportation, presumably due in great part to adulteration, is said to have declined from 500,000 pounds to about $\frac{1}{10}$ of that amount (?). Upon these considerations is based the claim that to continue our requirements under the 60 per cent. standard will result merely in cutting off our supplies, and that this standard should be lowered. The proposition to omit all official standards for the crude article, leaving this subject to be dealt with by the importer and the manufacturer, and substituting for crude asafetida an alcoholic extract, which apparently meets all pharmaceutical and therapeutical requirements, provides only a partial remedy. In view of the enormous distances through which the article is transported and the great cost of a part of this transportation, the wastefulness of these additions and the greatly increased cost to the consumer are seen to be sufficiently serious to demand at least some efforts looking toward reform.

Lloyd suggests that the fourth class of adulterants should be estimated by the determination of the acid number, but admits that present methods do not render this perfectly practicable, since the acid number for the tear asafetida averages about ½ greater than that for the cake form.

It is assumed that the United States Customs officials will exclude importations of grossly adulterated articles, but it is claimed by the Treasury Department that, owing to the fact that they appoint competent and trustworthy officials only at the larger ports of entry, such action is impracticable.

Constituents.—Pure asafetida is essentially an oleo-gum-resin, and should contain 6–9 per cent. of light-yellow volatile oil, to which its odor is due, 60–70 per cent. of resin, and 20–30 per cent. of gum. Besides this, there have been found 0.06 per cent. of vanillin, 1 per cent. of free ferulaic acid, a fraction of 1 per cent. of free asaresinotannol, and formic, acetic, valerianic, and malic acids. The resin is a red-brown amorphous ferulaic ester of asaresino-tannol ($C_{24}H_{35}O_5$), which yields umbelliferon ($C_9H_6O_3$) on dry distillation or by the action of sulphuric acid, and resorcin on fusion with potassium hydroxide. Ferulaic acid ($C_{10}H_{10}O_4$) crystallizes in odorless, tasteless, iridescent needles, soluble in boiling water and alkalies, and yielding, when fused with potassium hydroxide, acetic, oxalic, and protocatechuic acids. It is chemically related to vanillin, eugenol, and cinnamic acid.

It has been claimed by Dieterich that the cake form contains a larger percentage of volatile oil, other things being equal, and is, therefore, superior to the tears. While this may be true for a pure grade of the cake, it is also true that the latter is far more subject to adulteration, and that a degree of purity equalling that of the tears is upon the whole not to be looked for.

Pharmaceutical Preparations.—Emulsion (Mixture) of Asafetida, U. S. P.; Pill of Asafetida, U. S. P.; Tincture of Asafetida, U. S. P.

Action and Uses.—Asafetida has been employed as a stimulating expectorant, an antispasmodic, and as a carminative affecting principally the lower bowel. To it have also been ascribed emmenagogue, laxative, and anthelmintic properties. Its therapeutic value depends principally upon its volatile oil, which is rapidly absorbed. It is eliminated by all the secretions and by the breath. The drug probably increases peristalsis and promotes digestion, for which latter purpose it has been employed as a condiment in India and Persia.

Asafetida may be given with benefit in the tympanites of children dependent upon the various intestinal troubles peculiar to them. Tympanites of enteric fever and hysteria is frequently relieved by this drug when it is given by enema in the form of an emulsion. Hypochondriasis and hysteria may be benefited, but it is probable that the mental effect produced by its disagreeable odor and taste exceeds any real therapeutic value which the drug possesses. In the chronic constipation of the aged attended with flatulence asafetida is a most valuable remedy when combined with other laxatives. It has been employed in whooping-cough, chronic bronchitis, and the nervous irritability of children.

Asafetida is usually given in the dose of from 3 to 10 grains (0.20–0.60 Gm.). It is most commonly administered in the form of a pill or an emulsion. A tincture is sometimes employed.

ASARUM.—Wild Ginger; Canada Snake-root.

False colt's-foot or Colt's foot, Snake-root, Colic-root, Indian ginger, Heart snake-root, E.; *Canadische Schlangenwurzel, Indischer Ingwer,* G.; *Asaret,* Fr.; *Azaro,* Sp.

The dried rhizome and roots of *Asarum Canadense* L. (Fam. *Aristolochiaceæ*).

Origin.—This plant grows in greatest abundance in rich, especially rocky woodlands throughout eastern North America, as far south as the Carolinas. The creeping rhizome sends up a very short stem, at the summit of which are 2 broad, reniform, petioled leaves, with a single brown-purple, nodding, 3-parted flower in the fork. Recently, it has been learned that another species (*A. reflexum* Bicknell) has been confused with it, and has doubtless contributed a certain portion of the drug, though a small portion, as it is much less abundant. It may be distinguished by its reflexed perianth-segments. The odor of this rhizome is quite different from that of the genuine.

Description.—From 7 to 15 Cm. (3 to 6 In.) long and about 3 Mm. (⅛ In.) thick, somewhat bent and curved, with few branches and few thin, nearly simple roots, which are 5 to 7 Cm. (2 to 3 In.) long; nodes often presenting a pointed appearance from the remains of the petioles; externally deep purple-brown, internally whitish, the bark occupying about ⅛ of the diameter and containing the oil-cells, the wood in about 12 small wedge-shaped bundles, forming an interrupted circle and enclosing a large pith; odor aromatic, taste pungent and bitter.

Fig. 44.

Asarum (Nat.).

Constituents.—Asarum contains 2 or 3 per cent. of a yellowish or greenish-amber volatile oil, starch, gum, fixed oil, a neutral resin of agreeable odor and pungent, warm, lasting taste, and *asarin*, a yellow coloring-matter, turned dark-green by ferric salts, but not precipitated by tannin. *Asarone* ($C_{20}H_{26}O_5$), in odorless tasteless crystals which volatilize with irritating vapors, occurs only in *A. Europæum* L., but is replaced in *A. Canadense* by *asarol* ($C_{10}H_{18}O$), a fragrant body. A minute quantity of substance was found giving precipitates with most of the group-reagents for alkaloids.

Pharmaceutical Preparation.—Compound Syrup of Asarum, N. F.

Action and Uses.—Canada snake-root is a feeble remedy possessing tonic, aromatic, and slight diuretic properties. Overdoses sometimes occasion an erythematous or vesicular eruption on the skin, but do not produce nausea or vomiting. It has been employed as a substitute for serpentaria, and may be given in conjunction with other tonics during convalescence from the acute febrile infections.

The powdered drug may be given in the dose of from 15 to 30 grains (1–2 Gm.), or an infusion containing ½ ounce (16 Cc.) to the pint (480 Cc.) of boiling water may be used in doses of from 1 to 4 ounces (30–120 Cc.).

Other Species.—The genus comprises a dozen or more species, half of them Japanese, most of the remainder North American. All are aromatic bitters, like ours, but one or two are known to have more active properties. *A. Europæum* L., *Hazelwort* (*Haselwurz*), *Wild nard* (*Wilder nard*), *Cabaret*, *Asarabacca*, *Foalfoot*, or *European snake-root*, is sufficiently active to be highly sternutatory and actively emetic, and is used as an emmenagogue and in dropsy, while *A. albivenium* Riegel (*Heterotropa asaroides* Morr. et Decne), the *Si-sin* (Jap.), or *Sai-san* (Chin.), of eastern Asia, is used as a hydragogue cathartic and diuretic, as is the *A. Sieboldii* Miq., the *To-sai-shin* of Japan.

ASCLEPIADACEÆ.—The Milk-weed Family.

Genera more than 200, species nearly 1500, very abundant in the tropics, quite a large number extending into temperate regions. The plants produce an abundant milky juice, have mostly opposite, exstipulate leaves, and are distinguished from the *Apocynaceæ* by the absence of the annular stigma and the possession of a peculiar appendage called the "crown," almost infinitely varied, and affording the chief characteristics supporting the systems of classification.

The important constituents are caoutchouc, rendering some of them (see Elastica) rubber-producers, and a peculiar class, chiefly amorphous, some glucosidal, a very few alkaloidal, and some amaroidal, *asclepiadin* (see Asclepias) being the most widely distributed and in a general way typical of a majority of the others.

Properties.—Very many of the milk-juices are more or less poisonous, though those of *Sarcostemma viminale* R. Br. and *Gymnema lactiferum* R. Br., both of the East Indies, are said to be used like cows' milk. Cooking appears usually to destroy these poisonous properties, and the young shoots of *Sarcostemma stipitaceum* R. Br. and *S. Forskalianum* R. et S., both of Arabia, *Asclepias Syriaca* L., of the United States, and the herbage of *Oxystelma esculentum* R. Br., of New Holland, are used as potherbs. A very few edible fruits are produced by the

family, notably the *Moonga* of Beloochistan, from *Mastostigma varians* Stocks. Blue coloring-matters are very common, so that some of the plants (*Gymnema tingens* Spr., *Pergularia bifida* Zipp., etc.) have been utilized as indigo substitutes.

The *Asclepiadaceæ* frequently act as counterirritants, or internally as stomachics, carminatives, or antispasmodics of the stimulating class, occasionally diuretics, though more commonly closely resembling Ipecac in their action, thus nauseating diaphoretics and expectorants (or anti-asthmatics), emetics or purgatives, occasionally anthelmintics.

Arrow poisons are said to be yielded by the juices of *Gonolobus macrophyllus* Mich. and *G. obliquus* R. Br., both of North America. A curare-like principle (*sarcolobin*) exists in *Sarcolobus Spanoghei* Miq., of Java. *Periploca Græca* L., the *Silk-vine* or *Climbing dogs' bane* of the Mediterranean region, contains the heart-poisonous glucoside *periplocin*, and the roots of several other species of this genus are known to be poisonous. *Morrenia brachystephana* Griseb., of the Argentine, is believed to contain an alkaloid, *morresine*.

Ipecac-like properties pertain to the following: The roots of *Sarcostemma glaucum* H. et B., of Colombia, *Cynanchum fuscatum* Link, of southern Europe, many species of *Hoya* of tropical America, also used as fish poisons, and of *Dischidia* of the East Indies. *Barjonia racemosa* Decne, of the Mediterranean region, the *Chanik-el-kilab* of the Arabians, *Vincetoxicum officinale* Moench, the *Lorenzkraut* or *Hundswürger* of middle Europe, which contains *vincetoxin* and is used in the treatment of dropsy, *Gomphocarpus crispus* R. Br., of the Cape, also used as a purgative, *Camptocarpus Mauritanicus* Decne, *Secamone emetica* R. Br., of the East Indies, and the roots of *S. emetica* R. Br., of the East Indies, are also emetics. The following are used as purgatives: both leaves and flowers of *Solenostemma Arghel* Hayne, of Egypt, the leaves of *Gomphocarpus fruticosus* R. Br., of Syria, the milk-juices of *Cynanchum monspeliacum* L., of South America, and *C. acutum* L., of southern Europe, containing *cynanchol*, *cynanchocerin*, and *cynanchin* (*Jahrb. f. Ph.*, 1876, 471, and 1876, 124), and the milk-juices of *Oxystelma alpina* R. Br., of Africa, and of *Leptadenia reticulata* Wight, of Ceylon.

The root of *Chlorocodon Whitei* Hook., of South Africa, contains a principle believed to be cumarin.

The following are commercial articles, requiring special mention:

Calotropis R. Br. is associated in the most important ways with the religious and resulting medicinal superstitions of the Orientals, and is found serviceable, and considerably used, in modern medicine, especially in India. Two species are in use, namely, *C. gigantea* R. Br., the *Gigantic swallow-wort*, *Milk-weed*, or *Silk-weed*, and *C. procera* R. Br., the more important, *Madar*, *Ak*, *Akra*, *Akanda*, etc. All parts of the plants are in native use, but the important products are the root-barks, which resemble condurango in form and appearance, but have the peculiar gray-yellow color of angustura. The odor is characteristic; the taste first bitter, then acrid and strongly mucilaginous. These barks contain caoutchouc, resinous constituents similar to those of gutta-percha, and peculiar bitter substances. Preparations of Calotropis are used for the poisoning of infants and for the production of abortions, both internally and locally applied.

Tylophora asthmatica W. et A. is the *Jangli-pikwán*, *Antamúl*, *Berri-pala*, etc., of India. Its root and powdered leaves are considerably used in India, both by physicians and the laity, as a substitute for Ipecac. The leaves contain *tylophorine*, a crystalline alkaloid, soluble in alcohol and water, reddish, then green and indigo, with sulphuric acid. This has been experimentally shown to be the emetic and purgative principle. The roots of *T. fasciculata* Ham. have been found actively poisonous, with the throat dry, then moist, dizziness, partial paralysis of the extremities, and death with the right heart full, the left empty. Cooking in food did not destroy the activity. These roots are found to contain an amorphous alkaloid, reddish, then carmine and purple with sulphuric acid.

Dœmia extensa Br., the *Utran*, *Sagovani*, *Kuntiga*, etc., of India, has properties very similar to those of our pleurisy root, though rather more active, and anthelmintic. The leaves, which are used, exhale a disagreeable, mousey odor and contain the alkaloid *dœmine*, presenting some similarities to nicotine, and apparently also contained in the roots.

Hemidesmus Indicus Br., the *Anantamúl*, *Sogade*, etc., yields the root known as *Indian sarsaparilla*, used as a sarsaparilla substitute, and containing cumarin.

Gymnema silvestris Br., the Indian *Mera-singi*, *Kavali*, etc., possesses the curious property of destroying the sense of taste for sweetness and bitterness, though for nothing else. It would appear as though this property might be utilized in important ways. It is due to the constituent *gymnemic acid* ($C_{32}H_{55}O_{12}$), a glucoside somewhat resembling glycyrrhizic acid, soluble in both alcohol and water, and forming insoluble salts with alkaloids.

ASCLEPIAS.—Pleurisy Root.

Butterfly-weed, *Orange or yellow milk-weed*, *Orange-root*, *Orange swallow-wort*, *Indian posy*, *White-root*, E.; *Knollige Schwalbenwurzel*, G.; *Asclepiade Tubereuse*, Fr.

The dried root of *Asclepias tuberosa* L. (Fam. *Asclepiadaceæ*).

Origin.—From a perennial hairy herb with (mostly clustered) ascending, very leafy stems, and handsome orange-colored flowers, common in sandy soil thoughout North America, from Ontario south, except in the far West, the root usually deeply buried.

Description.—Irregularly or interruptedly fusiform, 10 to 20 Cm. (4 to 8 In.) long, 1 to 2 Cm. (½ to 1 In.), rarely more, in thickness, usually cut transversely or longitudinally into irregular pieces; externally light orange-brown, becoming gray on keeping, coarsely annular at the crown, bearing numerous fine longitudinal and transverse furrows, imparting a finely tuberculate appearance and feeling; fracture tough, uneven, granular, whitish, the thin bark

Fig. 45.

Fig. 46.

Asclepias (½ Nat.).

yellowish in the outer layer, the wood-bundles pale-yellow; almost inodorous, taste bitterish, slightly acrid, and nauseous.

A. decumbens L., of the central and southern States, may be distinct, but no endeavor has been made to distinguish it pharmaceutically. It probably yields a large part of the drug. No other species of the genus has a root much resembling this, nor is there any other drug which can readily be mistaken for it. The detection of possible adulterants of the powder has not been investigated. Adulteration with the roots of other species of the genus would not be serious, as they possess the same general properties.

Constituents.—Besides much starch, tannin, albumin, pectin, gum, fat, a trace of volatile oil, and 2 resins, only 1 ether-soluble (Elam Rhoads), the active constituent appears to be *asclepiadin*, widely distributed in the family, an unstable, amorphous yellowish glucoside, having the taste and activity of the root. It is soluble in ether, alcohol, and hot (difficultly in cold) water, precipitated by tannic acid, not by lead acetate, its yellow color deepened, afterward green or brown (Clabaugh), by concentrated sulphuric acid (Sonn), and pink, then purple, by nitric acid. It yields *asclepin*, which is less active.

Action and Uses.—The root of *Asclepias tuberosa* has been employed as a diuretic and carminative, and in large doses as a cathartic and an emetic.

Because of its diaphoretic properties the drug has been given with asserted success in the forming stages of acute diseases, such as pleurisy and pneumonia. As an expectorant it is recommended in many pulmonary and bronchial affections of a subacute or chronic character. It is claimed that asclepias may be employed with benefit in flatulent colic and indigestion, but in these conditions it is rarely used.

The dose of the powdered root is from 20 to 60 grains (1.3 to 4 Gm.). A decoction made with 50 Gm. of the drug and 1000 Cc. of water may be given in the dose of 2 or 3 fluidounces (60–90 Cc.) every 2 hours.

Other Species.—The genus contains about 80 species, mostly in North America, a few in South America and Africa. The juices of the others are usually much more abundant and milky than in *A. tuberosa*.

A. Syriaca L. (*A. Cornuti* Decne), the *Common milk-weed, Silk-weed*, or *Swallow-wort, Virginia silk, Wild cotton, Seidenpflanze, Asclépiade à la Soie, Herbe à la ouate*, is a tall, stout,

very milky perennial roadside weed of eastern and central North America. Its milk-juice is a domestic application to warts, and attempts have been made to use its seed-hairs as a cotton substitute. Its rhizome and roots are very extensively used like the official, as are those of *A. incarnata* L., the *Swamp milk-weed, Silk-weed,* or *Swallow-wort, White Indian hemp, Water nerve-root, Fleischfarbige,* or *Asclépiade incarnate,* exceedingly common in swamps in the eastern and central United States. *A. pulchra* Ehrh., by many regarded as a variety of the last, from which it is distinguished by its hairiness, the other being nearly smooth, is indiscriminately used under the same names. Another species, both root and herbage very largely used, especially in tropical America, where it grows abundantly, taking the place of our pleurisy root and much resembling it, is *A. Curassavica* L., the *Bastard ipecac, Blood flower, Blood-weed, Red-head, Cancerillo,* or *Ponchishuiz.* Chemical examinations of the three last-named species show them to agree very closely in composition with the official. More than a dozen other species are recorded as being similarly used, and probably the same constituents and properties prevail throughout the genus.

ASPARAGUS.—Asparagus.

Spargel, G.; *Asperge,* Fr.; *Sperage; Esparraguera,* Sp.; *Asparago,* F. It. (*Rhizoma et Turiones*).

Asparagus officinalis, L. (Fam. *Liliaceæ*), the well-known culinary vegetable.

The "turiones" are the young edible shoots. The "radix" or "root" is the rhizome and roots. Both are official in France and are more or less used medicinally.

Description.—Rhizome (which should be collected in the autumn) elongated and much branched, about 2 Cm. (½ In.) thick, somewhat compressed, flexuous, brown or brownish, scaly the upper surface marked with broad stem-scars, the lower bearing numerous yellowish-white fibrous roots; fracture fleshy or gummy; odor none; taste mucilaginous and sweetish.

Constituents.—Fixed oil, dextrose, mannite, gum, phosphates and malates, spargancin, and asparagin occur. *Spargancin* is an orange-red sublimable coloring-matter, soluble in ether, and crystallizing in scales. *Asparagin* (amido-succinamide, $C_4H_8N_2O_3.H_2O$), said to exist only in the shoots, occurs in rhombic prisms, insoluble in alcohol and ether, soluble in 12 parts of water, odorless, of saltish and cooling taste. It unites with acids and alkalies, and on boiling with them yields aspartic acid (amido-succinic acid, $C_4H_7NO_4$) and ammonia. Nitrous acid converts it into malic acid, water, and nitrogen. It is very widely distributed among plants, especially in the *Leguminosæ,* and occurs in convallaria, belladonna leaves, althæa, glycyrrhiza, euonymus, hops, and other drugs. The peculiar offensive odor of the urine after eating asparagus is due to the formation of methyl-mercaptan (Nencki).

Action and Uses.—All parts of the plant, principally the young shoots, seem to possess diuretic properties; increasing chiefly the watery constituent of the urine. The peculiar odor imparted to the urine is due to asparaginic acid It is claimed by some and disputed by others that asparagin in doses of 2 to 5 grains (0.10–0.30 Gm.) depresses the circulation, and produces headache, muscular relaxation, and in some individuals inflammation of the genito-urinary tract. In doses of 1 grain (0 05 Gm.), 3 times a day, asparagin has been employed in the treatment of cardiac dropsy and chronic gout. In these conditions the drug is usually combined with potassium bromide. Fluid-extract of asparagus has also been used with marked benefit in chronic parenchymatous nephritis. The drug is more largely employed in France than elsewhere.

The dose of the fluidextract is 1 to 4 fluidrachms (4–16 Cc.). A syrup, made by dissolving 190 parts of sugar in 100 parts of the juice expressed from the shoots and clarified by heat and filtration, is given in the dose of 1 to 2 fluidounces (30–60 Cc.). A solid extract and tincture have also been employed.

ASPIDIUM, *U. S.*—Male Fern.

Male shield fern, Basket-fern, Knotty or Sweet brake, Bear's-paw root, E.; *Wurmfarn, Waldfarn, Johanniswurzel,* G.; *Stipites Aspidii,* Ph. Nor.; *Fougère mâle,* Fr.; *Helecho Macho,* Sp.; *Feto Macho,* Port.

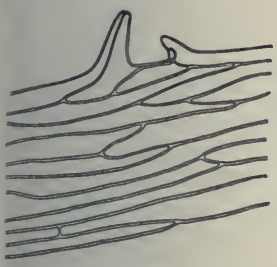
The dried rhizome of *Dryopteris Filix-mas* (L.) Schott (*Polypodium F.* L.; *Aspidium,* F. Sw.; *Lastræa F.* Presl.; *Nephrodium F.* Rich.; *Polystichum F.* Roth.) and of *Dryopteris marginalis* (L.) Asa Gray (Fam. *Filices*).

The synonyms of *D. marginalis* are similar.

Male fern is official in all pharmacopœias, which mostly require autumn-collection and use within a year. The latter requirement is unnecessary, if only the drug with green fracture is accepted.

Origin.—The first-named species is distributed over nearly the whole of the north-temperate zone, extending into the tropics in mountainous regions of both hemispheres. The second occurs in Canada and the United States. Both are tall, handsome ferns, the fronds erect from the slightly ascending ends of horizontal creeping rhizomes, the older portions of which are covered with the stipe-bases. The drug should be collected in the late summer or early autumn.

Fig. 47.



Male fern: section of scale from unpeeled rhizome (much enlarged).

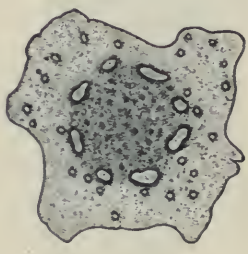
Fig. 48.

Male fern, "finger."

Fig. 49.

Aspidium: surface of peeled rhizome.

Fig. 50.



Dryopteris Filix-mas Schott; transverse section of rhizome.

Description.—Before being peeled, 10 to 15 Cm. (4 to 6 In.) long by 5 to 7 Cm. (2 to 3 In.) thick, including the densely imbricated, dark-brown, cylindraceous, slightly curved stipe-bases and the dense mass of brown, glossy, transparent, soft, chaffy scales; when peeled, 1 to 2 or 3 Cm. ($\frac{2}{3}$ to about 1 In.) thick, slightly curved, cylindraceous, pale-green when first peeled, becoming pale-brown, or, when long kept, rusty-brown, smoothish, or somewhat roughly scarred with remains of the stipe-bases; texture rather spongy, pale-green, with age becoming gradually brown from the outside inward, the *Filix-mas* showing about 10, the *marginale* about 6 steles in a loose and interrupted circle. The marginal hairs of the stipe-scales of *Filix-mas* consist each of two parallel, slender cells, neither of them glandular; those of *marginalis* are almost identical in appearance, being directed slightly more toward the apex of the scale, and their lower cell perhaps a little narrower. Upon the older scales they are nearly wanting.

Male fern has a disagreeable odor and a bitter-sweet, acrid, astringent, and nauseous taste.

The chaff, together with the dead portions of the rhizome and stipes, should be removed, and only such portions used as have retained their internal green color. The powder should be freshly prepared and bright green.

The peeled stipe-bases ("fingers") have almost superseded the rhizome proper in the American market. They are smaller, claw-shaped, and smoothish, with the exception of several blunt longitudinal ridges, separated by coarse furrows.

Male fern is one of the most extensively adulterated of drugs, the rhizomes of many other species of fern having been employed for the purpose. How far the properties of the latter agree with those of the genuine has been scantily investigated. Identification of some of these, in the peeled condition, is extremely difficult, when not actually impossible. For this reason, and because the drug retains its composition and properties for a much longer time when unpeeled, it should be retained in that condition until required for use.

Laurén (*Pharm. Rev.*, May, 1897, 96) relies upon the microscopical detection of the internal glandular structures and intercellular spaces (Fig. 51) in the fundamental tissue of the rhizomes of those species which have been found to be active.

It cannot be too strongly emphasized that the careless or too lengthy preservation of this drug results in certain deterioration. Most of the male fern of the American market at the present time is very small and inferior. It is doubtless due to this extensive adulteration and inferior and deteriorated quality that male fern, naturally one of the most certainly acting of medicines, has come to be regarded as one of the most unreliable.

Constituents.—The rhizome yields 10 per cent. of filixtannic acid, which is changed to filix-red by boiling with water, 19 to 31 per cent. of inactive filicic anhydride (so-called crystalline filicic acid or filicin), and 2 to 4 per cent. of active amorphous filicic

acid, $C_{14}H_{16}O_5$. Boehm (1898) isolated albaspidin, $C_{22}H_{28}O_7$, aspidinol, $C_{12}H_{26}O_4$, aspidinin, and active aspidin, $C_{23}H_{28}O_7$, the proportion of the latter increasing as that of the filicic acid decreased. His many investigations demonstrated the impossibility of one being changed into the other in the process of manufacturing. In preparations of male fern, the active filicic acid is changed into inactive filicic anhydride and deposited as crystals. If these are dissolved in alkali and reprecipitated by acid, they become again active. Pavesi's aspidin is a very impure filicic acid. Aspidium also yields 11 per cent. of uncrystallizable sugar, 0.04 per cent. of ethereal oil, 6 to 7 per cent. of green

Fig. 51.

Male fern: *a*, intercellular secreting cell; *b*, lemon-colored resin; *c*, intercellular space; *d*, starch-grains.

fixed oil composed of the glycerides of filixolic acid and of volatile filosmylic acid, a small quantity of a bitter principle, starch, wax, and 2 resins, one hard and brick-red, the other black and plastic.

Pharmaceutical Preparations.—Oleoresin of Aspidium, U. S. P.; Liquid Extract of Male Fern, Br.

Action and Uses.—Aspidium has been employed from the earliest antiquity as a tænicide. As a rule the drug is not absorbed when ingested, and produces no constitutional symptoms in the patient. If given in overdose or allowed to remain too long in the alimentary canal, grave, or even fatal, symptoms may arise. Poisonous amounts produce severe gastro-enteritis, vomiting, purging, abdominal pain, muscular relaxation, and somnolence. Ultimately convulsive seizures, followed by collapse, coma, and death, may occur. Permanent or temporary blindness with apparently little or no change in the retina sometimes results from an overdose of this drug.

Before employing male fern, it is well to starve the patient from 12 to 24 hours, during which time only small quantities of broth or milk should be administered. The morning following the period of fasting the drug should be given, and in the course of a few hours be followed by a brisk purge, which should not be castor oil, as it aids in the absorption of the drug. It is well to employ in addition a large saline enema after the stool, to insure the removal of any segments which might otherwise be left behind.

Male fern may be given in the dose of 30 to 60 grains (2–4 Gm.).

The oleoresin (U. S.) is usually administered either in emulsion or in capsule in the dose of 15 to 60 minims (1–4 Cc.). Extractum Filicis Liquidum, Br., is given in the dose of 45 to 90 minims (3–6 Cc.).

Other Species (see also *Filices*).—The ethereal extract of *D. spinulosa* (Retz.) Kuntze has been found practically identical with that of male fern. That of *D. Anthamanticum* (Hook.) Kuntze, the *Radix Pennæ* or *R. Uncomocomo* of South Africa, is similarly active and has an extensive native use. It is much larger than male fern, from which it presents distinctive structural characters, but has the same peculiar internal glandular structure.

ASPIDOSPERMA.—Quebracho.

White quebracho, E.; *Quebracho Blanco*, Sp.

The dried bark of *Aspidosperma Quebracho-blanco* Schlechtendal (Fam. *Apocynaceæ*).

Origin.—The Aspidosperma tree reaches a height of from 50 to 90 feet, with a thick trunk and a large crown, and is very ornamental. Its fruit ripens in July. It abounds in the dry central and western districts of the Argentine and adjacent regions. The wood is very valuable for building, as well as for carving and similar purposes. The juice of the green fruit is used like rennet. To what extent the bark and wood are used, like those of red quebracho, for tanning purposes, is very uncertain. Reports of such use are current, but it seems likely that most of them have arisen through confusion of this name with that of red quebracho. The name quebracho, derived from two Spanish words meaning to break an axe, is applied to various trees. In the present instance it is used in allusion, not so much to the wood, however hard and tough, as to the bark, which, on account of its great number of stone-cells, quickly nicks out the edges of any tools used upon it.

FIG. 52.

Aspidosperma (½ Nat.).

Description.—In nearly flat pieces, about 1 to 3 Cm. (⅜ to 1 In.) thick; outer surface yellowish-gray or brownish, deeply fissured; inner surface of a very pale-yellow, coarsely striate; fracture displaying 2 sharply defined strata, of about equal thickness, and both marked with numerous whitish dots and striæ arranged in tangential lines; fracture of the outer rusty-red layer rather coarsely granular, that of the nearly white inner layer very hard, tough, and splintery. Large and very hard groups of stone-cells abound in both layers. Aspidosperma is inodorous, and the taste is very bitter in both layers and slightly aromatic.

Upon soaking the shavings from the inner portion with alcohol, evaporating, boiling with water, and adding ferric chloride, a green and not a brown color should develop (distinction from red quebracho).

This is the largest and coarsest of our official barks, and is not readily to be mistaken for anything else, except the bark of the red quebracho, which is now often sold for it in this country. The presence of the latter is to be suspected when the inner bark fracture displays a red or brown color, and the test appended to the above description will then be found conclusive. Although distinctly bitter in all its parts, it is less so, especially in the inner layer, than the white. So general has been the substitution of the red for the white quebracho, and so little have the distinctions between them been known, that the description heretofore official has been that of a mixture of the two barks. It is not remarkable, under these circumstances, that such a wide discrepancy should exist between the therapeutic reports upon the drug. Grounds are not wanting even for the suspicion that there are two distinct barks known as "red quebracho."

Commercial supplies and therefore the price of the genuine drug are very irregular and uncertain. We have met with no other substitute or adulterant of aspidosperma than the red variety, but have received the outer bark, from which the inner had been removed, perhaps for the manufacture of the alkaloids.

Constituents.—The bark contains a small amount of tannin (3 to 5 per cent.) and the two sugars, quebrachit and inosit. Commercial aspidospermine is mostly a mixture of the alkaloids of this bark, of which 6 are recognized, as follows: aspidospermine, aspidospermatine, aspidosamine, quebrachine, hypoquebrachine, quebrachamine.

The extract, prepared with hot alcohol, is treated with sodium hydroxide and chloroform, the latter solution evaporated, the residue taken up with diluted sulphuric acid, and the filtrate precipitated by sodium hydroxide. On dissolving the mixed alkaloids in a little boiling alcohol, aspidospermine, quebrachine, and quebrachamine will crystallize on cooling,

and are separated by crystallization from diluted hydrochloric acid, aspidospermine remaining in the mother-liquor. The alcoholic mother-liquor contains the remaining bases, which are combined with acetic acid; from this solution ammonia precipitates aspidosamine; aspidospermatine and hypoquebrachine are precipitated by sodium hydroxide and separated by boiling benzin, in which the latter is nearly insoluble. All these alkaloids are more or less soluble in alcohol, ether, and chloroform. *Aspidospermine*, $C_{22}H_{30}N_2O_2$, melts at 205° C. (401° F.), and is a weak base, forming mostly amorphous salts; warm perchloric acid colors the solution permanently deep-red; platinic chloride gives a blue precipitate; sulphuric acid and lead peroxide (or potassium dichromate) color the alkaloid brown, afterward cherry-red or purplish. *Aspidospermatine*, $C_{22}H_{28}N_2O_2$, melts at 162° C. (324° F.), is a strong base, and yields amorphous salts; it is colored, like the preceding, by perchloric acid, but not by sulphuric acid and chromate. *Aspidosamine*, $C_{22}H_{28}N_2O_2$, melts near 100° C. (212° F.), is a strong base, is colored blue by sulphuric acid and dichromate, and gives with boiling perchloric acid a fuchsine-red liquid. *Quebrachine*, $C_{21}H_{26}N_2O_3$, melts at 215° C. (419° F.), yields crystallizable salts, is colored yellow by sunlight, also by warming with perchloric acid, and gives with sulphuric acid a colorless solution becoming blue on standing or more rapidly by adding lead peroxide or potassium dichromate, the color produced by the latter changing to red-brown. *Quebrachamine* resembles the preceding, but melts at 142° C. (228° F.), and is freely soluble in cold alcohol and ether. Hypoquebrachine is yellow, amorphous, melts near 80° C. (176° F.), and gives in solution a cherry-red color with ferric chloride.

Action and Uses.—Aspidosperma exercises a sedative influence upon the respiratory system, for which reason it has been employed in the various forms of dyspnœa. It has no effect upon the circulation except in overdose, when it acts as a depressant. The prolonged use of the drug not uncommonly causes somnolence, vertigo, headache, nausea, and ptyalism.

Quebracho was at one time employed to a limited extent in the treatment of all asthmatic conditions. It is stated by those who have used the drug most that it may act as a palliative in bronchial asthma, but is of little or no service in those forms dependent upon cardiac or renal disease.

It is usually administered in doses of from 15 to 60 minims (1–4 Cc.) of the fluid-extract, or from 1 to 3 grains (0.06–0.20 Gm.) of the extract. The sulphates of aspidospermine and quebrachine have been employed both hypodermically and by the mouth in doses of from 1 to 2 grains (0.06–0.12 Gm.).

ATROPINA, *U. S., Br.*—Atropine.

Atropia, Atropinum.—*Atropia*, E.; *Atropine*, Fr.; *Atropin*, G.

Formula, $C_{17}H_{23}NO_3$. Molecular weight, 287.04.

An alkaloid obtained from Atropa Belladonna and other plants of the same family. As it occurs in commerce it is usually accompanied by a small portion of hyoscyamine, from which it cannot be readily separated.—U. S. An alkaloid, $C_{17}H_{23}NO_3$, obtained from belladonna-leaves or root.—Br.

The pharmacopœias have omitted the processes for the preparation of atropine, as it cannot be economically prepared on a small scale. The alkaloid may be obtained by the following method: The finely powdered drug is exhausted with alcohol and the percolate mixed with calcium hydroxide to decompose the natural salt and liberate the alkaloid, which remains in solution; after filtration, the filtrate is acidulated with diluted sulphuric acid, concentrated to remove alcohol, fat, and resin, and treated with potassium carbonate in excess. (If necessary, the acid liquid, before addition of the alkali, is shaken with chloroform to remove chlorophyll.) The precipitated atropine is removed, washed with water, and dissolved in alcohol; to this alcoholic solution water is added, drop by drop, to incipient turbidity, and the alkaloid allowed to crystallize. Since it has been demonstrated that hyoscyamine is converted into atropine during the process of extraction, it is probable that much of the commercial atropine is prepared from scopolia rhizome. To obtain the alkaloid in a crystalline form, the dried alkaloid should be dissolved in 7–8 parts of absolute alcohol and evaporated at a moderate temperature out of contact with moisture or under a dessicator.

Properties.—Pure atropine occurs as colorless or white, lustrous, acicular needles or prisms, and has a disagreeably bitter and acrid taste. It is soluble at 25° C. (77°

F.) in 450 parts of water, 1.46 parts of alcohol, 16.6 parts of ether, and 1.56 parts of chloroform (U. S.). At 80° C. (176° F.) atropine dissolves in 86.7 parts of water, and at 60° C. (140° F.) in 0.9 part of alcohol (U. S.). The Br. P. gives the solubility of atropine at 15.6° C. (60° F.) as 1 part in 300 of water, while Wormley gives it as 1 in 400, and Allen and Prescott, both, as 1 in 600 parts. Atropine is said to be also soluble in 4.8 parts of an 80 per cent. aqueous solution of chloral hydrate and in about 50 parts of glycerin, also in amyl alcohol, benzene, and olive oil, but only sparingly soluble in petroleum benzin and carbon disulphide. "Pure atropine is optically inactive, being composed of dextro-atropine (dextro = + 10.02°) and lævo-atropine (lævo = — 9.22°), both of whose melting-points are 111° C. (231.8° F.), and the melting-point of whose chloraurates are both 146° C. (294.8 F.). The chloraurate may be made by adding gold chloride test-solution to a solution of atropine in diluted hydrochloric acid, washing, collecting, and drying the precipitate. Pure atropine chloraurate melts at 136° C. (277° F.). Pure hyoscyamine chloraurate melts at 160° C. (320° F.). Pure hyoscine chloraurate melts at 196° to 198° C. (384.8°–388.4° F.). Atropine chloraurate alone melts under boiling water. At about 113.8° C. (237° F.) atropine melts, forming a colorless liquid; the melting-point of atropine (free from hyoscyamine) is about 115.8° C. (240.4° F.). When ignited, it is consumed without leaving a residue."—U. S.

Its salts are mostly insoluble in chloroform and ether. Both of these solvents, however, extract notable quantities of the alkaloid from the solution acidulated with tartaric acid.

It is a strong base, its aqueous solution reacting alkaline to both litmus and phenolphthalein, but in aqueous solution it rapidly undergoes decomposition, acquiring a yellow color and disagreeable odor. It is a powerful mydriatic, 1 part dissolved in 45,000 parts of water will dilate the pupil in 40 minutes to 1 hour. It dissolves without color in concentrated sulphuric or nitric acid.

If a small quantity of atropine or one of its salts be heated with a few Cc. of concentrated sulphuric acid, a peculiar odor, recalling that of a mixture of rose, orange-flower, and melilot, will become noticeable. On now gradually adding minute fragments of potassium dichromate, the odor will change to that of oil of bitter almond (U. S.). Atropine and its salts are decomposed by prolonged contact with sodium or potassium hydroxide, and if heated with either of them, evolve ammonia. On dissolving a small quantity (about 0.1 Gm.) of atropine in 2 Cc. of alcohol, and adding an equal volume of mercuric chloride test-solution, a yellow precipitate, which soon turns red, is produced (Br.). Atropine is easily saponified, or hydrolyzed, by treatment with alkalies or acids. Heated with barium hydroxide, it is hydrolyzed into *tropic acid*, $C_9H_{10}O_3$, and *tropine*, $C_8H_{15}NO$. Atropine has been made synthetically by heating together these two compounds. It is also easily made from hyoscyamine, the latter changing to atropine by contact with sodium hydroxide in alcoholic solution or by keeping hyoscyamine at a temperature of 110°–115° C. (230°–239° F.). According to Einhorn (*Ber.*, 23, 1338–1344), atropine is closely related to cocaine, as evidenced by their respective decomposition-products *tropidine* and *anhydroecgonine*, the latter being the carboxylic acid of the former. It is converted into *apoatropine*, $C_{17}H_{21}NO_2$, or *anhydro-atropine*, by loss of water, by gradually adding the atropine to fuming nitric acid heated to about 50° C. (122° F.), or by simply keeping atropine sulphate in nitric acid of specific gravity 1.38 at ordinary temperatures for 24 hours, or when atropine sulphate or hyoscyamine sulphate is dissolved in concentrated sulphuric acid in the cold and the solution poured into water. A similar result is obtained by the action of acetic and benzoic acids or phosphoric anhydride upon these two alkaloids at 85° C. (185° F.). Apoatropine and *atropamine*, $C_{17}H_{21}NO_2$, are indentical (Hesse and Merck), and both convertible into the alkaloid *belladonnine*, $C_{17}H_{21}NO_2$, by warming with hydrochloric acid. The researches of W. Will, E. Schmidt, and others, clearly indicate the production of atropine from hyoscyamine during the various stages of the extraction and subsequent treatment of the alkaloid in its commercial preparation from belladonna and other sources. From its isomer hyoscyamine, $C_{17}H_{23}NO_3$, it is distinguished principally by its optical inactivity, and the melting-points of the two alkaloids and their aurochloride.

Since Ladenburg effected the synthesis of atropine from tropine and tropic acid (see above) other *tropeines*, or compound esters, have been produced with various organic acids, among the more important of which are—homatropine, $C_{16}H_{21}NO_3$, *oxytoluyl-tropeine*, crystallizable from absolute ether in prisms, which are difficultly soluble in water but soluble in ether and chloroform, melt at 98° C. (208.4° F.), and produce strong mydriatic

action; benzoyl-tropeine, $C_{15}H_{21}NO_3$, a crystallizable base forming salts similar to atropine, and producing strong mydriatic action; atrolactyl-tropeine, $C_{17}H_{23}NO_3$, a strong base similar in action to atropine; others of pronounced basic properties being salicyl-tropeine, cinnamyl-tropeine, phenyl-acetyl-tropeine, and the oxybenzoyl-tropeines.

Atropine readily forms a periodide ($C_{17}H_{23}NO_3.HI.I_3$) when an aqueous 0.5 per cent. solution of atropine acidulated with hydrochloric acid is added to an aqueous solution containing 1 per cent. of iodine and 1.5 per cent. of potassium iodide, forming a dark-brown to black powder, crystallizable from alcohol in dark-green prisms or leaflets, which lose iodine at 90° C. (194° F.) and melt at 140° C. (284° F.).—Prescott and Gordin.

Tests.—In solutions of 1 part in 2500 of water atropine yields yellow crystalline precipitates with picric acid and auric chloride (oily at first), and brownish amorphous precipitates with iodine in potassium iodide, and bromine in hydrobromic acid, the precipitates becoming crystalline after a time. "On adding sulphuric acid to atropine, no color should be produced (absence of readily carbonizable organic impurities), nor should any color be developed upon the subsequent addition of nitric acid (absence of, and difference from, morphine). Platinic chloride test-solution produces no precipitate (difference from most other alkaloids). Gold chloride test-solution yields a yellow, lustreless precipitate. If a few crystals of atropine be placed in a porcelain dish on a water-bath with a few drops of nitric acid, and heated to dryness, a yellow residue will be produced on cooling; if a few drops of alcoholic potassium hydroxide test-solution and a fragment of potassium hydroxide be added, a permanent violet color is produced; hyoscyamine and hyoscine will produce the same color, but the presence of strychnine masks the reaction. If a crystal of atropine be added to a few drops of sulphuric acid containing 1 drop of creosol a pink color should be produced, which is not dissipated by the addition of 0.5 Gm. of hydrated chloral (distinction from other alkaloids, hyoscyamine producing a brown color, strychnine black, and hyoscine, which remains colorless)."—U. S.

The physiological effect—dilating the pupil of the eye—is a most important test, though not characteristic of atropine and its isomers alone. The test should not be made in concentrations greater than 1 part of the alkaloid in 500 parts of distilled water, 1 or 2 drops of the solution being dropped into the eye and the size of the pupil compared with that of the other eye, of the same individual, not so treated. The character of the precipitate with auric chloride (oily drops changing on crystallizing from hot solution to lusterless yellow crystals melting at 135.5°–138° C.) is quite characteristic, also its behavior with mercuric chloride (Gerard's test), in which 0.1 grain of the free alkaloid is placed on a watch-glass or in a test-tube, and 20 minims of a 2 per cent. solution of mercuric chloride in proof spirit gradually added, producing at once a red coloration. Flückiger's test: a minute quantity of the alkaloid is placed on phenolphthalein paper, which is then wetted with strong alcohol. No color is produced at first, but on allowing the alcohol to evaporate, and then touching the alkaloid with a drop of water, a brilliant red coloration appears. On adding alcohol the color is destroyed, but reappears as the alcohol evaporates. Vitali's reaction for atropine is a most important chemical test, as but few alkaloids simulate the *violet color* produced. A small portion of the alkaloid is treated with a little fuming nitric acid, then heated on a water-bath to dryness (a fragrant odor results); the residue, when cooled, is touched with a drop of solution of potassium hydroxide in absolute alcohol, when in presence of atropine, or its isomers, a *violet color* will appear, slowly changing to a dark-red. Strychnine gives a red and brucine a green color under these conditions, but no fragrant odor is developed by these. Further, if the violet-colored residue be evaporated to dryness and touched a second time with a drop of the potassium hydroxide solution, the color is intensified in the case of atropine, while with strychnine, on drying, the color changes to a reddish-yellow. If the residue after the treatment with nitric acid be moistened with a few drops of solution of ammonia in water, a yellow-colored solution results (orange-red in the case of strychnine), which on further treatment with the alcoholic solution of potassium hydroxide turns a violet color (only transiently violet and quickly passing into a blood-red colored solution in the case of strychnine). Modifications of the Vitali test have been made by dissolving the alkaloid in concentrated sulphuric acid and adding a crystal of sodium nitrite (Arnold) or sodium nitrate (Flückiger), and then adding an alcoholic solution of potassium or sodium hydroxide, and thus obtaining the violet color.

For action and uses, see ATROPINÆ SULPHAS.

ATROPINÆ SULPHAS, *U. S.*, *Br.*—Atropine Sulphate.

Atropinum sulfuricum, P. G.; *Sulfas atropinæ*, Fr. Cod.—*Sulphate of atropia*, E.; *Sulfate d'atropine*, Fr.; *Atropinsulfat, Schwefelsaures Atropin*, G.

Formula, $(C_{17}H_{23}NO_3)_2H_2SO_4$. Molecular weight, 671.43.

A white, indistinctly crystalline powder, without odor, having a bitter, nauseating taste, and permanent in the air.—U. S.

Atropine sulphate, $(C_{17}H_{23}NO_3)_2H_2SO_4$, may be obtained by neutralizing atropine with diluted sulphuric acid.—Br.

White, crystalline masses melting at 180° C. (356° F.), prepared from atropine melting at 115.5° C. (240° F.).—G.

Preparation.—Atropine sulphate may be prepared either by adding atropine slowly to a mixture of sulphuric acid and alcohol or by dissolving atropine mixed with water by means of diluted sulphuric acid. In either case a perfectly neutral solution must be obtained, which is then evaporated to dryness at a temperature below 40° C. (104° F.). Some of the commercial salts show an acid reaction when dissolved in water, and are, therefore, unfit for use.

To crystallize the sulphate, M. Laneau directs that 2.89 parts of atropine be dissolved in 4 parts of absolute alcohol with the application of a gentle heat and the solution *neutralized* by the careful addition of a solution of 4 parts of sulphuric acid (specific gravity 1.85) in 3 parts of absolute alcohol, the mixture being constantly stirred. The neutralized solution is then allowed to evaporate spontaneously.

Properties.—Atropine sulphate occurs as a white crystalline powder or microscopical needles and prisms (the form of the latter being probably due to the hyoscyamine present), having a very bitter, nauseating taste and permanent in the air. It should be tasted with the utmost caution, and only in dilute solution. It is soluble at 25° C. (77° F.) in 0.38 part of water, 3.7 parts of alcohol, 2140 parts of ether, and in 620 parts of chloroform.—U. S. The Br. P. gives the solubility at 15.6° C. (60° F.) as 1 part in 1 of water, or 10 parts of 90 per cent. alcohol, and states that the salt is insoluble in ether and chloroform. Soluble in 1 part of water and in 3 parts of alcohol, forming colorless neutral solutions; almost insoluble in chloroform and in ether.—P. G. The salt melts at about 189.9° C. (373.5° F.); when free from hyoscyamine, it melts at about 188° C. (370.4° F.), U. S.; 183° C. (361.4° F.), Br.; 180° C. (356° F.), P. G.. When ignited it chars, emits acrid vapors, and is very rapidly and completely consumed. Its aqueous solution yields a white precipitate with solution of barium chloride which is insoluble in hydrochloric acid.

Tests.—On adding potassium hydroxide test-solution to a solution of atropine sulphate, a white precipitate is obtained, which should respond to the reactions and tests given under ATROPINE.—U. S. It should dissolve without color in sulphuric and nitric acids. To 0.01 Gm. of atropine sulphate contained in a test-tube and heated until white vapors arise, add 1.5 Cc. of concentrated sulphuric acid and continue the heating until the mass turns brown, and then *cautiously* add 2 Cc. of water. An agreeable, peculiarly aromatic odor will be given off, which on the further addition of a small crystal of potassium permanganate is changed to that of oil of bitter almond. An aqueous solution of atropine sulphate, 1 part in 60 parts of water, yields no precipitate on the addition of solution of ammonium hydroxide, but is precipitated on the addition of solution of potassium or sodium hydroxide.—P. G. A saturated aqueous solution of the salt yields, upon addition of sodium carbonate solution, a white precipitate having the properties of atropine, which see (Br.).

Action and Uses.—A solution of atropine instilled into the eye produces mydriasis by stimulating the radiating muscular fibers and the sympathetic nerve-fibers of the iris, and by paralyzing the peripheral ends of the motor oculi nerve. The action of the ciliary muscle is also suspended and paralysis of accommodation results, during which time physiological rest is maintained. Atropine also increases intraocular tension, but its application does not cause irritation or inflammation. The drug causes dilatation of the pupil in about 15 minutes, and complete paralysis of accommodation in about 2 hours. If 1 drop of a solution containing 4 grains (0.25 Gm.) in 1 ounce (30 Cc.) of water is employed 3 times in 1 day, paralysis of accommodation lasts about 1 week, but if its application is continued until the third or fourth day, the normal function of the

ciliary muscle is not restored before the twelfth or fourteenth day. Because of this fact it lends itself to the control of many congestive conditions resulting from pre-existing eyestrain. It is invaluable in the treatment of retinochoroidal disturbances and in iridochoroiditis. Because of its prolonged action, atropine is the best drug to employ in choroiditis associated with or resulting from ametropia. Synechia arising from iritis or other inflammatory condition of the eye, and possible prolapse of the iris after corneal perforation, may be prevented by its timely application. Its employment permits of a thorough inspection of the eye-ground and the transparent media of the eye, facilitates cataract operations, and makes possible the accurate determination of refractive errors. (For other action and use of atropine, see BELLADONNA.)

The ordinary dose of atropine, internally or hypodermically, is from $\frac{1}{150}$ to $\frac{1}{60}$ of a grain (0.0005–0.001 Gm.), but as much as $\frac{1}{20}$ of a grain (0.003 Gm.) may be employed when the condition justifies it.

OTHER SALTS OF ATROPINE.

Atropinæ Boras. *Atropine borate*, E.; *Atropinborat*, G.—Contains 33.3 per cent. atropine. It is not a definite chemical compound, but simply a mixture prepared by dissolving 1 part of atropine and 2 parts of boric acid in alcohol, evaporating to dryness, and pulverizing the mixture. A white powder soluble in water.

Atropinæ Iodas. *Atropine iodate*, E.; *Atropinjodat, Jodsaures Atropin*, G. $C_{17}H_{23}NO_3.HIO_3$. Molecular weight, 461.58.—Contains about 62 per cent. of atropine. It is prepared by neutralizing atropine, dissolved in alcohol, with its molecular proportion of iodic acid, and then concentrating the solution until it crystallizes on cooling. Colorless needle-shaped crystals soluble in water and alcohol. Generally used in solutions containing 0.5–15 per cent.

Atropinæ Salicylas. *Atropine salicylate*, E.; *Atropinsalicylat, Salicylsaures Atropin*, G. $C_{17}H_{23}NO_3.C_7H_6O_3$. Molecular weight, 424.05.—Contains 67.7 per cent. of atropine. Prepared by dissolving 2.89 parts of atropine in about 10 Cc. of alcohol and neutralizing with the requisite amount (1.38 parts) of salicylic acid, evaporating off the alcohol, and then drying the mass in a drying oven. A white crystalline powder sparingly soluble in water.

Atropinæ Santoninas. *Atropine santoninate*, E.; *Santoninsaures Atropin*, G.—10 parts of atropine and 8.5 parts of santonin are dissolved in dilute alcohol and the solution then evaporated to dryness. A colorless to white crystalline powder soluble in water.

Atropinæ Stearas. *Atropin stearate*, E.; *Atropinstearinat, Stearinsaures Atropin*, G. $C_{17}H_{23}NO_3.C_{18}H_{36}O_2$. Molecular weight, 569.18.—Contains 50.4 per cent. of atropine. Prepared by neutralizing 2.84 parts of stearic acid with a hot 2 per cent. solution of sodium hydroxide, and adding it to 2.89 parts of atropine dissolved in 50 parts of water; the resulting precipitate is collected, washed with water, and recrystallized from alcohol. Thin white glistening needles, fatty to the touch, soluble in oils, and melting at 120° C. (248° F.).

Atropinæ Valerianas. *Atropine valerianate*, E.; *Atropinvalerianat, Baldriansaures Atropin*, G. $C_{17}H_{23}NO_3.C_5H_{10}O_2 + H_2O$. Molecular weight, 406.23.—Contains about 70 per cent. of atropine. 29 parts of dry atropine and 10 parts of anhydrous valerianic acid are intimately mixed and ground in a mortar and then dissolved in 16 parts of absolute alcohol and poured into 110 parts of ether, and the valerianate crystallized at about 0° C. (32° F.). Anhydrous materials must be used throughout, or the valerianate will be recovered simply as a thick, syrupy mass. Atropine valerianate occurs as colorless or white crystalline masses, hygroscopic, softening at about 20° C. (68° F.), melt at 42° C. (107.6° F.), and at higher temperatures rapidly lose valerianic acid. The crystals have the odor of valerianic acid, are soluble in all proportions of water and alcohol, and sparingly soluble in anhydrous ether.

AURANTII AMARI CORTEX, *U. S.*—Bitter-orange Peel.

Cortex Aurantiorum, Cortex Pomorum Aurantii; Aurantii cortex, B. P.; *Seville-orange peel, Wild-orange peel*, E.; *Pomeranzenschale*, G. (*Cortex Fructus Aurantii*, P. G.); *Pericarpium Aurantii, Malicorium Aurantii*, Russ.; *Flavedo Aurantiorum*, Austr.; *Écorce* (*Zeste*) *d' Orange Amere* (*de Curaçao*), Fr.; *Cortex Aurantiorum Curassaviencis*, Belg.; *Corteza de Naranja Agria*, Span.; *Casca de Curaçao, Casca de Laranja Azeda*, Port.; *Corteccia di Arancio Amaro*, It.

The dried rind of the fruit of *Citrus amara* (L.) Lyons (*C. Aurantium amara* L.; *C. Aurantium Bigaradia* (Loisel) Hook. f.; *C. Bigaradia* Loisel; *C. vulgaris* Risso.—Fam. *Rutaceæ*).

Bitter-orange peel is official in all pharmacopœias, some of which require it from the green, others from the ripe fruit. The U. S. description, though not the definition, determines the former. It is here impracticable to employ the fresh rind, as is done in

the case of sweet-orange peel, since the bitter orange is not an article of commerce with us.

Dried sweet-orange peel is frequently used as an adulterant or substitute.

Origin.—The bitter-orange tree closely resembles the sweet, though somewhat smaller. The fruit is large, of irregular, puffy form and a deep-orange color, and with a much rougher, thicker, and more spongy rind. The flesh is both sour and bitter and quite inedible, although much used for preserves. It is often known as "wild orange," but is largely cultivated.

Description.—In narrow, thin bands, or in quarters; epidermis of a dark brownish-green color, glandular, and with more or less of the spongy white inner layer adhering to it; it has a fragrant odor and an aromatic, bitter taste.—U. S.

A special variety, cultivated in Curaçao, and so named, much thinner than the ordinary, is in the market.

Constituents.—For the volatile constituents, see Oleum Aurantii Corticis. The bitter constituents are: (1) *Naringin* (de Vrij's hesperidin or aurantiin ($C_{23}H_{26}O_{12}$?), a very bitter yellowish crystalline glucoside, soluble in alcohol, acetic acid, and 300 parts of water, and insoluble in ether, chloroform, and volatile oils. Heated with dilute acids, it splits into naragenin ($C_{15}H_{12}O_5$) and isodulcit. (2) *Aurantiamarin*, 1.5 to 2.5 per cent., yields an amorphous glucoside, readily soluble in water, to which the bitterness of the peel is chiefly due. (3) *Isohesperidin* ($C_{22}H_{26}O_{12}$), 0.4 to 3 per cent., a slightly bitter glucoside. (4) *Aurantiamaric acid* ($C_{10}H_{12}O_4$), 0.1 per cent., very bitter, green, uncrystallizable and resinous, and soluble in hot water. Other principles are *hesperic acid*, 0.05 per cent., and *hesperidin* ($C_{22}H_{26}O_{12}$), a tasteless glucoside in minute white hygroscopic needles, soluble in acetic acid, alcohol, and 500 parts of hot water, and insoluble in ether, chloroform, or acetone. It turns red-brown with ferric chloride, and with dilute acids yields glucose, isodulcit, and *hesperetin* ($C_{10}H_{16}O_4$), which crystallizes in plates with sweetish taste. Orange-peel contains also gum, albumin, some fixed oil, resin, volatile oil, and a principle resembling tannin in its behavior to iron salts.

Pharmaceutical Preparations.—Fluidextract of Bitter-orange Peel, U. S. P.; Tincture of Bitter-orange Peel, U. S. P.

Action and Uses.—Bitter-orange peel is employed as an aromatic carminative and stomachic. It is rarely used alone, but is generally combined with purgatives to diminish their griping effect, or exhibited in conjunction with the simple bitters to assist in disguising their disagreeable taste. In small amounts it has been employed to relieve nausea and colic, but if administered in overdose may cause both of these conditions. If large quantities are ingested, especially by children, convulsions may occur.

The dose of the fluidextract is from 30 minims to 1 fluidrachm (2–4 Cc.); of the tincture, from 1 to 2 fluidrachms (4–8 Cc.).

Allied Products.—Orange Berries (*Petits grains*, Fr.; *Orangettes, Unreife Pomeranzen*, G.; *Aurantia Immatura, Fructus* [or *Baccæ*] *Aurantii Immaturi*) are the dried unripe fruits. They are globular or ovate-globose, 5 to 15 Mm. ($\frac{1}{5}$ to $\frac{3}{5}$ In.) in diameter, with a basal circular scar surrounded by 8 to 12 smaller depressions, and slight style-remains at the apex, greenish- to brownish-black, densely rugose, 10- to 12-celled, with a central placenta and 2 rows of rudimentary seeds in each cell. Odor, taste, constituents, and uses are similar to those of bitter-orange peel.

Orange Flowers (*Aurantii Flores; Flore naphæ.—Fleurs d'oranger*, Fr.; *Orangenblüthen, Pomeranzenblüthen*, G.; *Azahar*, Sp.; *Aranelo amaro*, F. It.) are the partly expanded flowers of either the sweet or bitter orange, though the official oil (see Oleum Aurantii Florum) is from the latter. They are marketed, pressed into jars with half their weight of common salt.

Fig. 53.

Orange flower (½ Nat.).

Description (Fig. 53).—Calyx small, 5-toothed; corolla white (brownish when dried), of 5 oblong, obtuse, fleshy, glandular-punctate petals about 12 Mm. ($\frac{1}{2}$ In.) long; stamens about 20, basally united into 3 or more bundles; ovary globular, on a small fleshy disk, the style cylindrical and stigma globular; highly odorous, especially the bitter species, taste aromatic and bitterish. Lemon flowers are purplish externally and the odor is distinct.

Orange flowers contain, besides the oil, gum, a little bitter extractive probably similar to that of the peel, and acetic acid.

AURANTII DULCIS CORTEX, *U. S.*—Sweet-orange Peel.

Ecorce (Zeste) d' Orange, Fr.; *Corteza de Naranja Dulce*, Sp.; *Casca de Laranja Doce*, Port.

The undried outer rind of the ripe fruit of *Citrus Aurantium* L. (*Aurantium Olyssiponense* Tourne; *Citrus dulcis* Pers.—Fam. *Rutaceæ*).

Fresh orange peel requires no description. It is only slightly bitter. The dry peel, which is very largely used, contrary to official requirement, closely resembles bitter-orange peel, except in its taste and its orange-yellow color.

The active constituent is an oil almost identical with that of the bitter peel. Other constituents are also similar, but the bitter principle is present in exceedingly small amount.

Pharmaceutical Preparations.—Syrup of Orange, U. S. P.; Tincture of Sweet-orange Peel, U. S. P.

Action and Uses.—Sweet-orange peel is used principally as an aromatic, but may be employed for the same purposes as bitter-orange peel (see Aurantii Amari Cortex). Its preparations are commonly used as vehicles for potent remedies.

The dose of the tincture is from 1 to 4 fluidrachms (4–16 Cc.). The syrup may be given *ad libitum*.

AURI ET SODII CHLORIDUM, *U. S.*—Gold and Sodium Chloride.

Chloraurate de sodium, Chlorure d'or et de sodium, Fr.; *Natriumgoldchlorid*, G.; *Cloruro di oro e di sodio*, F. It., Sp.

A mixture composed of equal parts, by weight, of dry gold chloride and dry sodium chloride, containing not less than 30 per cent. of metallic gold. It should be kept in well-stoppered, amber-colored vials.—U. S.

The official preparation is not the true double salt of the same name, but simply a mixture of the two chlorides. The double chloride of gold and sodium, known also as sodium chloraurate, contains about 76 per cent. of pure auric chloride, whereas the official compound contains but 50 per cent. The exact composition of commercial gold and sodium chloride depends upon the mode of preparation; a simple mechanical mixture made by triturating sodium and gold chlorides together in equal proportions would be in conformity with the official definition.

A solution of metallic gold in a mixture of nitric and hydrochloric acids contains chlorauric acid, according to the equation: $Au_2 + 2HNO_3 + 8HCl = 2HAuCl_4$ or $2(AuCl_3 + HCl) + 2NO + 4H_2O$; and by adding sodium chloride to such a solution the double salt, sodium chloroaurate, is obtained upon evaporation; thus, $HAuCl_4 + NaCl = NaAuCl_4$ or $(AuCl_3 + NaCl) + HCl$. For the formation of this compound 5.187 parts of auric chloride require 1 part of sodium chloride.

Properties.—This preparation is an orange-yellow powder slightly deliquescent in damp air, odorless, and having a saline and metallic taste. The compound is very soluble in water; at least one-half of it should be dissolved by cold alcohol. When exposed to a red heat, it is decomposed and metallic gold is separated. A fragment of the compound imparts an intense, persistent yellow color to a non-luminous flame. Its aqueous solution has a slightly acid reaction, and yields with test-solution of silver nitrate a white precipitate insoluble in nitric acid.—U. S.

The French Codex orders the crystallized double salt, $NaCl.AuCl_3,2H_2O$ (molecular weight, 395.06), to be prepared by dissolving the auric chloride prepared from 10 parts of gold in sufficient distilled water, adding 3 parts of sodium chloride, and evaporating to crystallization. It forms orange-colored rhombic prisms or plates which are soluble in water and alcohol, not deliquescent, fusible, and at a red heat are gradually decomposed, 49.4 per cent. of metallic gold being separated. It is known in France as *sel de Chrestien* and *sel de Figuier*.

Tests.—On bringing a glass rod which has been dipped into ammonia water close to a portion of the compound, no white fumes should appear (absence of free acid). If 0.5 Gm. of gold and sodium chloride be dissolved, in a porcelain capsule, in 25 Cc. of water, the solution made alkaline by the addition of 5 Cc. of potassium hydroxide test-solution, and, after the addition of 5 Cc. of hydrogen dioxide solution, heated for 1 hour on a boiling water-bath, a precipitate of metallic gold will be obtained, which,

when washed, dried, and ignited, should weigh not less than 0.15 Gm. (corresponding to at least 30 per cent. of metallic gold). The filtrate from the precipitated gold should not be affected by hydrogen sulphide test-solution, nor, after being supersaturated with ammonia-water, by ammonium sulphide test-solution (absence of metallic impurities).—U. S.

Action and Uses.—Gold when used in medicine is almost always employed as chloride of gold and sodium. Gold and sodium chloride is said to possess alterative properties, but its action upon the system is unknown. Formerly it was employed in the treatment of hysteria, hypochondriasis, dysmenorrhœa, laryngismus stridulus, asthma, ovarian neuralgia, and chronic metritis. It was also thought to be beneficial in the treatment of tabes dorsalis, cirrhosis of the liver, and chronic interstitial nephritis, on the ground that it materially decreases the amount of connective tissue in the parts, but clinical experience has not justified this claim. This salt has been recommended as a valuable adjunct to mercury in the treatment of the later syphilitic manifestations, but in these conditions its value has probably been overestimated. It is said to be the preparation employed by quacks in the treatment of the alcohol habit, but it has no specific action upon the condition, and the tonics and stimulants given with it, combined with a good regimen, are probably of much more value. Its employment in pulmonary tuberculosis is also without benefit. Gold and sodium chloride acts as a stimulant to the nervous system, and has been used with asserted success in sexual impotence.

Gold and sodium chloride is given in the dose of $\frac{1}{20}$ grain (0.003 Gm.), in pill-form, 3 times daily; it has been mixed with inert powder and applied by friction to the sides of the tongue.

AURUM.—Gold.

Or, Fr.; *Gold*, G.; *Oro*, F. It., Sp.

Symbol, Au. Atomicity univalent and trivalent. Atomic weight, 195.7.

Origin and Properties.—This well-known metal is chiefly found in the metallic state, always associated with other metals and frequently in various native sulphides. It is the most precious of all metals, and the only one with a yellow color. It is the most ductile of all metals, softer than silver, fuses at about 1070° C. (1958° F.), has the density 19.3 and a metallic luster, but when powdered, a brown color, acquiring luster by pressure. It is not altered by exposure to air and water, and does not dissolve in acids, but is soluble in liquids containing or generating chlorine. Gold is extracted from its ores chiefly by two methods, known as the *cyanide* and the *chlorination* processes. In the former, the finely divided gold in the powdered ore is dissolved out by a solution of potassium cyanide, from which it is precipitated by zinc or deposited electrolytically on lead plates. Since the introduction of this method in the Transvaal, the output of gold has been increased by about half. In the chlorination process, the roasted ore is treated with chlorine water, which converts gold into its chloride, which is precipitated from the solution by reducing agents, such as ferrous sulphate, or by passing through long columns of wood-charcoal, which precipitates the gold upon itself. Besides these two processes, gold is also extracted by the *amalgamation* process, which consists in dissolving out the gold by mercury to form an amalgam, from which the mercury is finally distilled, leaving the gold. The world's production of gold and silver averaged in tons of 2200 pounds:

	Gold.	Silver.
1881–1890	160	3080
1891–1895	235	4730
1896–1898	400	5000

On account of its softness, pure gold is unsuitable for coins, apparatus, etc., and is therefore alloyed with copper or silver, or both. The purity of gold is designated by the word "carat." Pure gold is 24 carat. 14 carat means 14 parts of pure gold and 10 parts of other metal. The purity is also expressed in percentage or milligrams of pure gold in 1 Gm. of alloy. Thus, the purity of 14-carat gold is 58.33 per cent., or 0.5833.

AURUM FOLIATUM, *gold-leaf*, is transparent, with blue or green color; it should not be attacked by nitric acid nor become tarnished by ammonia.

AURI PULVIS, *powdered gold*, may be prepared by triturating gold-leaf with crystals of milk-sugar, potassium sulphate, or other hard soluble substance, until the metallic

lustre has completely disappeared, when the compound is washed out with water (obsolete). A solution of gold chloride yields the metal in a finely divided condition when added to solution of ferrous sulphate, oxalic acid, or other oxidizable compound. Aurum colloidale, colloidal or soluble gold, like silver, may be obtained by reducing a weakly alkaline solution of gold with formaldehyde, and purifying it from other substances by dialysis.

UNOFFICIAL GOLD SALTS.

Auri et Ammonii Chloridum.—*Gold-ammonium chloride.*—Equal parts of auric chloride and ammonium chloride are dissolved in water, acidulated with hydrochloric acid, and the solution evaporated to dryness (Dorvault). It resembles the preceding.

Auri Bromidum.—*Gold bromide.* $AuBr_3$.—Formed by bringing together under water finely divided gold and bromine in equivalent quantities and evaporating to dryness. It is dark-brown, soluble in water, alcohol, and ether.

Auri Chloridum.—*Gold chloride or Auric chloride.* $AuCl_3$.—On dissolving pure gold in nitromuriatic acid and crystallizing, yellow *hydrogen-gold chloride*, $AuHCl_4.4H_2O$, is obtained, which in a dry atmosphere loses $1H_2O$ (Julius Thomsen, 1878, 1883). But on evaporating the solution to dryness, dissolving in water, filtering from aurous chloride, AuCl, and again evaporating, auric chloride is obtained as a dark-red or red-brown salt. It is decomposed above 150° C. (302° F.), dissolves readily in water, and is also soluble in alcohol, ether, and volatile oils, which solutions are gradually reduced. Its solution yields with stannous chloride a dark-brown or purple precipitate known as *purple of Cassius*, which consists of a mixture of colloidal gold and colloidal stannic acid in varying amounts, and finds application in porcelain- and glass-painting.

Auri Cyanidum.—*Gold cyanide.*—Prepared best, according to Figuier (1874), by dissolving pure auric chloride in water, and adding a solution of an equivalent weight of pure potassium cyanide, when a lemon-yellow precipitate will be obtained; a larger quantity of the latter solution would change the color to brownish- or orange-yellow. It is inodorous and tasteless, and contains 75 per cent. of gold. With an excess of potassium cyanide, used in a concentrated hot solution, *auro-potassium cyanide*, containing 55 per cent. of gold, is obtained in colorless tabular crystals, which on exposure become white from loss of water of crystallization.

Auri Iodidum.—*Gold iodide.* AuI_3.—Obtained by precipitating a solution of auric chloride with potassium iodide, avoiding an excess of the latter, washing with water, and drying carefully. It is a dark-green powder, which is soluble in solution of potassium iodide, and on exposure loses iodine, being first converted into yellow *aurous iodide*, AuI, and finally into metallic gold.

Auri Oxidum.—*Auric acid, Gold hydroxide.* $Au(OH)_3$.—Pelletier directs the boiling of a solution of auric chloride with an excess of magnesia or zinc oxide, collecting the precipitate upon a filter, and washing it first with dilute nitric acid (which must be free from chlorine), and afterward with water. Frémy (1850) adds to auric chloride sufficient solution of potassium hydroxide until the precipitate is redissolved; the solution is boiled for 15 minutes, or until its dark-brown color has changed to light-yellow, when it is acidulated with sulphuric acid and the precipitate washed and dried; it retains a trace of potassium. Gold hydroxide is a blackish-brown powder which is readily soluble in hydrochloric and hydrobromic acids, and when heated to 245° C. (473° F.) or boiled with alcohol yields metallic gold. It dissolves in alkalies to form metaurates; for example, $KAuO_2$, a salt of metauric acid, $HAuO_2$.

Action and Uses.—All of the salts of gold are irritant poisons, and when ingested in poisonous dose cause gastro-intestinal inflammation with violent pain, vomiting, and purging. The chloride especially acts in this way, as it possesses the properties of a caustic, resembling in its action silver nitrate. Gold chloride has been locally applied to cancerous and other chronic ulcers, but the cost of the drug prevents its general use in medicine. The oxide is said to be an alterative, and may be given internally in scrofulous conditions in the dose of $\frac{1}{10}$ grain (0.006 Gm.), or gradually increasing doses may be rubbed into the gums or the sides of the tongue with friction. The cyanide has been found useful in syphilis and scrofulosis but is rarely employed at the present time. It may be given internally in the dose of $\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003–0.006 Gm.), or diluted with some inert powder and rubbed into the sides of the tongue. Gold ammonium chloride is said to be of use in the treatment of amenorrhœa, dysmenorrhœa, and ovarian neuralgia. The dose is $\frac{1}{10}$ grain (0.006 Gm.). The iodide has been recommended in syphilitic affections in doses of $\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003–0.006 Gm.). Gold bromide depresses the motor areas of the cortex and has been successfully employed in the treatment of epilepsy. Its action is said to be more prolonged than that of any other bromide, and its continued use does not cause bromism probably because in the small doses in which it is used it carries very little bromine into the body. It has also been recommended in chorea, hysteria, migraine, and exophthalmic goitre. The dose commonly given is from $\frac{1}{5}$ to $\frac{1}{2}$ grain (0.010–0.03 Gm.), 3 times daily.

AZEDARACH.—China Tree; Pride of China.

Indian or African lilac or Lilac-tree, Bead-tree, False sycamore, Hoop-tree, E.; *Zedrachrinde,* G.; *Écorce d'azedarach, Écorce de margousier,* Fr.; *Flor de Paris,* Sp.

The dried bark of the root of *Melia Azedarach* L. (Fam. *Meliaceæ*).

Origin.—From a handsome, rapidly growing tree, resembling a very large apple tree, native of southeastern Asia, extensively cultivated in tropical and warm-temperate regions, and naturalized along our Gulf coast. It blooms profusely, the handsome and fragrant panicles resembling those of the common lilac, and bears spherical fruits about 12.7 Mm. ($\frac{1}{2}$ In.) in diameter, the solitary large seed loosely enclosed in a fleshy pericarp. Besides their medicinal use, these fruits have been fermented for the production of alcohol. They are very bitter, this taste pertaining also to the fixed oil expressed from them, and are employed as an anthelmintic, antiperiodic, and locally as an antirheumatic. A poultice of the flowers is reported as being parasiticide and sedative.

Fig. 54.

Azedarach root-bark, with outer bark present (Nat.).

Description.—In quills, strips, or curved pieces of irregular size, externally blackish-brown and glossy if young, this layer present in the older bark only in patches upon the reddish- or rusty-brown lower layer, or completely giving place to the latter, which varies greatly in relative thickness; inner bark white, containing few scattered pale-yellow bast-fibers, and tangentially striate. Inner surface pale-brown or whitish, uneven, and longitudinally striate; fracture short and smooth in the outer, slightly fibrous in the inner layer; taste slight in the outer, sweetish, then bitter and nauseous in the inner layer. It is the inner bark only which should be employed.

Composition.—Tannin exists in the outer, but not in the inner bark. There is a little sugar. The bitter and medicinally active constituent is believed to be a yellowish-white resinous body, freely soluble in alcohol, ether, and chloroform, somewhat soluble in hot, but scarcely in cold water, but it is more likely some body associated with, and not yet isolated from this resinous substance.

Action and Uses.—The bark of *M. Azedarach,* in the form of a decoction, is employed as an anthelmintic for the removal of the round worm. The decoction is made by boiling 2 ounces (60 Gm.) of the drug in a quart (960 Cc.) of water, until only 1 pint (480 Cc.) remains. This is given in the dose of $\frac{1}{2}$ to 1 fluidounce (16–30 Cc.) every 2 hours until the bowels move.

In overdose the bark produces symptoms similar to those caused by spigelia and belladonna (see Belladonna-poisoning).

The fruit does not appear to possess the toxic properties characteristic of the bark, as they are frequently eaten by children and birds without ill effect.

The entire plant of *M. Azedarach* is employed in medicine as a tonic and antiperiodic, and the bark and leaves are official in the pharmacopœia of India. An oil expressed from the seeds has been recommended as an embrocation in chronic rheumatism.

M. AZADIRACHTA L., the *Nim* or *Nimb*, also called *Indian lilac*, is a similar tree of India, its medicinal use much greater there than is that of the preceding. All parts of the tree are employed, as well as an oil expressed from the seeds and a gum which exudes from the bark. Like the preceding, it is anthelmintic throughout, the bark being most largely used. It is externally rusty-gray and roughly fissured, yellowish on the inner surface, and has a fracture similar to that above described. The inner bark is bitter, the outer astringent. The bitter principle of the inner bark appears to be a neutral resin, or is perhaps contained in this resin.

The oil expressed from the seed is in commerce under the name of *Nim*, *Neem*, or *Margosa oil*, and is of a yellowish color and a strong, garlicky odor. It is very bitter. Thoroughly washed with alcohol, it loses to a great extent its odor and taste. (For complete description, see *Phar'g'a Ind.*, 1, 327.)

Decoctum Azadirachtæ, as a tonic, is administered in the dose of 1 fluidounce (30 Cc.), 3 times daily; as an antiperiodic, it is given every 2 hours before the expected paroxysm.

Tinctura Azadirachtæ is given in the dose of 1 to 2 fluidrachms (4–8 Cc.).

M. dubia Cav., the *Dinkarling* or *Nimbara*, is another Indian species, which is apparently very similar in its properties.

B.

BALSAMUM PERUVIANUM, *U. S., Br., P. G.*—Balsam of Peru.

Balsamum peruvianum nigrum, Balsamum indicum. Peru Balsam, Indischer Balsam, G.; *Baume du Pérou, Baume des Indes, Baume de Sansonate,* Fr.; *Balsamo negro, Balsamo de San Salvador,* Sp.; *Balsamo peruviano,* F. It.

A balsam obtained from *Toluifera Pereiræ* (Royle) Baill. (*Myrospermum P.* Royle; *Myroxylon P.* Klotzsch.—Fam. *Leguminosæ*).

Official in all pharmacopœias, some of which use one or another of the synonyms, instead of the generic name, published by Linné.

Origin.—From a handsome tree, yielding a precious mahogany-like wood. It is similar to, but somewhat smaller than, that yielding Tolu balsam. It grows in and near San Salvador, the country of exportation, chiefly at an altitude of from 1000 to 2000 feet. The balsam derived its misleading name from a supposition that it came form the *T. peruifera* (L. f.) Baill. (*Myroxylon P.* L. f.; *Myrospermum P.* DC.), of Peru, but that is now known to be quite distinct and inferior. The error is said to be due to its having been sent first to Callao and thence exported. The natives are said to recognize two varieties of the tree, distinguished chiefly by their bark-thickness, but this distinction does not extend to the balsam. Besides the commercial balsam, a small amount of a somewhat different substance, having the odor of vanilla, is collected from the fruit-cavity surrounding the seed. This, all consumed at home, is more highly esteemed than the commercial. A fragrant oil is yielded by the leaves. The tree is occasionally cultivated.

Collection.—When the tree is about 10 years old and the trunk about 0.34 M. (1 foot) in diameter, tapping commences. No balsam is found in the trunk or its bark except as the result of injury, though a non-aromatic gum-resin sometimes exudes. It is said that so long as an open wound exists in the bark a slight flow of balsam will continue. For the production of the balsam for collection, according to P. Preuss, the bark, down to the inner layer, is torn off in strips, and rags are bound upon the denuded surface to soak up the exudation, which appears in about a week, and is known as *tagauzonte*. The saturated cloths are removed and the bare surface is heated for about 5 minutes by a burning torch. The balsam is boiled out of the rags in water and collected from the bottom, where it sinks. About 8 days later a new flow, called *Balsam de trapo*, meaning *rag balsam*, commences, and is soaked up as before, and this process is continued so long as the flow lasts. The exposed parts are then deeply cut and scraped, to cause the occurrence of a third supply, called *Balsamo de contrapique*, meaning *balsam of the repeated wounding*. Sometimes an additional flow can afterward be caused by a second heating. If the process is carefully conducted, the lower wounds will heal while fresh ones are being worked above. After this, the loose bark and wood are ground up and extracted, and the extract added to the other collected portions. Some commercial balsam is wholly the product of bark-extraction. The annual yield is 3 to 5 pounds per tree, mostly between December and April, although some is obtained during the whole of the intervening period. There is a process of purification to remove foreign bodies, and then the balsam is packed in canisters with screw tops, of about 60 pounds capacity. Dieterich secured some perfectly pure balsam, specially collected for him, and found it much superior in appearance and odor to any sample of the commercial article. It yielded 77 per cent. of aromatic substances and only 13 per cent. of resins; whereas the commercial article, of the best quality, never yields more than 65 to 75 per cent. of aromatic substances. This would seem to indicate that adulteration is very generally resorted to. The chief adulterant, introduced by the native collectors, is water. The importations to the United States in 1899 amounted to about 4500 pounds. The greatest amount imported in one year was something over 10,000 pounds, in 1891.

Properties.—Balsam of Peru is a viscid liquid of a dark-brown color; free from stringiness or stickiness; transparent and reddish brown in thin layers; of an agreeable vanilla-like odor and a bitter, acrid taste, with a persistent after-taste. When swallowed,

it leaves a burning sensation in the throat. It does not harden on exposure to the air. It has a specific gravity of 1.130 to 1.140 at 25° C. (77° F.) (U. S.), or 1.137 to 1.150 (Br.), 1.140 to 1.150 (P. G.) at 15° C. (59° F.). Completely soluble in absolute alcohol, chloroform, and glacial acetic acid, only partially soluble in ether and petroleum benzin, soluble in 5 parts of alcohol, with not more than a slight opalescence (U. S.). Soluble in an equal volume of 90 per cent. alcohol, but on further addition of 2 more volumes of the alcohol, the mixture becomes turbid (Br.). Water, when agitated with the balsam, shows an acid reaction to blue litmus-paper.

Adulterants.—Balsam of Peru is frequently adulterated with alcohol, fixed oils, copaiba, Gurjun balsam, Canada turpentine, rosin, storax, benzoin, etc. If 10 drops of the balsam be triturated with 20 drops of sulphuric acid, a tough, homogeneous, brownish-red mixture should result, which, when washed with cold water, should develop a violet color upon its surface, and when drained be converted into a resinous mass which is brittle when cold (absence of fixed oils and oleoresins).—U. S., P. G. This resin should be perfectly soluble in ether (absence of benzoin), and in alcohol or acetone (absence of storax). "If 1 Gm. of the balsam be shaken with 5 Cc. of petroleum benzin, and the mixture warmed on a water-bath for 10 minutes, and a sufficient quantity of the solvent added to replace loss by evaporation, then if 2 Cc. of the benzin solution be evaporated, and treated with a drop of nitric acid (specific gravity 1.42), a permanent green or bluish-green color should not be produced (absence of rosin). The remaining 3 Cc. of the benzin solution, when shaken with an equal volume of an aqueous solution of copper acetate (1 in 1000), should not be colored green or bluish green (absence of rosin, turpentine, storax, fatty oils, etc.). On mixing the balsam with half its volume of calcium hydroxide and heating for ½ hour on a water-bath, a solid mass should not be formed (absence of rosin, storax, or copaiba). If 1 Gm. of the balsam be dissolved in 100 Cc. of alcohol and 1 Cc. of phenolphthalein test-solution be added, not more than 2 Cc. of half-normal alcoholic potassium hydroxide solution should be required to produce a pink color (limit of acid resins). Mix 3 Gm. of the balsam with 30 Cc. of sodium hydroxide test-solution and shake the mixture for a few minutes with 60 Gm. of ether. Transfer 51.1 Gm. of the ether-solution to a flask and evaporate to dryness. The residue, when dried to constant weight by a gentle heat, should weigh not less than 1.4 Gm. (presence of at least 56 per cent. of cinnamein). If this residue be dissolved in 25 Cc. of alcohol, then mixed with 25 Cc. of half-normal alcoholic potassium hydroxide solution, and heated carefully during ½ hour on a water-bath, it should require not more than 13.2 Cc. of half-normal hydrochloric acid to exactly neutralize the liquid, 1 Cc. of phenolphthalein test-solution being used as indicator."—U. S. "Balsam of Peru should not diminish in volume when shaken with an equal bulk of water (absence of ethyl alcohol). About 40 per cent. of resin should separate when 1 part of the balsam is treated with 3 parts of carbon disulphide, and the clear supernatant liquid should be of a pale-brown color with only a slight fluorescence (absence of Gurjun balsam)."—Br.

Constituents.—The balsam consists (Trog, 1894) of 60 to 64 per cent. of *benzyl benzoate* ($C_7H_5.C_7H_7.O_2$), a colorless oil boiling at 340° C. (644° F.), free vanillin, free cinnamic acid, a small portion of benzyl cinnamate, and 30 to 38 per cent. of resin composed of benzoic and cinnamic esters of peru-resinotannol. Kraut's *stilbene* ($C_{14}H_{12}$), in colorless and odorless pearly scales or prisms, has not been found by others. Trog found no styracin, free benzyl alcohol, free benzoic acid, or phenylpropyl cinnamate. Benzyl cinnamate ($C_9H_7.C_7H_7.O_2$), considered by Kraut the main constituent, is a colorless oily liquid, with faint agreeable odor and an aromatic sharp taste. It boils at 300° C. (572° F.), its specific gravity is 1.095, and by caustic alkalies it is decomposed into benzyl alcohol and cinnamic acid.

Cinnamein or Peru Balsam Oil, the oily liquid separated by agitation with sodium or potassium hydroxide, contains benzyl benzoate, benzyl cinnamate, benzyl alcohol (C_7H_7CH), and other aromatic compounds.

Action and Uses.—Balsam of Peru is not largely employed in internal medicine in this country. It is a stimulant to the mucous membranes, especially the bronchial, and may be employed in all chronic affections of the respiratory tract, such as chronic laryngitis, chronic bronchitis, asthma, and tuberculosis. Its employment in the latter affection is not attended with any benefit, however, other than moderation of the cough. Chronic rheumatism, diarrhœa and dysentery, leucorrhœa, and the later stages of gonorrhœa are said to be benefited by its use. Balsam of Peru is employed locally as an

application to indolent, suppurating ulcers, chronic nasal catarrh, and tubercular caries. Applied either pure or in the form of an ointment or liniment, it is said to be of value in the treatment of scabies, chronic eczema, and pruritus ani et vulvæ. It has also been used as a cure for fissured nipples and chilblains.

The internal dose is 5 to 15 grains (0.30–1 Gm.); or it may be employed by inhaling steam saturated with its volatile products.

Hofmann's balsam is given in the dose of 10 to 30 minims (0.60–2 Cc.).

Artificial Balsam of Peru.—Hager recommends the following substitute, for use in veterinary practice: Benzoin, 100 parts; pitch, 15; salicylic acid, 10; Gurjun balsam, 40; alcohol, 500. Dissolve, strain, and evaporate to the consistency of honey.

BALSAMUM TOLUTANUM, *U. S., Br., P. G.*—Balsam of Tolu.

Tolubalsam, G.; *Baume de Tolu, Baume de Carthagène*, Fr.; *Balsame de Tolu, B. Blanco*, Sp.; *Balsamo Tolutano*, F. It.; *Balsamum Americanum, B. Indicum Siccum.*

A balsam obtained from *Toluifera Balsamum* L. (*Myroxylon toluiferum* Kunth; *Myrospermum t.* A. Rich.—Fam. *Leguminosæ*).

Official in all pharmacopœias, some of which use one or other of the botanical synonyms instead of the original name published by Linné.

Origin.—From a handsome tall evergreen tree of the highlands of Venezuela and Colombia. The balsam occurs as a natural product only in the young tissues (leaves and bark of young twigs), where it exists in schizogenous cavities. This tissue is soon lost, by the falling of the leaves and by a process of bark-casting from the twigs, and does not reappear in the bark except as a result of injury, such as the incisions made in the trunk-bark to obtain it. It is therefore to be regarded as a probable method of defence by the plant against decay from wounding—that is, a process of natural antisepsis.

Collection.—Two sloping notches are cut through the bark, meeting at their lower ends in a sharp angle, below which the bark and wood are hollowed out a little to receive the calabash cup into which the balsam flows. Similar cuts are made as high up as a man can reach, or even higher by the aid of scaffolding. Often as many as 20 cups are found on one tree. Excessive collection is indicated by the appearance of very small and thin leaves. The balsam-gatherer collects the contents of the cups in flask-shaped bags made of raw-hide, a pair of them being slung over the back of a donkey. When filled, these bags are sent to the ports of exportation on the Magdalena River, where their contents are transferred to the cylindrical tins which arrive here, holding 10 or sometimes 25 pounds. During 1900, more than 50,000 pounds were imported into the United States. The largest importation, nearly 65,000 pounds, was in 1898.

Description.—Recently imported, Tolu balsam forms a semiliquid mass which gradually hardens, becoming quite brittle in the cold, but softening between the teeth and fusing readily at a somewhat elevated temperature. In thin layers, it is perfectly transparent and of a yellowish- or reddish-brown color. Viewed under the microscope, abundant crystals of cinnamic acid are observed. It has an acid reaction, an agreeable aromatic odor, suggesting that of vanilla, which becomes more apparent on warming it, and a mild aromatic taste. It is readily soluble in alcohol, chloroform, potassium hydroxide solution, and acetone; also in ether. Benzene and petroleum benzin scarcely act upon it, and carbon disulphide dissolves about 25 per cent.

Dissolved in the smallest quantity of potassium hydroxide solution, it acquires a clove-pink odor. By warming 1 Gm. with 5 Cc., then with 2 Cc. of carbon disulphide and evaporating to dryness, the residue should be distinctly crystalline, and should require not less than one-third of its weight of potassium hydroxide for saponification.

Constituents.—The balsam yields 7 per cent. of an acid, aromatic, oily liquid, chiefly benzyl benzoate, with a little benzyl cinnamate; 0.05 per cent. of vanillin; 0.2 to 1 per cent. of volatile oil, chiefly tolene ($C_{10}H_{16}$); 18 to 20 per cent. of free cinnamic acid, which may be obtained by distillation; and 75 to 80 per cent. of resin ($C_{18}H_{20}O_5$). This resin is a combination of tolu-resinotannol with cinnamic and a small proportion (about 1 or 1.5 per cent.) of benzoic acid. Part of this resin is soluble in carbon disulphide, on evaporating which, the residue should be crystalline and almost colorless, should be in the neighborhood of 25 per cent. of the balsam, and should have an acid number (*Braithwaite*) of not less than 300. The volatile oil rapidly hardens from oxidation on exposure to air. The balsam contains no styracin, is free from benzyl alcohol or phenyl-

propyl-cinnamate, and on dry distillation, besides its volatile constituents, it yields toluol (C_7H_8), styrol, and phenol.

Adulteration and Substitution.—These operations have been extensively practised. Common rosin, the resin of copaiba, storax, and various unknown resinous substances, have been used, either for adulteration or for entire substitution, so that careful attention to the description and tests is a necessity. In this connection, special emphasis is laid upon the abundance of crystals, as viewed under the microscope, upon the presence of about 20 per cent. of cinnamic acid, and upon the amount and character of the CS_2—soluble residue. The presence of turpentine, one of the commonest adulterants, is indicated by the blackish, instead of cherry-red, color imparted by treatment with concentrated sulphuric acid. Another practice sometimes resorted to is that of exhausting the Tolu by making the syrup from it, and then selling the resulting product as genuine. In such samples the percentage of cinnamic acid is found to be greatly reduced.

The U. S. P. prescribes the following tests: If 0.5 Gm. of the balsam be shaken with 25 Cc. of carbon disulphide and allowed to stand for 30 minutes, and then filtered, the residue obtained by evaporating the filtrate to dryness, when dissolved in glacial acetic acid, should not yield a green color on the addition of a few drops of sulphuric acid (absence of rosin). If 1 Gm. of balsam be shaken with 8 Cc. of petroleum benzin for 5 minutes, the supernatant liquid should not be colored green when shaken with an equal volume of copper acetate solution—1 in 1000—(absence of rosin and copaiba). If to 1 Gm. of balsam dissolved in 50 Cc. of alcohol, 1 Cc. of phenolphthalein test-solution be added, not less than 4 Cc. nor more than 6 Cc. of half-normal alcoholic potassium hydroxide solution should be required to produce a red color (limit of acidity); next add to this liquid more half-normal alcoholic potassium hydroxide solution until the total amount has reached exactly 20 Cc.; then heat the liquid in a water-bath for half an hour and allow it to cool. Not less than 13.2 Cc. nor more than 14.5 Cc. of half-normal sulphuric acid solution should be required to neutralize the excess of potassium hydroxide solution, phenolphthalein being used as indicator (limit of saponifiable substances).

Pharmaceutical Preparation.—Syrup of Tolu, U. S. P.

Action and Uses.—Balsam of tolu is a stimulating expectorant, and may be used in the treatment of subacute and chronic inflammations of the respiratory tract. Its agreeable odor renders it a valuable addition to many expectorant mixtures and lozenges, and the syrup prepared from it is frequently employed as a basis for cough mixtures. The inhalation of steam laden with the volatile portion of the drug is frequently beneficial in the treatment of acute laryngitis with aphonia and obstinate bronchitis.

It is best administered in the form of an emulsion prepared with acacia and sugar, in doses of 10 to 30 grains (0.60–2 Gm.).

Other Species.—The number of species in this genus has been variously estimated at from 2 to 6. They are poorly known, and it cannot at present be stated with certainty whether some of the published names are synonymous. The *Quino-quino* tree of Peru may be the same as the above or a distinct species, *T. punctatum* (Klotzsch) Baill.

BAPTISIA.—Wild Indigo.

American or Yellow indigo, Indigo broom or weed, Rattlebush, E.; *Pferdfliegenstrauch, Baptisie, Wilder Indigo,* G.; *Indigo Sauvage,* Fr.

The root of *Baptisia tinctoria* (L.) Br. (*Sophora t.* L.; *Podolyria t.* Mx.). The herbage has also been similarly used.

Origin.—This showy perennial smooth herb is abundant in dry sandy or gravelly soil, especially on the edges of forests or amid shrubbery, throughout eastern and central North America. It forms a dense, rounded mass, nearly 1 M. (2 or 3 Ft.) high and broad, of slender, erect, leafy branches and branchlets, covered with bright-yellow flowers. Leaf- and flower-habit are here illustrated (Fig. 57).

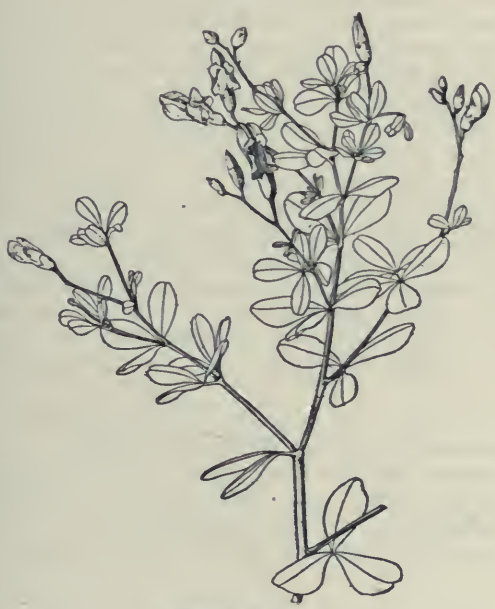
Description.—Crown, 5 to 7 Cm. (2 to 3 In.) thick, knotty, bearing several stem-scars; root terete, fleshy, quickly dividing into several cylindrical branches, often 60 Cm. (2 Ft.) or more in length and 1.2 Cm. (0.5 In.) or more thick, and sparsely beset with branching rootlets; externally dark-brown, with small warts arranged in transverse rows, or with a soft and friable corky layer; internally whitish, radially striate, thick and fleshy, covering a whitish, tough, porous wood with indistinct medullary rays; odor slight; taste of the bark bitterish, acrid, and nauseous, the wood nearly tasteless.

Constituents.—Besides resin and ordinary plant-constituents, Baptisia has been found to contain cytisine (*baptitoxine*) and one or two glucosides. *Baptisin* ($C_{26}H_{32}O_{14} + 9H_2O$, *Gorter*) is somewhat soluble in water and dilute alcohol, and melts at 240° C. (464° F.). It does not appear to be active. It yields *baptigenin*. *Baptin* occurs in needle-shaped crystals and is purgative.

Action and Uses.—Baptisia is said to be a violent emeto-cathartic, and an hepatic and intestinal stimulant. Moderate amounts increase the respiratory function and reflex activity, but poisonous doses produce death by respiratory paralysis. Internally, baptisia has been recommended in the treatment of typhus and scarlet fevers, and in epidemic dysentery. The drug has also been employed as a nervous stimulant and antipyretic in enteric fever, but its power in this condition has probably been overestimated. The decoction has been employed both internally and as a topical application in the treatment of aphthous stomatitis, chronic ulcers, and gangrene, but more potent remedies are commonly used in these conditions.

The tincture is given in the dose of from 1 to 5 minims (0.05–0.30 Cc.); the decoction, made by boiling 1 ounce (30 Gm.) of the drug with 1 pint (480 Cc.) of water, is usually given in doses of ½ fluidounce (15 Cc.) every 4 hours, and may be combined with tincture of opium to prevent vomiting. The dose of baptisin is from 2 to 5 grains (0.10–0.30 Gm.).

FIG. 55.



Baptisia (¾ Nat.).

B. alba R. Br., of the southern United States, is said to act and to be used similarly. Probably others of the 14 species, all of North America, have like properties.

BARIUM.—Barium.

Baryum, Fr., G.

Symbol, Ba. Atomicity bivalent. Molecular weight, 136.4.

Barium occurs in combination principally in two minerals, heavy spar, $BaSO_4$, and witherite, $BaCO_3$. It is also found to a small extent in some manganese ores and some silicates. An amalgam of barium was obtained by Berzelius and Pontin in 1808, and in the same year Davy isolated the metal by distilling the mercury from the amalgam. The latter is obtained by adding sodium amalgam to a hot saturated solution of barium chloride at 93° C. (199.4° F.), and kneading the barium amalgam formed in cold water to remove sodium.

Properties.—Barium is a lustrous, light-yellow metal of the specific gravity 3.6, and is rapidly oxidized on exposure to air. It acts energetically on water, liberating

hydrogen and forming barium hydroxide, $Ba(OH)_2$, also called *baryta*, which has strong alkaline properties similar to those of caustic soda, NaOH. Barium belongs to the group of elements known as *alkaline earth* metals, which consists of calcium, strontium, and barium. The name indicates the fact that the members of the group have properties which resemble those of the alkali metals as well as those of the earth metals. All soluble barium compounds are very poisonous. The proper antidote is a sulphate, for example, Glauber's or Epsom Salt, which forms the insoluble barium sulphate.

Action and Uses.—As barium chloride is the representative salt of barium, its uses will be considered here. When moderate doses of barium chloride are administered, the rapidity of the heart's action is decreased, its rhythm is steadied, a greater quantity of blood is forced out of the ventricle, and arterial tension is increased. The pulse beats more slowly and the pulse-wave is very materially prolonged. Barium chloride directly stimulates the heart muscle and the muscular coats of the arteries. It probably has no effect upon the vagus nerve or upon the vasomotor center, but the short period during which the heart's action is increased probably results from the stimulant action of the drug upon the accelerator nerves. Barium chloride is rapidly absorbed, and may be found in nearly all the tissues of the body, especially in the kidneys, liver, nerve-centers, and bones.

The drug is employed as a cardiac stimulant in all conditions resulting from failure of the heart muscle. It has been recommended in sclerotic nervous lesions, and is said to be of value, both when given internally and applied locally, in the treatment of varicose veins. It has been recommended and condemned by various members of the profession in the treatment of glandular tuberculosis, but the consensus of opinion at present is that it is of little value in this condition. Excessive amounts of barium chloride cause gastro-enteritis, with nausea, vomiting, pain, and serous purging. Collapse with its characteristic symptoms, followed by convulsions and death, results when the dose is sufficiently large. Death results from cardiac arrest due to the violent stimulating effects of the drug upon the heart muscle. Respiratory paresis occurs almost simultaneously. The treatment consists in the use of the stomach-pump or the employment of emetics and the administration of any of the soluble sulphates. Pain may be relieved by opium and demulcent drinks and appropriate stimulants may be used as indicated.

Barium chloride has been recommended as an alterative in the treatment of scrofulosis.

Barium chloride is usually employed in solution. One containing 5 grains (0.30 Gm.) of the salt in 1 fluidounce (30 Cc.) of water may be given in doses of $\frac{1}{2}$ to 1 fluidrachm (2–4 Cc.), 3 times daily. In substance the dose is from $\frac{1}{10}$ to $\frac{1}{2}$ grain (0.006–0.03 Gm.).

An ointment containing from 2 to 5 grains (0.12–0.30 Gm.) to 1 ounce (30 Gm.) of lard has been recommended as a remedy for enlarged glands.

The remaining salts of barium are rarely employed in medicine, except the oxide, which was formerly recommended as an escharotic, and the carbonate, which was used as a parasiticide in the treatment of certain skin diseases.

The following compounds are more or less employed in medicine, in chemistry, and in the arts:

Barii Acetas.—*Barium acetate*, E.; *Acétate de baryum*, Fr.; *Essigsaurer Baryt*, G. $Ba(C_2H_3O_2)_2 + H_2O$.—Made by neutralizing moderately dilute acetic acid with pure barium carbonate until the solution is slightly acid, and evaporating to the point of crystallization. The crystals are 4-sided prisms soluble in 1 part of water and in 100 parts of alcohol. It is a reagent for the determination of chromic acid, and for the preparation of aluminum mordant in cotton-printing.

Barii Bromidum.—*Barium bromide*, E.; *Bromure de baryum*, Fr.; *Brombaryum*, G. $BaBr_2 + 2H_2O$.—It is obtained on dissolving barium carbonate in hydrobromic acid, and crystallizes in colorless rhombic plates, which dissolve in their own weight of cold water and are freely soluble in alcohol. The salt has a very disagreeable taste.

Barii Carbonas.—*Barium carbonate*, E.; *Carbonate de baryum*, Fr.; *Kohlensaurer Baryt*, G. $BaCO_3$.—It is found native, as witherite, in large quantities in the lead mines at Alston Moor, and at Anglesark in Lancashire, England. It is also met with in Scotland and Sweden. It may be obtained artificially by precipitating a soluble barium salt with an alkali carbonate, or by heating to redness and fusion a mixture of 10 parts of heavy spar (barium sulphate), 2 of carbon, and 5 of potash, and washing the fused mass with water, when barium carbonate is left behind. Its formation is explained by the following equation: $BaSO_4 + C_2 + 2KOH = BaCO_3 + K_2S + CO_2 + H_2O$. Witherite is found in pale-yellowish or grayish fibrous masses or in rhombic crystals varying in specific gravity between 4.3 and 4.56. The artificially prepared barium carbonate forms a soft, white, amorphous or crystalline, tasteless powder. Its

specific gravity is 4.22 to 4.307. It requires more than 15,000 parts of boiling water for solution, but dissolves more readily in solution of chloride and some other salts of ammonium, and is also slightly soluble in some carbonates, and even sulphates. When recently precipitated, it decomposes the solutions of many salts, precipitating the metals either as hydroxides or carbonates. Owing to its solubility in hydrochloric and other acids, it acts as a poison when taken internally. Barium carbonate should be completely soluble, with effervescence, in dilute hydrochloric acid (absence of barium sulphate). The solution is not colored or precipitated by ammonia or hydrogen sulphide (absence of lead and other metals). When the solution is precipitated by excess of sulphuric acid, the filtrate, on being evaporated, should leave no fixed residue (absence of alkalies), and should yield no precipitate with sodium carbonate (absence of calcium and other earths).

Barii Chloridum.—*Baryum Chloratum*, P. G.; *Barium chloride*, E.; *Chlorure de baryum*, Fr.; *Baryumchlorid*, G. $BaCl_2 + 2H_2O$.—It is prepared by dissolving barium carbonate in diluted hydrochloric acid, evaporating the solution, and crystallizing. On the large scale it is obtained sometimes as a secondary product, as in the preparation of ammonium carbonate, or is made from native barium sulphate (heavy spar) by igniting its mixture with charcoal, so as to form barium sulphide, and carbon dioxide, according to the equation: $BaSO_4 + C_2 = BaS + 2CO_2$. The barium sulphide thus obtained is then dissolved in water and boiled with excess of hydrochloric acid, whereby hydrogen sulphide is given off, barium chloride remaining in solution: $BaS + 2HCl$ yields $BaCl_2 + H_2S$. By evaporating the solution the salt is obtained in crystals. Barium chloride exists in colorless, translucent, rhomboidal tables or lamellæ. It is permanent in the air at the ordinary temperature, but loses one-half of its water above 55° C. (131° F.), and becomes anhydrous at 121° C. (249.8° F.). 100 parts of water retain at 105° C. (221° F.) 60 parts, at 40° C. (104° F.) about 41, at 20° C. (68° F.) 35.7, and at 10° C. (59° F.) 34.3 parts of the salt in solution (Mulder). The aqueous solutions are partly precipitated by strong hydrochloric and nitric acids, in which the salt is less soluble than in water. It is insoluble in absolute alcohol, but dissolves in spirit containing water, and imparts to the alcohol flame a yellow color. It possesses the persistently bitter and disagreeable astringent taste of the soluble barium salts. Its solution yields with silver nitrate and with potassium sulphate or dilute sulphuric acid copious white precipitates, which are insoluble in nitric acid. Phosphates, carbonates, and the salts of most organic acids yield with barium chloride precipitates which are insoluble in water, but dissolve in nitric or hydrochloric acid. Barium chloride should be entirely soluble in water (absence of barium carbonate and sulphate), and the solution should not be colored or precipitated by ammonia or hydrogen sulphide (absence of lead and other metals). When precipitated by an excess of sulphuric acid, the filtrate should leave no fixed residue on evaporation (absence of alkalies), and should yield no precipitate with sodium carbonate (absence of calcium and other earths). Alcohol shaken with the powdered salt, then poured off and ignited, should not burn with a red flame (absence of strontium chloride). 1 Gm. of the salt dissolved in 20 Cc. of water should show no blue color with 0.5 Cc. of 5 per cent. potassium ferrocyanide solution.—P. G.

Barii Chromas.—*Barium chromate*, E.; *Chromate de baryum*, Fr.; *Chromsaurer Baryt*, G. $BaCrO_4$.—A lemon-yellow powder, insoluble in water and acetic acid, and soluble or decomposed in hydrochloric, nitric, or sulphuric acid. Obtained by double decomposition between $BaCl_2$ and K_2CrO_4, and used as a pigment as ultramarine yellow, jaune de Steinbuhl.

Barii Dioxidum.—*Barium dioxide, Barium peroxide*, E.; *Peroxyde de baryum*, Fr.; *Baryumhyperoxyd*, G. BaO_2.—Barium dioxide is prepared by conducting oxygen or atmospheric air over barium oxide or hydroxide heated to full redness. It is a heavy, grayish-white or pale yellowish-white, amorphous solid, odorless and tasteless, and permanent in the air. Almost insoluble in cold water, with which, however, it forms a definite hydrate, and to which it imparts a decidedly alkaline reaction. Hydrochloric, phosphoric, and most other mineral acids decompose it, producing the corresponding barium salts, and hydrogen dioxide which remains in solution for a considerable time, if the reaction has taken place in the cold and an excess of the acid is present. When heated to a bright-red heat, barium dioxide fuses, loses oxygen, and is reduced to barium oxide. Barium dioxide should be dissolved by diluted hydrochloric acid without leaving more than a trace of residue. If 0.422 Gm. of barium dioxide, in powder, be dissolved as completely as possible in 10 Cc. of ice-cold water, with the aid of a sufficient quantity of phosphoric acid, it should require not less than 40 Cc. of tenth-normal potassium permanganate solution to impart to the liquid a permanent pink tint, corresponding to not less than 80 per cent. of pure barium dioxide (each Cc. of the volumetric solution indicating 2 per cent. of the latter).—U. S., 1890. Barium dioxide is employed in making the official hydrogen dioxide solution. As it often contains iron, calcium, and silica as impurities, which enter the solution of hydrogen dioxide, it is better to use the purified hydrated barium dioxide described below.

Barii Dioxidum Hydratum seu Crystallisatum.—*Hydrated or crystallized barium dioxide.* $BaO_2 + 8H_2O$.—This compound, because of its greater purity, is better suited for the preparation of hydrogen dioxide than the article obtained by heating barium oxide in air or oxygen, as described above. It is prepared by adding finely powdered commercial barium dioxide to 2 per cent. hydrochloric acid until the reaction is just slightly acid, and then adding dilute baryta solution until weakly alkaline; the hydroxides of iron and aluminum, and silica, which are thus precipitated, are filtered off. To the filtrate strong baryta solution is added until a

precipitate no longer forms. The latter, which is crystalline, is filtered, washed with ice-cold water, and dried between filter-paper or preserved moist in well-closed bottles. When dried and heated to 130° C. (266° F.), pure BaO_2 remains as a white, magnesia-like powder.

Barii Hydroxidum.—*Barium hydroxide*, E.; *Oxyde de baryum hydraté*, Fr.; *Baryumhydroxyd, Aetzbaryt*, G. $Ba(OH)_2$.—Barium oxide is prepared by first calcining barium nitrate; the oxide is dissolved in water, and the filtered solution evaporated to dryness and heated to redness. $Ba(OH)_2$ remains as a white crystalline mass or a white powder, specific gravity 4.495, and having a strong alkaline reaction. When a hot concentrated solution is allowed to cool, large clear plates or prisms are formed, of the composition $Ba(OH)_2.8H_2O$, which melt at 80° C. (176° F.) and in dry air lose 7 molecules of water, or 40 per cent., leaving the compound $Ba(OH)_2.H_2O$, which loses its molecule of water only at red heat. The crystallized hydroxide is soluble in 20 parts of cold and 3 parts of hot water. It may also be prepared by adding 224 parts of barium chloride, $BaCl_2.2H_2O$, to a hot solution of 80 parts of sodium hydroxide in 500 parts of water. Barium hydroxide crystallizes out on cooling. The solution of the hydroxide is known as *baryta water*, and is used in analysis to precipitate magnesium and to detect and estimate carbon dioxide, which forms insoluble barium carbonate.

Barii Iodidum.—*Barium iodide*, E.; *Iodure de baryum*, Fr.; *Baryumiodid*, G. $BaI_2.2H_2O$. —It is conveniently made by boiling a solution of iodide of iron with excess of barium carbonate, filtering, and crystallizing. It forms large transparent rhombic prisms, which are very freely soluble in water and alcohol, and when heated melt and become anhydrous.

Barii Nitras.—*Barium nitrate*, E.; *Azotate de baryum*, Fr.; *Salpetersaurer Baryt*, G. $Ba(NO_3)_2$.—Obtained by the action of nitric acid on barium carbonate. Colorless hard octahedral crystals, permanent in the air, with a pungent, slightly bitter taste, soluble in 12.5 parts of water at 15° C. (59° F.) and 3 parts of boiling water, insoluble in alcohol. Strongly heated, it gives BaO. Its solution should be neutral and give no precipitate with silver nitrate (absence of chlorine). Other tests of purity are the same as under Barium Chloride. The salt is used as a chemical reagent and in pyrotechnics to produce a green-colored flame. It easily deflagrates or explodes when rubbed or heated with combustible substances.

Barii Sulphas.—*Barium sulphate*, E.; *Sulfate de baryum, Spath pesant*, Fr.; *Schwefelsaurer Baryt, Schwerspath*, G. $BaSO_4$.—This is a mineral from which other barium compounds are prepared by converting it first into soluble sulphide; on treating its solution with dilute sulphuric acid, barium sulphate is again formed, and this is used under the name of *permanent white* or *blanc fix* for glazing cards and by painters in place of white lead. It is insoluble in water and acids, and is unchanged by hydrogen sulphide, whereas white lead turns yellow under its influence.

Barii Sulphis.—*Barium sulphite.* $BaSO_3$.—Obtained by saturating finely powdered barium carbonate suspended in water with sulphur dioxide. The sediment is filtered and dried on porcelain plates at 25°–30° C. (77°–86° F.). It is a white crystalline powder difficultly soluble in water. Used in paper manufacture.

BELÆ FRUCTUS.—Bael Fruit.

Indian bael, Bengal quince, E.; *Bengalische Quitte*, G.; *Coing de Bengale*, Fr.; *Bél*, Hind.

The dried half-ripe fruit of *Ægle Marmelos* (L.) Correa (*Crataeva M.* L.—Fam. *Rutaceæ*).

Origin.—The Bael tree is indigenous in the Himalayas, and is largely cultivated throughout India, being sacred among the Hindoos and connected in many ways with their mythology and rites. It is of medium size, spiny, and not unlike the orange in appearance. The leaves, and the fresh juice expressed from them, are in native use as being carminative, laxative, and febrifuge, and the root-bark as an antispasmodic.

Description.—The fruit resembles an orange in form, size, and structure, but has a smooth or granular hard rind, like that of a gourd, and its numerous seeds are woolly. It consists of from 10 to 15 cells, the pulp completely filling it. Both the rind and pulp are aromatic, the former much more so. The pulp is sweetish, acidulous, very mucilaginous, and, before maturity, decidedly astringent. When fully ripe, it is somewhat laxative. As occurring in market, it is either entire or cut into sections, the rind brown or gray-brown, 2 or 3 Mm. ($\frac{1}{12}$ to $\frac{1}{8}$ In.) thick, the pulp varying from orange to red-brown in color.

Constituents.—The most abundant is gum, divisible into two portions, the one completely soluble, the other swelling, in water and associated with pectin. The rind contains concrete essential oil. The ripe fruit has been reported to contain 5 per cent. of tannin, but the statement lacks confirmation. It yields nearly 4 per cent. of ash, mostly in the pulp.

Action and Uses.—Bael is said to be astringent, aromatic, and demulcent. It has been especially employed in India in the treatment of diarrhœa and dysentery resulting

from an atonic condition of the mucous membrane of the gastro-intestinal tract. Those who have employed it most state that its administration does not produce constipation, but, on the contrary, that it acts as an aperient.

A liquid extract may be given in the dose of 1 or 2 drachms (4–8 Cc.). A decoction, made by boiling 2 ounces (60 Gm.) of the drug with 1 pint (480 Cc.) of water until 8 ounces (240 Cc.) remain, is frequently given in doses of ½ to 1 ounce (16–30 Cc.), every 2 hours in acute cases, and 3 times daily in those of subacute or chronic type.

BELLADONNA.

Black cherry (*Poison* B. C.), *Deadly nightshade, Doft-berry, Devale* (*Dwale*), *Dway-berry, Great morel, Mod, Mekilwort,* E.; *Belladonna, Tollkirsche, Tollkraut, Wolfskirsche,* G.; *Belladone* (Fr. Cod.), *Morelle Furieuse,* Fr.; *Belladoña,* Sp.

Belladonnæ Folia, *U. S., Br.*—Belladonna Leaves.

Folia Belladonnæ, P. G.

The dried leaves of *Atropa Belladonna* L. (Fam. *Solanaceæ*), yielding, when assayed by the U. S. P. process, not less than 0.35 per cent. of its alkaloids.

Official in most pharmacopœias, though some name the herb, and some specify collection when in flower. The Br. P. names the leaves, but defines as the fresh leaves and branches, collected when in flower. This fresh state should be allowed for, quantitatively, in the preparations, since the drug loses more than three-fourths in drying. The Br. P. calls the extract of this the *Green Extract,* so that no confusion can arise. Several pharmacopœias specify, of the dried drug, that the last fourth shall be rejected in powdering, as valueless.

Origin.—From a tall, stout, widely branched perennial herb, corresponding to Fig. 58. The flowers are of a dark-purple, and the berries are shining and purple-black. The plant grows wild in the greatest abundance through central and southern

FIG. 56.

Atropa Belladonna L.: branch, fruit, seed, and section of seed, the two last magnified.

FIG. 57.

Scopola leaf (½ Nat.).

Europe, and western Asia, and occasionally in other countries, and is the occasion of many serious or fatal poisoning accidents.

It is rather extensively cultivated for drug-production in Germany and England. Statements differ widely as to the relative strength of that of cultivated and of wild origin. The most favorable stage of growth for collection is also in doubt. The character of the

alkaloids, as well as their amount, is apparently subject to change, and until more is known in relation to these, positive statements regarding such questions are inadvisable. Gilpin and Langdon report, as the result of many assays, that the English leaves are usually distinctively superior to the German.

Description.—A much-wrinkled, brownish-green mass of leaves, frequently with more or less of the branchlets and flowers intermixed; leaf-blades from 7 to 20 Cm. (3 to 8 In.) long and 4 to 12 Cm. (1½ to 5 In.) broad, ovate, abruptly and nearly equilaterally narrowed into a rather broad petiole, acute at the summit, entire, thin, nearly smooth, above brownish-green, underneath grayish- or slightly brownish-green, both surfaces whitish-punctate under a lens; toughish; of a slight narcotic odor, greatly increased on moistening, and a bitterish, somewhat acrid, disagreeable taste. The powder is characterized by few hairs and by numerous arrow-shaped crystals of calcium oxalate.

The powder is of a dark-green or often brownish-green color. Its most characteristic element is the large crystal-cells, or "sacs," of the mesophyll, filled with crystal-sand, and visible in all except the finest powders. Even here their broken fragments are usually discernible. The peculiar, very wavy borders of the epidermal cells are also considered characteristic.

Although described as smooth, from their gross appearance, belladonna leaves bear some hairs, especially when young, part of them glandular, others not so. They frequently exhibit perforations, due to the separation of suberous growths. They are readily distinguished from the leaves of Scopola, which are commonly admixed, by the long-tapering base of the latter. All other leaves which have been sold for or admixed with them have toothed margins.

Constituents.—The general nature of the constituents will be considered under Belladonnæ Radix. From that, the leaves differ in the possession of an abundance of chlorophyll, some wax, and an odorous principle which has not been studied, as well as in having somewhat less of total alkaloid. Their use is therefore sometimes open to the objection of producing a green stain and yielding a rank odor. Kunz–Krause reports upon a "belladonna-balsam" resembling balsam of Peru, which is obtained in working up belladonna leaves upon a large scale.

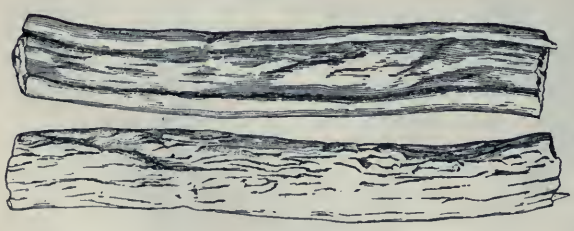
Belladonnæ Radix, *U. S.*, *Br.*—Belladonna Root.

The dried root of *Atropa Belladonna* L. (Fam. *Solanaceæ*), yielding, when assayed by the U. S. P. process, not less than 0.5 per cent. of its alkaloids.

Origin.—This has been discussed under Belladonnæ Folia, and the remarks there made concerning the wild and cultivated product and the season of collecting, apply here also. The Br. P. requires that the root be collected in the autumn.

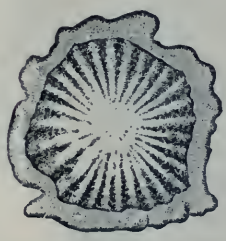
Description.—In cylindrical or slightly tapering, lightly longitudinally wrinkled pieces, 1 to 2.5 Cm. (⅖ to 1 In.) thick, the bark slightly incurved at the edges of roots which have

Fig. 58.



Belladonna root (Nat.).

Fig. 59.



Belladonna root: cross-section.

been split before drying; externally pale brown-gray, dusty or mealy, the outer layers of the periderm rather soft, frequently abraded, and thus showing lighter patches; fracture sharp, emitting a characteristic puff of dust, the fractured surface whitish, mealy, nearly smooth, finely and imperfectly radiate near the bark; nearly inodorous; taste sweetish, then bitterish and strongly acrid.

Tough and woody roots, of splintery fracture, as well as the short woody rhizome, knotty crown, and hollow-stem bases, should be rejected.

The powder is of a pale-gray or dirty-white color. It contains minute crystals or crystal-sand similar to those of the leaves, coming from the cortical cells. Both bast-fibers and stone-

cells are practically wanting, though the former have exceptionally been found. The vessels are highly porous, some with bordered pores. The abundant starch-grains are either simple or compound, about 5 to 10 mikrons in diameter, the hilum central or nearly so, small, entire, or faintly radiate, the concentric lines rather faint.

Belladonna-root is preferred when between 2 and 4 years of age, of the thickness of a man's finger, when it breaks with a mealy fracture. When much younger, it breaks with a horny or resinous fracture, and, besides containing less alkaloid, the latter is by many believed to be of a different nature. When much older, it becomes hard and woody, and the percentage of alkaloid is small. A good root contains alkaloid in the parenchymatic tissue of all parts, though mostly in the bark ; but in a woody root it is almost exclusively in the bark. We are frequently cautioned against accepting roots which have been peeled, the peelings used in the manufacture of atropine, but this article seems to have disappeared from the market. It would certainly be very inferior.

The root is generally believed to be richest in the late summer or autumn, and this is the season when it is mostly collected. E. Schmidt found nearly 3 times as much alkaloid in the fall as in the spring, while assays by Kremel showed nearly 4 times as much in the spring as in the fall. Kremel also reported that drying reduced the amount nearly one-half, and that there was a steady annual loss of about a tenth while keeping the drug. All but the smaller roots are split to insure drying without damage.

Adulterants.—There is but one root which bears a close resemblance to belladonna, yet a number have been used for purposes of adulteration. Medicago root has been frequently used for the purpose. It is tough and flexible, with a thin bark, lacks the snapping fracture with its puff of dust, exhibits a more regularly radiate appearance, and its stem-bases are not hollow. We have seen wild mallow roots admixed, but they also have a tough fracture. Scopola is easily detected if the rhizome be present, but if only its roots are used, the resemblance is extremely close. These roots are usually darker, more of a brown than of a gray, the surface less dusty and marked by transverse rows of very small, slightly transversely elongated root-scars of a light color. On fracture, the yellow color is seen to be more uniformly distributed toward the center, and the radiation is broader. Holmes has reported encountering adulteration with the root of a species of Phytolacca, easily recognized by its interrupted wood-wedges, forming concentric zones, as in ordinary poke-root.

Constituents.—The important constituents of belladonna root are a rather large amount of starch, mostly in the autumn, very little in early summer ; sugar, more especially in the spring, when there is almost no starch ; albumin, and a fluorescent principle which has passed under the name of *atrosin*, but is now identified as β-methyl-æsculetin. There is about 14 per cent. of ash. The important and active constituents are alkaloids varying in amount from 0.2 to about 1 per cent., the average being probably 0.55 to 0.6 per cent. The determination of this percentage has been a matter of great difficulty, as attested by the extreme diversity found in the reports of accomplished workers during the last decade, but the above statement may be regarded as fairly indicated by a comparison of the most trustworthy statements. With these, even more than with most other alkaloids, it is true that different results are obtained by different methods, and even with the same method applied by different experimenters ; and the value of comparative assays depends in a high degree upon the care taken to preserve uniformity in the operations.

As to the character of the alkaloids, our information is even more contradictory. That changes therein are liable to occur in the manipulation is well established, hyoscyamine being readily converted into atropine by a number of conditions. That such changes occur during the aging of the plant has also been generally believed, but appears clearly untrue. We are not disposed, in the present state of knowledge of this subject, to make positive statements concerning the identity of some of these alkaloids or the relative amounts of others. Almost all of the alkaloid is a mixture of atropine and hyoscyamine, both elsewhere discussed under those titles. As extracted, the former greatly predominates, but it is not certain that this is true as they exist in the living plant, or even in the dried root, the change of hyoscyamine into atropine in the meantime being at least possible.

A series of records by Gilpin and Langdon indicate that the volumetric method of assay gives much lower results than the gravimetric. One of the most carefully

conducted investigations, involving extraordinary measures of precaution, from the selection of the drug through all the processes of manufacture and alkaloidal examination, indicated that much more than half of the total alkaloid in these commercial roots is hyoscyamine. The other alkaloids are *scopolamine*, *atropamine* (or *aposterpine*), and *belladonnine*, the last an artificial derivative of the preceding. They are present in such small amounts as to probably not modify appreciably the action of the drug.

The U. S. P. requires that, when assayed by the following process, belladonna-leaves shall yield not less than 0.35 per cent. and belladonna-root not less than 0.5 per cent. of the alkaloids present in the drug:

Assay of Belladonna.—Belladonna-leaves or root, in No. 60 powder, 10 Gm.; chloroform, ether, normal sulphuric acid, ammonia-water, distilled water, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, hematoxylin test-solution, or iodeosin test-solution, each a sufficient quantity. Place the belladonna-leaves or root in an Erlenmeyer flask, and add 50 Cc. of a mixture of chloroform 1 part and ether 4 parts (by volume). Allow the flask to stand 10 minutes after inserting the stopper securely, then add 2 Cc. of ammonia-water mixed with 3 Cc. of distilled water, and shake the flask well at frequent intervals during 1 hour. Then transfer as much as possible of the contents of the flask to a small percolator, which has been provided with a pledget of cotton packed firmly in the neck and inserted in a separator containing 6 Cc. of normal sulphuric acid diluted with 20 Cc. of distilled water. When the liquid has passed through the cotton, pack the belladonna-leaves firmly in the percolator with the aid of a glass rod, and having rinsed the flask with 10 Cc. of the chloroform-ether mixture, transfer the remaining contents of the flask to the percolator, by the aid of several small portions (5 Cc.) of the chloroform-ether mixture, and continue the percolation with successive small portions of the same liquid (in all 50 Cc.). Next, shake the separator well for one minute, after securely inserting the stopper, and when the liquids have completely separated, draw off the acid solution into another separator. Add to the chloroform-ether mixture 10 Cc. of the sulphuric acid mixture of the same strength as that previously used, agitate well, and again draw off the acid solution into the second separator; repeat this operation once again, drawing off the acid solution as before; introduce into the acid solutions contained in the second separator a small piece of red litmus-paper, then add ammonia-water until the liquid is distinctly alkaline, and shake out successively with three portions (15, 15, 5 Cc.) of chloroform; collect the chloroform solutions in a beaker, place it on a water-bath containing warm water, and allow the chloroform to entirely evaporate. Dissolve the residue in 3 Cc. of ether and let this also evaporate completely. To the alkaloidal residue add 3 Cc. of tenth-normal sulphuric acid and 5 drops of hematoxylin test-solution (or iodeosin test-solution), then titrate the excess of acid with fiftieth-normal potassium hydroxide solution. Divide the number of cubic centimetres of fiftieth-normal potassium hydroxide solution used by 5, subtract the quotient from 3 (the 3 Cc. of tenth-normal sulphuric acid used), and multiply the remainder by 0.0287, and this product by 10; the result will be the percentage of total alkaloids contained in the belladonna-leaves or root.

The figure 0.0287 represents the weight in grammes of alkaloids (mainly atropine) required to neutralize 1 Cc. of tenth-normal sulphuric acid.

Pharmaceutical Preparations.—Of the leaves: TINCTURE OF BELLADONNA, U. S. P.; EXTRACT OF BELLADONNA, U. S. P. Of the root: FLUIDEXTRACT OF BELLADONNA, U. S. P.; LINIMENT OF BELLADONNA, U. S. P.

Action and Uses.—As has been pointed out, belladonna belongs to a very large class of drugs, the physiological effect of each of which is nearly identical. When taken in overdose, it produces dryness of the throat, dilatation of the pupils, sometimes difficulty in swallowing, and a flushed face, which is peculiar in that the flush is over each cheek-bone, while the skin at the corners of the nose and about the angles of the mouth is often unduly white. The skin is also apt to be hot and dry, and the bodily temperature may be raised as much as 2 degrees. In susceptible persons an active, talkative delirium often becomes quite marked, and double vision may be present owing to the influence of the drug upon the oculomotor nerve, whereby the action of the extra-ocular muscles is impaired. In some instances the flushing of the skin of the face extends all over the body, and a rash closely resembling that of scarlet fever is developed which may be so severe as to be followed by desquamation. The pulse is apt to be rapid and running, and the respirations quickened. Death very rarely follows belladonna-poisoning, because it is a drug which is not exceedingly lethal in its influence, and also because it is very rapidly destroyed and eliminated from the body, escaping chiefly through the kidneys in such considerable quantities that if the urine of a poisoned person be dropped in the eye of one of the domestic animals it will cause mydriasis. The dilatation of the pupil which is seen under large medicinal or poisonous doses of belladonna depends upon depression of the peripheral ends of the oculomotor nerves and stimulation of the peripheral ends of the sympathetic nerves. The drug also probably depresses the contractility of the circular fibers in the

iris, and increases the activity of the radiating fibers. The loss of accommodation under the influence of belladonna is largely due to its influence upon the oculomotor nerves and the ciliary muscles, and part of the mydriasis may be due to the effect of the drug upon the bloodvessels of the iris. Dropped into the eye, it produces wide dilatation of the pupil; but its alkaloid, atropine, is usually used for this purpose. The drug, whether given internally or used locally, increases intra-ocular tension, and is contraindicated in glaucoma. Belladonna acts as a stimulant of the vasomotor center and raises the arterial pressure thereby, although upon the capillaries of the skin it seems to cause vascular relaxation.

Belladonna is used in medicine for the purpose of checking excessive secretion in cases of profuse sweating, in serous diarrhœa, and for profuse urinary flow not depending upon diabetes mellitus. It is also sometimes employed to check excessive ptyalism. In checking excessive secretion, it acts by depressing the ends of the nerves supplying the glands involved. It is a remedy of inestimable value in collapse complicating injuries or acute diseases, and has been largely employed for the purpose of relieving muscular spasm when this spasm involves unstriped muscular tissues. Thus, it is used in purgative pills to prevent griping, and in cases of incontinence of urine to allay irritability of the bladder. It is also sometimes employed as a sedative for the purpose of relieving spasm in renal and gallstone colic, but under these circumstances it is usually administered with opium or its alkaloid, morphine.

Still another condition of spasm in which it is very valuable is true spasmodic asthma, in which it does good by acting upon the muscular fibers of the bronchial tubes and upon the walls of the bloodvessels in the bronchial mucosa, and by diminishing the activity of the pneumogastric nerves. Often belladonna leaves are smoked in cigarettes for this purpose. It has also been used in spasmodic croup with asserted advantage, and in certain types of nervous vomiting it is said to be useful.

Locally applied, the extract is valuable in suppositories in the treatment of hemorrhoids, and in the form of atropine, when dropped into the eye, it is a necessity in the treatment of iritis to prevent adhesions. At one time it was thought that belladonna and atropine were powerful antagonists to opium, and were to be considered as the physiological antidotes for that drug, but their usefulness in opium-poisoning is now recognized as not very great. Belladonna has been employed for the relief of various forms of pain, and sometimes does good in neuralgia, but is not of much value unless the pain depends upon spasm.

The dose of the tincture of belladonna is from 8 to 20 minims (0.50–1.30 Cc.); of the fluidextract, from 1 to 10 minims (0.05–0.60 Cc.); and of the solid extract, grain $\frac{1}{4}$ (0.015 Gm.).

Belladonna de Pais, of Mexico, is *Nicandra physaloides* L. (see SOLANACEÆ).

BENZALDEHYDUM, *U. S.*—Benzaldehyde.

Oleum amygdalarum æthereum artificiale; Oleum amygdalarum æthereum sine acido prussico.—Synthetic oil of bitter almond, E.; *Aldéhyde benzoique*, Fr.; *Benzaldehyd, Künstliches Bittermandelöl*, G.

Formula, C_7H_6O or $C_6H_5.COH$. Molecular weight, 105.25.

An aldehyde produced artificially, or obtained from oil of bitter almond or other oils, and containing not less than 85 per cent. of benzaldehyde. It should be kept in small amber-colored, well-stoppered bottles.—U. S.

Benzaldehyde was first prepared in a pure state by Liebig and Wöhler in 1837, who ascertained its composition and studied its relation to benzoic acid. Having first been isolated from bitter almond oil, it was designated pharmaceutically as *oleum amygdalarum æthereum sine acido prussico*. Because of its relation to the benzoyl radicle, C_6H_5CO, it was designated benzoyl hydrate. Inasmuch as it is the aldehyde corresponding to benzoic acid, C_6H_5COOH, it is commonly designated benzaldehyde. It is now prepared on a large scale from toluene, $C_6H_5CH_3$, the hydrocarbon underlying benzyl alcohol, $C_6H_5CH_2OH$, benzaldehyde, C_6H_5CHO, and benzoic acid, C_6H_5COOH.

Preparation.—(A) FROM BITTER ALMOND OIL.—1. In order to remove the hydrocyanic acid, oil of bitter almonds is shaken with milk of lime and a small quantity of solution of iron sulphate, set aside for several days, and the mixture distilled with water vapor. The hydrocyanic acid is thereby converted into Prussian blue.

2. The benzaldehyde can likewise be isolated by shaking the oil with two or three times its weight of freshly prepared concentrated solution of sodium acid sulphite, whereby it is converted into the crystalline benzal hydroxysulphonate of sodium, $C_6H_5CH(OH)\text{-}SO_2ONa$. The crystalline magma is drained, washed with cold alcohol, and the benzaldehyde regenerated by treatment with strong sodium carbonate solution. The regenerated aldehyde is rectified either by direct distillation or by distillation with steam.

(B) From Toluene.—This hydrocarbon is first converted, by direct substitution, into benzyl chloride or benzal chloride, either of which may be used for the preparation of benzaldehyde.

1. Benzyl choride, $C_6H_5CH_2Cl$, is heated with barium nitrate and water while passing a current of CO_2 through the mixture. The benzyl nitrate resulting decomposes with the formation of benzaldehyde and oxides of nitrogen.

2. Benzal chloride can be converted directly into benzal glycol, $C_6H_5CH(OH)_2$, and benzaldehyde by heating it with caustic soda or milk of lime, or with water under pressure. The benzaldehyde resulting from either method can be purified through the sodium-acid-sulphite addition product, as directed above (A, 2).

Properties.—Benzaldehyde is a colorless, strongly refractory liquid, which possesses the odor peculiar to bitter almond oil and a burning aromatic taste. Its specific gravity is about 1.045 at 25° C. (77° F.); it boils at 179° to 180° C. (354.2°–356° F.), and is optically inactive. It is sparingly soluble in water (about 1 : 300), but readily soluble in most organic solvents. When exposed to oxygen it readily oxidizes to benzoic acid, $C_6H_5CHO + O = C_6H_5COOH$, hence it should be kept in small, well-stoppered bottles. Unlike the natural bitter almond oil, it is not poisonous.

Tests.—The absence of hydrocyanic acid can be ascertained by dissolving 10 drops of the aldehyde in question in a little alcohol. This alcoholic solution is shaken with a few drops of a strong solution of sodium hydroxide, then with a little ferrous sulphate test-solution. Finally, hydrochloric acid is added in excess. The formation of a blue precipitate or blue color would indicate the presence of hydrocyanic acid. Benzaldehyde prepared from toluene is apt to contain traces of the intermediate derivation products unless carefully rectified. The presence of chlorine can be ascertained by burning the aldehyde in question, whereby the chlorine is converted to hydrochloric acid. This combustion is best effected by burning a taper of filter-paper saturated with the aldehyde in a small porcelain dish covered by a large beaker, the inner surface of which has been moistened with distilled water. After the vapors have had time to be absorbed by the moisture, the beaker is rinsed with a little distilled water, the liquid filtered, and the filtrate tested with silver nitrate test-solution in the usual manner. A turbidity or a white precipitate of silver chloride would indicate the presence of chlorine.

Assay of Benzaldehyde.—Benzaldehyde is readily oxidized to benzoic acid, especially when poorly kept. In ordinary containers the oxidation sometimes proceeds so far that the benzoic acid will crystallize out. However, since the benzoic acid constitutes no serious impurity, the U. S. Pharmacopœia demands no higher percentage of benzaldehyde than 85 per cent. The amount can be determined by the following assay process. Rosolic acid is preferable as indicator to phenolphthalein employed in the U. S. P. assay: Introduce into a tared 150 Cc. flask, by means of a pipette, 12 drops of benzaldehyde, and note the exact weight of the latter; then add 10 Cc. of purified petroleum benzin and afterward 20 Cc. of distilled water with 6 drops of phenolphthalein test-solution, and neutralize the solution exactly by the addition of tenth-normal sodium hydroxide solution, agitating the flask thoroughly. Add from a burette, gradually, a solution of sodium sulphite (1 in 5), alternating with half-normal hydrochloric acid from a second burette, until 10 Cc. of the sodium sulphite solution have been added, and enough half-normal hydrochloric acid to maintain the neutrality of the mixture; after adding a few drops of phenolphthalein test-solution, and agitating the flask frequently, allow it to stand 2 hours to insure a permanent condition of neutrality, and then note the number of cubic centimetres of the half-normal hydrochloric acid used. Carry out a blank test, identical with the foregoing, except that the benzaldehyde is omitted, and note the amount of half-normal hydrochloric acid consumed. Subtract the number of cubic centimetres required in the blank test from the number required in the original test; each Cc. of this difference corresponds to 0.0526 Gm. of benzaldehyde. To find the percentage, multiply the above difference by 0.0526, and this product by 100, and divide by the weight of the benzaldehyde taken.—U. S.

Action and Uses.—Benzaldehyde, or artificial oil of bitter almonds, is used largely as a flavoring agent instead of the natural oil. Being devoid of hydrocyanic acid, it is not poisonous except in very large quantity.

BENZENUM.—Benzene (sometimes called Benzol).

Benzol, Br.; *Phenyl hydride*, E.; *Benzole*, *Benzène*, Fr.; *Benzol*, *Steinkohlenbenzin*, G.

Formula, C_6H_6. Molecular weight, 77.46.

A mixture of homologous hydrocarbons obtained from light coal-tar oil. It contains about 70 per cent. of benzene, C_6H_6, and 20 to 30 per cent. of toluene, $C_6H_5.CH_3$. —Br.

The discovery of benzene is credited to Faraday, who found it in the condensed liquid from oil gas, and it was observed next by Mitscherlich as a product of the distillation of benzoic acid with lime, and later as a constituent of coal-gas tar by A. W. Hofmann.

There is much confusion in the use of the term *benzene*, a substance of definite composition, with the term *benzin*, a liquid consisting of various hydrocarbons obtained from petroleum. The term *benzene* should be applied solely to the product from *coal-tar* boiling at 80.4°–81° C. (176.7°–177.8° F.), and having the definite composition C_6H_6. Although the ending "ol" is confined to the names of the alcohols and phenols, and the more appropriate ending "ene" used for the hydrocarbons proper, the term *benzol* is used commercially for some coal-tar products to designate various mixtures of benzene with *toluene*, *xylene*, *cumene*, etc., the grades being designated and sold according to percentage content of volatile matter distilling below 100° C. (212° F.). Thus 50°, 70°, 90° benzol yield the respective volume per cent. of distillate before the thermometer registers 100° C. during the distillation.

Preparation.—The purest form of benzene is obtained by the dry distillation of benzoic acid mixed with an excess of lime, and purifying the oily distillate by further treatment with solution of an alkali hydroxide and subsequent rectification. The product is the "Benzolum ex acido benzoico." Benzene is largely obtained from *coal-tar*, one of the secondary products of coal-gas manufacture: on subjecting it to distillation water and ammonia pass over, accompanied by a brown oily liquid (8 or 10 per cent. of the tar), known as *light oil*, because it floats on water. Subsequently *dead oil* is obtained as an oily liquid heavier than water, and containing aniline, quinoline, naphthalene, carbolic acid, etc.; the residue in the retort constitutes pitch, and is used in place of asphaltum. The light oil contains mainly *benzene*, *toluene* (C_7H_8), *xylene* (C_8H_{10}), and *isocumene* (C_9H_{12}), and after rectification to free it from some dead oil is known in commerce as *coal-naphtha*, which owes most of its disagreeable odor to volatile bases removable by agitation with dilute sulphuric acid. The hydrocarbons are separated from one another by repeated fractional distillation until liquids of a nearly constant boiling-point are obtained. The fraction boiling near 80° C. (176° F.) consists chiefly of benzene, that with the boiling-point 110° C. (230° F.) of toluene, that distilling near 140° C. (284° F.) of xylene, and the portion coming over near 170° C. (337° F.) of isocumene. The benzene may be further purified by exposing it to a low temperature and expressing the portion remaining liquid. The impurities commonly found in commercial benzene are acetylene, thiophene, carbon disulphide, and the homologues toluene, xylene, etc.

Properties.—At the ordinary temperature benzene is a thin, colorless, very inflammable liquid, of considerable refractive power and strong odor of coal-gas; but when obtained from benzoic acid it has a peculiar aromatic odor and a sweetish aromatic taste. It has the density 0.899 at 0° C. (32° F.) and 0.884 at 15° C. (59° F.), congeals at the freezing-point of water, melts again at 5.5° C. (42° F.), and boils at 80.5° (177° F.). The Br. P. requires that benzol shall begin to distil at 80° C. (176° F.), and that 90 per cent. of the whole shall pass over at a temperature below 100° C. (212° F.), and should wholly distil below 120° C. (248° F.). It is nearly insoluble in water, but readily soluble in 4 parts of alcohol, in methyl alcohol, ether, acetone, and chloroform; it dissolves some phosphorus, sulphur, and iodine, and considerable quantities of fats, volatile and fixed oils, caoutchouc, gutta-percha, some resins and alkaloids (quinine). With antimony trichloride W. Smith and G. W. Davis (1882) obtained a colorless crystalline compound having the composition $3SbCl_3.2C_6H_6$, and on exposure becoming opaque and liquefying. It is readily converted to nitrobenzene by the action of nitric acid.

Tests.—To distinguish it readily from petroleum *benzin*, Pusch (1875) recommends iodine, which dissolves in benzin with a raspberry-red and in benzene with a

violet-red color; the first color is so intense that a small admixture of benzin can be recognized by neutralizing the violet tint. It should boil and evaporate completely between 80° and 85° C. (176° and 185° F.), and when shaken with sulphuric acid should not acquire a dark color. On shaking 5 Cc. of benzene with 1 Cc. of sulphuric acid and 1 drop of fuming nitric acid, no green or blue tint should be produced; or if a small quantity of isatine be added in place of the nitric acid, no blue color should be developed (absence of thiophene). If 1 Cc. of benzene be cautiously poured onto 5 Cc. of fuming nitric acid, it dissolves, disengaging brown fumes, and on the addition of water separating oily globules of nitrobenzene, recognized by the odor of oil of bitter almond (distinction from benzin). It should congeal at 0° C. (32° F.), the crystals melting again at + 4° C. (39.2° F.) (distinction from benzin, which does not solidify). If 1 Cc. of the sample is thoroughly agitated with 20 Cc. of pure concentrated sulphuric acid, the discoloration, if any, should not exceed a pale straw-yellow. Not more than 0.5 Cc. of saturated bromine water should be required to impart a persistent (3–5 minutes) yellow tint when shaken with 10 Cc. of benzene. Commercially benzene is assayed by the process of fractional distillation (Allen's *Org. Anal.*, vol. 2, p. 496), the different fractions being matters of contract, the proportion by volume which passes over below and at a given temperature being called the "strength" of the sample at that temperature.

Action and Uses.—Because of its narcotic properties, benzol has been recommended by inhalation in the treatment of pertussis. It was formerly employed by the stomach as a remedy for trichiniasis, and its local application was said to do good in many parasitic skin diseases; it is, however, rarely used at the present time. The drug possesses antifermentative properties resembling those of phenol, and may be employed in the treatment of flatulent dyspepsia. Benzene was at one time suggested as a general anæsthetic; however, the fact that it does not cause muscular relaxation, but, on the contrary, produces muscular tremors and sometimes violent convulsions, and that the preliminary excitement is very great, renders it unfit for such a purpose. Where poisonous amounts are ingested with suicidal intent or accidentally inhaled by workmen, it occasions vertigo, mental aberration, delirium and tonic convulsions, followed by deep sleep. In fatal poisoning by this drug petechial spots are frequently noted, which Sauterson states are the result of fatty degeneration of the bloodvessels.

The ordinary dose of benzol is from 5 to 10 minims (0.3–0.6 Cc.), either in capsules, in emulsion, or on sugar. As much as 50 minims (3.3 Cc.) have been given without deleterious effect, but ordinarily that quantity should not be employed. When employed locally, benzol may be mixed with soapsuds in the proportion of 1 part of the former to 9 parts of the latter.

BENZINUM, *U. S.*—Petroleum Benzin.

Benzinum petrolei, P. G.; *Æther petrolei.—Benzin, Petroleum ether*, E.; *Esprit (Naphté, Éther) de pétrole*, Fr.; *Petroleumbenzin, Petroläther, Benzin*, G.

A purified distillate from American petroleum, consisting of hydrocarbons chiefly of the marsh-gas series [C_5H_{12}, C_6H_{14}, and homologous compounds]. Benzin should be carefully kept in well-stoppered bottles or tin cans, in a cool place, remote from lights or fire.—U. S.

Preparation.—The lower hydrocarbons present in American petroleum are separated from the heavier compounds by fractional distillation, and from all the lightest hydrocarbons by fractional condensation (see PETROLEUM). It is purified by agitation with sulphuric acid, which removes most of the disagreeable odor of the crude benzin. The peculiar sulphurous odor may be removed by treatment with lime, or better by washing it with an aqueous solution of potassium dichromate and sulphuric acid, and thorough subsequent washing with water. The method suggested by Beringer (see BENZINUM PURIFICATUM), in which the benzin is shaken with an acid solution of potassium permanganate, is even more effective,

Since *pentane*, C_5H_{12}, boils at 38° C. (100.4° F.), and *hexane*, C_6H_{14}, at 70° C. (158° F.), it is evident that the benzin of the U. S. P., boiling-point 45°–60° C. (113°–140° F.), consists principally of pentane, while that of the P. G., boiling-point 50°–75° C. (122°–167° F), contains much hexane with variable quantities of pentane and *heptane*, C_7H_{16}, the latter boiling at 98° C. (208.4° F.).

Properties.—Benzin is a transparent, colorless, diffusive liquid of a strong characteristic odor slightly resembling that of petroleum, but much less disagreeable; neutral in reaction; insoluble in water, soluble in about 6 parts of alcohol, and readily so in ether, chloroform, benzene, volatile oils, and fixed oils, with the exception of castor oil. It is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently. It has a specific gravity of from 0.638 to 0.660 at 25° C. (77° F.) (0.640 to 0.670 at 15° C., P. G.), and boils at 45° to 60° C. (113°–140° F.) (50° to 75° C. = 122°–167° F., P. G.).

Tests.—If 5 drops of petroleum benzin are added to a mixture of 40 drops of sulphuric acid with 10 drops of nitric acid in a test-tube, the liquid warmed and set aside for half hour, and then diluted in a shallow dish with twice its volume of water, it should not have the bitter-almond-like odor of nitrobenzene (difference from and absence of benzene).—U. S. Benzene being much higher in price than benzin, adulteration of the latter with the former is not likely to occur. For special tests for distinguishing benzin from benzene, see BENZENUM.

Action and Uses.—Scabies, favus, and other parasitic diseases are said to be benefited by the application of benzin. As it possesses local anæsthetic properties, it has been used in superficial neuralgia in the form of a spray. Its vapor when inhaled is said to be of value in the treatment of whooping-cough.

BENZINUM PURIFICATUM, *U. S.*—Purified Petroleum Benzin.

Ether de pétrole purifié, Fr.; *Gereinigter Petroläether*, G.

Preparation.—Potassium permanganate, 10 Gm.; sodium hydroxide, 2 Gm.; sulphuric acid, 60 Cc.; petroleum benzin, 1000 Cc.; water, a sufficient quantity. Add the acid to 550 Cc. of water, and when the mixture has become cold, pour it into a bottle having the capacity of about 2 liters. Add 8 Gm. of potassium permanganate and agitate until it is dissolved, then add the petroleum benzin, in four portions, shaking the liquid after each addition. Allow the liquids to remain in contact for 24 hours, shaking the bottle at frequent intervals; then decant the petroleum benzin into another bottle of the same capacity, and having dissolved 2 Gm. of potassium permanganate in 240 Cc. of water in which the sodium hydroxide has previously been dissolved, mix the liquids and agitate the mixture frequently during several hours. Finally, repeat the washing with water and again decant the petroleum benzin.—U. S.

Commercial petroleum benzin is contaminated with sulphur compounds and other impurities which it is intended to remove by the official method of purification. If the purified product is intended for use in plant analysis and similar work, it may be best to distil the same, collecting that portion passing over between 45° and 50° C. (113° and 140° F.).

Properties and Tests.—On evaporating 10 Cc. of purified petroleum benzin from a piece of clean filtering paper, no greasy stain should remain and the odor should not be disagreeable or notably sulphuretted; no residue should be left upon evaporating purified petroleum benzin from a warmed dish (absence of heavy hydrocarbons). When it is boiled for a few minutes with one-quarter its volume of spirit of ammonia and a few drops of silver nitrate test-solution, the ammoniacal liquid should not turn brown (absence of pyrogenous products and sulphur compounds). Purified petroleum benzin should have an ethereal or faint petroleum-like odor, and should respond to the tests given under PETROLEUM BENZIN.—U. S.

Action and Uses.—Benzin may be employed as a parasiticide in the treatment of scabies and pediculosis. It has also been used locally in tinea tonsurans, scabies, sycosis, etc. It is an ingredient of many of the household insecticides. Internally it is rarely administered, but if taken in a large quantity it produces an intoxication similar to that of alcohol, and may cause vertigo, unconsciousness, convulsions, and death.

BENZOINUM, *U. S.*, *Br.*—Benzoin.

Benzoé, P. G.; *Resina benzoe, Asa dulcis. Gum Benjamin*, E.; *Benjoin*, Fr.; *Benjui*, Sp.; *Benzoino*, F. It.

A balsamic resin obtained from *Styrax Benzoin* Dryander, and from another unknown species of Styrax (Fam. *Styraceæ*).

Origin.—The species named is a handsome, medium-sized tree, indigenous in Borneo Sumatra, Java, and other of the East India islands, where it is also cultivated. I yields the *Sumatra benzoin.* The tree of the neighboring mainland, yielding the *Sian benzoin,* is doubtless a distinct species, but is of very similar appearance. Siam benzoi is obtained by making a circle of notches through the bark of the trunk, into which th substance, caused to be produced as a result of the wounding, chiefly by tannin-trans formation, exudes. After 3 months this is hard and dry, and is picked out with th point of a knife or a sharp stick, and collected in baskets, being afterward assorted as t size, cleanness, and quality, the larger "tears," "marbles," or "almonds," bringing higher price. The largest and cleanest is called *slua,* the poorest, *mun,* and there is a intermediate or ordinary class recognized by the natives. It can be collected at an season, but the other occupations of the people cause collection to occur chiefly betwee July and November. Sumatra benzoin apparently exudes in the same way, but th tears come massed together with an interstitial resinous substance, so as to form a cake The origin and nature of this matrix are unknown. It is claimed to be that portion o the juice which will not form in tears, and it is said that its amount increases with th number of years that the tree has been tapped, so that the product of the first years con tains more tears and is of a better quality. On the other hand, it appears not impossibl that this amorphous substance originates in a different plant. A very inferior quality containing no tears, called "foots," is scraped from the bark of the exhausted trees whe they are cut down. As originally produced, benzoin is sold to the exporters, who pa tially soften it by heating and pack it solidly into strong boxes. Besides the natura impurities, in the form of twigs, bark, and splinters, large amounts of adulteratin material often are added, chiefly earthy matter, resulting in a product characterized a "drossy." The foreign matter is mostly put into the center, with clean superficial po tions, thus known as "false packed." Large stones were formerly imbedded, this pra tice having resulted in the habit of splitting the cakes diagonally before accepting then Penang benzoin is a form very similar to Sumatra, but having a strong odor of storax.

Description.—In pebble-like bodies or "tears," mostly 0.5 to 5 Cm. (0.2 to 2 In.) long an about one-fourth as thick, lightly flattened, straight or curved, yellowish to rusty-brown exte nally, milky-white on fresh fracture, separate or very slightly agglutinated (Siam benzoin) (Sumatra benzoin) imbedded in a dry resinous mass, which varies from reddish-brown to re dish-gray or gray-brown, is opaque or slightly translucent and more or less sparkling. Whe heated, benzoin gives off fumes of benzoic acid. It has an agreeable balsamic odor (vanill like in the Siam variety), and a rather disagreeable, slightly acrid taste.

After the removal of the bark and other vegetable tissue, the remainder, not less than 7 per cent., should dissolve in 5 times its weight of alcohol, and in solutions of the fixed alkalie The ash should not exceed 2 per cent.

Dieterich gives the saponification number as between 180 and 240 (Siam, 220 to 240).

When benzoin is boiled with milk of lime, the hot filtrate should not give off th odor of oil of bitter almond on the addition of test-solution of potassium permanganat (absence of cinnamic acid). For determining the presence of cinnamic acid, the tinctur of benzoin may be precipitated by hot water, filtered from the resin, and the filtrat treated with a solution of potassium permanganate or chlorinated lime; or the benzoi may be triturated with peroxide of lead and the mixture boiled with water.

Constituents.—The Sumatra benzoin contains from 10 to 20 per cent. of free benzoi and cinnamic acids, the latter in small proportion, or even wanting, 2 to 3 per cent. o styracin, 0.1 to 1 per cent. of vanillin, a little styrol and benzaldehyde, 1 per cent. of pheny propyl cinnamate, and 75 per cent. of the cinnamic esters of benzoresinol and resinotann ($C_{18}H_{20}O_4$). Of these esters, 92.6 per cent. are those of resinotannol, and the rest o benzoresinol, and their yield of cinnamic acid is 33 per cent. of their weight. Sia benzoin contains less free benzoic acid, little or no cinnamic acid, more vanillin (up t 1.5 per cent.), 5 per cent. of benzoresinol benzoate, and 57 per cent. of resinotannol be zoate. Ludy found that the Penang variety varied from much benzoic and little ci namic, to much cinnamic with little benzoic. Benzoin also contains traces of volatile oi fragments of bark and wood amounting to from 8 to 30 per cent., and other impuritie the Siam variety being the purest and least variable.

Substitutes.—Besides the adulterants mentioned above, several substances are use as substitutes. *Palembang benzoin,* which is very rarely seen in our market, is almost quite free from tears, is of a uniform pale reddish-brown and a peculiar opalescent luste

and has little odor. It contains considerable moisture, to which its opalescence is probably due, and it readily becomes mouldy. Holmes has shown it to be derived from *S. benzoin*. Its peculiarities may be due to the method of preparation. It contains benzoic acid, but no cinnamic acid nor vanillin. While its origin would include it in the official definition, it is excluded by the description.

An aromatic exudate used as incense in the East Indies under the name of *False benzoin*, is obtained from *Buceras angustifolius* (Jacq.) Lyons (*Terminalia a.* Jacq.; *T. Benzoin* L. f.; *Catappa B.* Gærtn.), a good-sized tree of Mauritius, of the family *Combretaceæ*. This substance bears little resemblance to benzoin.

Pharmaceutical Preparations.—Tincture of Benzoin, U. S. P.; Compound Tincture of Benzoin, U. S. P.

Action and Uses.—Benzoin is a stimulating expectorant, but is rarely employed in internal medicine. (For its internal uses, see Acidum Benzoicum.) The compound tincture of benzoin is commonly employed, and its local application is of the greatest service in the treatment of acute coryza and in the early stage of inflammation of the pharynx when the throat feels harsh and dry. The inhalation of steam laden with the volatile portion of the preparation is also an excellent procedure in treating acute laryngitis. Anal fissure, cracked nipples, and superficial abrasions of the skin are also said to be benefited by its application. The compound tincture when mixed with water in the proportion of 1 part of the former to 7 parts of the latter has been largely employed by the laity as a cosmetic for the purpose of beautifying the complexion.

The dose of the drug is stated to be from 10 to 30 grains (0.60–2 Gm.) in emulsion or capsule.

BENZOSULPHINIDUM, *U. S.*—Benzosulphinide.

Glusidum, Br.; *Acide Anhydro-Orthosulfamide-Benzoique*, Fr. Cod.—*Gluside, Saccharin, Neosaccharin, Glucusimide, Benzoyl-sulphonic-imide, Orthosulphamide-benzoic anhydride, Anhydro-orthosulphamide-benzoic acid*, E.; *Saccharine, Sulfinide benzoique, Sucre de houille*, Fr.; *Saccharin, Benzoesäuresulfimid, Zuckerin, Toluolsüss, Saccharol, Sycose*, G.

The anhydride of orthosulphamide-benzoic acid.—U. S. A sweet imide derivable from toluene.—Br.

Formula, $C_6H_4\begin{matrix}SO_2\\CO\end{matrix}\!\!>\!NH$. Molecular weight, 181.77.

The name saccharin was first applied to this compound by C. Fahlberg, who had observed its sweet taste while working on the subject under the direction of Remsen at the Johns Hopkins University (see *Amer. Chem. Journ.*, 1879 and 1880). The name saccharin had been previously applied by Peligot to a crystalline, but not sweet, derivative-product of the sugar group.

Preparation.—Benzosulphinide is prepared commercially by different processes. Usually toluene is treated with concentrated sulphuric acid at 100° C. (212° F.), whereby ortho- and paratoluenesulphonic acids, $C_6H_4(CH_3)SO_3H$, are formed, which are first converted into calcium salts, and then, by means of sodium carbonate, into sodium salts. From these a mixture of ortho- and paratoluenesulphochlorides, $C_6H_4(CH_3)$-SO_2Cl, is obtained by action of phosphorus pentachloride; upon strongly cooling the mixture the para-modification crystallizes out, and is thus separated. Orthotoluenesulphamide, $C_6H_4(CH_3)SO_2NH_2$, is formed from the other isomeric chloride by means of dry ammonia gas. This sulphamide is next oxidized with potassium permanganate, converting it into potassium orthosulphamidebenzoate, the solution of which is freed from precipitated manganese dioxide and decomposed by means of an acid; instead of separating as free orthosulphamidebenzoic acid, the latter splits up into its anhydride and water. It is this anhydride which is officially recognized under the name benzosulphinide, but is commercially better known as saccharin or gluside.

Properties and Tests.—Saccharin occurs as a white, crystalline powder, nearly odorless, having an intensely sweet taste even in dilute solutions. It is soluble at 25° C. (77° F.) in 250 parts of water and in 25 parts of alcohol, and but slightly soluble in ether and chloroform; soluble in 24 parts of boiling water. (The Br. P. gives the solubility at 1 part in 400 parts of cold and 24 parts of boiling water, or 25 parts of cold 90 per cent. alcohol, whereas the Fr. Cod. gives it as 1 part in 335 of cold

or 28 parts of boiling water, or 30 parts of 95 per cent. alcohol). It is easily soluble in ammonia-water, in alkaline hydroxide solutions, and in a solution of sodium bicarbonate, with the evolution of carbon dioxide. Heated to between 219° and 220° C. (426.2° and 428° F.), saccharin melts and at higher temperature burns with an odor of oil of bitter almond, without leaving a weighable residue. If 0.2 Gm. of benzosulphinide be dissolved with agitation in 10 Cc. of pure sulphuric acid, and the solution kept at a temperature of from 48° to 50° C. (118.4°–122° F.), on a water-bath, it should not within 10 minutes show a brown color (absence of carbohydrates). If 0.2 Gm. of benzosulphinide be dissolved in 5 Cc. of potassium hydroxide test-solution, the solution should be clear, and not become colored, even on prolonged heating (absence of glucose). A similar solution mixed with 5 Cc. of alkaline cupric tartrate volumetric solution should not, on heating, deposit any red cuprous oxide (absence of glucose or milk sugar). If to a hot aqueous solution of benzosulphinide ferric chloride test-solution be added, drop by drop, no precipitation or violet color should appear (absence of benzoic or salicylic acids).—U. S. On evaporating gluside with excess of solution of potassium hydroxide, maintaining the residue in a state of semifusion for a few minutes, cooling, dissolving in water, faintly acidulating with hydrochloric acid, and adding a few drops of ferric chloride test-solution, a reddish-brown or purplish color is produced (Br.). Since parasulphamidebenzoic acid does not possess a sweet taste, and its presence in the official article would materially reduce the sweetening power of the latter, the Br. P. directs the following test for the presence of this contamination: A solution of 0.5 Gm. of gluside in 80 Cc. of warm water, set aside for 12 hours, deposits tabular crystals which melt between 218.8° and 220° C. (426° and 428° F.); and it should not, even when briskly shaken, deposit crystals melting at a higher temperature. Crystals of parasulphamidebenzoic acid melt between 280° and 283° C. (536° and 541.4° F.). When first introduced commercially, saccharin frequently contained 30 per cent. or more of this impurity. The sweet taste of saccharin is perceptible even in dilution of 1 to 100,000. Fused with sodium or potassium hydroxide it yields salicylic acid. When saccharin is fused with potassium nitrate and sodium carbonate, sodium sulphate is formed.

The presence of saccharin in food-products and mixtures may usually be determined by extracting the saccharin from an acidulated solution of the substance with ether, separating the ether, and subjecting the residue obtained by evaporation of the ethereal solution to the tests given above.

Action and Uses.—Saccharin is employed as a substitute for sugar to sweeten the food, drinks, or medicines of diabetic or gouty patients. Tablets containing ½ grain of saccharin combined with a small quantity of sodium bicarbonate are conveniently carried by diabetics to be used in coffee, etc. As the substance retards the action of all digestive ferments, it should be used with caution in those whose digestion is impaired.

Allied and Derivative Products.—Sodium Saccharin.—*Soluble Saccharin. Soluble Gluside. Crystallose.* $C_6H_4COSO_2N.Na + 2H_2O$.—This compound is prepared by neutralizing an aqueous solution of saccharin with sodium carbonate or bicarbonate and slowly crystallizing the solution. It occurs in colorless crystals, readily soluble in water, intensely sweet to the taste, and not discolored by concentrated sulphuric acid. It is much used in place of saccharin on account of its greater solubility.

Dulcin.—*Sucrol. Valzine. Paraphenetol carbamide.* $C_6H_4.OC_2H_5NH.CONH_2$.—Another synthetic sweet compound obtained when ammonia is allowed to act on a body produced by the reaction between 1 molecule of carbonyl chloride in benzene or toluene solution and 2 molecules of paraphenetidin. Dulcin occurs in colorless needles or scales, soluble in 80 parts of cold water, in 150 parts of boiling water, in 25 parts of alcohol, in 80 parts of 45 per cent. alcohol, and in 480 parts of glycerin. It melts at 173° C. (343.4° F.), leaves no residue after ignition, and is soluble in sulphuric acid without discoloration.

If 0.05 Gm. of dulcin be heated with 5 drops of concentrated sulphuric acid until vapors arise, then cooled, diluted with 10 Cc. of water, and ammonia-water carefully superimposed, a blue ring will appear at the point of contact of the acid and alkaline liquid. Dulcin, evaporated on the water-bath with either silver nitrate or mercuric chloride, produces a violet color soluble in alcohol to a wine-red solution (Hager). It does not yield sulphate on fusion with potassium nitrate and sodium carbonate (distinction from saccharin). Dulcin is used like saccharin.

BERBERIS, *U. S.*—Berberis; Barberry.

The dried rhizome and roots of *Berberis aquifolium* Pursh., or of other species of *Berberis* (Fam. *Berberidaceæ*).

Origin.—A genus (Fam. *Berberidaceæ*) of some 75 species, widely distributed through temperate regions, including tropical mountains. They are erect or prostrate shrubs or small trees, usually spiny and with spiny-toothed, coriaceous leaves, yellow flowers, and berry-like fruits somewhat resembling currants in appearance and in their strongly acid taste. These fruits have been used for preserves and as refrigerants, those of some Indian species being regularly in native commerce for the latter purpose. Both the bark and the wood are of a bright yellow color, and are permeated with the bitter alkaloids, the former more so. As drugs, the bark is most largely used, the roots next, the trunk-wood occasionally. The bark of the root is richer than that of the stem. The leaves also are used as an antiscorbutic. The well-known medicinal species form three groups, as follows, besides which some Andean species are similarly used:

1. BERBERIS VULGARIS L., the common European and West Asiatic barberry (*Sourberry* or *Sowberry, Wood-sour, Jaundice-berry, Barbaraune*, E.; *Berberitze, Saurach, Sauerdorn*, G.; *Berbéride, Épine-vinette, Vinettier*, Fr.; *Berberos*, Sp.), is a large scarlet-fruited shrub, cultivated and naturalized in some parts of North America.

FIG. 60.

Berberis: stem-bark, young and old (Nat.).

Description.—The root is thick, strongly branched, hard and tough; its wood porous, radiate, light-yellow. Its *bark* occurs in small, very thin, soft, and brittle fragments, which are easily separable into layers, externally yellowish-gray or light yellow-brown and short scaly, the inner, yellow surface smooth, the fracture deep-yellow, radiate, with the bast-fibers arranged tangentially. It has little odor but an intensely bitter taste, and tinges the saliva yellow. The stem-bark can be distinguished by its occurrence in strips or longer fragments, usually of a rather lighter yellow, and the outer surface ragged with more elongated scales or strips of partly detached cork.

Constituents.—The bark contains gum, fat, wax, resin, very little tannin, phytosterin ($C_{26}H_{44}O.H_2O$), and 4 alkaloids, 1 of which is yet unstudied. *Berberine* ($C_{20}H_{17}NO_4$), first found in Xanthoxylum, and called *xanthopicrit*, crystallizes in yellow bitter prisms or needles, and is soluble in alcohol and in 300 parts of water, insoluble in ether; its golden-yellow salts dissolve in water with difficulty. *Oxyacanthine* (berbine or vinetine, $C_{18}H_{19}NO_3$, and not the same as the alkaloid from *Cratægus Oxyacantha*) occurs in bitter white crystals, which are alkaline and turn yellow in sunlight. It dissolves in ether, 30 parts of alcohol, and with difficulty in water. *Berbamine* ($C_{18}H_{19}NO_3$) is crystalline and soluble in water, alcohol, and ether. The wood contains berberine and oxyacanthine.

The flowers and berries of this species (as of *B. aquifolium* L.) contain berberine, oxyacanthine, 3.5 to 4.7 per cent. of sugar, 6 to 6.6 per cent. of malic acid, and some volatile oil.

2. A group of semi-prostrate Rocky Mountain species classed by Nuttall as a separate genus, *Mahonia* (chiefly *B. aquifolium* Pursh), known as *Oregon grape-root, Rocky Mountain grape, Holly-leaved barberry*, or *California barberry*, and having a very high repute among miners and frontiersmen. The entire root is used. It closely resembles the last, but the bark is either nearly smooth or somewhat fissured, very little inclined to scale. The wood is also rather tougher than the last, and of a rather deeper yellow. The roots rarely exceed 2 inches in diameter, and are flexuous and somewhat knotty. The prostrate stem, or pseudorhizome, is frequently buried and rooting, and is collected with the root. The composition and properties of Oregon grape-root practically agree with those of *B. vulgaris*.

3. A Himalayan group, the species most used being *B. Asiatica* Roxb. (*Darhalad*, Hind.). Both the bark and the root are employed, and they are very similar in all respects to those of *B. vulgaris*. *B. aristata* DC. has been found to contain more than 2 per cent. of berberine.

Nearly 50 species are recorded as being similarly used.

Fig. 61.

Berberis aquifolium (¾ Nat.).

Pharmaceutical Preparation.—Fluidextract of Berberis, U. S.

Action and Uses.—Moderate doses of berberis act as a tonic, stimulant, and antiperiodic; larger amounts, as an active cathartic and hepatic stimulant. It is also said to be diuretic and antiscorbutic. Berberis has been given in atonic dyspepsia, diarrhœa, and dysentery, intermittent, remittent, and typhoid fevers, and in chronic enlargement of the spleen resulting from malarial infection. It has been suggested in the treatment of infantile and tubercular diarrhœa and in scorbutic and scrofulous conditions, but its employment has not been attended with any more success than that derived from the administration of other bitter tonics and purges.

The dose is stated to be from 5 to 12 grains (0.30–0.60 Gm.), in powder, pill, or capsule. The dose of the fluidextract is from 5 to 12 minims (0.30–0.60 Cc.), several times daily. An infusion, 2 drachms (8 Gm.) to 1 pint (480 Cc.), may be given in tablespoonful doses.

Berberis aquifolium has been employed as an antisyphilitic, antiperiodic, and tonic, and is said to have been successfully used in the treatment of inveterate cases of psoriasis and eczema and in chronic uterine diseases. It has also been suggested in atonic dyspepsia with constipation.

Berberidaceæ.—This family, of 8 genera and about 130 species, besides yielding the important drugs Podophyllum, Caulophyllum, and Berberis, elsewhere considered, contributes several minor drugs, the most important being *Jeffersonia*.

Jeffersonia (*Twin-leaf, Yellow root, Helmet pod, Ground-squirrel pea*), the rhizome and roots of *Jeffersonia diphylla* (L.) Pers. (*Podophyllum d.* L.; *J. binata* Bart.; *J. Bartonis* Mx.).—This is a low perennial herb, growing abundantly in rich forest-land between the Alleghenies and the Mississippi River, flowering in early spring. The leaves are radical, long-petioled, of 2 obliquely ovate leaflets. The scape is nearly a foot high, and terminates in a white flower, about 1 inch broad, of 4 fugacious sepals and 8 petals and stamens, followed by a many-seeded obovoid capsule. The rhizome somewhat resembles that of Caulophyllum, but is shorter. It is knotty, yellowish-brown, and matted with numerous long fibrous roots of similar color. It has little odor, but a bitter and acrid taste. Like its relatives, it contains berberine (but little) and a white alkaloid. It contains also an acrid glucoside of the nature of saponin, and perhaps another similar one resembling polygalic acid, resin, tannin, starch, and a little sugar. Its action and uses are very similar to those of Caulophyllum, or perhaps even more like those of Senega.

The leaves of *Epimedium alpinum* L. (*Bischofschmütze, Sockenblume*), of the Alps, are used as a diaphoretic, are credited with preventing conception, and are applied to swollen breasts.

The tuberous rhizome of *Leontice Leontopetalum* L., of the Mediterranean region, appears to have a composition similar to that of *Jeffersonia*. It is used as an antidote to opium- and snake-poisoning; so also is *Nandina domestica* Thunb., of Japan.

BETANAPHTHOL, *U. S.*—Betanaphthol.

Naphthol, Br.; *Naphtholum*, P. G.; *Naphtol*, U. S., 1890; *Naphthol β*, Fr. Cod.; *Naphtol, β-Naphthol, Beta-mono-hydroxy-naphthalene, Iso-naphthol*, E.; *Beta-Naphthol*, G.

Formula, $C_{10}H_7OH$. Molecular weight, 142.98.

A phenol occurring in coal-tar, but usually prepared artificially from naphthalene. It should be preserved in dark amber-colored, well-stoppered bottles.—U. S.

Naphthol was first prepared by Schäffer (1869) by fusing beta-naphthalene sulphonic acid with potassium hydroxide, and later (1876) by Liebermann by action of nitrous acid on beta-naphthylamine.

Preparation.—Concentrated sulphuric acid is allowed to act on naphthalene for several hours at a temperature of 200° C. (392° F), whereby β-naphthalene sulphonic acid is formed ($C_{10}H_7.HSO_3$); during the early stage of the process, and particularly at 80°–90° C. (176°–194° F.), much alpha acid is produced, but at a higher heat this is converted into the beta variety. The acid is next dissolved in water, saturated with milk of lime, and the resulting calcium salt separated by crystallization; this is redissolved in water and decomposed by sodium carbonate, yielding sodium-naphthalene-sulphonate, $C_{10}H_7SO_3Na$. The sodium-salt is next added to fused sodium hydroxide, and thus sodium-naphthol, $C_{10}H_7ONa$, and sodium sulphite, Na_2SO_3, are obtained; the former is treated with hydrochloric acid, yielding β-naphthol and sodium chloride. Betanaphthol thus obtained is purified by sublimation and final recrystallization from hot water or benzin (petroleum ether). Medicinal naphthol should be free from alpha-naphthol, with which the commercial varieties are frequently contaminated to the extent of 5 per cent. or more.

Properties and Tests.—Colorless or pale buff-colored, shining, crystalline laminæ, or a white or yellowish-white crystalline powder, having a faint phenol-like odor, and a sharp and pungent, but not persistent taste. Permanent in the air. Soluble at 25° C. (77° F.) in about 950 parts of water and in 0.61 part of alcohol (at 15° C. (59° F.) in 1000 parts of water or 0.75 part of alcohol, Br. and P. G.); in about 75 parts of boiling water, and very soluble in boiling alcohol. Also very soluble in ether, chloroform, or solutions of caustic alkalies. When heated betanaphthol sublimes easily. It is also volatilized with the vapors of alcohol or water. It melts at 122° C. (251.6° F.) and boils at 286° C. (546.8° F.). On ignition it leaves no residue. It is neutral to litmus-paper moistened with alcohol. A cold, saturated, aqueous solution of betanaphthol, when mixed with ammonia-water, exhibits a faint bluish fluorescence. Chlorine- or bromine-water, added to the aqueous solution, produces a white turbidity, which disappears on adding ammonia-water in excess. On adding about 0.1 Gm. of betanaphthol to a few Cc. of a concentrated, aqueous solution (1 in 4) of potassium hydroxide, then about 1 Cc. of chloroform, and gently warming, the aqueous layer will acquire a blue tint, changing after a while to green and brown. Ferric chloride test-solution colors an aqueous solution of betanaphthol greenish, and after some time causes the separation of white flakes, which turn brown upon the application of heat. On dissolving betanaphthol in 50 parts of ammonia-water, no residue should be left (absence of naphthalene), and the solution should not have a deeper tint than pale yellow (absence of other organic impurities). An aqueous solution of betanaphthol on the addition of chlorinated lime should show a pale-yellow color and not a dark violet (distinction from, and absence of, alphanaphthol). If a few drops of iodine test-solution be added to an aqueous solution of betanaphthol and followed by sodium hydroxide test-solution in excess, no color should appear (distinction from, and absence of, alphanaphthol, which produces an intensely violet color).—U. S. 0.1 Gm. of betanaphthol dissolved in 10 Cc. of boiling water, and treated with 10 drops of a 3 per cent. aqueous solution of ferric chloride, gives a white precipitate, becoming brown, but not violet (absence of alphanaphthol).—Br. Iodic acid substituted for the ferric chloride in the previous test gives similar color reactions. A cold saturated solution of aqueous betanaphthol gives a white turbidity with solution of chlorine, which, on the addition of excess of ammonia-water, gives place to a green or brown coloration (Br.). Betanaphthol containing as little as 1 per cent. of alphanaphthol gives a violet to violet-rose color when a saturated aqueous solution of the same, previously diluted with an equal volume of water, is treated with 3 drops of solution of sodium hypobromite.

Action and Uses.—Betanaphthol is employed both internally and externally as an antiseptic. It has been recommended internally as an antiseptic in the treatment of enteric fever, fetid diarrhœa, and gastric fermentation accompanied with flatulence. It may be locally applied in the form of an ointment containing from 10 to 15 per cent. of the drug in the treatment of scabies, psoriasis, pruritus, acne, and lupus. The internal dose is from 2 to 5 grains (0.12–0.30 Gm.), in capsule, several times daily.

Derivatives and Allied Compounds.—ALUMNOL, *Aluminum naphtholsulphonate.*—Introduced by Heinz and Liebrecht toward the close of the year 1892 as an astringent antiseptic. It is obtained by mutual decomposition between aluminum sulphate and barium naphtholsulphonate. An almost colorless non-hygroscopic powder readily soluble in cold water or glycerin ; it is less soluble in alcohol and insoluble in ether. The aqueous and alcoholic solutions show a blue fluorescence and have an acid reaction. A peculiar reaction of alumnol consists in the precipitation of solutions of albumen and gelatin, the precipitate being redissolved by an excess of the latter substance. A 40 per cent. solution prepared with hot water remains clear upon cooling ; an aqueous solution of alumnol is colored blue by ferric chloride.

ASAPROL, *Abrastol, Calcium beta-naphthol-alpha-monosulphonate.* $(C_{10}H_6.OH.SO_3)_2Ca + 3H_2O$.—This compound was introduced by Stackler and Duleif as an antiseptic in 1892. It is obtained by neutralizing the free acid with calcium carbonate, concentrating the solution and crystallizing. Asaprol occurs as a colorless neutral crystalline powder soluble in 1½ parts of water and 3 parts of alcohol. Its aqueous solution is colored blue by ferric chloride. It has been given internally in doses of from 15 to 60 grains (1 to 4 Gm.) a day.

BENZONAPHTHOL. *β-Naphthol benzoate, Benzoyl-naphthol. Benzoesäure-β-Naphthol-ester,* G. $C_6H_5CO_2.C_{10}H_7$.—Benzonaphthol is obtained by the action of benzoyl chloride on betanaphthol. The reaction begins at 125° C. (257° F.), and is completed in half an hour at 170° C. (408° F.). The product is washed several times with dilute solution of sodium hydroxide and recrystallized from hot alcohol. It occurs as a white crystalline powder melting at 107° C. (224.6° F.). It is tasteless, odorless, and insoluble in water and dilute sodium hydroxide solution, but soluble in alcohol, chloroform, and hot ether. It dissolves in concentrated sulphuric acid with a yellowish color, which, diluted with about 10 volumes of water and supersaturated with ammonia, develops a strong green fluorescence. Administered internally it splits up into β-naphthol and benzoic acid in the intestines. It is used more particularly as an intestinal antiseptic, and administered in doses of from 4 to 8 grains (0.25 to 0.50 Gm.) in capsules, or suspended in syrup and water.

BETOL OR BETANAPHTHOL SALICYLATE, *Naphthalol, Naphthosalol, Salinaphthol.* C_6H_4-$OHCO_2.C_{10}H_7$.—A crystalline compound analogous to salol and prepared in a manner identical with that employed for the latter substance, except that sodium-naphthol is used instead of sodium-phenol. In order to free the crude product from the accompanying sodium chloride and metaphosphate, it is well washed with water and then crystallized from its solution in alcohol. Pure betol occurs as a colorless lustrous crystalline powder, without odor and taste and melting at 95° C. (203° F.) ; it is insoluble in water or glycerin, difficultly soluble in turpentine and cold alcohol, but readily soluble in boiling alcohol, ether, benzene, and warm linseed oil. Betol is not affected in the cold by moderately strong acids or solutions of the caustic alkalies, but when heated with concentrated solution it is split up into salicylic acid and beta-naphthol. As in the case of salol, the same effect is produced by the alkaline pancreatic juice and other intestinal ferments, but gastric juice has no effect upon it. Betol is readily distinguished from salol by its much higher melting-point (salol melts at 43° C. (109.4° F.)), and by the production of a pure lemon-yellow colored solution with pure concentrated sulphuric acid, which a trace of nitric acid changes to olive brownish-green ; salol gives no such color reactions. Betol has been administered in cases of vesical catarrh and articular rheumatism in doses of 5 or 6 grains 4 times a day. Alphol is the corresponding salicylic ester of α-naphthol.

CAMPHORATED NAPHTHOL is a brownish transparent, syrupy liquid, obtained by mixing 1 part of beta-naphthol with 2 parts of camphor ; it has been used with success in the antiseptic treatment of boils, coryza, etc. The pain caused by painting the diseased parts with camphor-naphthol may be alleviated by the addition of cocaine.

DIIODO-BETA-NAPHTHOL or NAPHTHOL-ARISTOL. $C_{10}H_6I_2O_2$.—A greenish-yellow compound, odorless and tasteless, insoluble in water, sparingly soluble in alcohol, ether, or acetic acid, but freely soluble in chloroform ; when heated, it evolves violet fumes. It is made by mixing a solution of 2.4 parts each of iodine and potassium iodide with a solution of 11 parts of beta-naphthol and 4 parts of sodium carbonate, and then adding to the mixture a solution of sodium hypochlorite, which precipitates the new compound.

EPICARIN. *β-Oxynapthyl-o-Oxy-m-Toluylic Acid.* $(COOH)(OH)C_6H_3.CH_2.C_{10}H_6.OH$.—A parasiticide occurring commercially as a pure and as an impure variety, the latter used for veterinary purposes. Epicarin (pure) is prepared by recrystallizing "Epicarinum Veterinarium" from glacial acetic acid and drying the crystals at 120° C. (248° F.) or recrystal-

lizing them from alcohol. A colorless crystalline powder, difficultly soluble in chloroform, glacial acetic acid, benzene, oils, and hot water, but easily soluble in alcohol, acetone, and ether. It melts at 199° C. (390.2° F.). Its alcoholic solution is colored blue by ferric chloride. Concentrated sulphuric acid dissolves epicarin to a reddish-brown solution with a green fluorescence. The alkali salts of epicarin are soluble in water and alcohol. Epicarinum veterinarium occurs as a yellowish to reddish-colored crystalline powder. Epicarin is a non-poisonous antiseptic and parasiticide. Administered internally it is excreted mostly undecomposed. It has been found useful in the treatment of skin diseases, particularly scabies, herpes tonsurans, prurigo, and certain eczemas (*Apoth. Ztg.*, Feb. 21, 1900, 126). It is applied in the form of a 10 per cent. solution, or 10 to 20 per cent. ointment (*Dermatol. Zeitschrift*, 7, p. 1052).

HYDRONAPHTHOL.—A substance claimed to be a derivative of beta-naphthol, produced by acting upon the latter with reducing agents. It is stated to crystallize in silver-white laminæ, of a slight aromatic odor, and dissolving readily in alcohol, ether, chloroform, glycerin, benzene, and fixed oils, but requiring 1000 parts of water for solution. It melts at about 117° C. (242.6° F.). Commercial hydronaphthol is said to be merely impure beta-naphthol. Hydronaphthol has been suggested as a substitute for carbolic acid on account of its greater antiseptic power and because it is non-toxic and non-corrosive. It is not decomposed by organic matter, and is said to destroy the parasite causing *tinea tonsurans*.

LACTOL. *Lactonaphthol. β-Naphthol Lactate.* $CH_2CH.(OH)CO_2.C_{10}H_7$.—Phosphoric oxychloride is allowed to act at 120°–130° C. (248°–266° F.) upon molecular proportions of β-naphthol sodium and sodium lactate. The product is washed with water and crystallized from alcohol. Colorless crystals soluble in alcohol, but insoluble in water.

MICROCIDIN. *β-Naphthol-sodium.* $C_{10}H_7.ONa$.—Under this name a compound was recommended by Polaillon as an antiseptic, which is practically sodium-naphthol, and is obtained as a white powder by fusing beta-naphthol with half its weight of sodium hydroxide, and cooling. It is soluble in water (about 3 parts) and is non-caustic, and is used as a surgical antiseptic in aqueous solution containing from 0.3 to 0.5 per cent. of microcidin.

NAPHTHOL-BISMUTH.—*Betanaphthol-Bismuth, Orphol.* $C_{10}H_7O.Bi_2O_2(OH)$ or $(C_{10}H_7O)_3Bi + 3H_2O$(?).—The composition of this product is variously stated by different authors. It is said to be formed by the action of an alkaline solution of beta-naphthol on a solution of bismuth ternitrate in dilute glycerin, and occurs as a light-brown odorless powder, having but a slight, rather aromatic taste. It is insoluble in alcohol as well as water, and splits up in the intestines into naphthol and bismuth. Orphol is used as an intestinal astringent and antiseptic in the treatment of cholera infantum, gastro-intestinal catarrh, and typhoid fever in adult doses of 7.7 grains (0.5 Gm.), 5 or 6 times a day.

ALPHANAPHTHOL, isomeric with the beta-compound, may be obtained in the manner stated above; its chief use has been as a test for sugar in urine, as follows: If 1 drop of urine with 1 drop of a 10 per cent. solution of alpha-naphthol in chloroform is placed in a test-tube with 15 minims of water and concentrated sulphuric acid be then carefully poured in so that the chloroformic solution floats on it, a beautiful violet ring is formed at the line of contact of the two liquids if only $\frac{1}{30}$ per cent. of sugar be present (Molish and Luther). It resembles β-naphthol, but is more readily soluble in water, and according to M. Maximovitch (*Therap. Gaz.*, 24, 402) is three times more powerful as an antiseptic than beta-naphthol, and only one-third as poisonous. It melts at 95° C. (203° F.), and boils at 278° to 280° C. (532.4°–536° F.), and is distinguished from betanaphthol by the color reactions (see above). Alphanaphthol is official in the French Pharmacopœia.

BETULA.—Birch.

Birke, G.; *Bouleau*, Fr.; *Abedul*, Sp.

The bark and leaves of different species of *Betula* L. (Fam. *Betulaceæ*). There are about 35 species, aromatic trees, shrubs, or undershrubs, of the northern hemisphere. Their medicinal value depends partly upon natural constituents, partly upon those produced by destructive processes.

B. LENTA (*Sweet, Cherry, Spice*, or *Mahogany birch*, often incorrectly called *Black birch*, a name which properly belongs to *B. nigra* L.) is, medicinally, the most important species. It is abundant in the forests of northeastern North America, and southward in the mountains, preferring a sandy or gravelly loam. The young bark is of a beautiful dark glossy brown, with small light-colored spots. That of large trunks becomes nearly 12 Mm. (½ In.) thick, and roughly fissured, though the scales are thick and tenacious. Beneath the surface is a greenish or yellowish-green layer.

Constituents.—The important constituent is the glucoside *gaultherin*, which, upon decomposition, yields oil of birch, very similar to oil of wintergreen, and consisting of

almost pure methyl salicylate. There is also 3 or 4 per cent. of tannin. Gaultherin ($C_{14}H_{18}O_8+H_2O$) crystallizes in colorless needles, is soluble in alcohol, glacial acetic acid, and water, but not in chloroform, benzene, or acetone. It is very easily decomposed by water, even that in 94 per cent. alcohol being sufficient, doubtless through the action of an associated enzyme. It can be obtained unchanged by using a solution of lead acetate equal to 15 per cent. of the weight of the bark. It is easily decomposed by mineral acids or alkalies. The leaves contain the same constituents, and, like the bark, are largely used in domestic practice for their diuretic properties. The bark, as well as the oil, is largely employed as a flavoring agent.

Action and Uses.—Birch depends for its activity upon the volatile oil which it contains. This oil is nearly pure methyl salicylate, and is employed locally and internally for all conditions in which oil of wintergreen proves useful (see OLEUM GAULTHERIÆ). An infusion made with 1 ounce (30 Gm.) of the leaves and 1 pint (480 Cc.) of water, and also the saccharine juice which exudes from the tree when wounded, have been employed in the treatment of gouty and rheumatic conditions, in dropsy, and in diseases of the kidneys and bladder.

The dose of oil of birch is from 10 to 15 minims (0.60–1 Cc.), 3 times daily, usually administered in capsule. The infusion may be given in doses of from 1 to 2 fluidounces (30–60 Cc.).

Other Species.—*B. alba* L. (*B. verrucosa* Ehrh.), the European *White birch*, *Lady birch*, or *Ribbon tree*, is a native of northern Europe and Asia, represented in the United States by *B. populifolia* Marsh, long regarded as a variety of it. Its bark and leaves are aromatic, but the aroma is different from that of the last. The leaves are used similarly as a diuretic. Distilled with water, they yield ½ per cent. of a colorless, balsamic, and pungent volatile oil. Betuloresinic acid ($C_{36}H_{26}O_5$) exists as a whitish powder upon the young shoots and leaves. It is bitter, and dissolves in sulphuric acid with a red color. Upon dry distillation of the wood and bark, *birch-tar* or *Daggett* is obtained. This is the substance used in tanning Russian leather, and to which its agreeable odor is due. It yields the *oleum rusci* or *empyreumatic oil of birch*. The bark contains also a camphoraceous body, *betulin*, $C_{36}H_{60}O_3$, which forms light, flocculent, crystalline, tasteless masses, fusible at about 258° C. (496° F.), subliming when heated with care, and soluble in ether, volatile oils, hot alcohol, and alkalies. It forms a useful dyeing substance. On oxidation, one or more acids are obtained; and on dry distillation an oily body, which may be oleum rusci. Oleum rusci, or the empyreumatic oil obtained from this plant, has been used in the treatment of acne and other moist lesions of the skin, either in conjunction with an ointment-base or combined with ether and alcohol in the form of a lotion.

Quite a large number of other species of *Betula* are employed in domestic practice for their aromatic properties. The bark of *B. papyracea* Ait. is well known in the manufacture of Indian canoes.

BETULACEÆ.—This family, of 6 genera and about half a hundred species of shrubs and trees, yields a number of substances of pharmacological interest, outside of the genus *Betula*, just considered.

The ALDERS (*Alnus* Tournef) (*Erlenrinde*, *Erle*, *Eller*, G.; *Écorce d'aune*, *Aune*, Fr.; *Aile*, Sp.) comprise about 14 species, of which the barks of a number are used as mild astringents. They are largely used in Canada and elsewhere, in the powdered condition, for dusting upon chafed surfaces. The principal species employed are the *A. glutinosa* Gærtn. (*Betula alnus* L.), a tree of northern Europe and Asia, and *A. serrulata* Ait., a large shrub of North America. The European variety occurs in quills or curved pieces about 1.2 Mm. ($\frac{1}{20}$ In.) thick, smooth, of a brownish ash-gray color externally, the young bark with reddish-brown dots, the inner surface brownish-orange. It is almost odorless, and of an astringent and somewhat bitter taste; brittle, the fracture uneven but not splintery. The American variety, usually called *Black alder*, is of similar form, but blackish-gray with small suberous warts, the orange-brown inner surface more striate. The only active constituent of alder bark appears to be tannin, of which there is 4 or 5 per cent. The leaves and bark of A. *viridis* DC. are used as diaphoretics and as diuretics in dropsy, and a half dozen other species are employed locally as astringents and stomachics. The varieties of *Alnus* all possess astringent properties, and an infusion or decoction made with 1 ounce (30 Gm.) of either the leaves or bark and 1 pint (480 Cc.) of water has been given in doses of from ½ to 1 fluidounce (16–30 Cc.) in the treatment of diarrhœa and hæmaturia. The decoction may also be used as a mouth-wash or gargle in the treatment of stomatitis and pharyngitis. When injected into the vagina, it is said to cure leucorrhœa. *Alnus viridis* is said also to possess diuretic properties, and it may be efficacious in the treatment of dropsy.

The heart-wood and bark of *Ostrya Virginiana* (Mill.) Willd. (*Carpinus V.* Mill.; *O. Virginica* Willd.), the *Iron-wood*, *Hop hornbeam*, *Lever wood*, or *Black hazel*, of eastern North America, are bitter and employed as a substitute for quassia. Besides the bitter principle, there is about 5 per cent. of tannin. The wood is extremely hard and heavy. *Carpinus Cariolinana* Walt. (*C. Americana* Mx.), the *Iron-wood*, *American hornbeam*, *Blue*, *Water*, or *Horse beech*, of eastern North America, is often mistaken for Ostrya, but is not bitter. The

barks of both yield a yellow dyestuff. Iron-wood is said to be tonic, astringent, and antiperiodic. It may be employed in anorexia, diarrhœa, and intermittent fever. The dose in substance is from 30 to 60 grains (2–4 Cc.); of the fluidextract, from ½ to 1 fluidrachm (2–4 Cc.).

To this family also pertains the genus *Corylus* L., which yields the well-known filberts (*C. Avellana* L.) and hazelnuts, their kernels rich in bland fixed oil. The bark of *C. Avellana* yields a yellow dye. The bland oil obtained from the kernels of filberts may be employed for the same purposes as cotton-seed oil. The spicula covering the scaly involucre of *Corylus rostrata* is said to possess anthelmintic properties, which are probably due to its irritant effect.

BIGNONIACEÆ.—Calabash Family.

A large family, chiefly tropical, the plants mostly woody climbers. Aside from its highly ornamental character, it is of little importance, although a number of species are used in native medicine and have found a place in works on materia medica.

Catalpa (*Bean tree, Cigar tree, Candle tree*) is the bark or fruit of *Catalpa Catalpa* (L.) Karst. (*Bignonia C.* L.; *C. bignonioides* Walt.; *C. syringifolia* Sims), and of *C. speciosa* Warder (*C. cordifolia* Duham.), large trees of the eastern and southern United States. They bear large cordate leaves, of a peculiar satiny luster, ample panicles of 2-lipped, white flowers with purple and yellow spots, and 2-celled pods nearly a foot in length and half as thick as the finger, which hang upon the trees through most of the winter and spring. The seeds are numerous, thin, flat, and with a silky, membranaceous, fringed wing. The bark occurs mostly in quilled strips, about 6 Mm. (¼ In.) thick. It is gray-brown, glossy, and nearly smooth, except for its numerous small circular warts. The inner surface is smooth and white, becoming yellow or brownish with keeping. It has a slight peculiar odor and a very bitter taste. Both the bark and seeds contain tannin, resin, and sugar. E. A. Rau obtained from the bark a nauseous and bitter principle occurring in scales and soluble in ether, chloroform, and hot alcohol. F. K. Brown obtained 2 crystalline bodies from the seeds. Catalpa is rarely employed in medicine. The drug is said to possess emetic, vermifuge, and anodyne properties. A tincture made with 1 ounce (30 Gm.) of the seeds and pods in 1 pint (480 Cc.) of alcohol has been recommended in fluidrachm (4 Cc.) doses every 3 hours, in the treatment of asthma. The fresh juice obtained from the root is said to be valuable in treating chronic ophthalmia.

Catalpa speciosa is said to be a cardiac depressant, but its action has never been thoroughly studied.

Caroba, or Jacaranda, is the leaflets of *Jacaranda procera* (W.) Spreng. (*Bignonia p.* W.), *J. Caroba* (Vell.) DC. (*Bignonia C.* Vell.), and probably of other species of *Jacaranda*, these being tropical American trees. The leaflets pertain to a bipinnate leaf and vary greatly in size, being from 1 to 6 Cm. (⅖ to 2½ In.) long and about half as wide, elliptical to lance-oblong, oblique at the base, acute or obtusish, entire, coriaceous, glandular-hairy on both surfaces, and velvety along the veins underneath; nearly odorless, bitter, and astringent. They yield nearly 3 per cent. of the soft aromatic resin *carobone*, which is greenish and slightly acrid, about half as much of a balsamic substance having the odor of cumarin, an amaroid, tannin, tasteless resin, several acids, and the crystalline inodorous substance *carobin*. Caroba is said to be alterative, diaphoretic, and diuretic. An infusion or decoction is employed in Brazil in the treatment of syphilis, strumous conditions, and chronic rheumatism.

Oroxylum (*Arlu, Sona, Nasona*) is the bark and seeds of *Oroxylum Indicum* (Blume) Vent. (*Calosanthes I.* Blume), a small and curious tree of India, where the drug is largely used as an astringent, tonic, and alterative. Holmes describes the bark as "about 2 lines thick, the external portion consisting of a soft, spongy cork of a fawn or light-brown color, easily indented by the nail and striated longitudinally. The internal layer or liber is fibrous and of a greenish-yellow tint. It is nearly odorless and has an acrid and faintly bitter taste." The important constituents are fat, wax, pectin, sugar, an astringent principle, an acrid principle, and *oroxylin*, a peculiar crystalline principle, insoluble in water but readily soluble in alcohol and ether, and, even in very minute amount, yielding a cherry-red color with alkali hydroxides, quickly changing to brick-red and olive-green. The seeds, under the name of *damree*, have been found very efficacious as an application to a destructive cattle disease practically identical with *tinea tonsurans*.

Some 50 other species of the family have been recorded as of medicinal use, and the indications are that some of them, used in asthma and as hypnotics, will be found to possess valuable properties. The ripe fruit of *Kigelia pinnata* DC. contains a bitter principle and is used in tropical Africa as a purgative. While green, it is used as an alterative. The pulp of the fruit of the calabash (various species of *Crescentia*) is used in pulmonary diseases. The various parts of *Stereospermum chelonioides* (L.) DC. have many medicinal uses. *Newbouldia lævis* Seem., of West Africa, is an antidysenteric; the root of *Pajanelia multijuga* DC., of Malabar, is used to relieve headache and in the treatment of catarrh. A number of species of *Bignonia* and *Tecoma* are used in tropical America as sarsaparilla substitutes or as diuretics, and *T. radicans* (L.) Juss., of the southern United States, is a fish poison.

BISMUTHI CITRAS, *U. S.*—Bismuth Citrate.

Citrate de bismuth, Fr.; *Wismutcitrat, Citronensaures Wismutoxyd*, G.

Formula, $BiC_6H_5O_7$. Molecular weight, 394.52.

It should yield not less than 58 per cent. nor more than 60 per cent. of pure bismuth oxide.—U. S.

The salt is directed to be prepared by boiling together for about 15 minutes 100 parts of bismuth subnitrate, 75 parts of citric acid, and 400 parts of water. The reaction is over when some of the sediment yields a clear solution with ammonia water. 5000 parts of distilled water are then added, and the suspended matter is allowed to settle and finally washed by decantation and on the filter until the wash-water is tasteless, after which it is dried at a gentle heat.—U. S. This is the process of R. Rother, proposed in 1876, and consists in the decomposition of the subnitrate by citric acid at the boiling temperature. Yield, about 135 parts.

Properties.—Bismuth citrate is a white, amorphous or microcrystalline powder, odorless and tasteless, permanent in the air, insoluble in water or alcohol, but soluble in ammonia water and in solutions of alkali citrates. It chars when strongly heated and leaves a residue soluble in nitric acid. When dropped into water, this solution gives a white turbidity of bismuth subnitrate. Hydrogen sulphide precipitates black bismuth sulphide from its solution in ammonia; and when the filtrate is mixed with an equal volume of concentrated sulphuric acid and cooled, no dark color should appear around a crystal of ferrous sulphate dropped into the liquid (absence of nitrate). If 1 Gm. of the salt be thoroughly ignited in a porcelain crucible, and, after cooling, be dissolved by cautiously warming with nitric acid, evaporated to dryness, and again ignited, the residue of bismuth oxide should weigh not less than 0.58 Gm. nor more than 0.6 Gm. (U. S.). Tests for arsenic and heavy metals, chlorides, and sulphates are the same as under the following compound.

Action and Uses.—Bismuth citrate is not employed in medicine, but was made official for the purpose of preparing *Bismuthi et Ammonii Citras.*

BISMUTHI ET AMMONII CITRAS, *U. S.*—Bismuth and Ammonium Citrate.

Bismuthi ammonio-citras. Bismuthum citricum ammoniatum.—Citrate de bismuth ammoniacal, Fr.; *Wismutammoncitrat, Citronensaures Wismutammonium*, G.

It should yield not less than 48 per cent. of pure bismuth oxide.—U. S.

Preparation.—Bismuth citrate, 100 Gm.; ammonia-water, distilled water, each a sufficient quantity. Mix the bismuth citrate with 200 Cc. of distilled water to a smooth paste, heat the mixture on a water-bath, and gradually add ammonia-water until the salt is dissolved and the liquid has a neutral or only faintly alkaline reaction. Then filter the solution. Evaporate it to a syrupy consistence, and spread it on plates of glass, so that on drying the salt may be obtained in scales. Keep the product in small, well-stoppered vials, protected from light.—U. S.

Rother (1876) states that dry bismuth citrate yields with ammonia water a syrupy liquid and a hard white mass, the latter being unaffected by excess of ammonia, but dissolving on the application of a gentle heat; this solution crystallizes on cooling, and the crystals, after being dried on a water-bath, are again soluble in water, and may be regarded as a compound of triammonium citrate with bismuth hydroxide, having the formula $(NH_4)_3C_6H_5O_7Bi(OH)_3$. Since the Pharmacopœia makes no provision for supplying the ammonia lost during the concentration of the liquid, the salt will have a more or less variable composition, probably approaching that determined by N. Gray Bartlett (1865) for a salt prepared by a similar process, namely, $BiC_6H_5O_7NH_4OH.2H_2O$ (molecular weight, 468.33). The yield by the official process is about 120 Gm.

Properties.—Bismuth and ammonium citrate occurs in small, shining, pearly or translucent scales, odorless, having a slightly acidulous and metallic taste, and becoming opaque on exposure to the air, very soluble in water, and but very sparingly soluble in alcohol. When strongly heated, the salt fuses, then chars, and leaves a more or less blackened residue having a yellow surface and soluble in warm nitric acid. This solution, when dropped into water, occasions a white turbidity. The aqueous solution of the salt is neutral or faintly alkaline to litmus-paper. When boiled with potassium or sodium hydroxide test-solution, it evolves the vapor of ammonia, and when treated with hydrogen

sulphide it yields a black precipitate. If the filtrate from the latter be deprived by heat of the excess of hydrogen sulphide and cooled, a portion of it, boiled with lime-water, produces a white precipitate (citrate). If another portion of the filtrate be mixed with an equal volume of concentrated sulphuric acid and cooled, no brown or brownish-black zone should appear around a crystal of ferrous sulphate dropped into the liquid (absence of nitrate). If 3 Gm. of the salt be ignited and the residue, dissolved in the least amount of nitric acid, be poured into 100 Cc. of water, and the filtrate, separated from the precipitated subnitrate, be evaporated to 30 Cc., refiltered and divided into 5 Cc. portions, these should respond to the tests for purity given under BISMUTHI SUBCARBONAS. —U. S. No evidence of arsenic should be obtained when 3 Gm. of the salt are ignited and tested by the Bettendorf method, as given under ARSENI TRIOXIDUM.

The dry salt slowly loses ammonia on keeping, thereby becoming partly insoluble in water; the cautious addition of a few drops of ammonia water to such a turbid mixture will then usually make a perfect solution.

Action and Uses.—This salt differs from the insoluble salts of bismuth in being more astringent and irritating. It may be employed in internal medicine in the treatment of serous diarrhœa resulting from a relaxed condition of the mucous membrane of the intestinal tract; but it should never be given when acute inflammation or irritation is present. The dose is from 2 to 4 grains (0.12–0.25 Gm.), best administered in solution.

BISMUTHI OXIDUM, *Br.*—Bismuth Oxide.

Bismuthum oxydatum.—*Oxyde de bismuth*, Fr.; *Wismutoxyd*, G.

Formula, Bi_2O_3. Molecular weight, 461.44.

Preparation.—The present British Pharmacopœia gives no details of preparation. Former directions were as follows: Take of bismuth subnitrate, 1 pound; solution of soda, 4 pints. Mix and boil for 5 minutes; then, having allowed the mixture to cool and the oxide to subside, decant the supernatant liquid, wash the precipitate thoroughly with distilled water, and finally dry the oxide by the heat of a water-bath. In this process the bismuth subnitrate is decomposed by the soda, sodium nitrate and white bismuth hydroxide being formed, the former of which remains dissolved in the water: $2(BiONO_3.H_2O) + 2NaOH$ yields $2Bi(OH)_3$ or $Bi_2O_3.3H_2O + 2NaNO_3$. On drying the precipitate without heat, it loses water and leaves *bismuthyl hydroxide*, BiO.OH, but at the temperature of boiling water the anhydrous oxide is left.

Properties.—Bismuth oxide forms a dull-yellow more or less crystalline powder, which dissolves in mineral acids without effervescence, and these solutions are colorless and yield black precipitates with hydrogen sulphide, and white ones with alkalies, alkali carbonates, and much water, the precipitates being insoluble in an excess of the precipitants. When heated to incipient redness, the oxide is not diminished in weight. At a higher temperature it fuses to a brown mass, which becomes yellow again on cooling. The oxides of lead and silver are likely to be present as impurities, and are detected by dissolving in nitric acid and testing as described under Bismuthi Subnitras. Each Gm. should yield 1.1 Gm. of bismuth sulphide (Br.).

Action and Uses.—Oxide of bismuth may be employed for the same purposes as the subnitrate of bismuth. Its dose is from 5 to 20 grains (0.3–1.3 Gm.).

BISMUTHI SUBCARBONAS, *U. S.*—Bismuth Subcarbonate.

Bismuthi carbonas, Br.; *Bismuthum subcarbonicum.*—*Carbonate of bismuth, Bismuthyl carbonate, Bismuth oxycarbonate*, E.; *Sous-carbonate de bismuth*, Fr.; *Wismutsubcarbonat, Basisches kohlensaures Wismutoxyd*, G.

Formula, $(Bi_2O_2CO_3)_2.H_2O$, Br.; $(BiO)_2CO_3.H_2O$(?). Molecular weight, 522.99(?).

It should yield not less than 90 per cent. of pure bismuth oxide.—U. S.

Preparation.—Neither the United States nor the British Pharmacopœia gives an official process. The British states that it may be prepared by the action of ammonium carbonate on bismuth nitrate. The details of such a process may be stated as follows: Mix 4 fluidounces of nitric acid with 3 fluidounces of distilled water, and add 2 ounces of purified bismuth in small pieces in successive portions. After the action is

over, heat for 10 minutes at nearly the boiling-point, let settle, and decant from any insoluble matter present. Evaporate the solution to 2 fluidounces and add it a little at a time to a cold filtered solution of 6 ounces of ammonium carbonate in 2 pints of distilled water, with constant stirring. Filter, and wash the precipitate until the washings are tasteless. Dry at a temperature not above 65.6° C. (150° F.) (Br. 1885).

Most metallic bismuth contains some arsenic, which is also oxidized by the nitric acid, so that bismuth arsenate is found in the solution, unless purified bismuth has been used. In order to remove nearly the whole of the arsenic, the nitric acid solution may be diluted with sufficient distilled water until it remains faintly milky after stirring; on being set aside for a day most of the arsenate will be found deposited as a white crystalline precipitate. The clear solution, still retaining a small proportion of arsenic, may be almost completely deprived of it by pouring it into an excess of ammonia water, whereby soluble ammonium nitrate and arsenate are formed, while bismuth hydroxide is precipitated; this may then be converted into subcarbonate by dissolving in sufficient nitric acid, pouring the liquid slowly and with constant stirring into a solution of sodium carbonate, draining the precipitate upon a strainer, and washing it with distilled water. This process was originally proposed by Dr. Squibb, and adopted in the U. S. P. 1870. In following this process it is important that the dilution with water should be carried sufficiently far to cause a turbidity which does not disappear completely on stirring; this solution should be set aside for a sufficient length of time, as indicated; the acid solutions should be added slowly and with continual stirring to the alkaline solutions, in order to insure the complete decomposition of the acid salt; and the washing should not be continued for too long a time, in order to avoid gradual decomposition of the subcarbonate into hydrate. If the final precipitation be effected at a boiling temperature, an anhydrous subcarbonate would be precipitated. The final reaction may be explained by the equation: $2Bi(NO_3)_3 + 3Na_2CO_3 + H_2O = (BiO)_2CO_3.H_2O + 6NaNO_3 + 2CO_2$, showing that carbon dioxide is given off.

Properties.—Bismuth subcarbonate is a white or pale yellowish-white powder of somewhat varying chemical composition, odorless and tasteless, and permanent in the air. It is insoluble in water or alcohol, but completely soluble in nitric or hydrochloric acid with copious effervescence. When heated to redness, the salt loses water and carbon dioxide, and should leave not less than 90 per cent. of a yellow residue which is soluble in nitric or hydrochloric acid and blackened by hydrogen sulphide.—U. S.

Tests.—If 3 Gm. of the salt be dissolved in just a sufficient quantity (about 4 Cc.) of warm nitric acid, and the solution poured into 100 Cc. of water, a white precipitate is produced (subnitrate). After filtering, and evaporating the filtrate on a water-bath to 30 Cc., again filtering, and dividing this filtrate into portions of 5 Cc., these should respond to the following tests: On mixing one portion with an equal volume of diluted sulphuric acid it should not become cloudy (absence of lead). If another portion be precipitated with a slight excess of ammonia water, the supernatant liquid should not exhibit a bluish tint (absence of copper). Other portions should not be affected by barium nitrate test-solution (sulphate), nor yield, with hydrochloric acid, a precipitate which is insoluble in a slight excess of the latter (silver). If 1 Gm. of the salt be boiled with 10 Cc. of a mixture of equal parts of acetic acid and water, and the cold filtrate freed from bismuth by hydrogen sulphide, the new filtrate should leave no fixed residue on evaporation (absence of alkalies and alkaline earths). On boiling 1 Gm. of the salt with 10 Cc. of sodium hydroxide test-solution, it should not evolve the odor of ammonia. If 0.05 Gm. of the salt be shaken with 5 Cc. of a mixture of equal parts of water and ferrous sulphate test-solution, and then cautiously poured upon 5 Cc. of sulphuric acid (free from nitrous compounds), no brownish-red zone should form at the line of contact (limit of subnitrate). If 0.1 Cc. of tenth-normal silver nitrate be added to 0.3 Gm. of the salt dissolved in 10 Cc. of diluted nitric acid, and the precipitate, if any, filtered off, the clear filtrate should not be affected by addition of more of the silver solution (limit of chloride). 2 Gm. of the salt should not respond to the Bettendorf test for arsenic (see under ARSENI TRIOXIDUM).—U. S.

The Br. P. requires that 1 Gm. dissolved in hydrochloric acid and diluted with water acidified with the same acid, when treated with hydrogen sulphide, should yield a precipitate weighing, after rapidly washing and drying at 100° C. (212° F.), 0.99 Gm., corresponding to 89.7 per cent. of Bi_2O_3. F. A. Upsher Smith (*Pharm. Jour.*, Dec. 15, 1900) thinks this method troublesome and liable to give erroneous results in inexperi-

enced hands, and he therefore prefers the determination of bismuth as oxide as being simpler and more reliable.

Action and Uses.—The subcarbonate of bismuth may be used interchangeably with the subnitrate of bismuth, as its effects are practically identical.

BISMUTHI SUBGALLAS, *U. S.*—Bismuth Subgallate.

Bismutum subgallicum, P. G.; *Bismuthyl gallate*, E.; *Sous-gallate de bismuth*, Fr.; *Basisches Wismutgallat (gallsaures Wismutoxyd)*, *Wismutsubgallat*, G.

Formula, $C_6H_2(OH)_3COOBi(OH)_2$(?). Molecular weight, 408.43(?).

It should yield not less than 52 per cent. nor more than 57 per cent. of pure bismuth oxide.—U. S.

Preparation.—Dissolve 15 parts of normal bismuth nitrate in 30 parts of glacial acetic acid, add 200 to 250 parts of water, and filter. To the filtrate add with constant stirring a warm solution of 5 parts of gallic acid in 200 or 250 parts of water. The resulting precipitate is separated by decantation and washed until free from nitric acid; it is then dried at 100° C. (212° F.).

Properties.—It is known commercially as *dermatol*. Bismuth subgallate occurs as an impalpable, lemon-yellow, odorless powder, permanent in the air, and insoluble in all ordinary solvents. It may be sterilized at 100° C. (212° F.) and is indifferent to light. The composition of the commercial samples varies slightly. L. F. Kebler found 52.73 per cent. and 54.63 per cent. as the lowest and highest content, respectively, of Bi_2O_3 in 10 samples examined (*Am. Jour. Pharm.*, 1899). The per cent. of Bi_2O_3 according to the formula above is 54.33. The compound was prepared and described by H. Bley, in 1841, but was lost sight of until 1891, when B. Fischer again prepared and described it. It is readily soluble, with decomposition, when heated with hydrochloric, nitric, and sulphuric acids, but is insoluble in very dilute solutions of these acids. It is easily dissolved by the alkalies, forming a clear yellow solution, which rapidly changes to a deep red. It loses from 5 to 7 per cent. of water at 120° C. (248° F.), and on heating to redness it first chars and finally leaves a yellow residue, which is soluble in hydrochloric and nitric acids and is blackened by ammonium sulphide solution (bismuth). When 0.1 Gm. of the salt is thoroughly shaken with an excess of hydrogen sulphide solution, the black precipitate of bismuth sulphide filtered off, and the filtrate boiled to expel the hydrogen sulphide and cooled, it will assume a blue-black coloration upon adding 1 drop of ferric chloride test-solution (gallic acid).

Tests.—If 1 Gm. be incinerated and the yellow residue dissolved in nitric acid, cautiously evaporated to dryness and heated again, not less than 0.52 Gm. nor more than 0.57 Gm. of Bi_2O_3 should remain. The residue resulting from 2 Gm. of the salt, as just described, should not respond to the Bettendorf test for arsenic (given under ARSENI TRIOXIDUM). If 3 Gm. of the salt be ignited, cooled, cautiously dissolved in nitric acid by warming, evaporated and again ignited, then redissolved in about 4 Cc. of nitric acid and further treated as described under BISMUTHI ET AMMONII CITRAS, 5-Cc. portions of the resulting liquid should respond to the tests for purity given under BISMUTHI SUBCARBONAS. The filtrate from 0.5 Gm. of the salt, well shaken with 5 Cc. of alcohol, should not turn moistened blue litmus-paper red (absence of free gallic acid). If 0.5 Gm. of the salt be well mixed with 5 Cc. of diluted sulphuric acid and 5 Cc. of ferrous sulphate test-solution, and the mixture carefully poured upon 5 Cc. of sulphuric acid (free from nitrous compounds), no brown ring should appear after standing for 10 minutes (limit of nitrate).—U. S.

1 Gm. dissolved in 5 Cc. of sodium hydroxide solution and warmed with a mixture of 0.5 Gm. each of zinc filings and powdered iron, should give no ammonia (absence of nitrate). A mixture of 1 Gm. of the subgallate and 3 Cc. of stannous chloride solution should not assume a dark color in one hour (absence of arsenic). The filtrate from 1 Gm. of the subgallate shaken with 10 Cc. of alcohol should not leave a weighable residue when evaporated.—P. G.

Action and Uses.—The subgallate of bismuth, largely used under the trade name of dermatol, has been introduced as an absorbent and astringent dressing-powder in various eruptions and irritations of the skin accompanied by excessive secretion. By its physiological properties it aids in drying up secretion, and by its astringent effect constricts the bloodvessels in the inflamed part. It has also been used internally in the treatment of diarrhœa and dysentery, in the dose of from 5 to 20 grains (0.3–1.3 Gm.).

BISMUTHI SUBNITRAS, *U. S.*, *Br.*—Bismuth Subnitrate.

Bismutum subnitricum, P. G.; *Bismuthum hydrico-nitricum*, *Magisterium bismuthi.*—*Bismuthyl nitrate*, E.; *Sous-azotate* (*Sous-nitrate*) *de bismuth*, Fr.; *Basisches Wismutnitrat* (*salpetersaures Wismutoxyd*), *Wismutsubnitrat*, G.

Formula, $BiONO_3HO_2$, Br. Molecular weight, 302.23.

It should yield not less than 80 per cent. of pure bismuth oxide.—U. S.

Preparation.—No method is given in the present United States and British Pharmacopœias.

In the method of the German Pharmacopœia, 1 part of bismuth is dissolved in 5 parts of nitric acid, specific gravity 1.2, previously heated to 75°–90° C. (167°–194° F.). After standing several days the solution is decanted and evaporated to crystallization. 1 part of the crystals is then rubbed uniformly with 4 parts of water and poured while stirring into 21 parts of boiling water. The precipitate is collected, drained, and washed with a volume of cold water equal to the filtrate, and then dried at 30° C. (86° F.). In this process the arsenic is gotten rid of as bismuth arsenate by allowing the first solution to subside for some days, and finally crystallizing the bismuth ternitrate, which salt is afterward decomposed by boiling water.

A former method of the Br. was as follows: Mix 4 fluidounces of nitric acid with 3 ounces of distilled water; dissolve in this 2 ounces of purified bismuth in small pieces. After solution heat for 10 minutes nearly to the boiling-point and decant from any sediment. Evaporate the solution to 2 fluidounces and pour it into ½ gallon of distilled water, let settle, decant, add ½ gallon of distilled water, stir the precipitate well, and after 2 hours decant the liquid, collect and dry the precipitate at a temperature not above 150° C. (302° F.).

By dissolving the metal in nitric acid the latter is partly decomposed, nitric oxide being evolved and water generated, while the bismuth dissolves, forming normal bismuth nitrate; thus, $Bi_2 + 8HNO_3 = 2Bi(NO_3)_3 + 2NO + 4H_2O$. Other metals likely to be present are dissolved with the formation of nitrates, except arsenic, which is oxidized to arsenic acid. The bismuth having been previously purified, the solution practically should contain only bismuth nitrate. The latter requires now to be converted into the subnitrate, which is accomplished by water. The most uniform results are obtained by adding the acid solution to a definite quantity of cold water; the decomposition taking place may be explained by the following equation: $6Bi(NO_3)_3 + 10H_2O = 5BiONO_3H_2O + Bi(NO_3)_3 + 10HNO_3$. The nitric acid which is liberated will retain a portion of normal bismuth nitrate in solution. Ditte ascertained that water containing in each liter 83 Gm. of $N_2O_5 = 96.83$ Gm. of HNO_3, will dissolve both normal and basic nitrate, forming with the latter the normal salt, so that no decomposition will take place on further addition of the acid liquid; but if the precipitate is left for too long a time in contact with the acid mother-liquor, an oxynitrate of the formula $4BiONO_3.Bi(OH)_3.3H_2O$ is gradually formed; by precipitating the solution with water at about 50° C. (122° F.) an oxynitrate is obtained having the composition $5BiONO_3.Bi(OH)_3.3H_2O$; and by washing the official or the above compounds for some time with water they are decomposed into still more basic salts of the formulas $3BiONO_3.Bi(OH)_3.3H_2O$ and $3BiONO_3.2Bi(OH)_3.H_2O$. It is obvious from the foregoing that even with the most careful manipulation the product obtained is not likely to be of a definite composition, but to consist of a mixture of the above two salts or of intermediate basic salts.

The physical character of the subnitrate is influenced by the temperature of precipitation. From cold solutions the precipitate is comparatively light and bulky; at 80° C. (176° F.), the precipitate formed is heavier and scanty, and more so at 100° C. (212° F.). F. A. Upsher Smith (*Pharm. Jour.*, 1900) has given a full account of the various methods of analysis and varying physical appearances of bismuth subnitrate.

Properties.—Bismuth subnitrate is a heavy white powder in minute crystalline scales and of a somewhat satiny appearance. It is not altered on exposure to air or light, is inodorous, has a faintly acid taste, and when moistened on litmus-paper has a slight but decided acid reaction. It is insoluble in water and alcohol, but dissolves completely and without effervescence in mineral acids. When heated to 120° C. (248° F.) it loses not over 3 per cent. of moisture, and at a red heat it gives off yellowish-red vapors, and leaves not less than 80 per cent. of a yellow residue, which is soluble in nitric or hydrochloric acid, and is blackened by hydrogen sulphide.—U. S. The formula given above requires 76.34 per cent. of Bi_2O_3. This difference may be due to loss of water by

drying at too high a temperature, but is usually owing to changes in its composition occurring during its preparation under the circumstances described above. The loss by ignition of these non-official oxynitrates ranges between 16 and 20 per cent.

Tests.—On dissolving 3 Gm. of the salt in 3 Cc. of warm nitric acid no effervescence should occur (absence of carbonate) and no residue should be left (absence of insoluble foreign salts). If this solution be poured into 100 Cc. of water, a white precipitate is produced, and, after filtering, evaporating the filtrate on a water-bath to 30 Cc., again filtering, and dividing the filtrate into portions of 5 Cc. each, these should respond to the tests of purity described under Bismuth Subcarbonas. When further tested as there described, the salt should be found free from alkalies and alkaline earths, and should give no reaction for ammonia. If 2 Gm. of the salt be heated in a porcelain crucible until nitrous vapors cease to be evolved, the residue, when cold, should not respond to the Bettendorf test for arsenic given under ARSENI TRIOXIDUM.—U. S.

Action and Uses.—Bismuth subnitrate is employed locally as a dusting-powder, mixed with powdered starch, in intertrigo and other irritative conditions of the skin. It has even been employed as a dusting-powder in the treatment of ulcers and burns, but has largely gone out of use for this purpose. Internally bismuth subnitrate is a valuable drug in that it exercises a sedative and astringent influence upon inflamed mucous membranes, and therefore is valuable in the treatment of acute gastric catarrh, acute gastro-enteritis, and in serous diarrhœa. It is also valuable for the purpose of checking vomiting depending upon acute gastric catarrh or gastric ulcer. Its use is contraindicated in diarrhœa associated with the passage of much mucus, unless a purge like castor oil or magnesium sulphate is previously administered, as it tends to cause retention of this secretion and thereby aggravates the condition. As a rule in the treatment of serous diarrhœa sufficiently large doses of bismuth subnitrate are not given. Doses varying from 20 to 60 grains (1.3–4 Gm.), every few hours, should be employed to get the full effect of the drug.

The administration of bismuth not infrequently gives a garlic-like odor to the breath, which is supposed to be due to contamination of the bismuth by tellurium. Bismuth also causes any coating of the tongue to become black in color, and the stools also become black. As bismuth is insoluble, it is administered best in powdered form or in capsules or cachets. As it is almost tasteless, the powder is not objectionable. If extremely large doses of bismuth are taken for a long period of time, it is capable of producing chronic poisoning, consisting in the formation of ulceration and sloughing of the intestinal mucosa. Bismuth has been employed in many other affections than those named, but possesses little value except in the diseases mentioned.

The dose is from 10 grains to 1 drachm (0.60–4 Gm.).

BISMUTHI SUBSALICYLAS, *U. S.*—Bismuth Subsalicylate.

Bismuthi salicylas, Br.; *Bismutum subsalicylicum*, P. G.; *Bismuth salicylate, Bismuthyl salicylate, Bismuth oxysalicylate*, E.; *Sous-salicylate de bismuth*, Fr.; *Basisches Wismutsalicylat (salicylsaures Wismutoxyd), Wismutsubsalicylat*, G.

Formula, $C_6H_4(OH)COO.BiO$, Br. Molecular weight, 358.79.

It should yield not less than 62 nor more than 64 per cent. of pure bismuth oxide.—U. S.

Preparation.—The U. S. P. and P. G. give no method of preparation, and the British gives only an outline, stating that the compound may be prepared by the interaction of sodium salicylate and bismuth nitrate. It may be prepared by Duyk's process; thus, 500 Gm. of pure bismuth subnitrate are digested with 1000 Cc. of distilled water for 2 days, with frequent stirring, in a warm place; 50 Cc. of strong ammonia water are now added, the liquid drawn off, and the residue, Bi_2O_3, washed until free from nitric acid; the moist oxide is transferred to a wide-mouthed bottle, a little distilled water and 125 Gm. of salicylic acid are added, and the mixture digested at ordinary room temperature, with frequent stirring, for at least 48 hours. The bismuth subsalicylate is then washed with small quantities of cold water until all free acid has been removed, and the product finally dried at a low temperature and kept in a dark place. As thus prepared, the salt occurs as a cream-colored, odorless, and tasteless amorphous powder, free from uncombined salicylic acid and from bismuth subnitrate.

Fischer and Grützner (1894) found that commercial bismuth subsalicylate is not

constant in composition, and proposed a method of preparation which they claim gives a constant basic compound. Bismuth nitrate crystals are dissolved in 4 parts of dilute acetic acid, the solution is diluted with 40 times its weight of water, and ammonia-water added to precipitate bismuth hydroxide, which is washed and digested on a water-bath with the molecular proportion of salicylic acid. The mass of bismuth subsalicylate is poured on a filter, washed, and dried.

Paul Thibault (*Bull. Soc. Chim.*, 1901) describes a new crystallized bismuth salicylate, with the composition $(C_7H_6O_3)_2Bi_2O_3$. He attempted to get a pure compound by the various methods proposed, but failed. The process by which he obtained the above compound consists in digesting salicylic acid with bismuth oxide obtained in the usual way by precipitation from the nitrate by caustic soda and heating. Thibault's salt is described as a dirty, rose-colored crystalline powder, stable up to 140° C. (284° F.), which parts with the whole of its Bi_2O_3 with alkalies, in contrast to other salts of bismuth which are soluble in alkalies.

Properties.—It is a white, or nearly white, amorphous or crystalline powder, odorless, tasteless, and permanent in the air. It is almost insoluble in cold water, but prolonged boiling with water gives rise to a more basic salt, while a portion of the salicylic acid passes into solution. Treatment with alcohol or ether dissolves salicylic acid with decomposition of the salt. It is partly soluble with decomposition in hydrochloric and nitric acids, forming a white flocculent precipitate of salicylic acid. Heated to 120° C. (248° F.) the salt should not lose more than 1 per cent. of water, and at a red heat it at first chars and finally leaves a yellow residue (oxide), which is soluble in hydrochloric or nitric acid and is blackened by ammonium sulphide solution. The salt when agitated with a solution of 5 drops of ferric chloride test-solution in 10 Cc. of water produces a deep violet-blue color (salicylate). If 1 Gm. of the salt be thoroughly shaken with 10 Cc. of diluted hydrochloric acid and filtered, the residue, after washing and drying, should conform to the reactions and tests given under ACIDUM SALICYLICUM. Upon pouring the filtrate into an excess of water, a heavy white precipitate of basic bismuth chloride should be obtained.—U. S.

Tests.—If 1 Gm. of the salt be shaken with 5 Cc. of chloroform, and the liquid filtered into 5 Cc. of water containing 3 drops of ferric chloride test-solution, no violet zone should form within 5 minutes at the line of contact of the two liquids (absence of free salicylic acid). The Br. P. and P. G. have the following tests for free salicylic acid: If 0.5 Gm. of the salt be shaken with 5 Cc. of water, the filtrate should not redden blue litmus-paper at once (P. G.); the filtrate, after shaking the salt with 90 per cent. alcohol, should not give a purple color with ferric chloride solution. If 3 Gm. of the salt be ignited in a porcelain crucible, and when cold dissolved by cautious addition of nitric acid and warming, and the solution when concentrated to 4 Cc. be further treated as described under BISMUTHI ET AMMONII CITRAS, 5-Cc. portions of the resulting liquid should respond to the tests for purity described under BISMUTHI SUBCARBONAS. If 0.2 Gm. of the salt be triturated with 0.3 Gm. of sodium salicylate and 5 Cc. of distilled water, and carefully poured, without mixing, over 5 Cc. of sulphuric acid (free from nitric acid), no pink to brownish-red zone should form immediately (limit of nitrates). 1 Gm. of the salt dissolved in 5 Cc. of sodium hydroxide solution and warmed with a mixture of 0.5 Gm. each of zinc filings and powdered iron should give no ammonia (absence of nitrate, P. G.). The copper test for nitric acid should give only the faintest evidence of nitrate (Br.). If 1 Gm. of the salt dried at 120° C. (248° F.) be thoroughly ignited in a porcelain crucible, and treated further as described under BISMUTHI CITRAS, it should leave a residue of not less than 0.62 Gm. nor more than 0.64 Gm. of bismuth oxide. 1 Gm. should yield 0.7 Gm. of bismuth sulphide, or 62 to 64 per cent. (63 per cent., P. G.) of Bi_2O_3 (Br.). The residue of oxide, obtained by ignition of 2 Gm. of the salt and further treatment as described above, should not respond to the Bettendorf test for arsenic given under ARSENI TRIOXIDUM.

Action and Uses.—Bismuth subsalicylate has been largely employed as a substitute for the older bismuth preparations in conditions of diarrhœa associated with fermentation in the gastro-intestinal tract. By many practitioners it is considered a valuable intestinal antiseptic in typhoid fever and in infantile diarrhœa. It is a mistake to suppose that it in any way shortens the course of enteric fever, but it often does control diarrhœa. Its increased antiseptic power depends upon the salicylic acid which is combined with it.

The dose is from 2 to 20 grains (0.12–1.3 Gm.), according to the age of the patient.

BISMUTHUM.—Bismuth.

Wismuth, Wismut, G.; *Bismuth,* Fr.; *Bismutte,* It.; *Bismut,* Sp.

Symbol, Bi. Valence, in all bismuth salts, 3; in a few compounds, 5. Molecular weight, 206.9.

The supply of bismuth is chiefly derived from mines in Saxony, where it exists in the metallic state associated with cobalt, nickel, and silver ores. It is likewise found oxidized as *bismuth ochre,* in combination with sulphur and with tellurium, and in gold ores. Deposits of bismuth ore have been discovered in Hungary, France, Cornwall, and other parts of Europe, in Texas, California, Mexico, Bolivia, and other parts of America, and in Australia. Bismuth appears to have been first recognized as a distinct metal by Basilius Valentinus in the fifteenth century, but was afterward frequently confounded with antimony, tin, and zinc, until Pott (1739), and afterward Bergmann, Davy, and others, proved its distinct properties. The metal is extracted by a simple process of smelting, advantage being taken of its low melting-point, and run into hot iron receiving-pots, where it congeals. The bismuth sulphide requires to be roasted; it is thus converted into oxide, which is reduced to the metallic state by being heated with charcoal. The crude metal thus obtained contains variable quantities of arsenic, copper, iron, silver, gold, antimony, lead, nickel, cobalt, selenium, and tellurium.

Purified Bismuth.—Crude bismuth may be purified by careful fusion with a little niter, or, better, with 7 per cent. of potassium cyanide mixed with 2 per cent. of sulphur, or with sodium carbonate to which a little potassium chlorate has been added. Very pure bismuth can be obtained by heating insoluble bismuth oxalate or by boiling an alkaline glycerin solution of a bismuth salt with sugar, washing the precipitated bismuth with 1 per cent. sulphuric acid, and fusing.

Properties.—Bismuth is a brilliant grayish-white metal with a distinct roseate tinge and a crystalline lamellate texture. When fused bismuth is cooled until a crust has formed, and the liquid portion is then poured out, the crucible will be found lined with rhombohedral crystals resembling cubes. Its specific gravity is 9.83, which is diminished by high pressure. It fuses at 264° C. (507.2° F.), and when congealing expands considerably, like water under similar circumstances, the density of the liquid metal being more than 3 per cent. greater than that of solid bismuth. It boils at about 1600° C. (2912° F.), and may be distilled in a current of hydrogen. It is superficially tarnished at the ordinary temperature by exposure to the air, but at a red heat decomposes the vapor of water and burns in the air with a bluish flame to brown oxide, becoming yellow on cooling. It has the peculiar property of lowering the fusing-point of metals; an alloy of 2 parts of bismuth and 1 part each of lead and tin fuses at 93.75° C. (200.75° F.). It is but slightly attacked by boiling hydrochloric or dilute sulphuric acid; but nitric acid dissolves it readily, the solution on concentrating yielding crystals of bismuth nitrate (see Bismuthi Subnitras); the mother-liquor or the original solution in nitric acid, suitably diluted with water and separated from the white precipitate of subnitrate, should not yield a white precipitate with sulphuric acid (lead), or a blue one with potassium ferrocyanide (iron), or with the same reagent a reddish-brown (copper). The presence of arsenic is ascertained by adding sulphuric acid to the solution, evaporating it to complete dryness, and applying Marsh's or Fleitmann's test (see pages 247 and 249). Silver, which is occasionally present, will be indicated by the white precipitate which takes place in the nitric acid solution, previously diluted with water as much as possible, on the addition of hydrochloric acid. The fetid breath following the administration of bismuth preparations has been attributed by C. Ekin (1876) to the presence of tellurium; but from observations made by Squibb (1882) this appears to be doubtful, or at least not the sole cause.

The *salts of bismuth* are colorless, except those formed with a colored acidulous radical. The nitrate, sulphate, and chloride dissolve in a small quantity of acidulated water, but are decomposed by a large quantity of water, with the formation of insoluble basic salts. The solutions of bismuth salts yield with hydrogen sulphide a black precipitate insoluble in ammonium sulphide, with alkalies a white precipitate insoluble in an excess, and with zinc, cadmium, or copper a dark-gray spongy mass consisting of metallic bismuth. The solutions give with potassium iodide a yellowish-brown precipitate, becoming red on the addition of water; this coloring being so intense that a minute quantity

of bismuth may be detected in lead if the acetate is precipitated by an excess of potassium iodide and the mixture heated to boiling; on cooling, the golden-yellow color of the lead iodide will be tinged crimson, orange, or brown, according to the proportion of bismuth present (Field and Abel, 1877).

BISMUTH COMPOUNDS.

Bismutal.—*Bismuthol.*—A mixture of bismuth-sodium phosphate and sodium salicylate.

Bismutan.—*Isutan.*—A yellow powder, insoluble in water, consisting of bismuth tannate and resorcin.

Bismuthi Albuminas. *Bismuthum Albuminatum.*—*Bismuth albuminate*, E.; *Wismutalbuminat*, G.—A compound of Bi_2O_3 with egg-albumen, of uncertain composition. It is prepared by adding a solution of 75 parts of dried egg-albumen to 25 parts of bismuth and ammonium citrate dissolved in the least quantity of water, and drying at a low temperature. It is a grayish-white powder, of slightly acid reaction, forming usually a cloudy solution in water due to some insoluble albumen. The commercial article contains 10–12 per cent. of bismuth.

Bismuthi Benzoas. *Bismuthum Benzoicum.*—*Bismuth benzoate*, E.; *Benzoate basique de Bismuth*, Fr. Cod.; *Wismutbenzoat, Benzoësaures Wismut*, G. $C_6H_5CO_2BiO$ (?).—Prepared by heating on a water-bath a mixture of bismuth hydroxide and benzoic acid in water. A white, amorphous, odorless, tasteless powder, insoluble in water. Acids precipitate benzoic acid from it. Ferric chloride produces a tawny color, due to ferric benzoate. It leaves on incineration 65–70 per cent. of Bi_2O_3. It was first proposed by M. P. Vigier as a substitute for bismuth salicylate. It has been recommended as a substitute for iodoform.

Bismuthi Beta-naphtolas.—*Bismuth beta-naphtolate, Orphol.* $Bi_2O_2(OH).(C_{10}H_7O)$.—Formed by the action of an alkaline solution of beta-naphtol on bismuth trinitrate in solution in dilute glycerin or an acid. A brown, odorless, tasteless, neutral powder, insoluble in water and alcohol. Acids precipitate beta-naphtol. Internal antiseptic and substitute for iodoform.

Bismuthi Boras.—*Bismuth borate.* $BiBO_3$ (?).—Made by fusing boric acid with bismuth trinitrate. A yellowish-white insoluble powder, used as an intestinal antiseptic, like the subnitrate.

Bismuthi Borophenas.—*Bismuth borophenate, Markasol.*—A slightly astringent absorbent powder, recommended as a substitute for iodoform. It is free from odor.

Bismuthi Cerium-salicylas.—*Bismuth-cerium salicylate.*—An insoluble pink powder, used in diseases of gastric and intestinal mucous membranes.

Bismuthi Chrysophanas.—*Bismuth chrysophanate, Dermol.*—A yellowish-brown powder, said to have the composition $Bi(C_{15}H_9O_4)_3.Bi_2O_3$. According to E. Merck, it is a mixture of impure chrysarobin and bismuth hydroxide.

Bismuthi Dithiosalicylas.—*Bismuth dithiosalicylate, Thioform.* Probable composition, $[S\text{–}C_6H_3(OH)CO_2BiO]_2 + Bi_2O_3 + 2H_2O$.—Obtained by digesting sodium dithiosalicylate with bismuth trinitrate in the presence of caustic soda. A yellowish-brown, odorless powder, insoluble in water. Antiseptic, in place of iodoform. Internally for gastric and intestinal catarrh.

Bismuthi Lactas.—*Bismuth lactate.*—This is prepared by boiling 10 parts of bismuth subnitrate with an excess of caustic soda, washing the oxide well with water, and while still moist mixing it with 9 parts of lactic acid; the mixture is digested, and dried on a water-bath.

Bismuthi Loretinas.—*Bismuth loretinate or Iodo-oxyquinoline-sulphonate.*—Obtained by the action of bismuth trinitrate, dissolved with the aid of glacial acetic acid, on an aqueous solution of sodium loretinate. A yellow powder, insoluble in water. Internally in cases of diarrhœa of phthisis, externally as dusting-powder and as lanolin ointment.

Bismuthi Metacresolas.—*Bismuth metacresolate.*—A grayish-white powder, odorless and tasteless, similar in all respects to the phenolate, insoluble in water and alcohol. Used internally as an antiseptic, externally as a substitute for iodoform.

Bismuthi Methylenum-digallas.—*Bismuth methylene-digallate, Bismal.*—Obtained by digesting 4 molecules of methylene-digallic acid (a condensation-product between formaldehyde and gallic acid) with 3 molecules of bismuth hydroxide. A bluish-gray powder, soluble with yellow color in alkalies, from which it is reprecipitated by acids.

Bismuthi Oleas.—*Bismuth oleate.* $Bi(C_{17}H_{33}CO_2)_3$.—Formed by action of sodium oleate on bismuth trinitrate. An insoluble powder, with emollient and astringent properties.

Bismuthi Oxybromidum seu Subbromidum.—*Bismuth oxybromide.* BiOBr.—A yellow powder used in nervous dyspepsia.

Bismuthi Oxychloridum seu Subchloridum.—*Bismuth oxychloride or subchloride, Bismuthyl chloride*, E.; *Oxychlorure de bismuth*, Fr.; *Wismutoxychlorid*, G. BiOCl.—This is prepared by slowly pouring a solution of bismuth in nitric acid into a solution of sodium chloride. It is a white powder, known as *pearl white*, and in France, like bismuth subnitrate, as *blanc de fard*. When heated in closed vessels, it turns yellow and melts without decomposition, but on being heated in the air chlorine is given off and bismuth oxide is left. The salt is insoluble in water, but readily soluble in acids. It has occasionally been sold as oxide of bismuth.

Bismuthi Oxyiodidum seu Subiodidum.—*Bismuth oxyiodide or subiodide, Bismuthyl iodide*, E.; *Oxyiodure de bismuth*, Fr.; *Wismutoxyiodid*, G. BiOI.—It may be prepared by pouring with constant stirring a solution of 95.4 Gm. of crystallized bismuth nitrate in 120 Cc. of glacial acetic acid into 2 liters of water containing 33.2 Gm. of potassium iodide and 50 Gm.

of sodium acetate. Wash by decantation, filter, wash, and dry at 100° C. (212° F.). It is a vivid red, heavy powder with an odor of iodine, insoluble in water, alcohol, and chloroform. Heated in a dry tube, it gives off iodine, leaving a residue of Bi_2O_3. Acids and alkalies decompose it. It is used as a dusting-powder or as an ointment.

Bismuthi Oxyiodo-methylgallolum. — *Bismuth oxyiodo-methyl-gallol. Iodo-gallicin.* $C_6H_2(OH)_2\begin{cases}OBi(OH)I\\CO_2CH_3\end{cases}$.—Prepared, like airol, by the action of bismuth oxyiodide on gallicin (methylgallate). It is a dark-gray powder, insoluble in the ordinary solvents. It contains 23.6 per cent. of iodine and 38.4 per cent. of bismuth. Substitute for iodoform.

Bismuthi Oxyiodo-pyrogallas.—*Bismuth oxyiodo-pyrogallate.* $C_6H_2(OH)_2.O.Bi(OH)I$.—Prepared by digesting bismuth oxyiodide with pyrogallic acid, or precipitating a solution of potassium iodide and pyrogallic acid with bismuth nitrate in acetic acid. A fine yellowish-red powder, stable in light and air. Powerful antiseptic and substitute for iodoform.

Bismuthi Oxyiodo-subgallas seu Gallas.—*Bismuth oxyiodosubgallate*, E.; *Wismutoxyiodidgallat*, G.; *Airol.* $C_6H_2(OH)_3CO_2Bi(OH)I$.—It is prepared by heating 35 parts of freshly precipitated bismuth oxyiodide in 50 parts of water with 18.8 parts of gallic acid on a water-bath until the oxyiodide has been converted into a grayish-green powder. Also by warming equivalent quantities of bismuth subgallate and hydriodic acid in water. It is a voluminous, odorless, tasteless powder, insoluble in water or alcohol. It is soluble in acids and alkalies with change of color. It gradually changes to a red powder in moist air. It contains 24.4 per cent. of iodine. It is used as a substitute for iodoform as a dusting-powder, or in 10 per cent. ointment free from water.

Bismuthi Peptonas.—*Bismuth peptonate.*—This is prepared from 20 parts of bismuth and ammonium citrate and 80 parts of dried peptone, exactly as described under Bismuth Albuminate. A grayish-brown, slightly acid powder, insoluble in alcohol. The commercial article contains 7–8 per cent. of bismuth.

Bismuthi Phenolas seu Carbolas.—*Bismuth phenolate or carbolate*, E.; *Phenol-Wismut*, G. $C_6H_5O.Bi(OH)_2$.—Prepared by action of bismuth nitrate in solution on sodium phenolate. A grayish-white, neutral, nearly odorless and tasteless powder, insoluble in water and alcohol. Decomposed by hydrochloric acid into bismuth chloride and phenol. Intestinal antiseptic and substitute for iodoform.

Bismuthi Phosphas Solubilis.—*Bismuth phosphate, soluble.*—Obtained by fusing bismuth oxide, phosphoric oxide, and sodium phosphate together. A white crystalline powder, soluble in 2 parts of water. Concentrated solutions are unstable, dilute ones become cloudy only after 2 or 3 days. The solutions are alkaline, have a bitter, salty taste, and are rendered cloudy by acids or alkalies, or by boiling.

Bismuthi Pyrogallas. — *Bismuth pyrogallate*, E.; *Pyrogallol-Wismut*, G. *Helcosol.* $[C_6H_3(OH)_2O]_2Bi.OH$.—A yellow, odorless, tasteless powder, insoluble in water. It is soluble in alkalies, turning brown by absorption of oxygen. It contains 48 per cent. of Bi_2O_3.

Bismuthi Resorcinas.—*Bismuth resorcinate*, E.; *Resorcin-Wismut*, G. $[(C_6H_4O_2)_3Bi_2]_3 + Bi_2O_3$.—A yellowish-brown powder containing about 40 per cent. of Bi_2O_3.

Bismuthi Sulphis.—*Bismuth sulphite.*—Obtained by precipitating a solution of bismuth nitrate with sodium sulphite. Antiseptic and antifermentative.

Bismuthi Tannas.—*Bismuth tannate*, E.; *Tannate de bismuth*, Fr.; *Wismuttannat*, G.—12 parts of bismuth subnitrate are converted to the hydroxide by shaking repeatedly with 10 parts of ammonia water (0.96) in 15 parts of water. After 4 or 5 hours, filter, wash well, and while yet moist mix the oxide carefully with 15 parts of tannic acid in 15 parts of water, evaporate, and dry thoroughly on a water-bath and rub to a powder. It forms a light-yellow powder which is insoluble in water and alcohol, and is entirely tasteless. When thoroughly dried, its composition represents 53 per cent. of bismuth oxide and 47 per cent. of tannin.

Bismuthi Tribrom-phenolas seu Carbolas.—*Bismuth tribrom-phenolate or carbolate*, E.; *Tribromphenol-Wismut*, G.; *Xeroform.* $Bi_2O_2.(OH).(OC_6H_2Br_3)$.—Yellowish, neutral, odorless, tasteless powder, insoluble in water and alcohol, containing about 57 per cent. of bismuth oxide. Acids act on it as in the case of the phenolate.

Bismuthi Valerianas.—*Bismuth valerianate*, E.; *Valérianate de bismuth*, Fr.; *Wismutvalerianat*, G.—A solution of bismuth nitrate in the smallest quantity of nitric acid, previously diluted with half its weight of water, is precipitated by a rather concentrated solution of sodium valerianate; the precipitate is washed with water, to which some valerianic acid has been added, until the washings, on evaporation, leave no residue, and afterward dried. Or 50 parts of bismuth subnitrate are digested for 4 hours with 150 parts of ammonia diluted with an equal weight of water; the sediment, consisting of bismuth hydroxide, is well washed with water, drained, transferred to a mortar, and well triturated with 15 parts of concentrated valerianic acid, 30 parts of alcohol being gradually added during the trituration. It is afterward collected upon a filter and dried at the ordinary temperature. Prepared by either process, it is a white amorphous powder having a decided odor of valerianic acid, insoluble in water and alcohol, soluble in nitric and in sulphuric acid; the latter solution does not acquire a black color on the addition of ferrous sulphate (absence of nitrate). Other impurities may be detected by the same tests as given under Bismuth Subnitrate.

BOLDUS.—Boldo.

Boldo, G., Fr.

The dried leaves of *Boldu Boldus* (Molino) Lyons (*Peumus Boldus* Molino.—Fam. *Monimiaceæ*).

FIG 62.

Boldo leaf (Nat.).

Origin.—A large, stout, dense, aromatic, evergreen, diœcious shrub of the Chilian coast-region, the bark used for tanning and the wood esteemed for charcoal-making.

Description.—Very shortly and stoutly petioled, the blade 4 to 6 Cm. (1½ to 2½ In.) long and two-thirds as broad, ovate-oval, subcordate at the base, blunt or slightly notched at the summit, entire and revolute at the margin, thick and coriaceous, yellowish or pale-green or sometimes brownish, harshly papillose above, hairy and paler underneath, where the reticulate venation is very prominent; aromatic, the odor somewhat terebinthinate; taste aromatic and pungent.

Constituents.—The leaves contain tannin, aromatic resinous compounds, 2 per cent. of yellow volatile oil, of a specific gravity of 0.915 to 0.945, and lævogyrate, colored hyacinth-red by sulphuric acid, violet by nitric acid, red by potassium hydroxide, and decolorized by hydrochloric acid; it is freely soluble in alcohol, commences to boil at 185° C. (365° F.), and contains no aldehyde. There is also 0.1 per cent. of *boldine*, a bitter alkaloid scarcely soluble in water, but readily soluble in alcohol, ether, and chloroform.

Pharmaceutical Preparation.—FLUIDEXTRACT OF BOLDO, N. F.

Action and Uses.—Boldus acts as a nervous sedative and hypnotic, and has been employed as a tonic and hepatic stimulant. It has been suggested as a remedy for atonic dyspepsia, chronic rheumatism, torpid liver, and chronic hepatitis. The volatile oil contained in the leaves is eliminated by the kidneys, and is said to be efficacious in the treatment of catarrhal conditions of the genito-urinary tract. Boldine has been used as a local anæsthetic, and it is claimed to be the equal of cocaine. Its administration in mania and excitement of the brain has been productive of quiet sleep, and it is thought by some to be superior to opium, in that it produces no untoward after-effects.

Tincture of boldus (1 in 5) is given in doses of from 5 to 20 minims (0.3–1.30 Cc.); the fluidextract, from 1 to 4 minims (0.05–0.25 Cc.); and boldine, in doses of 3 grains (0.20 Gm.), preferably in capsule.

Monimiaceæ.—This family, to which Boldo pertains, comprises some 23 genera, and about 150 species of trees and shrubs, mostly of tropical America. They are characterized generally by terebinthinate, aromatic, and resinous constituents, in many cases associated with bitter substances. *Atherosperma moschatum* R. Br., the *Sassafras tree* of New Holland, yields a bark much like that of sassafras and similarly employed, containing saffrol and the alkaloid *atherospermine*, which is a white amorphous powder readily soluble in alcohol and chloroform, but dissolving sparingly in ether; its colorless solution in sulphuric acid becomes green with potassium chromate (Zeyer, 1861). *Daphnandra micrantha* Benth. and *Atherosperma repandulum* F. Müll. (*Daphnandra r.* F. Müll.) appear to act similarly. The bark of the latter is very poisonous. It yields an alkaloid, which is to some extent antagonistic to strychnine. Locally applied, it paralyzes all muscles. It retards putrefaction and deodorizes putrid meat; checks the growth of *Torula cerevisiæ* and kills some water-plants. *Doryphora sassafras* Endl., of the same region, also contains saffrol and is similarly used, as are the leaves and fruit of *Laurelia aromatica* Juss., of Chile, and several species of *Siparuna* Aubl., of tropical America. In Australia, the leaves of *Piptocalyx Morrei* Oliv. are used for their bitter tonic effects, and the same is true of the barks of *Tambourissa quadrifida* Sonn. (*Mithridatea q.* W.; *Ambora Tambourissa* Lam.) and *T. religiosa* DC.

Calycanthus.—Several species of the genus *Butneria* Duham. (*Calycanthus* L.—Fam. *Calycanthaceæ*) possess properties, and apparently constituents, similar to those of the *Monimiaceæ*. These are the deliciously fragrant shrubs cultivated under the names *Sweet-scented shrub*, *Strawberry shrub*, *Bubby bush*, *Carolina* or *Florida allspice*, etc. The root, leaves, and bark of *B. fertilis* (Walt.) Kearney (*Calycanthus f.* Walt.; *C. lævigatus* W.; *C. glaucus* W.), of the southeastern United States, are a much used antiperiodic. Its seeds contain the very peculiar alkaloid *calycanthine*, occurring in crystals of phenomenal hardness. *Chimonanthus præcox* (L.) Lindl., *Calycanthus p.* L., the *La-mei* or *Hwang-mei-hwa* of Japan, has a pungently aromatic bark.

BORAGINACEÆ.—The Borage Family.

Few families of plants have contributed more herbs to professional and domestic medicine than this. Of its 1200 species, in nearly 100 genera, more than 100 are recorded as having been in medicinal use, yet not one is now official or has a place in any list of important therapeutic agents. This disrepute is perhaps not wholly deserved, since recent examinations have shown some of them to contain, though in very small amount, active and even poisonous constituents. Mucilage abounds in nearly all. Those which are called for with sufficient frequency to be of interest to the pharmacist are here considered.

Borago (*Borage, Burrage,* or *Star-flower,* E.; *Borasch* or *Boretsch,* G.; *Bourrache,* Fr.; *Borraja,* Sp.) is the annual herb *Borago officinalis* L., indigenous to the Levant, wild in various parts of Europe, and extensively cultivated for ornament and as a salad and medicinal plant (Fig. 65). It is from a fleshy, white root, 30 to 60 Cm. (1 to 2 Ft.) high, erect-branching, hispid-hairy throughout; leaves alternate, oval to obovate, the lower petioled, the upper becoming sessile, entire or somewhat wavy, thickish; calyx and corolla 5-parted, the latter rotate, blue to reddish, the throat closed by 5 emarginate appendages and bearing 5 stamens; fruit of 4 brownish-black, ovate, roughish nutlets which are excavated at the base to sit upon the broad gynobase; odor and taste slight, peculiar, mucilaginous. It contains mucilage, a little resin, and a large percentage of salts, among them 2 or 3 per cent. of potassium nitrate. Borage is slightly diuretic, diaphoretic, and demulcent. An infusion made with 3 drachms (12 Gm.) of the drug and 1 pint (480 Cc.) of boiling water, may be employed in the treatment of febrile conditions, catarrhal affections, and rheumatic complaints. The expressed juice from the leaves and stem may be used in doses of from 1 to 3 fluidounces (30–90 Cc.).

Cynoglossum officinale L. (*Hound's tongue, Dog's tongue* or *Dog-bur, Sheep-lice, Gypsy-flower, Tory-weed,* E.; *Hundszunge, Venusfinger,* G.; *Cynoglosse, Langue de Chien,* Fr.), *Anchusa officinalis* L. (*Ox-tongue, Bugloss, Garden alkanet,* E.; *Ochsenzungenkraut,* G.; *Buglosse,* Fr.), and *Echium vulgare* L. (*Viper's bugloss, Blue-thistle, -weed, -stem,* or *-devils,* E.; *Natterkopf,* G.; *Viperine,* Fr.), form a group containing the alkaloid *cynoglossine,* which forms double compounds with mercuric and platinic chlorides, and acts like curare, and the glucoside *consoldin,* which acts in some ways like an alkaloid and paralyzes the central motor system. It splits up into glucose and the alkaloid consolicine, which is also found free in the plants. The latter acts like the glucoside, but is 3 times as active. Both the *Anchusa* and the *Echium* named, are stout, erect, very hispid-hairy perennial herbs, 1 to 2 feet high, with blue flowers, changing to a purplish-red, those of the former in a cyme, of the latter in axillary clusters, forming an interrupted raceme. The roots are long, thick, and fleshy, brown externally, white internally. The leaves are petioled below, sessile above, those of the Anchusa lanceolate or lance-ovate, of Echium lance-linear to linear. Echium is abundantly naturalized in waste fields of this country. Hound's tongue has been recommended as a sedative and demulcent in the treatment of bronchial and pulmonary affections. It is said to be of value also in dysentery. The fresh leaves are used locally as a remedy for superficial burns and abraded surfaces. The extract when injected into the circulation is said to paralyze the motor nerves without diminishing sensation or muscular irritability.

Fig. 63.

Borage (½ Nat.).

Alkanna (*Alkanet, Orcanette, Spanish bugloss*) is the root of *Alkanna tinctoria* (L.) Tausch (*Anchusa t.* L.), a perennial herb, native of southeastern Europe and adjacent Asia. It is used rather in dyeing than in medicine, containing 5 to 6 per cent. of the red coloring-matter alkannin (*anchusic acid*). The root as found in the market is 30 Cm. (1 Ft.) or less in length, and about as thick as the finger, several-headed, and often crowned by whitish leaf-remnants. The soft bark easily separates into 3 layers, has a dark-purplish color like the medullary rays, and covers a harder, yellowish, irregularly twisted, and spongy wood. Syrian alkanna is the root of *Macrotomia cephalotes* DC., grown in Asia Minor. It is very similar to the ordinary, and is said to contain more than twice as much of the same or a very similar red coloring-matter, which is also found in many other plants of this family. The root of *Onosma echioides* Lam. is used similarly. Alkanet is no longer employed in medicine, but its coloring-matter is used for coloring various pharmaceutical preparations.

Pulmonaria (*Lungwort, Jerusalem* or *Bedlam cowslip, Spotted comfrey, Beggar's basket,* E.; *Lungenkraut,* G.; *Pulmonaire officinale,* Fr.) is the perennial rough-hairy herb of *Pulmonaria officinalis* L., its root-leaves ovate-cordate and petioled, the upper becoming smaller and at length sessile, frequently marked with white spots and bluish-purple nodding flowers. Quite similar is the American or Virginian lungwort (*Mertensia Virginica* (L.) DC. (*Pulmonaria V.* L.), which, however, is smooth and has a pale-blue or white corolla. Lungwort has been suggested in the treatment of pulmonary tuberculosis and other chronic bronchial conditions, but its administration is probably of little or no benefit. Among the numerous other plants

which have been reputed to possess similar properties, are various species of *Onosmodium* (*False gromwell*), *Lithospermum* (*Gromwell*), *Echinospermum*, *Cordia*, *Piptocalyx*, and *Heliotropium* or *Heliotrope*.

BROMELIACEÆ.—The Pineapple Family.

This family, of some 40 genera and 500 species, many epiphytic, is of exceptional interest. The strange habits and great beauty of many of the plants render them very attractive. Its most important economic product is the pineapple, the fruit of *Ananas Ananas* (L.) Lyons (*Bromelia A.* L.; *Ananas sativus* Schult.), the dietetic value of which is far too little appreciated. Although the tough tissue of the green fruit is indigestible, the properly ripened fruit is not only thoroughly digestible, but contains a proteolytic enzyme which is usefully active in stomach and intestinal digestion. It also contains a milk-curdling ferment. The enzyme is more like trypsin than pepsin. It is separable from the neutralized juice by the action of sodium chloride or magnesium sulphate. The juice of the unripe fruit is astringent and anthelmintic, and is generally regarded as being an active abortifacient. Even ripe pineapples, eaten in excess, are known to have produced abortion. Legend has it that the juice of the green fruit is a powerful poison when introduced into the blood, and that the Malays and other eastern people so employ it upon their weapons, but we cannot learn that this view is supported. Its ferment, *bromelin*, which is closely related to *trypsin*, has the power of converting albuminous matter into peptone and proteoses. Bromelin is active between the temperatures of 30° and 60° C. (86° and 140° F.) either in acid, alkaline, or neutral media, but acids and alkalies are said to restrict its activity to some extent. It is destroyed by a temperature of 70° C. (158° F.). Pineapple syrup and essence are employed merely as flavoring agents. It is to be remembered that much of the pineapple extract used in flavoring is factitious, being made from butyrate of ethyl and alcohol.

Among the other products of this family, the following may be mentioned: The juice of *Bromelia pinguin* L. and of other bromelias is sharp and anthelmintic. The root of *B. karatas* is used in Paraguay as a sarsaparilla substitute under the name *Sarsaparilla Colorado* (*Red sarsaparilla*). *Hechtia argentea* Baker, of Mexico, yields an antiseptic gum-resin, and several Chilian species of *Puya* yield gums. The fruits of a number of species of *Ananas* and *Bromelia*, as well as of other genera, are edible. The *Black* or *Florida moss* (*Tillandsia usneoides* L.) and some other species, possess special qualities as packing substances, and the leaf-fibers of many species are utilized for cordage-making. Pineapple-juice has been recommended in the treatment of gastric indigestion, and has been used by the laity as a gargle for sore throat.

BROMOFORMUM, *U. S.*—Bromoform.

Bromoformium, P. G.; *Tribrommethane*, *Formyl tribromide*, E.; *Bromoform*, *Tribrommethan*, G.

Formula, $CHBr_3$. Molecular weight, 250.99.

A liquid consisting of 99 per cent. by weight of absolute bromoform and 1 per cent. of absolute alcohol. It should be kept in dark amber-colored, glass-stoppered bottles, in a cool place, protected from light.—U. S.

A colorless liquid having a chloroform-like odor, a sweetish taste, slightly soluble in water, readily soluble in ether and alcohol (P. G.).

Preparation.—60 parts of chlorinated lime (35 per cent. Cl) are made into a paste with water and added to 71.5 parts of potassium bromide dissolved in 150 parts of water, and the whole, after the addition of 12 parts of acetone, distilled in a current of steam until oily drops cease to come over. The apparatus is then cooled to about 45° C. (113° F.), and a second charge of 60 parts of chlorinated lime and 9 parts of acetone added and distilled as before. The operation is repeated thrice with successive charges of 60 parts of chlorinated lime and 6 parts of acetone. The collected distillates are washed with water, shaken with concentrated sulphuric acid, again washed with water, and the traces of remaining acid removed with sodium hydroxide solution. The purified bromoform is then dehydrated with fused calcium chloride, and finally submitted to distillation, collecting the portion distilling at 149°–150° C. (300.2°–302° F.) (Fromm). It may also be prepared by adding bromine gradually to a solution of potassium hydroxide in alcohol as long as the color is discharged, and then distilling it.

Properties.—Bromoform is a heavy, transparent, colorless, mobile liquid, with an ethereal odor, and a penetrating, sweet taste resembling chloroform. Specific gravity 2.808 at 25° C. (77° F.). It is very slightly soluble in water, but soluble in all proportions in alcohol, ether, benzene, and petroleum benzin, and in the fixed and volatile oils. Bromoform is slightly volatile at ordinary temperatures, and boils at 148° C. (298.4° F.), and solidifies at 6° C. (42.8° F.). It is not inflammable, but when

vaporized by the application of heat its vapor may be burned.—U. S. Pure bromoform is very apt to decompose on exposure to light and air, a property readily prevented by the addition of 1 per cent. of absolute alcohol, as directed in the U. S. P. The bromoform of the German Pharmacopœia congeals crystalline on cooling with ice and melts clear again at 7° C. (44.6° F.); boiling-point 148° to 150° C. (298.4°–302° F.); specific gravity 2.829–2.833; appears to contain a somewhat larger (4) per cent. of alcohol. Pure bromoform contains 94.854 per cent. of bromine, and may readily be recovered from admixture of organic matter by distillation in a current of steam, the distillate boiled after the addition of potassium hydroxide under a reflux condenser, and the resulting equivalent of bromide used for qualitative or quantitative determination. Heated with potassium hydroxide solution, carbon monoxide is evolved during the reduction to bromide.

Tests.—"If 10 Cc. of bromoform be evaporated in a dish over a naked flame, no solid residue should remain. If 10 Cc. of bromoform be well shaken with 10 Cc. of distilled water, and the liquids, upon standing, be allowed to completely separate, the water removed from the layer of bromoform should be neutral to blue litmus-paper (absence of free acid), and a portion should not produce a turbidity when treated with silver nitrate test-solution (absence of bromides and brominated compounds), and another portion treated with potassium iodide test-solution should not be tinted blue upon the addition of starch test-solution (absence of free bromine). If 10 Cc. of bromoform be well shaken with 10 Cc. of distilled water, and the liquids, upon standing, be allowed to completely separate, the water removed from the bromoform, treated with an excess of ammonium hydroxide, and then with a solution of iodine in ammonium iodide, until the black precipitate of nitrogen iodide, which may sometimes form, slowly disappears, it should not become milky in appearance, due to the separation of iodoform (absence of acetone).—U. S. On shaking 2 Cc. of bromoform and 2 Cc. of water with 0.5 Cc. of zinc-iodide-starch test-solution, the bromoform should not be discolored nor the starch turn blue. Shaken with an equal volume of concentrated sulphuric acid, not more than a light-yellow color should be developed within ten minutes.—P. G.

Action and Uses.—Bromoform, like its congener chloroform, depresses the reflex centers of the spinal cord, and so decreases their function. It produces sleep and insensibility to pain by its depressing action upon the cerebral centers governing those functions, but as an anæsthetic it has caused symptoms sufficiently alarming to prevent its employment for this purpose. It depresses the vasomotor center, causing a material decrease in blood-pressure, and in this way assists in the dissipation of heat. The pulse usually remains full and strong, as the heart and peripheral vagi are seemingly not affected by its administration. The drug is eliminated by the lungs and kidneys, the urine containing bromine several days after its employment.

When taken in overdose bromoform produces laughing intoxication, followed by nausea, vomiting, loss of reflex action, cyanosis of the face, and coma; at times collapse, cardiac failure, and extreme pallor may occur. Fatty degeneration of the viscera is also said to result from poisonous amounts. The use of external heat, the hypodermic injection of ether and strychnine, and the application of the faradic current, usually cause a return to consciousness in from 4 to 6 hours in such cases.

Bromoform is principally employed as a palliative in the treatment of whooping-cough. It decreases the number and intensity of the paroxysms, but does not shorten the course of the disease. It has also been recommended in hiccough, spasmodic asthma, laryngismus stridulus, and in the cough of phthisis and chronic bronchitis, and is said to have been successful in overcoming reflex headaches and vertigo. Locally applied, bromoform has been recommended for the relief of pain caused by tubercular ulceration of the larynx.

The dose for internal use is stated to be from 1 to 5 minims (0.05–0.3 Cc.). It is to be remembered, however, that a fluidrachm of bromoform contains about 360 drops. When used in pertussis, the beginning dose to a child one month old is 1 drop 3 times daily; under a year old, 3 drops; under 4 years old, 5 drops: all of which may be increased according to the intensity of the disease and the susceptibility of the patient.

BROMUM, *U. S.*, *P. G.*—Bromine.

Brôme, Fr.; *Brom*, G.; *Bromo*, It.

Symbol, Br. Atomicity univalent. Molecular weight, 79.36.

It should contain not less than 97 per cent. of pure bromine, and be kept in protected glass-stoppered bottles, in a cool place.—U. S.

Origin and Preparation.—Bromine was discovered by Balard (1826) in the mother-liquor obtained in the preparation of common salt from the water of the Mediterranean; he also investigated its chemical properties, and proved its close analogy to chlorine and iodine. Bromine does not exist in the free state, but is found widely distributed in nature, the bromides usually accompanying chlorides. It is found more particularly in sea water, in the waters of Kreuznach, Kissingen, and other mineral springs, but is now obtained in considerable quantities from the mother-liquors of many salt-works in the United States and at Stassfurt, Germany. These mother-liquors, which have been freed by crystallization as much as possible from other salts (chlorides and sulphates), contain the bromine, usually in combination with magnesium or calcium. These compounds are decomposed either by heating their solution with black manganese dioxide and hydrochloric acid, or by warming it to between 45° and 50° C. (113° and 122° F.) while chlorine gas is being passed into it; the bromides are at once decomposed: $MgBr_2 + Cl_2$ forms $MgCl_2 + Br_2$. The bromine volatilizes, and is condensed under a small quantity of water, which is contained in a deep Woulf's bottle kept cool by water, while that portion of bromine which escapes condensation is conducted into a solution of caustic potash contained in an open bottle; this solution, when it has nearly lost its alkaline reaction, is utilized subsequently for the preparation of potassium bromide. The mother-liquors, as obtained in Western Pennsylvania and West Virginia, yield about 0.5 per cent. of bromine, or the brine about 1 pound of bromine to 13 bushels of salt. The annual output of bromine in the United States is between 450,000 and 500,000 pounds, valued at about $135,000. The production in the German salt-works for 1897 was 490 tons.

Properties.—It is a heavy, brownish-red, mobile, and very volatile liquid, evolving at the ordinary temperature deep orange-red vapors, which are highly irritating to the eyes and lungs, and on being conducted into a flame impart to it a green color. Its odor, which is suggestive of chlorine and iodine, is suffocating and disagreeable, hence its name (from βρῶμος, a stench). It boils at 63° C. (145.4° F.) (Pierre). The melting-point of perfectly pure bromine is —7° C. (19.4° F.), but very small quantities of impurities lower the melting-point considerably. At 15° C. (59° F.) its specific gravity is 2.99, and at 0° C. (32° F.) it is 3.187; its vapor density (air = 1) is 5.4. It destroys cork, wood, etc., bleaches litmus and other coloring principles, and alters or destroys most odorous organic compounds. It dissolves in 28 parts of water at 25° C. (77° F.), and in less of alcohol and ether, with gradual decomposition of these liquids; the brown-red, or if diluted brown-yellow, solutions are bleached rapidly in the sunlight, hydrobromic acid being formed. Potassium bromide increases the solubility of bromine in water. Carbon disulphide, benzene, and chloroform dissolve bromine freely with an orange-red color, and, like ether, take it up from an aqueous solution on being agitated with the latter. When in contact with water at a low temperature, bromine forms a deep-red hydrate, $Br_2 + 10H_2O$, crystallizing in octahedrons or in scales, which at 15° C. (59° F.) are decomposed into bromine and water. Bromine and its solutions color starch-paste brown-yellow.

Impurities.—Commercial bromine may contain chlorine in the form of bromine chloride, BrCl, which may be removed by distilling in contact with ferrous or potassium bromide, $KBr + BrCl = KCl + 2Br$. Iodine is difficult to remove from bromine, but it does not often occur in it. German bromine is free from it. Carbon tetrabromide, when present in bromine, may be removed by careful distillation, as it has a higher boiling-point.

Tests.—Bromine should completely volatilize by exposure to air or to heat (absence of salts, etc.). If bromine be added to an excess of sodium hydroxide test-solution, it should combine to form a permanently clear liquid, without the separation of oily drops or the development of an odor resembling that of chloroform (absence of bromoform or other organic bromine compounds). If an aqueous solution of bromine be shaken with

a slight excess of reduced iron until it becomes nearly colorless, the filtered liquid, on the addition of a small amount of ferric chloride and of starch test-solution, should not assume a blue color (absence of iodine).—U. S.

Pharmaceutical Preparations.—AQUA BROMI, AQUA BROMATA. *Bromine water*, E.; *Bromwasser*, G.—The U. S. P. directs bromine water (for use as test-solution) to be prepared by dissolving 1 Cc. of bromine in sufficient water to make 100 Cc. Ordinarily, bromine water for use in chemical analysis is understood to be a stronger solution, 1 part in 50 by weight. If intended for medicinal purposes, bromine water should not be made stronger than 0.5 per cent., or 1 part in 200 by weight. It changes readily, but is more permanent than chlorine water, and should be kept in a dark place.

BROMIPINE.—This name has been applied to a 10 per cent. oleaginous solution of bromine, said to be made with oil of sesame, which retains almost entirely the physical characters of the oil, and does not suggest, by odor or taste, the presence of bromine. It is said to be particularly valuable in epilepsy, causing no disturbance of the stomach or bowels.

BROMOCOLL.—This preparation, also known as dibromotannic glue, is a compound of bromine, tannin, and gelatin, containing 20 per cent. of bromine in organic combination. It occurs as a faint, yellowish-brown, odorless and tasteless powder, which is almost insoluble in acid fluids, but is gradually dissolved in alkaline liquids, and is consequently absorbed in the intestines. It is employed also as a dusting-powder or in the form of an ointment.

Action and Uses.—Bromine is an irritant poison and a powerful escharotic. When given in overdose, it produces the symptoms common to other irritating substances, namely, burning pain in the mouth, œsophagus, and abdominal cavity, followed by collapse and death. Vomiting and purging may occur: the mucous membrane of the stomach is corroded and softened, and perforation of that viscus sometimes results. When locally applied to the skin in pure form, it produces deep and widespread destruction of the tissues, followed by slowly healing ulcers. Poisoning is treated best by the administration of ammonia water largely diluted, and demulcent drinks. Bodily temperature should be maintained in cases of poisoning by applying external heat, and opium be given for the relief of pain. Stimulation with atropine and strychnine should be given according to the indications.

Bromine is not largely employed in medicine at the present time. Formerly it was used in those conditions in which iodine is at present often given; for example, glandular enlargements, scrofulous ulcers, tertiary syphilis, bronchocele, chronic affections of the skin, amenorrhœa, depraved conditions of mucous membranes, and cardiovascular conditions characterized by high arterial pressure. Its local application was recommended by Dr. Goldsmith in the treatment of hospital gangrene, in which condition it was applied pure by means of a glass rod. A solution containing 30 minims (0.2 Cc.) in a pint of water has also been applied to chronic ulcers as a stimulating lotion, and has been proposed as a specific for poisoning by *Rhus radicans*. Superficial cancers have been treated by local injections of a strong solution in alcohol (1 in 3) or of bromine chloride, but this treatment is now abandoned. The topical use of bromine in diphtheria has been largely replaced by other more suitable remedies.

The internal dose of bromine is from $\frac{1}{10}$ to $\frac{1}{2}$ of a minim (0.005–0.010 Cc.), largely diluted with water, 3 times daily. Because of its volatility, care should be taken in removing the stopper from bottles containing bromine, lest it irritate the eyes or respiratory tract.

Two-thirds or more of the bromine manufactured is used for the preparation of bromides for medicinal use and photography, the rest being used for aniline dyes. For safer transportation and disinfecting purposes, *bromine blocks* have been recommended by Frank (1882), and consist of a porous mass formed by incinerating a mixture of diatomaceous earth with crude tartar or with calcium saccharate; cut into cubes of 45 Cc., these weigh about 30 Gm. and absorb 100 Gm. of bromine, which is very gradually given off on exposure. In this form bromine is sometimes called *solid bromine* or *bromum solidificatum*.

BRYONIA.—Bryonia; Bryony.

The dried root of *Bryonia alba* L. or of *Bryonia dioica* L. (Fam. *Cucurbitaceæ*).

White vine, Radix Uvæ Anguinæ, Devil's turnip, E.; *Zaunrübe, Gichtrübe*, G.; *Bryony Blanche*, Fr. Cod.; *Couleuvrée, Navel Fou*, Fr.; *Brionia*, Sp.

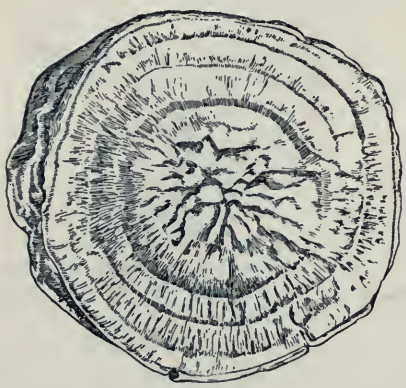
Origin.—Rough, slender, tendril-bearing, cucumber-like vines, of Europe. *B. dioica* has dicœcious flowers and red berries. *B. alba* has monœcious flowers and black

berries, and ranges more to the northward. In allusion to the color of its fruit, it is often called *Black bryony*, but this tends to confuse it with *Tamus communis* L., a plant not at all related. The long, tapering, fleshy, horseradish-like root is usually produced in sandy soil, and often weighs 4 or 5 pounds. Its surface is yellowish and marked with long transverse ridges, and it is whitish internally, with a strong, nauseous odor and a very bitter taste. It is usually cut into transverse or oblique slices to facilitate drying.

Description.—In circular transverse or oval oblique sections, 2 to 10 Cm. ($\frac{4}{5}$ to 4 In.) broad and mostly 6 to 12 Mm. ($\frac{1}{4}$ to $\frac{1}{2}$ In.) thick, little if at all thinner at the center, the edges dirty gray-yellow and irregularly circumferentially ridged, the transverse surface white or slightly yellowish-white, somewhat hard to the touch, annulate, radiate, the projecting wood-bundles continuous or interrupted; fracture sharp, whitish, mealy; odor slight but characteristic and disagreeable; taste bitter and nauseous.

No other drug, excepting possibly sliced arum or dracontium, neither of which has a radiate structure, bears even a remote resemblance to bryony.

Fig. 64.



Bryonia.

Constituents.—Bryony root contains starch, gum, sugar, wax, fat, malates, *bryoresin* which yields its active properties to water, and two glucosides, *bryonin* and *bryonidin*. Bryonin ($C_{34}H_{48}O_9$) is extremely bitter. On boiling with dilute acid, it yields bryoretin and hydrobryoretin, the former soluble, and the latter insoluble in ether. Bryonidin is bitter and poisonous, but has not been well studied. The substances formerly known as bryonin are mixtures of these two glucosides, or more or less purified extracts (Mankowsky, 1890). *Bryogenin*, a yellow amorphous resin, was obtained from bryonin by Masson in 1893. The genus contains about 8 species, and the roots of most of them appear to have been used widely.

Action and Uses.—Bryony was employed by the ancients as a purgative, diuretic, emmenagogue, and abortifacient. It is an active hydragogue cathartic, and when given in full dose causes gastro-intestinal inflammation with nausea and vomiting. Poisonous doses cause violent abdominal pain, due to irritation, with purging and vomiting. Mild delirium, vertigo, dilated pupils, failing circulation, profuse sweating, and a subnormal temperature, followed occasionally by death, have been recorded as the result of its ingestion in large doses. The effects of poisonous doses should be combated by the application of external heat and the administration of stimulants. Opium may be given to relieve pain.

Bryony is employed in atonic conditions of the gastro-intestinal tract. In dyspepsia resulting from a depressed condition of the peptic glands and in the constipation of children resulting from scanty secretion of the intestinal glands, in which state the stools are hard and friable, its administration is frequently attended with good results. Its exhibition is said to prevent serous effusions, especially those of the pleura, and also to aid in their absorption when present. It should not be given in the early stages of pleurisy, however, when the temperature is high. The drug is said to do good in chronic rheumatism, and is recommended as a hydragogue cathartic in dropsy. The fresh root when bruised and applied to the skin produces vesication, and in this way it has been employed in hydrarthrosis. *Bryonia alba*, by stimulating the capillaries, is said to be useful in controlling post-partum hemorrhages.

The dose of the powdered drug is from 20 grains to 1 drachm (1.30–4 Gm.), and of the tincture from 1 to 2 fluidrachms (4–8 Cc.). A mother-tincture, such as that prepared by the homœopaths, is probably the best preparation to employ, and may be given in doses of from 5 to 40 minims (0.30–2.6 Cc.).

BUCHU, *U. S.*—Buchu Leaves.

Buchu folia, Br.; *Buckublätter, Buccoblätter*, G.; *Folia Bucco, Folia diosmæ, Folia barosmæ, Feuilles de Bucco (Buoko, buchu)*, Fr.

The dried leaves of *Barosma betulina* (Thunb.) Bartling et Wendland (*Diosma b.* Thunb.—Fam. *Rutaceæ*).

Official in most pharmacopœias, some of which admit also *B. serratifolia* (Curt.) Willd. (*Diosma s.* Curt.).

Origin.—The buchus are from good-sized, erect, but widely branching shrubs of South Africa. Their properties and uses were learned from the Hottentots. They are usually imported in large bales.

Description.—From 10 to 25 Mm. ($\frac{2}{5}$–1 In.) long, and about two-thirds as broad, rhomboidally oval or obovate, abruptly contracted into a short, petiole-like base, blunt or obscurely notched at the recurved apex, sharply and finely dentate, thick and rigid, warped, brittle when dry, cartilaginous when moist, yellowish green, the surface glabrous and shining, coarsely and sparingly warty, with ascending veins and wrinkles; pellucid-punctate, a large gland near the base of each tooth; odor and taste strongly aromatic, somewhat mint-like; taste aromatic, slightly bitterish and pungent, and mucilaginous. The powder exhibits numerous yellowish sphæro-crystals, from the epidermal layer, and mucilage-cells.

B. crenulata leaves are very similar, but somewhat smaller and relatively narrower, more inclined to an oval form, and have the margin crenate.

FIG. 65.

Buchu leaves: *a, b, Barosma crenulata; c, d, B. betulina; g, h, B. serratifolia; e, f, Empleurum serrulatum.*—*b, c, f, g,* natural size.

Constituents.—Buchu leaves contain gum, resin, volatile oil, barosmin, hesperidin, etc. *Barosma betulina* yields 4.25 per cent. of dark olive-green, bitter oleoresin, with the odor of buchu, and equivalent to 1.2 to 1.45 per cent. of volatile oil. *B. crenulata* yields 3.76 per cent. of the same oleoresin, but containing about 1.6 per cent. of a probably identical volatile oil. *Barosmin* (or diosmin) is a bitter glucoside, soluble in ether, volatile oils, dilute acids and alkalies, scarcely soluble in cold alcohol, and crystallizing in microscopic needles. Oil of buchu contains 30 per cent. of the very peculiar crystallizable phenol *diosphenol* ($C_{10}H_{16}O_2$).

Impurities and Substitutes.—Buchu is apt to be contaminated with an excessive amount of the twigs, flowers, and fruits, and its efficiency thereby correspondingly diminished. The only important substitute is the so-called *Long buchu, B. serratifolia* (Curt.) Willd., once official and preferred to the other. This leaf is well illustrated in Fig. 65. It is very much thinner than the short variety, of a bright deep-green and a strong minty odor. It contains less than 1 per cent. of volatile oil, and this contains no diosphenol. It also yields less mucilage than short buchu.

Long buchu, in turn, is itself frequently substituted by, or contaminated with, the leaves of *Empleurum serrulatum* Ait., of the same family. These, also here figured, are usually distinguished by a yellowish-green color and a very acute tip, as well as by a somewhat different odor and taste. They are less mucilaginous, and contain less than 1 per cent. of volatile oil, without any crystallizable constituent.

Pharmaceutical Preparations.—FLUIDEXTRACT OF BUCHU, U. S. P.; COMPOUND FLUIDEXTRACT OF BUCHU, N. F.

Action and Uses.—Buchu is employed as a stimulant in certain morbid conditions of the genito-urinary tract. It should not be employed in acute inflammatory conditions,

but its use is advantageous in the treatment of subacute and chronic conditions in which the mucous membrane has lost its normal tone. It has been employed in chronic catarrh of the bladder, in chronic cystitis with incontinence of urine resulting from hyperacidity in pyelitis, in chronic urethritis, in retention of urine, and in diseases of the prostate gland. As it does not materially augment the urinary flow, its employment is of little benefit in conditions attended with dropsy. When first introduced into medicine, an ointment containing the drug was employed as a vulnerary, and a tincture was said to be useful in treating flatulent dyspepsia; at present, however, it is rarely employed for this purpose.

The dose of fluidextract of buchu is 1 fluidrachm (4 Cc.) 3 times daily to an adult, and from 10 to 30 minims (0.60–2 Cc.) to a child. An infusion, 1 ounce (30 Gm.) to the pint (480 Cc.), or one containing of buchu and uva ursi 4 fluidrachms (16 Gm.) each to the pint (480 Cc.), may be given in doses of from ½ to 2 fluidounces (16–60 Cc.).

BURSERACEÆ.—The Myrrh Family.

Genera, about 16; species, about 200; tropical shrubs and trees. Myrrh, Elemi, Olibanum, and Bdellium are elsewhere considered, and illustrate the family habit of producing oleoresins and gum-resins. The number of such which have been utilized medicinally or as incense is too great to allow of their consideration here. A number are considered in connection with the above-named drugs, others here follow:

Caranna gum is exuded by *Protium Carana* (H. B. K.) March. (*Icica C.* H. B. K.; *Amyris C.* H. B. K.), of tropical America. It is described as pitch-like when fresh, of balsamic odor and bitter and resinous taste, becoming brittle when dry, with a lustrous fracture and translucent in thin pieces. The West Indian article so-called, also known as *Chibou* or *Cachibou resin*, is from *Bursera gummifera* L., the *Gumbo-limbo* or *West Indian birch* (*Gommert*, Fr.). Caranna gum may be employed for the same purposes as Tacamahaca resin.

Tacamahaca resin or **gum** is a name applied to a number of tropical American exudations which are closely similar to one another, though apparently derived from a number of different trees, the following having been named: *Protium heptaphyllum* March. (*Icica h.* H. B. K.; *I. Tacamahaca*; *Amyris ambrosiana* W.); *P. altissimum* March. (*Icica a.* Aubl.); *Bursera tomentosa* Tri. et Pl. (*Elaphrium t.* Jacq.; *Fagara octandra* L.). This substance is very similar to Caranna gum, but usually lighter-colored and with a distinct odor. The East Indian Tacamahacas do not pertain to this family. Tacamahac possesses properties in common with the terebinthinates. It is no longer employed in internal medicine. The oil obtained from the seeds, and plasters containing the resin, have been used in treating muscular rheumatism.

Goqui, Bélám-pú, or **Pan Oleoresin,** is yielded by *Santiriopsis balsamifera* Engl., of San-Thomé.

Gommier or **Incenso.**—Several West Indian products of this family are there traded in under these names. The *G. rouge* of Dominica, or *G. à Canots* of Santa Lucia, appears to come from *Dacryodes hexandra* Griseb.; the *G. à l'encens* of Santa Lucia is one of the Tacamahacas (*T. huilense inicolore*), and is from *Protium Guianense* March.

Hedwigia balsamifera Sw. (*Bursera b.* Pers.; *Tetragastris b.* Sw.), of tropical America, is remarkably productive of active substances. It exudes a balsam (*B. de cachou* or *B. de Sucrier*) which is used like copaiba. Its seeds yield an oil much like that of sweet almonds. Its bark (called *Copalchi* or *Campanilla* in Mexico) contains an alkaloid which is powerfully convulsant and a heart poison, while its resin is a powerful depressant of the nerve-centers. Copalchi bark has been substituted for both cinchona and cascarilla. It is said to be tonic, aromatic, and antiperiodic, and capable of asserting itself in the treatment of mild intermittent fevers. An infusion made with 1 ounce (30 Gm.) of the drug in 1 pint (480 Cc.) of boiling water may be given in the dose of from ½ to 1 fluidounce (16–30 Cc.), 3 times daily.

A number of aromatic woods also are yielded by the *Burseraceæ*. One sort of linaloe or aloes wood is yielded by *Bursera fagaroides* Engl. Colophon wood is from *Bursera paniculata* Lam., of Mauritius. The wood of *Marignia obtusifolia* DC. (*Bursera o.* Lam.; *Protium o.* Lam.) is sold as *Bastard colophon.*

BUTYL-CHLORAL HYDRAS, *Br.*—Butyl-chloral Hydrate.

Butylchloralum hydratum, Chloralhydratum butyli, Chloral butylicum. Hydrous butyl-chloral; Trichlorbutylidene glycol; Croton-chloral hydrate (wrongly so called), E.; *Hydrate de chloral butylique,* Fr.; *Butylchloralhydrat, Trichlorbutylaldehydhydrat,* G.

Formula, $C_4H_5Cl_3O + H_2O$, or $CH_3.CHCl.CCl_2.CH(OH)_2$. Molecular weight, 191.94.

Butyl-chloral hydrate was discovered by Kramer and Pinner in the by-products resulting in the manufacture of chloral, and later found by R. Schiff to exist in 2 isomeric forms distinguishable by the difference in the melting-points of the various

amides of the same. It was originally misnamed "croton-chloral hydrate," owing to its supposed relationship to crotonic acid, until Pinner proved it to belong to the butyl series and corrected the error.

Preparation.—Dry chlorine gas is conducted into aldehyde, or paraldehyde, cooled to a low temperature, about —9.5° C. (15° F.), until the aldehyde is saturated. The current of gas is then continued at a gradually increasing temperature to about 100° C. (212° F.), the resulting product being washed with sulphuric acid and submitted to fractional distillation, collecting the portion distilling at 163°–165° C. (325.4°–329° F.), which is *butyl-chloral*, $C_4H_5Cl_3O$, a dense, oily liquid. The latter is mixed with water in the ratio of 9 to 1, and when the mass has crystallized it is recrystallized from boiling water.

Properties.—Thin, white, glistening laminæ or scales, having a sweetish melon-like odor, and a burning, bitterish taste; melt at 78° C. (172.4° F.); specific gravity 1.69; dissolve in 30 parts (50 parts, Br.) of cold water, more soluble in hot water and water containing glycerin; soluble in its own weight of glycerin or 90 per cent. alcohol and in 20 parts of chloroform, Br.; readily soluble in alcohol and ether. It does not yield chloroform when heated with solution of potassium hydroxide (distinction from chloral hydrate).—Br. Alkalies decompose it successively into *propylic chloroform*, $C_3H_5Cl_3$, and *dichloride of allylene*, $C_3H_4Cl_2$, the latter producing the medicinal effects attributed to butyl-chloral hydrate. From a solution in alcohol it is precipitated by the gradual addition of water, in the form of globules consisting of butyl-chloral alcoholate, $C_4H_5Cl_3O.C_2H_5HO$. Yellow ammonium sulphide added to an aqueous solution of butyl-chloral hydrate produces a yellow to orange-yellow color, which is hastened by heating to the production of a reddish-orange-colored precipitate in solutions not too dilute (Ogsten).

Tests.—Butyl-chloral hydrate should be neutral to litmus in alcoholic solution, and give no precipitate with test-solution of silver nitrate. Mixed with concentrated sulphuric acid and gently warmed, no discoloration should result. When butyl-chloral hydrate is melted with acetamide, 2 isomeric butyl-chloral-acetamides, $C_6H_{10}Cl_3NO_2$, are formed, the *α*-form being soluble in hot alcohol and melting at 158° C. (316.4° F.), and the *β*-form soluble in dilute alcohol and melting at 170° C. (338° F.) (Schiff, *Ber.*, 25, 1690–1691).

Action and Uses.—The physiological action of butyl-chloral hydrate closely resembles that of chloral itself (which see). Its indications, contraindications, the symptom-complex resulting from overdose, and treatment of poisoning by this drug, are practically identical with those of the latter drug. It possesses more analgesic and anæsthetic power, however, than chloral, and Liebreich states that 1 drachm (4 Gm.) produces deep sleep, anæsthesia of the head, and loss of irritability of the fifth pair of nerves. This last statement is disputed by von Mering. Upon the heart it is much less of a depressant than chloral, and may therefore be substituted for chloral when the indications for the use of the latter are contraindicated by cardiac disease. It is an excellent palliative in the treatment of tic douloureux, migraine, and facial neuralgia. Headaches resulting from eyestrain, associated with nausea, or caused by anæmia, are sometimes benefited by its use. As a palliative it may do good in sciatica and dysmenorrhœa, and its administration in insomnia accompanied by pain is frequently attended with success.

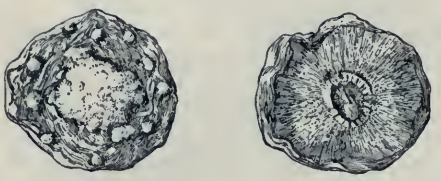
The dose as a hypnotic is from 5 to 20 grains (0.30–1.30 Gm.), given in pills or in syrup or elixir. For the relief of pain it may be given in doses of from 3 to 5 grains (0.20–0.30 Gm.) every 2 hours until relief is afforded or sleep produced. As much as 1 drachm (4 Gm.) has been given at a dose, but as a rule 30 grains (2 Gm.) should be considered the maximum dose. A mixture containing from 5 to 10 parts of the drug, 20 parts of glycerin, and 130 parts of distilled water, has been recommended in doses of ½ fluidounce (16 Cc.), repeated in 5 minutes, and again in 10 minutes, unless relief is afforded; but it is not certain that this amount is always safe, and it should be given with caution.

C.

CACTACEÆ.—The Cactus Family.

Genera about 20; species upward of 600, chiefly inhabiting arid and barren localities, their leaves therefore metamorphosed into spines, the stems green, fleshy, and succulent. Many species which are wanting in the spiny armature, secure protection by means of poisonous constituents, chiefly alkaloids, against desert animals, which seek them for their thirst-quenching and nutritive properties. Their fruits are berries, and very many of them, like the *Tunya*, are edible.

FIG. 66.



a *b*

Anhalonium, slightly swollen by soaking: *a*, upper, *b*, lower surface (½ Nat.).

But few of the species have been utilized in medicine, although others are quite likely to become so. In addition to *Cereus*, elsewhere considered, the following deserve attention:

Anhalonium (*Mescale-* or *Muscale-buttons; Pellote*) is the dried tops of the plants *Lophophora Williamsii* (Lem.) Coulter (*Anhalonium W.* Lem.) and *L. Lewinii* (Henning) Rusby (*Anhalonium L.* Henning; *Mammillaria L.* Auct.; *L. Williamsii Lewinii* Coulter). These plants grow in inaccessible places, especially on limestone cliffs, at high altitudes, in northern Mexico. They possess small cylindrical or ovoid stems a few inches in length and almost equally as broad, only the upper portion projecting above the surface of the ground, as a flattened or slightly convex green disk, bearing numerous triangular, radially flattened fleshy lobular appendages, somewhat spirally arranged. These aërial portions, an inch or less in height, are sliced off and dried. They are thus greatly reduced, both in breadth and thickness, so that they become button-shaped disks, mostly 1 to 2 inches in breadth and about ⅛ to ¼ of an inch in thickness, roughened on the lower surface by the wrinkling produced in drying, and upon the upper surface by the fleshy lobules above referred to and by a central tufted mass of yellowish or whitish hairs occupying about one-third of the total breadth. In the midst of these hairs several pink flowers are commonly found. The two species are readily distinguished by the character of this central hairy mass. In *L. Williamsii* the hairs are in tufts more or less distinct from one another, whereas in *L. Lewinii* they are massed together, shorter (6 to 9 Mm.—¼ to ⅓ In. long) and of a more dirty or yellowish-white color. Rarely, some dried fruits, about as large as dried currants, are also found. The plants contain very powerful alkaloids. That of *L. Williamsii*, amounting to nearly 1 per cent., is *pellotine* ($C_{13}H_{19}NO_3$). It occurs in colorless transparent flakes, melting at 110° C. (230° F.) and dissolving in sulphuric acid with a yellowish color, becoming red with nitric acid. *A. Lewinii* contains *anhalonine* ($C_{12}H_{15}NO_3$), very similar to pellotine; *mescaline* ($C_{11}H_{17}NO_3$), *anhalonidine* ($C_{12}H_{15}NO_3$), and *lophophorine* ($C_{13}H_{15}NO_3$). Although these two species are chiefly used, others are said to be similarly employed. *Anhalonium fissuratum* contains a very small amount of the alkaloid *anhaline* ($C_{10}H_{17}NO$), which crystallizes in colorless, stellate prisms and melts at 115° C. (239° F.). With sulphuric acid it gives a colorless solution, green on the addition of nitric acid. With nitric acid it is yellow, changing to orange-red with potassium hydroxide. *A. prismaticum* is said to contain an exceedingly poisonous alkaloid. Experiments made upon animals with anhalonium prove that it is a powerful narcotic poison. When moderate amounts are given to man, it first increases reflex excitability, and later the patient passes into quiet sleep. The respiration is primarily depressed, but later becomes full, deep, and regular. It at first weakens the circulation, but later increases the force and diminishes the rapidity of the heart's beat. Blood-pressure is increased, and the pulse is full and forcible. Lethal doses produce intense muscular spasm, especially of the abdominal muscles and the diaphragm, followed by tetanic convulsions resembling those caused by overdoses of strychnine, death occurring from respiratory failure, while the heart stops in diastole almost simultaneously. This drug has been recommended as a heart stimulant and tonic, and is said to be an excellent adjuvant to digitalis. It has also been employed as a respiratory stimulant in those conditions in which strychnine proves beneficial. It is further stated that the drug possesses narcotic properties resembling those of opium. Anhalonium has been given with asserted success in pneumothorax, advanced tuberculosis, and angina pectoris. The beginning dose is from ½ to 1 minim (0.025–0.05 Cc.) of the fluidextract, which may be gradually increased to 2 or 3 minims (0.10–0.20 Cc.).

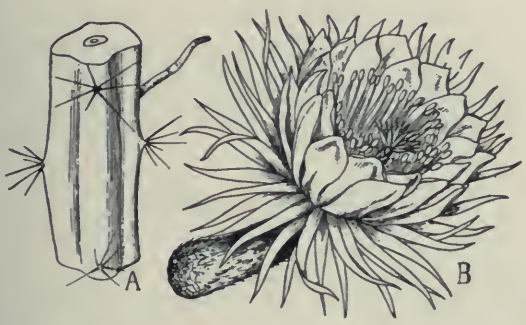
Alkaloids have also been encountered in *Mammillaria centricirrha* Lem. and in *Echinocactus mammillosus* Lem. *Rhipsalis Cassytha* Gærtn., of the West Indies, is anthelmintic, as is the fruit of *Opuntia Opuntia* (L.) Coulter (*Cactus O.* L. ; *Opuntia vulgaris* Mill.). Several species, in widely separated genera, yield tragacanth-like gums, and one, *Cereus gummosis*, is rich in saponin (see also CACTUS).

CACTUS.—Cactus.

Night-blooming cereus, Sweet-scented or Vanilla cactus, E.; *Kaktus, Fackeldistel, Königin der Nacht*, G.; *Cactier, Cierge a grandes fleurs*, Fr.

Cereus grandiflorus (L.) Miller (*Cactus g.* L.—Fam. *Cactaceæ*). No precise definition can be assigned to this title, since the activity of the plant has not been located. The

FIG. 67.



Cactus grandiflorus (stem, Nat.; flower, $\frac{1}{4}$). (After Holmes.)

fresh stem has been used, but the evidence is pretty conclusive that this has little, if any, activity. The flower has been largely used, but competent authorities, employing an undoubtedly genuine article, have rendered contradictory reports as to its activity. From this it appears to follow that the activity must be confined to the flower in some special stage of development, or to certain parts of it, or to some part gathered with it.

Origin.—A plant of the West Indies, with a weak, prostrate or ascending, green and fleshy, 5- to 7-angled, spiny stem, and an acrid juice, producing very large and remarkably fragrant, white, nocturnal flowers. It is largely cultivated in greenhouses.

Description.—Stems (Fig. 69, A) in pieces of varying length, about $1\frac{1}{2}$ to 2 Cm. ($\frac{3}{5}$ to $\frac{4}{5}$ In.) in diameter, cylindrical, with 5 to 7 angles, furnished along the angles at intervals of about 2 Cm. ($\frac{4}{5}$ In.) with small tufts of 6 to 8 spines about 2 Mm. ($\frac{1}{12}$ In.) long, and at irregular intervals of 5 to 15 Cm. (2 to 6 In.) or more, with a branched root. Internally, the transverse section presents a central woody ring about 3 Mm. ($\frac{1}{8}$ In.) in diameter, the remainder of the stem presenting a spongy parenchyma with numerous large crystals or "spæraphides," immersed in it (*after Holmes*).

The bud at first is globose, acute, then clavate, sessile, covered with imbricated scales bearing long setæ. When fully expanded, the flower is a span across; the tube of the calys is long, green, the limb cup-shaped; the former is composed of the imbricated scales above mentioned; the latter is formed of numerous long, spreading, tawny-orange upper calyx segments, forming a sort of ray, and of an inner series of petals, which are oblong, broader upward, nearly erect, and of a pure white color. Stamens numerous, long, at length inclined to one side. Filaments white; anthers linear, oblong, yellow; style as long as the stamens; stigma of many rays (*Bot. Mag.*).

Adulterants.—Holmes has found a triquetrous stem and the flowers of *Opuntia decumana* Haw, as adulterants, and others are doubtless used. The flowers last named have their largest petals only about three-fourths of an inch long, more than double the length of the stamens, while the petals of the genuine are 2 or 3 inches long, and the stamens fully three-quarters as long.

Constituents.—We have only indefinite knowledge of the constituents of the drug. Parr reported "Some waxy and fatty bodies, several acid, slightly acrid, glucosidal resinous bodies, and also an alkaloid, which is present in very small quantities only."

Action and Uses.—When locally applied to the skin, the fresh juice of the cactus produces vesication and occasionally pustulation. The drug has long been employed by

the native population as a remedy for dropsy, but its chief use at present is in the treatment of cardiac disease. It stimulates the cardiac muscle, the accelerator nerves, and the motor ganglia of the heart, thereby increasing the force and frequency of the heart's action. The increase in blood-pressure is due both to its stimulating effect upon the vasomotor center and to the above-named action upon the heart. Cactus is also said to increase reflex action by its stimulating effect upon the spinal centers. It is stated that it does not cause a cumulative effect nor produce gastric disorder. Cactus is employed as a substitute for digitalis in those cases in which the latter remedy seems to be inefficient. It may be tried in the treatment of cardiac palpitation and weakness, and also in valvular disease of the heart. It is said to be especially useful in aortic regurgitation, as it does not prolong diastole. Certain cases of angina pectoris and the low fevers are also said to be benefited by its employment.

The ordinary dose of the tincture is from 2 to 8 minims (0.10–0.50 Cc.); of the fluid-extract, from 1 to 4 minims (0.05–0.25 Cc.), but much larger doses are often used.

Other Species.—The juice of *C. flagelliformis* Mill. is said to be anthelmintic. That of *C. divaricatus* (Lam.) DC. is used as an epispastic and internally as an anthelmintic and diuretic. *C. Petayaya* (L.) DC. is used as a diuretic. The stem of *C. Peruvianus* Mill. is said to contain an alkaloid. The fruit of *C. geometrizans* Mart. is reported diuretic and antipyretic.

CADMIUM.—Cadmium.

Cadmium, Fr., G.; *Kadmium*, G.

Symbol, Cd. Atomicity bivalent. Atomic weight, 111.6.

Origin and Preparation.—This metal is found near Bishopstown, Scotland, in the form of sulphide as the mineral *greenockite*, but it is more frequently present in small quantities in some kinds of calamine, blende, and other zinc ores. It was discovered by Stromeyer and Hermann in 1817. Cadmium being more volatile than zinc, it is contained in the first portions obtained in the distillation of the latter metal, and its presence is indicated by the appearance of a brown flame (the so-called "brown blaze") before the greenish-white flame of burning zinc is noticed. To obtain cadmium, the zinc, or the zinc oxide containing it, is dissolved in dilute sulphuric or muriatic acid, and the cadmium precipitated by metallic zinc; or the acid solution is treated with hydrogen sulphide to precipitate the cadmium as yellow sulphide, which is used as a pigment under the name of *cadmia;* the sulphide is dissolved in strong hydrochloric acid, the solution precipitated by excess of ammonium carbonate to remove copper and traces of zinc, and the washed and dried precipitate mixed with lampblack and distilled.

Properties.—Cadmium is a malleable and ductile metal having the color of tin, and like the latter it emits a crackling sound when bent, It crystallizes readily in octahedrons, is superficially tarnished on exposure to the atmosphere, becomes brittle at 82° C. (180° F.), fuses near 315° C. (599° F.), and volatilizes at 860° C. (1580° F.). Its density varies between 8.60 and 8.69; its vapor is dark-yellow, has a nauseous taste, and burns with a dark-red flame to brown oxide. In acetic, hydrochloric, and dilute sulphuric acids it dissolves more slowly than zinc, with evolution of hydrogen. It is easily soluble in dilute nitric acid, with evolution of nitric oxide, NO.

The salts of cadmium are mostly white; those soluble in water have an acid reaction and a disagreeable metallic taste. The solutions, treated with hydrogen sulphide or ammonium sulphide, afford an orange-yellow precipitate of CdS, which is insoluble in an excess of the precipitant and in dilute acids and alkalies. Caustic alkalies produce a white precipitate of $Cd(OH)_2$, which is soluble in ammonia, but not in potassium or sodium hydroxide. The soluble carbonates, phosphates, and oxalates, and potassium ferrocyanide produce white precipitates.

Tests.—The impurities likely to be present in metallic cadmium are mainly zinc and copper, the former of which is recognized by precipitating the solution in nitric acid with hydrogen sulphide, when the filtrate from the bright orange-yellow precipitate will yield a white precipitate on the addition of ammonia and ammonium sulphide. When the solution in nitric acid is precipitated by slight excess of ammonium carbonate, the filtrate will have a blue color if copper be present.

Uses.—As a constituent of several alloys and to prepare cadmium salts.

SALTS OF CADMIUM.

Cadmii Bromidum.—*Cadmium bromide*, E.; *Bromure de cadmium*, Fr.; *Cadmiumbromid*, *Bromcadmium*, G. $CdBr_2 + 4H_2O$.—Obtained by acting on granulated metallic cadmium under water with bromine, letting the mixture stand, with occasional shaking, in a warm place until the color of bromine disappears. Filter and evaporate to crystallization. It forms colorless, shiny, transparent prismatic needles, easily soluble in water and alcohol. It loses all water of crystallization at 260° C. (500° F.). It contains 37.21 per cent. of oxide and 46.51 per cent. of bromine. For test for impurities, see Cadmium Iodide.

Cadmii Iodidum.—*Cadmium iodide*, E.; *Iodure de cadmium*, Fr.; *Cadmiumiodid*, *Jodcadmium*, G. CdI_2.—It may be prepared like cadmium bromide or by dissolving 20 parts of potassium iodide and 15 parts of cadmium sulphate in water, evaporating the solution to dryness, exhausting the residue with warm absolute alcohol, and filtering and crystallizing (A. Vogel, 1863). By the first process a direct combination of the metal and iodine is effected, while in the second process a mutual decomposition of the two salts takes place, with the formation of cadmium iodide and potassium sulphate. The latter, being insoluble in alcohol, remains upon the filter: $CdSO_4 + 2KI$ yields $CdI_2 + K_2SO_4$. Cadmium iodide occurs in white, flat, micaceous crystals of a pearly luster, inodorous, of a nauseous metallic taste, permanent in the air, soluble in alcohol, and at the ordinary temperature in a little more than its own weight of water. Heated to about 310° C. (600° F.), it forms an amber-colored liquid, and at a dull-red heat is decomposed, vapors of iodine being given off. The aqueous solution, which reddens litmus, yields with hydrogen sulphide a yellow precipitate of CdS, which is insoluble in ammonium sulphide (difference from arsenic), and the filtrate from this precipitate is not affected by ammonia, ammonium sulphide or carbonate (absence of the metals of the zinc group and of the earths and alkaline earths), and after applying these tests leaves no residue when evaporated to dryness and ignited (absence of alkalies). The presence of heavy metals would be indicated by the brown or blackish discoloration in the yellow color of the precipitated sulphide. Ammonia would be detected by the odor given off on the addition of an excess of potassium hydroxide solution. Most other cadmium salts differ considerably from the iodide in appearance. Cadmium iodide is said to be superior to lead iodide in the treatment of chronic diseases of the skin, scrofulous enlargements of glands, and chronic joint-affections. It is usually applied in the form of an ointment containing from 30 grains to 1 drachm (2–4 Gm.) of the salt in 1 ounce (30 Gm.) of lard. Unguentum Cadmii Iodidi was formerly official in the British Pharmacopœia, and was made by triturating 62 grains of cadmium iodide with 1 ounce of simple ointment.

Cadmii Salicylas.—*Cadmium salicylate*, E.; *Salicylate de cadmium*, Fr.; *Cadmiumsalicylat*, *Salicylsaures Cadmium*, G. $(C_6H_4(OH)CO_2)_2Cd$.—It may be prepared by warming salicylic acid in 30 times its weight of water and adding cadmium carbonate until the solution is very slightly acid, evaporating to less than half of the volume and letting stand to crystallize. It forms colorless, neutral or slightly acid, tabular crystals, soluble in 68 parts of cold and 24 parts of hot water, in alcohol, ether, and warm glycerin, insoluble in chloroform. An aqueous solution is colored violet by ferric chloride. Cadmium salicylate is a very active antiseptic, and has been recommended in the treatment of purulent ophthalmia.

Cadmii Sulphas.—*Cadmium sulphate*, E.; *Sulfate de cadmium*, Fr.; *Cadmiumsulfat*, *Schwefelsaures Cadmiumoxyd*, G. $3CdSO_4.8H_2O$.—It may be prepared by bringing together 2 parts of cadmium, 10 parts of water, 2 parts of sulphuric acid, and 1 part of nitric acid, to facilitate the action: $3Cd_2 + 6H_2SO_4 + 4HNO_3 = 3CdSO_4 + 8H_2O + 4NO$. At the end heat is applied and the whole evaporated to dryness to expel any acid. The residue is dissolved in water, filtered, and crystallized. Salts containing different quantities of water of crystallization are formed under varying conditions of temperature. Cadmium sulphate crystallizes in colorless rhombic prisms, which effloresce somewhat in the air, have an astringent and strongly metallic taste, and change the color of blue litmus-paper to red. It dissolves at 23° C. (73.4° F.) in 1.6 parts of water, is somewhat more soluble in hot water, and is insoluble in alcohol; at 100° C. (212° F.) it loses 11.8 per cent. (5 molecules) of water, and the remainder when heated to redness; at a full red heat one-half of the acid is also expelled. Cadmium sulphate is an irritating astringent and emetic. If given internally in overdose, it causes severe gastro-intestinal pain, with profuse ptyalism, nausea, and vomiting. The respiration and circulation are depressed, and vertigo, fainting, and convulsions sometimes ensue. The drug has been recommended as an astringent in the treatment of chronic conjunctivitis, chronic gonorrhœa, and gleet, and is said to be beneficial also in treating otorrhœa and opacities of the cornea. It may be prescribed either in solution containing from 1 to 4 grains (0.05–0.25 Gm.) of the salt in 4 fluidounces (120 Cc.) of water, or in an ointment made by triturating 1 to 2 grains (0.05–0.10 Gm.) of the drug with 1 drachm (4 Gm.) of fresh lard.

CÆSIUM—Cæsium. RUBIDIUM—Rubidium.

Symbols, Cs and Rb. Atomic weights, 131.90 and 84.8.

Both these elements are widely distributed, but only in small quantities. They generally occur in company with potassium, which they resemble closely. Bunsen and Kirchhoff discovered them by the spectroscope, the characteristic spectrum of rubidium being 2 dark-red lines, hence the name of the metal, from *rubidus*, dark-red, while cæsium was given its name because of 2 blue lines in its spectrum, from *cæsius*, sky-blue. Cæsium occurs in 2 minerals, namely, *castor* and *pollux* (cæsium-aluminum silicate), and also accompanies rubidium in very small quantity in the water of the Dürkheim and Nauheim springs. Rubidium occurs in *carnallite* of the Stassfurt beds, and is obtained, as rubidium alum, from the mother-liquors after the potassium chloride is crystallized out. It occurs also in *lepidolite*, a variety of mica. The isolation of these metals is difficult and tedious. Cæsium was isolated first by Setterberg in 1881. It has a density of about 2, melts at 26.5° C. (79.7° F.), and takes fire in air at ordinary temperature. Its salts are much like those of rubidium and potassium, and it is the most electropositive of all metals. Rubidium is silvery-white, with high luster, takes fire in air, decomposes water with greater energy than does potassium, and melts at the temperature of the body. Rubidium hydroxide, Rb(OH), has even stronger basic properties than potassium hydroxide. Both rubidium and cæsium have a marked power of forming double salts. C. Chabrié prepared and described a number of cæsium salts about which hitherto there has been very little exact information (*Comptes rend.*, 132, p. 678, 1901).

Action and Uses.—The salts of these two metals are said to increase blood-pressure, and slightly to decrease the rapidity of the heart's action. Cæsium bromide has been employed in doses of from 3 to 5 grains (0.20–0.30 Gm.) in the treatment of cardiac palpitation resulting from nervousness. The other salts have all been recommended as anti-epileptics. Cæsium-rubidium-ammonium bromide is probably the most popular salt, and is given in daily doses of from 30 to 45 grains (2–3 Gm.).

CÆSIUM AND RUBIDIUM SALTS.

Cæsium-ammonium Bromide. $CsBr.3NH_4Br$.—This double salt exists as a white soluble powder.

Cæsium Bromide. CsBr.—A white, granular powder soluble in water.

Cæsium Carbonate. Cs_2CO_3.—A white granular mass, hygroscopic, and soluble in water and alcohol.

Cæsium Sulphate. Cs_2SO_4.—Colorless prisms, permanent in air, very soluble in water, but not in alcohol.

Cæsium-rubidium-ammonium Bromide. $(CsRb)Br_2 3NH_4Br$.

Rubidium-ammonium Bromide. $RbBr.3NH_4Br$.—A white crystalline powder, soluble in water, containing 36 per cent. of rubidium bromide.

Rubidium Bromide. RbBr.—Transparent soluble crystals, which may be substituted for potassium bromide in medicine.

Rubidium Iodide. RbI.—Colorless cubical crystals, very soluble in water, recommended as a substitute for potassium iodide.

CAFFEA.—Coffee.

Semen Coffea.—Kaffee, Kaffeebohnen, G.; *Café*, Fr.

The dried ripe seed of *Coffea Arabica* L. or of *C. Liberica* Hiern. (Fam. *Rubiaceæ*).

Origin.—The coffee plants are large shrubs or small trees, the first-named native of northeastern Africa, and possibly also of Arabia, the second of the west coast of Africa; *C. Arabica*, of cultivation, yields almost the whole of our commercial coffee, the most coming from Brazil, the best probably from Guatemala. Java and India also yield large quantities, and cultivation is carried on to a greater or less extent in nearly all tropical countries which offer a suitable climate. The best results are attained at a considerable elevation, from 2000 to 4000 feet, in southern India. The plant is greatly subject to disease under adverse conditions. *C. Liberica* can be grown down to the sea-level, and it is much hardier and more capable of resisting disease. The genus contains some 25 species, all of the old world, and mostly African. Several others besides the two

mentioned are somewhat cultivated, but the products can scarcely be considered commercial.

The coffee plant is very handsome. Its snowy-white and fragrant flowers are closely clustered in the axils of the opposite, coriaceous, dark-green and shining leaves, and are frequently present toward the summit of the long and slender branches, while the fruits, both the green and the bright-red ripe ones, are present below. The fruit is an oval, deep-purple, 2-seeded drupe, each seed enclosed in a parchment-like endocarp, the 2 placed together by their flat, longitudinally grooved sides. The Liberian coffee plant has the corolla 6- to 9-lobed, and the fruit globular and much larger.

When the fruits are ripe, they are gathered and freed from the scanty pulp by suitable apparatus and washing; the seeds are then dried and subsequently freed from the parchment-like husk (*putamen* or *endocarp*) by passing them between wooden rollers and winnowing. The seeds then constitute one-third the weight of the ripe berries.

Description.—The seeds are oval, longitudinally grooved upon the flat side, usually almost completely deprived of the parchment-like, finely wrinkled endocarp, fragments of which remain in the groove. The horny perisperm is of the shape of the seed, according to the variety, of a yellowish, brownish, bluish, or greenish tint, and is folded, or rather rolled up, whereby the groove is produced. The embryo is situated under the convex side, near the end, is slightly curved, and occupies about one-fourth the length of the seed. Raw coffee has a very faint odor and a sweetish, slightly astringent, and bitterish taste. The commercial varieties vary considerably in flavor, in size, and in the shade of color. On keeping, coffee loses during the first year about 8 per cent. in weight, principally moisture; during the second, 5 per cent.; and during the third year, 2 per cent., the flavor being at the same time greatly improved.

Constituents.—The most important constituent of coffee, from a medicinal point of view, is its *caffeine* (see CAFFEINA), the amount of which ranges from a little less than 1 to a little more than 2 per cent., as shown by the appended table. With this, there is an exceedingly variable amount of *caffeo-tannic* (*chlorogenic*) *acid*, yielding *caffeic acid* by precipitation with lead salts and baryta, and by other processes; about 15 per cent. of sugar, the most of it very similar to glucose, the rest dextrin; about 13 per cent. of fat (olein and palmitin), and an equal amount of proteids, with a trace of volatile oil. It yields 4 to 5 per cent. of ash; Mocha coffee, as much as 7.84 per cent., consisting chiefly of potassium, sodium, magnesium, and calcium carbonates and phosphates, the earthy salts amounting to one-seventh or one-sixth of the weight. There is about 12 to 15 per cent. of moisture. With the caffeo-tannic acid, there is believed to be a small amount of citric acid. Caffeo-tannic acid is amorphous and gum-like. Caffeic acid ($C_9H_8O_4$) occurs in straw-yellow crystals. Both yield protocatechuic acid when fused with potassa. A small amount of kinic acid has been obtained. The caffeine apparently exists partly free and partly in combination with caffeic acid. *Caffeanic*, *cærulic*, and *caffeelic acids* are considered oxidation-products, and *viridinic* acid, and chlorogenic acid, in part, are regarded as mixtures of them.

Foster and Reichelmann report another alkaloid than caffeine in coffee, which is amorphous and insoluble in chloroform.

Gaucher has shown that caffeo-tannic acid is present in all parts of the plant, but that caffeine exists in appreciable quantities only in the mesophyll of the leaves, in the embryo, and in the endosperm. He finds the best test for the alkaloid to be a saturated solution of ammonium molybdate and ammonium chloride, giving a white amorphous precipitate which turns blue on drying.

The roasting of coffee, which is best accomplished at a temperature of about 250° C. (482° F.), renders the seeds pulverizable, and at the same time gives them a more agreeable taste and enables them to yield more of their constituents to water. The coffee thus acquires a chestnut-brown color and loses about 18 per cent. of its weight. The generation of gaseous compounds ruptures the cells, and a peculiar and agreeable aroma is produced, probably largely through decomposition of the fat and tannin. But Payen's (as well as Rochleder's) investigations failed to point out the principles to which the changes are due. Very probably they depend in part upon the decomposition of several of the organic compounds, and unquestionably upon the production of a pyrogenated volatile oil. Caffeine does not partake of these changes except that it is slowly volatilized at the temperature stated; hence the roasting of coffee ought to be effected in closed vessels. Bernheimer (1880) found nearly one-half of the products of roasting

to consist of palmitic acid, the remainder being acetic acid, carbon dioxide, probably acetone, hydroquinone, pyrrol, methylamine, 0.18 to 0.28 per cent. caffeine, and 0.04 or 0.05 per cent. of *coffeol* ("coffeone," $C_8H_{10}O_2$), to which he considered the aroma of coffee to be due. Coffeol is an oil boiling at 195° C. (383° F.), and is probably a methyl ether of saligenin.

Varieties.—The commercial varieties of coffee are very numerous indeed, but of little interest from a pharmaceutical standpoint. For culinary purposes, their selection depends upon both the amount of caffeine and the flavor, chiefly the latter, and blending of different varieties is largely resorted to for securing the desired combination of the two properties. It is almost a rule that one variety will not excel in both of these particulars. From a pharmaceutical standpoint, however, the caffeine content is considered almost alone. In this particular, the Java coffee perhaps takes precedence. Dragendorff determined the following percentages in a number of leading varieties:

	Per cent. of caffeine.		Per cent. of caffeine.
Brown Panang	0.71	First Native Ceylon	0.87
Finest Mocha	0.64	Second Native Ceylon	1.54
Yellow Menado	1.22	Third Native Ceylon	1.59
Finest Plantation Jamaica	1.43	Costa Rica	1.18
Pearl Plantation Ceylon	0.78	West Indian	1.22
First Surinam	1.78	Rio	1.14
Yellow Java	0.88	Jamaica	0.67
Gray Java	2.21	Santos	1.46

Warnier, in 1900, examined 9 samples of Java coffee and found the percentage of caffeine to range between 1 and 1.48. With these he contrasted Liberian coffee, and found it to contain when raw 1.59 per cent., when roasted 2.19 per cent. It is not likely that the roasted coffee actually contained such an excess, but that it was rendered more readily extractable by the changes in roasting. All results agree in according to the Mocha variety a very low percentage of caffeine, although its flavor is probably the most highly esteemed of all.

Maragogipa coffee is a kind very similar, apparently, to the Liberian, if not a form of it.

Adulterants.—In the entire condition, that in which the pharmacist will be likely to handle the drug, the presence of artificial seeds, made by moulding various pastes, has been frequently recorded. These have been detected by placing them in ether. Those which sink are usually spurious, and this fact can be determined by finding the membranous covering absent along the groove of the seed. Aside from sophistication, recourse is had upon a great scale to "doctoring" one variety so as to sell it under the name of another, especially of the Java, which is sought for its high caffeine percentage. A false color and surface are imparted by many ingenious methods of treatment. It has been claimed that some highly poisonous substances, especially arsenic, are used for this purpose, but investigation seems to show that this report was originated by interested parties and is without foundation. Sugar has been considerably used during the roasting process for the purpose of retaining the aromatic oil upon which the flavor depends. An addition of sugar amounting to 1 per cent. of the weight of the green seed is sufficient for this purpose, but very much larger quantities have frequently been employed as an adulterant. An excess of sugar may be detected by shaking the seeds in cold water. The natural sugar does not discolor the water, but that used as an adulterant promptly causes a deep coloration. The difficulty of controlling the amount of the sugar-admixture has led to the use for this purpose of an extract from the fresh pulp of the coffee berry, made at the point of production. Besides retaining the aroma, this develops aromatic products of its own in roasting, probably from the caffeo-tannic acid, these products being very similar to those of the roasted seed. Egg-albumin is used upon an enormous scale to give a beautiful glossy surface to the coffee seeds.

So many adulterants have been used in the case of ground coffee that it is impossible to discuss fully the subject here. Foremost among the substances so used is chicory, sometimes dandelion. Although it was originally introduced as an adulterant, many coffee-drinkers have become attached to the flavor imparted by chicory, and this admixture has now come to be a semi-legitimate trade procedure. F. M. Rimmington (1880) suggests the following process for the detection of these adulterations: The coffee is boiled with water and a little sodium carbonate, then washed with water and macerated

in a weak solution of chlorinated lime for 2 or 3 hours, when the ground coffee will form a dark stratum and the ground chicory a nearly white layer.

Next in degree of importance, perhaps, is the use of beans. Acorns have been largely employed. Since all such substances contain starch, the iodine test will indicate their presence. During recent years various coffee substances made from cereal grains have been introduced for the special benefit of those persons who desire a warm flavored drink, but object to the effects of caffeine upon the nervous system and upon the digestion. Doubtless these substances have found their way to a greater or less extent into ground coffee as an adulterant. Innumerable other substances have been used for the same purpose.

Pharmaceutical Preparations.—Fluidextract of Green Coffee, N. F.; Fluidextract of Roasted Coffee, N. F.; Syrup of Coffee, N. F

Action and Uses.—It is hardly necessary to point out that caffea is consumed in enormous quantities in the form of an infusion or decoction all over the world. Its large consumption depends upon its pleasant taste when it is roasted, which taste is due largely to an empyreumatic oil, and to the fact that the caffeine which it contains acts as a general stimulant. Taken in overdose, caffea, or its active principle caffeine, is capable of acting as a powerful nervous stimulant, increasing the reflexes and the mental activity, but not usually the depth of thought, Its influence upon the kidneys in medicinal or overdose is diuretic. When taken for a long period of time, it often produces indisposition and acidity of the stomach, due to hypersecretion of gastric juice. In other persons it tends to produce biliousness, and in still others palpitation of the heart and tremors. Very large poisonous doses are capable of producing marked increase of the reflexes, cramps in the extremities, staggering gait, and convulsions of a tetanic character. Such severe symptoms, however, practically never follow the use of coffee as a beverage.

Coffee, or its alkaloid caffeine, may be employed as a stimulant in collapse and in opium-poisoning, since it powerfully affects the respiratory center, which is depressed by the opium. By stimulating the intellectual centers in the brain, it also keeps the patient awake, and thereby does not allow him to "forget to breathe." So, too, coffee may be employed as a powerful stimulant in cases of collapse complicating serious operations and injuries, and if it cannot be swallowed, should be given as hot as possible by the rectum.

In France caffeine is very largely employed as a stimulant to the heart in cases of circulatory failure, but in England and America it has not gained great popularity for this purpose. A portion of the increased rapidity of the heart and strength of the pulse under its influence is probably dependent more upon its effects on the nervous system than directly upon the circulatory apparatus. It is one of the few powerful direct diuretics that we have in that it increases urinary flow not only by stimulating the circulation, and so increasing the supply of blood to the kidney, but it also stimulates the secreting epithelium of the uriniferous tubules, and so increases the amount of solids eliminated in the urine. Its employment as a stimulant to the heart is not to be resorted to for long periods of time. It is rather a remedy which is to be used to bridge over a crisis.

The dose of caffeine, or of citrated caffeine, which is more soluble, is from 1 to 5 grains (0.05–0.30 Gm.) 3 times a day. When large doses are repeatedly given, patients not infrequently develop what is known as caffeine insanity, owing to its stimulating effect upon the nervous system, and probably by causing increased activity of the kidneys. This may be prevented to some extent by the simultaneous administration of one of the bromides. As caffeine is insoluble in water, it cannot readily be given hypodermically. Tanret has suggested the following mixture for hypodermic use: Sodium benzoate, 56 grains (3.6 Gm.); caffeine, 48 grains (3 Gm.); distilled water, sufficient to make 2½ drachms (10 Cc.). Each Cc. of this mixture contains 0.3 Gm., or about 5 grains of caffeine.

An additional purpose for which caffeine is employed is the relief of neuralgic headache or that dependent upon eye-strain, in which conditions it does good by stimulating the nervous system. For these conditions it is usually combined with some of the bromides, and often with acetanilid, phenacetin, or antipyrine. There can be no doubt that in this combination it forms one of the most valuable remedies we have for ordinary neuralgic headache.

Coffee Substitutes.—The most important substitutes are the cereal coffees above referred to. Coffee leaves have also been proposed, and are to some extent in native use, since they contain 0.5 per cent. or more of caffeine. Their flavor is, however, very inferior. The membranous covering (*putamen*) of the raw coffee contains nearly 1 per cent. of caffeine, and has been sold as *Sultan* or *Succa* coffee. The pulp of the berry (*sarcocarp*) develops an agreeable flavor, and a method might be found for utilizing it in an admixture with coffee, but it is practically devoid of caffeine, hence not serviceable as a substitute.

Tea, cola, guarana, maté, and related products containing caffeine, will be found treated under these headings. Chocolate is considered under Oleum Theobromatis.

A number of coffee substitutes have been produced which contain no caffeine or related substance. Among these are the following:

The roasted, flattish, ovate seeds of *Cassia occidentalis* L. are used in the tropics as a substitute for coffee under the name of *Negro coffee* or *Mogdad coffee*, and have been met with as an adulterant in Europe; they are best detected by the microscope.

Mussaenda coffee is believed to proceed from *Gærtnera vaginata* Lam. (Fam. *Loganiaceæ*).

Soudan coffee is the seeds of *Parkia Roxburghii* D. Don. The pulp in which they are imbedded in the pod is edible, like that of figs

CAFFEINA, *U. S.*, *Br.*—Caffeine.

Coffeinum, P. G.; *Caffeia, Theine, Guaranine, Trimethyl-xanthine, Methyl-theobromine*, E.; *Caféine, Théine*, Fr.; *Koffeïn, Kaffeïn, Theïn*, G.

Formula, $C_8H_{10}N_4O_2 + H_2O$ or $C_5H(CH_3)_3N_4O_2 + H_2O$. Molecular weight, 210.64.

A feebly basic, proximate principle, obtained from the dried leaves of *Thea sinensis* L. (Fam. *Ternstræmiaceæ*), or from the dried seeds of *Coffea arabica* L. (Fam. *Rubiaceæ*), and found also in other plants or prepared synthetically.—U. S.

An alkaloid usually obtained from the dried leaves of *Camellia Thea* Link, or the dried seeds of *Coffea arabica* L. Crystallized from aqueous solution, it contains 1 molecule of water.—Br.

Preparation.—Caffeine was discovered independently by Runge, Pelletier and Caventou, and Robiquet, in 1821, as a constituent of coffee, and by Oudry, in 1827, as the alkaloid in tea. The pharmacopœias allow its preparation from either coffee or tea, but commercially it is prepared almost exclusively from tea and tea dust or sweepings. From coffee or tea it may be prepared by making a strong decoction of the same, treating it with lead acetate to remove tannic acid and other principles, then removing the excess of lead from the filtrate by hydrogen sulphide, concentrating and crystallizing. The mother-liquor may be treated with animal charcoal to decolorize it, and on concentration will yield an additional crop of crystals of caffeine. Good coffee yields between 0.8 and 2 per cent.; coffee leaves, 0.3 per cent.; maté or Paraguay tea, 0.5 to 2 per cent.; Japan and Chinese teas, 1.5 to 3.5 per cent.; kola-nuts, 1 to 2.3 per cent.; and guarana, about 5 per cent. of caffeine. Synthetically it has been prepared from *guanine*, $C_5H_5N_5O$, and also by heating the theobromine silver compound with methyl iodide in sealed tubes to 160° C. (320° F.) for about 20 hours.

Properties.—Caffeine occurs in white, flexible, silky, glistening needles, usually matted together in fleecy masses, permanent in the air, odorless, and having a bitter taste. If crystallized from water, it contains one molecule of water of crystallization, but if crystallized from alcohol, chloroform, or ether, it contains none. It is soluble at 25° C. (77° F.) in 45.6 parts of water, 53.2 parts of alcohol, 375 parts of ether, and 8 parts of chloroform. Its solubility in water is increased by the presence of certain salts, as, for instance, potassium bromide, sodium benzoate, sodium salicylate, and others. It is also soluble in 5.2 parts of water at 80° C. (176° F.) and in 17.1 parts of alcohol at 60° C. (140° F.). Caffeine sublimes at about 178° C. (352.4° F.), and should leave no residue. Its melting-point is 236.8° C. (458.3° F.).—U. S. The Brit. and Germ. pharmacopœias give the solubility of caffeine as 1 part in 80 parts of cold water, the latter authority also stating that it is soluble in 50 parts of cold alcohol, in 9 parts of chloroform, and in 2 parts of boiling water. Benzene, chloroform, or amyl alcohol, when repeatedly agitated with its solution in acidulated water, dissolves the whole of the caffeine (Dragendorff). Crystallized from alcohol or ether, it is anhydrous; crystallized from water it contains 8.5 per cent. (1 molecule) of water, with which it parts slowly on long exposure to air, or rapidly at temperatures above 100° C. (212° F.). Heated above 100° C. (212° F.) it begins to volatilize, and is completely sublimable at 180° C. (356° F.); it melts to a clear liquid at 230.5 C. (447° F.), and when ignited

burns with a sooty flame leaving no residue (P. G.). The anhydrous crystals have the composition $C_8H_{10}N_4O_2$, and contain 28.8 per cent. of nitrogen. Caffeine, moistened with strong nitric acid or dissolved in chlorine-water and evaporated at the heat of a water-bath, leaves a reddish-yellow residue, which becomes purple by ammonia from the formation of *murexoin* (Schwarzenbach). If a small quantity of caffeine is dissolved in about 1 Cc. of hydrochloric acid, a little potassium chlorate added, the whole evaporated to dryness on a water-bath, and the capsule then inverted over a vessel containing a few drops of ammonia-water, the residue will acquire a rich purple color, which is destroyed by alkalies. It should dissolve in sulphuric or nitric acid without producing a color (absence of organic impurities) and its aqueous solution should not be precipitated by mercuric potassium iodide test-solution (absence of other alkaloids). —U. S. Concentrated aqueous solutions of caffeine give with silver nitrate a white granular, crystalline precipitate; with mercuric chloride, long needles soluble in hydrochloric acid; with palladium chloride, yellow scales; with picric acid, no precipitate; the alkaloid dissolves in sulphuric and in nitric acid, and the solution remains colorless for several hours (Dragendorff). On adding to a solution of a small quantity of caffeine in concentrated sulphuric acid a minute fragment of potassium dichromate, it will acquire a yellowish-green color, which gradually becomes green.—U. S. Lloyd (1881) and Biedermann (1882) showed that caffeine salts with organic acids may be obtained from chloroform, and that they are easily decomposed by water. Tanret (1882) regards the solutions of caffeine in sodium benzoate, cinnamate, and salicylate as definite compounds suitable for hypodermic use; these solutions may be made so as to contain in each Cc. (15 minims) 0.20 Gm. (3 grains) of caffeine, and with sodium salicylate 0.30 Gm. (4½ grains). The salts with mineral acids have an acid reaction to test-paper, and are decomposed by water or alcohol. Their concentrated solutions yield with mercuric-potassium iodide a precipitate which soon crystallizes in needles. Similar precipitates obtained with other alkaloids remain amorphous (Delffs, 1854). Diluted acidulated solutions of caffeine are not precipitated by mercuric-potassium iodide (Mayer's test); but in aqueous solution containing a large excess of mineral acid caffeine is precipitated with quantitative accuracy by solution of iodine in potassium iodide (Wagner's reagent) as $C_8H_{10}N_4O_2.HI.I_4$, in which 1 part of iodine represents 0.3834 part of caffeine, or 1 Cc. decinormal iodine solution is equal to 0.00485 Gm. of caffeine. Under different conditions of precipitation it forms various haloid combinations, a thorough *résumé* of which is detailed by Gomberg (*Jour. Am. Chem. Soc.*, 18, pp. 347–377).

When caffeine is heated with solutions of fixed alkali hydroxides, it is decomposed, water being assimilated, methylamine and ammonia given off, and *caffeidine-carboxylic acid*, $C_8H_{12}N_4O_3$, formed, which on further heating with fixed alkali hydroxide may be changed to the strong uncrystallizable base caffeidine, $C_7H_{12}N_4O$ (Strecker, 1861), which is easily soluble in water and alcohol, and but sparingly soluble in ether. The decomposition takes place mainly according to the equation $C_8H_{10}N_4O_2 + H_2O = C_7H_{12}N_4O + CO_2$. O. Schultzen (1867) and F. Rosengarten (1871) proved that by prolonged boiling a further decomposition takes place, affecting chiefly the caffeidine, and resulting in the production of sarkosine, formic acid, methylamine, and ammonia; thus, $C_8H_{10}N_4O_2 + 6H_2O = C_3H_7NO_2 + CH_2O_2 + 2CH_3H_2N + NH_3 + 2CO_2$.

A cold saturated aqueous solution of caffeine should not be rendered turbid on the addition of solution of chlorine or iodine, nor discolored on the addition of water of ammonia (P. G.). 0.1 Gm. of caffeine added to 1 Cc. of either sulphuric or nitric acid should dissolve without discoloration (P. G.). In an aqueous solution of caffeine tannic acid gives a white precipitate soluble in excess of the reagent (Br., P. G.).

Pharmaceutical Preparation.—Elixir of Caffeine, N. F.

Action and Uses.—The physiological effects and therapeutic uses of this remedy are discussed under Caffea.

CAFFEINE COMPOUNDS.

The hydrochloride, hydrobromide, and nitrate of caffeine may be prepared by dissolving the caffeine in the respective acid, setting the solution aside over quicklime for spontaneous evaporation, and collecting the resulting crystals on blotting-paper for final drying.

Caffeinæ Hydrobromidum. *Coffeinum hydrobromicum. Caffeine hydrobromide, Koffeinhydrobromat, Bromwasserstoffsaures Koffein.* $C_8H_{10}N_4O_2.HBr + 2H_2O$. Molecular weight, 308.88. Contains 62.4 per cent. of caffeine.—Colorless transparent crystals readily decomposed by treatment with alcohol or water. It is somewhat more stable than the hydrochloride, but

loses its hydrobromic acid when dried at 110° C. (230° F.). It is used for nervous headache.

Caffeinæ Hydrochloridum. *Coffeinum hydrochloricum. Caffeine hydrochloride, Koffeinhydrochlorat, Salzsaures Koffein.* $C_8H_{10}N_4O_2.HCl + 2H_2O$. Molecular weight, 264.70.—Caffeine hydrochloride contains 72.8 per cent. of caffeine and crystallizes in large colorless monoclinic prismatic needles. It is readily decomposed into its constituents by washing with alcohol or water, and loses water of crystallization and acid on long exposure to air, the crystals becoming opaque. Dried at 100° to 110° C. (212° to 230° F.) all the chlorine may be volatilized, leaving pure caffeine.

Caffeinæ Nitras. *Coffeinum nitricum. Caffeine nitrate, Koffeinnitrat, Salpetersaures Koffein.* $C_8H_{10}N_4O_2.HNO_3 + H_2O$. Molecular weight, 273.21.—Crystallize in small thick prisms, readily decomposed by water and alcohol, loses all the nitric acid when dried at 100° C. (212° F.), and contains about 70.5 per cent. caffein.

Caffeinæ Phenylas. *Coffeinum phenylicum. Caffeine phenol, Koffein-phenol, Coffeo-phenol.* $C_8H_{10}N_4O_2.C_6H_6O + H_2O$. Molecular weight, 303.98.—A white or faint reddish crystalline mass, soluble in water, and obtained by dissolving 22.6 parts of caffeine in 10 parts of fused carbolic acid.

Caffeinæ Sulphas. *Coffeinum sulfuricum. Caffeine sulphate, Koffeinsulphat, Schwefelsaures Koffein.* $C_8H_{10}N_4O_2.H_2SO_4$. Molecular weight, 290.11. Contains 66.4 per cent. of caffeine.—To prepare the sulphate, caffeine is dissolved in about 10 times its weight of alcohol containing more than the proper equivalent of sulphuric acid, and set aside to crystallize. The crystals are decomposed by water and alcohol, but may be recrystallized from alcohol containing sulphuric acid.

Æthoxycaffeina, *Æthoxycoffeinum. Ethoxycaffeine,* E.; *Æthoxy-Koffein,* G. $C_8H_9(OC_2H_5)N_4O_2$. Molecular weight, 236.46.—Prepared by adding caffeine to an excess of bromine and then boiling the resulting bromide with an alcoholic solution of potassium hydroxide; or according to Thoms by adding to an alcoholic solution of monobromcaffeine gradually, and in small pieces, an equivalent of metallic sodium sufficient to take up the bromine, and then boiling the solution and concentrating it to crystallize. Colorless needles, difficultly soluble in cold water, readily soluble in alcohol, and melting at 138°–139° C. (280.4°–282.2° F.). Distinguished from caffeine by being precipitated when sodium hydroxide is added to an aqueous (1 per cent.) solution of the æthoxycaffeine, the solution of caffeine remaining clear.

CAFFEINA CITRATA, *U. S.*—Citrated Caffeine.

Caffeinæ Citras, Br.; *Caffeine citrate,* E.; *Citrate de Caféine* Fr.; *Koffëincitrat, Citronensaures Koffein,* G.

An unstable compound, $C_8H_{10}N_4O_2,C_6H_8O_7$, prepared from caffeine and citric acid.—Br.

Molecular weight, 382.38. Contains 50.25 per cent. of anhydrous caffeine and 49.75 per cent. of anhydrous citric acid.

Preparation.—Caffeine, 50 Gm.; citric acid, 50 Gm.; distilled water, hot, 100 Cc. Dissolve the citric acid in the hot distilled water, add the caffeine, and evaporate the resulting solution on a water-bath to dryness, constantly stirring toward the end of the operation. Reduce the product to a fine powder and transfer it to well-closed bottles.—U. S. The process of the British Pharmacopœia is identical with the above. It also is readily prepared by mixing an alcoholic solution of citric acid with a chloroform solution of caffeine and evaporating the mixture.

Citrated caffeine is a white odorless powder having a slightly bitter, acid taste, and an acid reaction. One part of citrated caffeine forms a clear, syrupy solution with about 4 parts of hot water. Upon dilution with 5 parts of water, a white crystalline precipitate (caffeine) separates, which redissolves when about 25 parts of water have been added. It is soluble also in a mixture of equal volumes of chloroform and alcohol.—U. S.

Lime water added to a 1 per cent. aqueous solution of citrated caffeine should produce no turbidity, but should cause a precipitate on boiling the solution, the precipitate disappearing after the solution has cooled (test for citric acid). Citrated caffeine should give the caffeine reaction with chlorine as mentioned under Caffeine. It should not discolor when dissolved in either sulphuric or nitric acid; leave no residue when burned; give no turbidity with barium nitrate, silver nitrate, or potassium oxalate, nor a discoloration with hydrogen sulphide (absence of sulphate, chloride, lime, and lead).

If 1 gram of caffeine citrate be dissolved in 20 Cc. of boiling water, the solution made alkaline with excess of solution of sodium hydroxide, and after cooling extracted successively with 15, 10, and 10 Cc. of chloroform, the combined chloroform extracts when evaporated and dried at 100° C. (212° F.) should weigh 0.5 Gm. (Hager).

Action and Uses.—Citrated caffeine may be employed for the same purposes as caffeine. For its mode of administration and dose, see CAFFEA.

CAFFEINA CITRATA EFFERVESCENS, *U. S.*—Effervescent Citrated Caffeine.

Caffeinæ Citras Effervescens, Br.; *Coffeinum citricum effervescens. Effervescent caffeine citrate*, E.; *Brausendes Koffeincitrat*, G.

Preparation.—Citrated caffeine, 40 Gm.; sodium bicarbonate, dried and powdered, 570 Gm.; tartaric acid, dried and powdered, 300 Gm.; citric acid, uneffloresced crystals, 195 Gm., to make about 1000 Gm. Powder the citric acid and mix it intimately with the citrated caffeine and tartaric acid, then thoroughly incorporate the sodium bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. (199.4°–219.2° F.). When the mixture, by the aid of careful manipulation with a wooden spatula, has acquired a moist consistence, rub it through a No. 6, tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2 F.).—U. S.

The Br. P. directs that a mixture of sodium bicarbonate, 51 Gm., and refined sugar, 14 Gm., be thoroughly incorporated with a previously prepared mixture of caffeine citrate, 4 Gm., tartaric acid, 27 Gm., and citric acid, 18 Gm., and the whole then placed in a dish or pan heated to between 93.3° and 104.4° C. (200° and 220° F.). When the mixture has assumed a granular character, it is passed through sieves of suitable size. The product dried at a temperature of 54.4° C. (130° F.) should weigh 100 Gm.

Action and Uses.—This remedy is merely an agreeable form of administering the alkaloid. Its uses and effects are identical with those of caffeine. The dose is 1 drachm (4 Gm.) in a half glass of cold water, taken during effervescence.

CAFFEINÆ SODIO-SALICYLAS.—Caffeine Sodio-salicylate.

Coffeino-Natrium salicylicum, P. G.; *Koffein-Natriumsalicylat*, G.

Preparation.—Caffeine, 50 Gm.; sodium salicylate, 50 Gm.; alcohol, a sufficient quantity. Triturate the caffeine with the sodium salicylate and a sufficient quantity of alcohol to a smooth paste, and dry this by exposure in a moderately warm place. Rub the dry mass to powder, and keep it in well-stoppered bottles.

The P. G. directs that 50 parts of caffeine and 60 parts of sodium salicylate be dissolved in 200 parts of water, and the solution evaporated to dryness.

Properties.—Caffeine sodio-salicylate occurs both as a white amorphous powder and as white granules, odorless, of a sweetish-bitter taste, and soluble in twice their weight of water; also soluble in 50 parts of alcohol. If heated in a test-tube, white vapors, having the odor of carbolic acid, will be developed. An aqueous 20 per cent. solution should be colorless when freshly made, and develop at most a faint pink color and faint acid reaction after standing a few hours. The addition of ferric chloride solution causes a bluish-violet coloration even in very dilute aqueous solution, which serves to distinguish caffeine sodio-salicylate from the sodio-benzoate, the latter causing a brown precipitate.

Tests.—An aqueous 5 per cent. solution should not be affected by hydrogen sulphide nor by barium nitrate solution; and if 2 volumes of the same be mixed with 3 volumes of alcohol and then acidulated with nitric acid, the mixture should not be affected by silver nitrate solution. 0.1 Gm. of caffeine sodio-salicylate should dissolve in 1 Cc. of sulphuric acid without effervescence and without color. If 0.5 Gm. of the salt be boiled with successive portions of 5 Cc. of chloroform, the united clear solutions should yield on evaporation at least 0.2 Gm. of dry caffeine.—P. G.

This preparation is used as a diuretic (see THEOBROMINE).

Allied Preparations.—CAFFEINÆ SODIO-BENZOAS; COFFEINO-NATRIUM BENZOICUM. *Caffeine sodio-benzoate*, E.; *Koffein-Natriumbenzoat*, G.—The Swiss Pharmacopœia directs that 50 parts of caffeine and 59 parts of sodium benzoate shall be dissolved in 200 parts of water, the solution evaporated to dryness, and the residue reduced to powder. The proportions given by the National Formulary are very similar, being 50 parts each of caffeine and sodium benzoate, to be made into a smooth paste with sufficient alcohol, and then dried by exposure in a moderately warm place. Caffeine sodio-benzoate is a colorless amorphous powder, having a bitter, aromatic taste, and soluble in 2 parts of water.

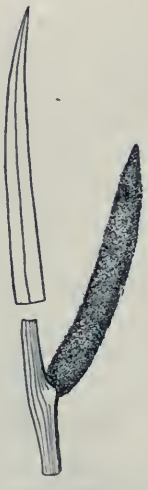
CAFFEINÆ SODIO-CINNAMAS; COFFEINO-NATRIUM CINNAMYLICUM. *Caffeine sodio-cinnamate*, E.; *Koffein-Natriumcinnamat*, G.—This compound may be made in the same manner as the preceding, using sodium cinnamate in place of the benzoate. It is a white amorphous powder, soluble in 2 parts of water and about 30 parts of alcohol.

CALAMUS, *U. S.*—Calamus.

Radix Calami Aromatici, Radix Acori; Rhizoma Calami (P. G.), *Sweet flag* (*Sweet sedge, cane, rush, root, or myrtle*), *Myrtle-flag* (*-grass or -sedge*), E.; *Kalmus or Kalmuswurzel*, G.; *Acore vrai* (Cod.), *Acore odorant*, Fr.; *Acorro verro*, It.; *Calamo aromatico*, It., Sp.

The dried unpeeled rhizome of *Acorus Calamus* L. (Fam. *Araceæ*).

Fig. 68.



Calamus: inflorescence and part of leaf (½ Nat.).

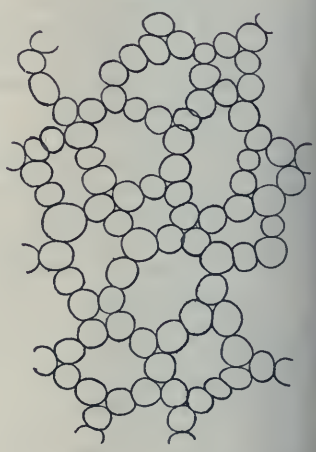
Fig. 69.

Upper and lower surface of rhizome (¾ Nat.).

Official in most pharmacopœias. The German defines it as peeled.

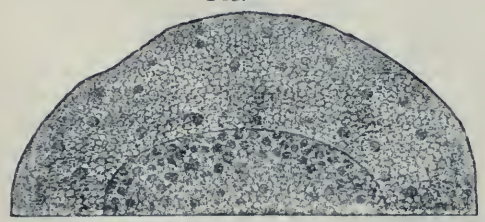
Origin.—A herbaceous perennial bog-plant, about a yard high, the stem, leaf, and inflorescence here illustrated. It grows wild in abundance over a large part of the north temperate zone. It inhabits muddy swamps and is highly gregarious, the rhizome branching and extending most widely. All parts of the plant are aromatic. The young and tender inflorescence is eaten by children, and a sort of confection was formerly extensively used, made by "candying" the surfaces of transverse slices of the fresh rhizome, and constituted a popular form of its medicinal use.

Fig. 71.



Calamus texture, greatly magnified.

Fig. 70.



Transverse section of rhizome of calamus; magnified 3 diameters.

Description.—In entire or split pieces of indefinite length and 1 to 2 Cm. (⅖ to ⅘ In.) thick; when entire, cylindraceous and somewhat flattened from above downward, occasionally exhibiting a short stump of a lateral branch; externally yellowish-brown with blackish patches,

sharply longitudinally wrinkled, the upper surface obliquely marked with broad, dark, often fibrous leaf-scars which are often broadly V-shaped, and have sharply projecting margins, the lower surface thickly pitted with root-scars which exhibit a low whitish rim and a dark depressed center; fracture short, sharp, corky, whitish, starchy, the texture spongy, exhibiting numerous oil-cells and scattered wood-bundles, the latter crowded just within, and scattered outside of the endodermis; odor strongly aromatic; taste strongly aromatic, pungent, and bitter.

The handsome, white, peeled ("German") calamus of the market cannot be used in accordance with the official requirements. This, when fresh, is white, but turns pinkish on drying, and is less aromatic and bitter than the unpeeled. The agreeable aromatic odor is best preserved by keeping the rhizome unpeeled, as directed by the Pharmacopœia. Calamus should, it is said, be collected early in the spring, and deprived of the far less aromatic and bitter roots, which are 10 to 15 Cm. (4 to 6 In.) long, unbranched, but near the tip beset with soft thin fibers. On drying, calamus loses from 70 to 75 per cent. in weight.

Constituents.—The official rhizome yields 1.5 to 3.5 per cent. of a pale-yellow volatile oil having the odor and sharp taste of calamus, choline (formerly thought to be a specific alkaloid, *calamine*), soft resin, gum, starch, and the glucoside *acorin* ($C_{36}H_{60}O_6$). This last is amorphous, semifluid, resinous, of neutral reaction, aromatic odor, and bitter, aromatic taste. It is insoluble in water, but soluble in ether, chloroform, and absolute alcohol. In a current of hydrogen, it may be split into sugar and oil of calamus, but acted upon in the presence of air it oxidizes to *acoretin*, a neutral resin, which, however, by reduction in alkaline solution, yields the volatile oil and sugar.

The fresh rhizome yields 0.8 per cent. of volatile oil, 2.3 per cent. of soft resin, 5.5 per cent. of gum, and 1.6 per cent. of starch.

Pharmaceutical Preparation.—Fluidextract of Calamus, U. S. P.

Action and Uses.—Calamus is not largely employed in medicine at the present time, but may be given as a mild aromatic stimulant and tonic. It was formerly used in the treatment of flatulent colic and atonic dyspepsia, and was supposed to be beneficial as a mild stimulant in typhoid states.

The dried root may be chewed *ad libitum* to relieve dyspepsia, or an infusion made with 1 ounce (30 Gm.) of the drug and 1 pint (480 Cc.) of water may be given in doses of from 1 to 2 fluidounces (30–60 Cc.).

CALCII BROMIDUM, *U. S.*—Calcium Bromide.

Calcium bromatum.—*Bromure de calcium*, Fr.; *Bromcalcium, Calciumbromid*, G.

Formula, $CaBr_2$. Molecular weight, 198.52.

It should contain not less than 97 per cent. of pure calcium bromide and should be kept in well-stoppered bottles.—U. S.

Preparation.—Calcium bromide is readily prepared by dissolving pure calcium carbonate in hydrobromic acid until effervescence ceases, filtering to remove any excess of undissolved carbonate, and evaporating to dryness.

Properties.—Thus obtained, calcium bromide is a whitish, granular or pulverulent, neutral, very deliquescent salt, having a pungent, bitter and saline taste. It is freely soluble in alcohol (1 part, U. S.) and water, the latter solution yielding with difficulty colorless needles. It dissolves in 0.5 part of water at 25° C. (77° F.). The aqueous solution is neutral to litmus.

The salt melts at a red heat, giving off bromine; treated with strong sulphuric acid, hydrobromic acid is evolved, afterward bromine and sulphur dioxide. The aqueous solution yields with ammonium oxalate a white precipitate insoluble in acetic acid, but soluble in hydrochloric acid (calcium oxalate); with silver nitrate, a curdy precipitate insoluble in nitric acid and in diluted ammonia water (silver bromide); and with a few drops of chlorine water liberates bromine, which dissolves in carbon disulphide with a yellow or brown-yellow color free from violet tint. The solution left in contact with lime forms calcium oxybromide, which has a strong alkaline reaction, and on evaporation is left as a very white salt.

Tests.—The neutral reaction of the salt and its ready solubility in water and alcohol exclude most impurities. If to 5 Cc. of a 5 per cent. aqueous solution, slightly acidu-

lated with hydrochloric acid, an equal volume of hydrogen sulphide test-solution be added, neither coloration nor turbidity should be perceptible after the tube has stood corked at 35° C. (95° F.) for at least half an hour, either before or after rendering alkaline with ammonia-water (absence of heavy metals). 1 Gm. of the salt in 20 Cc. of water should form a clear, colorless solution, free from residue (absence of insoluble impurities). If diluted sulphuric acid be dropped upon the salt, the latter should not at once assume a yellow color (absence of bromate). If to 10 Cc. of a 5 per cent. solution of the salt 1 Cc. of chloroform be added, then chlorine-water diluted with an equal volume of water, drop by drop, with constant shaking, the liberated bromine dissolved in the chloroform should have a yellow to orange color free from any violet (absence of iodine). If 1 Gm. of the salt and 1 Gm. of sodium acetate be dissolved in 5 Cc. of distilled water and made slightly acid with dilute acetic acid, after boiling and cooling, the solution should not become cloudy within 5 minutes after shaking with 5 drops of potassium dichromate test-solution (absence of barium). If 5 Cc. of a 1 per cent. solution of the salt, 5 Cc. of potassium hydroxide test-solution, and about 0.2 Gm. of aluminum wire be placed in a tube, in the upper portion of which is then inserted a plug of purified cotton and over the mouth a piece of wet red litmus-paper, and the tube be heated in boiling water for 15 minutes, no blue coloration of the paper should be discernible (limit of nitrates and ammonia).—U. S.

Pharmaceutical Preparation.—Elixir of Calcium Bromide, N. F.

Action and Uses.—Calcium bromide may be employed for the same purposes as its corresponding potassium salt (see Potassii Bromidum). It was introduced into medicine in 1871, by Dr. Hammond, as a remedy for hysteria, insomnia, and epilepsy, but it has no distinct advantage over the potassium salt, except that the calcium base is not so depressant to the heart as the potassium. The dose is from 20 to 60 grains (1.30–4 Gm.), best administered in syrup or elixir.

CALCII CARBONAS PRÆCIPITATUS, *U. S., Br.*—Precipitated Calcium Carbonate.

Calcium carbonicum præcipitatum, P. G.; *Calcaria carbonica præcipitata, Creta præcipitata.—Precipitated carbonate of lime, Precipitated chalk*, E.; *Carbonate de chaux précipité, Craie précipitée*, Fr.; *Calciumkarbonat. Präcipitirter kohlensaurer Kalk*, G.; *Carbonato di calcio precipitato*, It.; *Carbonato de cal*, Sp.

Formula, $CaCO_3$. Molecular weight, 99.35.

It should contain not less than 99 per cent. of pure calcium carbonate.—U. S.

Preparation.—It is obtained by adding to a hot solution of pure calcium chloride, while stirring, a solution of ammonium carbonate until an alkaline reaction is obtained. Ammonium chloride and a precipitate of calcium carbonate are formed. The latter is washed by decantation and on the filter with boiling water until silver nitrate gives no test for chlorine in the filtrate. It is then dried at 100° C. (212° F.). If calcium carbonate is precipitated in the cold, it is flocculent and quite voluminous, and with difficulty deprived of the mother-liquor by washing; hence it is advisable to heat the solutions before mixing them.

Properties.—Thus prepared, it is a white, impalpable, inodorous, tasteless powder consisting of microscopic rhombohedric crystals, but entirely free from grittiness. It has the specific gravity 2.72, is without action upon moistened test-paper, and is not altered in the air, but above 400° C. (752° F.) begins to evolve carbon dioxide, and at a red heat is entirely converted into calcium oxide. The salt is nearly insoluble in water; the solubility is increased by presence of ammonium salts, and especially by carbonic acid; alkali hydroxides diminish it. It is insoluble in alcohol, but dissolves without residue in dilute hydrochloric, nitric, or acetic acid, carbon dioxide being copiously given off.—U. S.

Tests.—For applying tests of identity and purity, 5 Gm. are mixed with 100 Cc. of pure water, followed by hydrochloric acid, drop by drop, while stirring, until solution takes place. The solution, after boiling and cooling, should be of acid reaction and free from more than a trace of insoluble matter. A portion of this solution, neutralized with ammonia-water, yields with ammonium oxalate test-solution a white precipitate of calcium

oxalate, insoluble in acetic but soluble in hydrochloric acid. In 20 Cc. of the solution rendered alkaline with ammonia-water, no turbidity or precipitate should be produced either before or after boiling (absence of iron, alumina, phosphates, etc.). If to 5 Cc. of the solution 5 drops of hydrochloric acid and 1 Cc. of potassium sulphate test-solution be added, no turbidity should result (absence of barium). 10 Cc. of the solution, mixed with 1 Cc. of diluted hydrochloric acid and 10 Cc. of fresh hydrogen sulphide test-solution, should not produce a color or turbidity when kept corked at 35° C. (95° F.) for at least half an hour, either before or after rendering slightly alkaline with ammonia-water (absence of heavy metals). If 1 Gm. of the salt be agitated with 50 Cc. of water, the filtrate should not show an alkaline reaction with litmus-paper, and, on evaporation, should not leave more than a trace of fixed residue (limit of soluble impurities).—U. S.

A substitution of calcium sulphate for the carbonate, wholly or partly, has been occasionally observed; this will not readily dissolve in diluted hydrochloric acid. Boiled with distilled water and allowed to cool and then filtered, a liquid will be obtained giving a white precipitate with barium chloride.

Action and Uses.—This remedy is employed for the same purpose as prepared chalk (see CRETA PRÆPARATA).

CALCII CHLORIDUM, *U. S.*, *Br.*—Calcium Chloride.

Calcium chloratum.—Chlorure de calcium, Fr.; *Chlorcalcium, Calciumchlorid*, G.; *Cloruro di calcio*, It., Sp.

Formula, $CaCl_2$. Molecular weight, 110.16.

Calcium chloride deprived of its water by fusion at the lowest possible temperature. It should be preserved in a well-stoppered bottle, and should contain not less than 99 per cent. of pure calcium chloride.—U. S.

Preparation.—This compound is a by-product in many chemical processes, among others that for solution of ammonia. It may be formed by neutralizing hydrochloric acid with marble or other calcium carbonate: $CaCO_3 + 2HCl$ yields $CaCl_2 + CO_2 + H_2O$. Iron being usually contained in these native carbonates, it is removed by digesting the solution with chlorinated lime and slaked lime, by which the iron is first converted into ferric chloride and then precipitated as ferric hydroxide. The filtrate, which will be found to have an alkaline reaction, is neutralized with hydrochloric acid, evaporated, and the residue fused at the lowest temperature. The Br. P. directs that the salt be heated at a temperature not above 200° C. (392° F.), whereby the salt $CaCl_2 + 2H_2O$ is obtained.

Properties.—Calcium chloride is in white, dry, but very deliquescent inodorous masses, and has a hot, saline, bitterish, sharp taste. When the salt is overheated in fusing, a small quantity of chlorine is expelled as hydrochloric acid; hence the anhydrous salt usually has a faint alkaline reaction, which is increased at a red heat. It is soluble at 25° C. (77° F.) in 1.3 parts of water with production of heat, and in 8 parts of alcohol; soluble in 1.5 parts of boiling alcohol, insoluble in ether, chloroform, fatty and ethereal oils, etc. A saturated aqueous solution at 15° C. (59° F.) has the specific gravity 1.41104. Alcoholic solutions, when evaporated to crystallization, yield compounds containing alcohol of crystallization, as $CaCl_2 + 4C_2H_6O$ and $CaCl_2 + 4CH_4O$; hence the chloride cannot be used as a drying agent for alcohol. It is unsuitable for drying ammonia gas, since it forms with the latter a compound, $CaCl_2 + 4NH_3$. On cooling a concentrated aqueous solution, crystals of the composition $CaCl_2 + 6H_2O$ are formed, which melt at about 30° C. (86° F.). The salt containing 2 molecules of water, when mixed with two-thirds of its weight of snow or finely crushed ice, produces a temperature of —45° C. (—49° F.). From an aqueous solution, insoluble white calcium oxalate is precipitated by adding ammonium oxalate solution. The precipitate is insoluble in acetic, but soluble in hydrochloric acid. The chlorine present is detected by silver nitrate solution in the usual way.

Tests.—The aqueous solution (1 in 20) should remain clear upon addition of ammonia-water, even after boiling (absence of iron, aluminum, etc.), or of barium chloride test-solution (absence of sulphate). If from 100 Cc. of the solution the calcium be completely precipitated by ammonium oxalate test-solution, the filtrate should, on evaporation, leave not more than a trace of fixed residue (limit of magnesium and alkalies). If 10 Cc. of the aqueous solution, acidulated with hydrochloric acid, be mixed with an equal volume

of hydrogen sulphide test-solution, neither color nor turbidity should appear after standing corked at 35° C. (95° F.) for at least half an hour, either before or after addition of ammonia-water (absence of arsenic, lead, etc.). If to 5 Cc. of the solution (1 in 20) 5 drops of hydrochloric acid and 1 Cc. of potassium sulphate test-solution be added, no turbidity should result (absence of barium).—U. S.

Action and Uses.—Overdoses of calcium chloride produce severe gastro-intestinal inflammation, which may be followed by death if the amount is sufficiently great. In moderate doses it frequently causes gastric irritability, and for this reason its employment often has to be discontinued. The drug has been given with varying success in the treatment of scrofulous enlargements of the superficial lymphatic glands, of lupus, and of scrofulous caries. Its employment is sometimes of service in those cases where insufficient bone-formation exists, and also after fractures. The drug has also been used for the purpose of increasing the coagulability of the blood in purpura, hæmophilia, and other hemorrhages. In these conditions it should be given in large doses for a period not longer than 4 days, as its secondary effect is to decrease the coagulability of the blood. Its administration has been recommended a few days prior to surgical operations upon the gall-bladder for the purpose of preventing the continual oozing of blood which sometimes occurs when marked jaundice is present. It is said to prevent urticaria and pruritus by some influence on the blood-plasma. A solution of the drug has been employed in poultices for the purpose of hastening the suppuration of boils.

The internal dose of calcium chloride is from 5 to 30 grains (0.30–2 Gm.), best administered in one full dose followed at frequent intervals by a smaller one. The liquor calcii chloridi (U. S. P., 1870) contains 228 grains of the salt in 1 ounce of distilled water, and may be given in doses of from 10 to 40 minims (0.6–2.6 Cc.).

CALCII GLYCEROPHOSPHAS.—Calcium Glycerophosphate.

Calcium glycerino-phosphoricum.—*Glycerino-phosphate de chaux*, Fr.; *Calcium glycerinophosphat*, G.

Formula, $C_3H_5(OH)_2CaPO_4 + H_2O$. Molecular weight, 226.46.

Preparation.—This is obtained by neutralizing a solution of glycerophosphoric acid with milk of lime or calcium carbonate, filtering off the calcium phosphate, and concentrating the filtrate in a vacuum. The calcium salt is then precipitated by addition of alcohol, filtered, and washed with alcohol. To purify the salt, this treatment is repeated.

Properties.—It is a white crystalline powder, soluble in 20 parts of water, but less soluble in hot water; neutral to litmus, but the commercial product is sometimes acid. The salt loses its water of crystallization at or above 130° C. (266° F.).

Tests.—The salt should be free from ordinary phosphoric acid, which would yield a precipitate with magnesia mixture or ammonium molybdate solution; in the latter case, heat must be avoided, since a solution of the salt is decomposed by heat into phosphoric acid and glycerin. A solution of the salt should not give a precipitate with excess of ammonium molybdate on long standing, indicating the absence of free glycerophosphoric acid, which slowly decomposes in solution. Adhering glycerin is detected by shaking the salt with absolute alcohol and evaporating the filtrate. Hydrogen sulphide should give no precipitate when passed into a solution of the salt (absence of heavy metals), nor barium chloride (absence of sulphate); and silver nitrate should cause only a slight opalescence. These tests also apply to the corresponding potassium, sodium, and lithium salts, and, in addition, the latter should give no precipitate with dilute sulphuric acid (absence of barium).

Action and Uses.—This preparation is regarded as an excellent tonic and nervine, and as an efficient substitute for the other calcium salts used for these purposes. It has been given in the treatment of diabetes mellitus for the double purpose of furnishing phosphates to the system and of supplying the calcium which is eliminated in excess by the urine in this disease. In the treatment of neurasthenia it has recently acquired considerable reputation. It has also been proposed as a remedy for incontinence of urine.

The dose for an adult is from 5 to 10 grains (0.30–0.60 Gm.); for a child, from 4 to 6 grains (0.25–0.40 Gm.), according to the age, twice daily.

CALCII HYPOPHOSPHIS, *U. S.*, *Br.*—Calcium Hypophosphite.

Calcium hypophosphorosum. Hypophosphite of lime, E.; *Hypophosphite de chaux*, Fr.; *Calciumhypophosphit, Unterphosphorigsaurer Kalk*, G.

Formula, $Ca(H_2PO_2)_2$. Molecular weight, 168.86.

It should contain not less than 98 per cent. of pure calcium hypophosphite, and should be kept in well-stoppered bottles; caution should be taken in dispensing the salt, as explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents.—U. S.

Preparation.—This salt is formed when milk of lime and phosphorus are heated together in a deep vessel, the chief products being calcium hypophosphite and inflammable hydrogen phosphide; thus, $3Ca(OH)_2 + 8P + 6H_2O = 3Ca(H_2PO_2)_2 + 2PH_3$. When the phosphorus has disappeared, the mixture is filtered, evaporated to dryness on a water-bath or allowed to crystallize when strongly concentrated. Nearly half the phosphorus is oxidized to phosphoric acid, probably by the decomposition of water, since the escaping gas contains free hydrogen (Wurtz), and remains with the excess of lime as calcium phosphate. E. Scheffer (1858) succeeded in avoiding much of this loss by using phosphorus which had been partially oxidized under water by passing atmospheric air into it, whereby the phosphorus assumes a spongy appearance and unites with the lime even at the ordinary temperature, but more readily at 55° C. (about 130° F.), very little spontaneously inflammable gas being generated. The salt is prepared on the large scale by adding granulated phosphorus to milk of lime and exposing the mixture to the air, and agitating frequently until the phosphorus has disappeared. A small portion of hydrogen phosphide is evolved (Gmelin-Kraut's *Chemie*). It is well to precipitate the dissolved lime by passing carbon dioxide through the warm filtrate and by filtering again.

Hypophosphites, when boiled in aqueous solution with alkali, are decomposed into phosphite or phosphate and hydrogen.

Properties.—Calcium hypophosphite crystallizes in transparent, thin, flexible scales composed of flat monoclinic prisms, but is usually met with as a white crystalline powder with a pearly lustre, of neutral or slightly acid reaction, inodorous, and of a bitter, nauseous taste. In the dry state it is permanent in the air, but when dissolved in water it is gradually oxidized to calcium phosphate. Heated to redness in a retort, it decrepitates, evolves water, spontaneously inflammable hydrogen phosphide, and a little phosphorus, and leaves nearly 80 per cent. of a reddish residue containing a little amorphous phosphorus and calcium pyrophosphate. The salt dissolves in 6.5 parts of water at 25° C. (77° F.) and in 6 parts of boiling water; it is insoluble in strong and but slightly soluble in dilute alcohol (H. Rose). The solution yields white precipitates with silver nitrate and with mercuric chloride, both turning dark when heated, from reduction to the metallic state. Metallic gold is precipitated from the chloride, and the soluble copper salts yield with the solution, particularly on heating, metallic copper. Ammonium oxalate produces in the solution a white precipitate which is insoluble in acetic acid, but dissolves in hydrochloric acid.

Tests.—If 1 Gm. of the salt be dissolved in 20 Cc. of water, not more than a trace of insoluble residue should be left (absence of phosphate, sulphate, and other insoluble impurities). In this solution no precipitate should be produced by the addition of lead acetate test-solution (absence of soluble phosphate and phosphite, Br.). If 5 Cc. of the solution (1 in 10) be mixed with 10 Cc. of water and 3 Cc. of nitric acid in a beaker, and the whole evaporated to dryness on a water-bath, the residue should not respond to the modified Gutzeit s test for arsenic (given under ARSENI TRIOXIDUM). The object of the nitric acid is to oxidize the salt to calcium acid phosphate, on which the nascent hydrogen in the test has no action. 10 Cc. of the solution of the salt (1 in 20), acidulated with hydrochloric acid, should yield no color or turbidity when mixed with an equal volume of fresh hydrogen sulphide solution and kept corked at 35° C. (95° F.) for at least half an hour, either before or after making alkaline with ammonia-water (absence of heavy metals).—U. S. The assay method by tenth-normal potassium permanganate given in the U. S. P., 1890, has been dropped, and no method is now official. On boiling 0.25 Gm. of the salt for 10 minutes with a solution of 0.6 Gm. of potassium permanganate, a nearly colorless filtrate should be obtained.—Br.

H. A. D. Jowett (*Pharm. Jour.*, 1898) has critically examined the former method of analysis and the properties of pure and commercial hypophosphites, and comes to the

conclusion that the permanganate method is defective in itself, and also is not applicable, because the commercial hypophosphites usually contain as impurity some phosphite, which reacts with the permanganate. This is detected by lead acetate, giving an insoluble precipitate, which is attributed, in U. S., 1890, to the presence of soluble phosphate, but the latter, according to Jowett, is an unlikely impurity. The Br. test with lead acetate requires that no precipitate be produced, whereas it is only rarely that commercial specimens are free from phosphite, which, hence, would give a precipitate of lead phosphite.

Jowett's method of assay, which seems to be accurate, consists in removing impurities by solution of lead acetate, precipitating excess of lead and the calcium from the filtrate by addition of sulphuric acid and alcohol, filtering, and oxidizing the hypophosphorous acid in the filtrate by bromine, or, better, by potassium chlorate and hydrochloric acid to phosphoric acid, which is then determined gravimetrically or volumetrically in the usual way. Jowett gives the solubility of pure calcium hypophosphite as 1 in 6.43 parts of water at 20° C. (68° F.), while that of the commercial specimens was found variable.

Pharmaceutical Preparations.—Elixir of Calcium Hypophosphite, N. F.; Syrup of Calcium Hypophosphite, N. F.; Syrup of Hypophosphites, U. S.

Action and Uses.—Calcium hypophosphite is probably converted into a phosphate in the stomach and absorbed as a lactophosphate. It does not possess the property of stimulating or regenerating nervous matter and other tissues containing phosphorus, and has a physiological action wholly different from the latter substance. Because of the calcium base it has been given with asserted success in the treatment of rachitis, mollities ossium, in fractures where union is sluggish, in dental caries (particularly in nursing women), and in scrofula and incipient tuberculosis. The drug is practically of no value in the later stages of phthisis, except that it may to a certain extent combat the accompanying anæmia.

The dose of this salt is from 10 to 30 grains (0.60–2 Gm.) 3 times daily. It is commonly prescribed in the form of a syrup.

CALCII PHOSPHAS PRÆCIPITATUS, *U. S.*—Precipitated Calcium Phosphate.

Calcii phosphas, Br.; *Calcium phosphoricum*, P. G.; *Calcaria phosphorica—Precipitated phosphate of lime*, E.; *Phosphate de chaux hydraté*, Fr.; *Calciumphosphat. Phosphorsaure Kalkerde*, G.

Formula, $Ca_3(PO_4)_2$. Molecular weight, 307.98.

It should contain not less than 99 per cent. of pure di- and tricalcium phosphate.—U. S.

Preparation.—The U. S. gives no method of preparation, while the Br. gives only an outline, thus: Bone ash (calcined bone) is dissolved in moderately dilute hydrochloric acid, forming acid calcium phosphate, $Ca(H_2PO_4)_2$, and calcium chloride, $CaCl_2$, in solution, which is then poured into dilute ammonia water in sufficient quantity to leave an alkaline reaction. A precipitate of tricalcium phosphate is formed; thus, $Ca(H_2PO_4)_2 + 2CaCl_2 + 4NH_4OH = Ca_3(PO_4)_2 + 4NH_4Cl + 4H_2O$. When formed in cold solution, the precipitate is at first amorphous and voluminous, and difficult to wash, but on stirring a long time it becomes crystalline. The precipitate is washed on the filter with hot water until the filtrate no longer gives a precipitate with silver nitrate acidified with nitric acid and then dried at 100° C. (212° F.).

The calcium phosphate of the German Pharmacopœia is prepared by precipitating a solution of calcium chloride with sodium phosphate, has the composition $CaHPO_4 \cdot 2H_2O$, is more readily soluble than the above salt, and when heated to redness loses 26 per cent. of water. The percentage of water in this salt varies with the temperature of precipitation and the length of time that the precipitate remains in contact with the solution.

Occasionally commercial calcium phosphate is contaminated with ammonium chloride, due to imperfect washing.

Properties and Tests.—This preparation is often called *bone phosphate*, to dis-

tinguish it from other calcium phosphates: it forms a light, white, amorphous, permanent powder, which at an intense white heat fuses without decomposition, and on cooling yields a porcelain-like mass. When fused with sodium carbonate or digested with a solution of this salt, it is partly decomposed, with the formation of calcium carbonate. It is almost insoluble in water; almost insoluble in acetic acid, except when freshly precipitated, but somewhat soluble in solutions of sodium chloride and other neutral alkali salts. Continued boiling with water induces decomposition, with the formation of basic phosphate, $Ca_5(PO_4)_3OH$, and of hydrophosphate, $CaHPO_4$. When moistened with silver nitrate test-solution, a yellow color (silver phosphate) is assumed by the salt either before or after ignition (distinction from acid calcium phosphate, which, after ignition, remains white when moistened with silver nitrate, $CaHPO_4$ forming the pyrophosphate, $Ca_2P_2O_7$, and $Ca(H_2PO_4)_2$ the metaphosphate, $Ca(PO_3)_2$, on ignition, neither of which gives a yellow color with silver nitrate). For applying tests of identity and purity, shake 2 Gm. of the salt with 20 Cc. of water, and add nitric acid, drop by drop, until solution is effected; then add water to make the liquid measure 40 Cc. No effervescence should occur on adding the acid (absence of carbonate). From a portion of this solution the salt is precipitated unchanged by a slight excess of ammonia water. From another portion ammonium molybdate test-solution precipitates yellow ammonium phosphomolybdate; the reaction is accelerated by gentle heat. If to 5 Cc. of the solution, acidulated with nitric acid, 0.5 Cc. of silver nitrate test-solution be added, not more than a slight turbidity should result (limit of chloride). If to 5 Cc. of the solution, strongly acidulated with nitric acid, 1 Cc. of potassium sulphate test-solution be added, no turbidity should result upon standing (absence of barium). If 5 Gm. of the salt be boiled with about 20 Cc. of sodium hydroxide test-solution and filtered, and to the filtrate, acidulated with hydrochloric acid, there be added a few drops of ferrous sulphate test-solution, and again boiled, no blue precipitate or coloration should result (absence of cyanides). 10 Cc. of a solution of the salt (1 in 20), obtained by shaking the salt with water and adding hydrochloric acid, drop by drop, to slight excess and heating, should not be colored or made turbid by an equal volume of hydrogen sulphide solution when kept corked at 35° C. (95° F.) for at least half an hour, either before or after making alkaline with ammonia-water (absence of heavy metals). 2 Gm. of the salt should not respond to the modified Gutzeit's test for arsenic (given under ARSENI TRIOXIDUM).—U. S.

The Br. demands that 1 Gm. of the salt, dissolved in hydrochloric acid, reprecipitated by ammonia water, washed and dried at 100° C. (212° F.), should give not less than 0.95 Gm. weight.

The salt of the P. G., when calcined, should lose 25 to 26 per cent. of its weight.

Pharmaceutical Preparations.—ELIXIR OF CALCIUM LACTOPHOSPHATE, N. F.; SYRUP OF CALCIUM LACTOPHOSPHATE, U. S. P.; SYRUP OF CALCIUM LACTOPHOSPHATE WITH IRON, N. F.; SYRUP OF CALCIUM CHLORHYDROPHOSPHATE, N. F.

Action and Uses.—Precipitated calcium phosphate may be employed for the same purposes and in the same doses as calcium hypophosphite (which see). In the form of Syrupus Calcii Lactophosphatis it is said to be more readily assimilable than is the latter salt, and for this reason is considered the better preparation. The dose of the syrup is 1 fluidrachm (4 Cc.).

CALCII SULPHAS EXSICCATUS, *U. S.*—Dried Calcium Sulphate.

Calcium sulfuricum ustum, P. G.; *Dried gypsum, Plaster of Paris*, E.; *Plâtre cuit*, Fr.; *Gebrannter Gyps*, G.

A powder containing about 95 per cent. of calcium sulphate ($CaSO_4$; molecular weight, 135.15) and about 5 per cent. of water.—U. S.

Preparation.—Native calcium sulphate is carefully heated until about three-fourths of its water has been expelled.—U. S.

It should be preserved in well-closed vessels, to prevent gradual absorption of moisture from the atmosphere.

Properties.—Dried gypsum occurs as an amorphous white powder, without taste or odor, and when mixed with half its weight of water it forms a smooth paste which rapidly hardens. It is soluble at 25° C. (77° F.) in about 378 parts of water, at

35° C. (95° F.) in 370 parts, and at 100° C. (212° F.) in 451 parts. It is insoluble in alcohol, but dissolves readily in diluted nitric or hydrochloric acid, also in saturated solutions of potassium nitrate, sodium thiosulphate, and of various ammonium salts. Heated to above 204° C. (399.2° F.), dried gypsum becomes anhydrous, and loses the property of forming a paste with water and hardening rapidly. Its saturated solution in water should be neutral to litmus-paper, and forms a white precipitate with alcohol and with solutions of ammonium oxalate (calcium) and of barium chloride (sulphuric acid). The addition of diluted acids to dried gypsum should not cause effervescence (absence of carbonate).—U. S.

Action and Uses.—Plaster-of-paris is never employed in internal medicine. It is used in surgery for immobilizing injured or diseased portions of the body. Gauze bandages, the meshes of which are filled with this substance, are immersed in water, or preferably in a weak solution of sodium chloride, and then applied evenly and firmly over the injured part which has first been bandaged with canton flannel. In the course of 10 or 15 minutes this hardens and forms a firm cast over the part. This dressing is especially applicable to tubercular disease of the hip-, knee-, or ankle-joints, gonorrhœal rheumatism, injuries or diseases of the spine, and fractures of the long bones. By some it is employed to hold the dressing after operative procedures; for instance, amputation of the breast and Pirogoff's amputation. In dental surgery it is extensively employed for making moulds for interdental splints and other forms of apparatus.

Calcii Sulphas.—*Native calcium sulphate, Gypsum,* E.; *Sulfate de chaux,* Fr.; *Calciumsulfat, Schwefelsaurer Kalk, Gyps,* G. $CaSO_4 + 2H_2O$. Molecular weight, 170.91.—This compound is met with in nature in the form of transparent prisms known as *selenite,* and in semi-opaque masses which are called *alabaster* and *gypsum.* The same compound is precipitated on adding sulphuric acid or a sulphate to a solution of a calcium salt. It is a white crystalline powder, insoluble in alcohol. Its solubility in water is about the same as for dried gypsum. Another form of calcium sulphate, containing no water of crystallization, occurs in nature, and is called *anhydrite.*

CALCIUM.—Calcium.

Calcium, Fr., G. Symbol, Ca. Valence, 2. Atomic weight, 39.8.

Calcium is an element belonging to the so-called *alkaline earth* metals, which consist of calcium, strontium, and barium. These 3 metals form a natural group, in which there is a gradation of properties. The atomic weights increase from calcium to barium, and the valence is bivalent for all 3 metals. The chlorides, hydroxides, and nitrates are soluble in water; the sulphates decrease in solubility as the atomic weights increase, while the reverse is true in the case of the hydroxides. Unlike the alkali metals, they are more permanent in air, harder and heavier, decompose water only slowly at ordinary temperature to form difficultly soluble hydroxides, and form insoluble phosphates and carbonates (the bicarbonates are soluble). Moreover, the sulphates, chromates, borates, fluorides, and silicofluorides of the alkali earth metals are insoluble or difficultly soluble in water.

Calcium occurs in enormous quantities in nature, chiefly in the form of carbonate, as limestone, marble, and chalk; also as sulphate or gypsum, as phosphate or apatite and phosphorite, and as fluoride or fluorspar. It is found in most mineral waters as carbonate or sulphate, and in plants and animals. Bones contain a large quantity of calcium phosphate; coral and shells of eggs and molluscs contain calcium carbonate. Next to aluminum and iron, calcium forms the greatest proportion of the solid crust of the earth.

Calcium was first prepared by Bunsen by electrolysis of molten calcium chloride. Moissan prepared it pure by heating metallic sodium and calcium iodide to a high temperature in a closed vessel. On cooling, small compact crystals of calcium separated from the excess of sodium, which were isolated by alcohol, which dissolved the sodium.

Pure calcium is silver-white (Moissan), and not yellow as formerly described, has a metallic luster, the hardness of calcspar, and a specific gravity of 1.554 at 18° C. (64.4° F.). It melts at red heat and burns violently in the air; is readily soluble in dilute mineral acids, but is not acted on by concentrated nitric acid.

Calcium salts are colorless unless the acid be colored, have a neutral reaction upon

test-paper, and impart to the flame of the blowpipe a yellowish-red color. Calcium salts soluble in water are not precipitated by ammonia, but yield white precipitates with ammonium carbonate, phosphate, and oxalate, and with sulphuric acid, the latter precipitate being soluble in a large quantity of water, and the former ones in acetic acid, with the exception of the oxalate. Those salts which are insoluble in water are dissolved by dilute hydrochloric acid, and this solution is not disturbed (that of calcium oxalate excepted) when solution of sodium acetate is added in excess; but if to this liquid a solution of ammonium oxalate is added, all the calcium will be precipitated as calcium oxalate.

Calcii Carbidum.—*Calcium carbide*, E.; *Calciumkarbid, Gasstein*, G. CaC_2. Molecular weight, 63.62

Carbides are compounds of carbon with the elements, particularly the metals. The manufacture of these and their industrial application became possible when the electric furnace was devised, whereby temperatures between 3500° and 4000° C. (6332° and 7232° F.) could be obtained. The essential feature of this furnace is the intense heat of a flame produced by a powerful current passing between two carbon electrodes, in an enclosure of some difficultly fusible substance, as magnesia or graphite. Calcium carbide has attained great commercial value, because it is the source of acetylene gas, which is now coming into general use for lighting purposes (see Acetylenum). It is the most important of all the carbides, and is prepared by heating a mixture of 120 parts of freshly heated lime and 80 parts of carbon (coal, coke, or carbon from sugar) between the carbon electrodes of a furnace which is supplied with a current of 350 ampères and 70 volts. The yield is 120–150 parts. The reaction is $CaO + 3C = CO + CaC_2$. The present commercial variety contains about 20 per cent. of impurities. An article of good quality presents relatively heavy crystalline, brownish-red masses. Chemically pure carbide is colorless and transparent (Moissan). It gives off, when exposed to the air, a garlic odor, due to hydrogen phosphide, and is gradually converted into hydroxide and carbonate of calcium. Its most characteristic and valuable property is its behavior when in contact with water, whereby acetylene gas is formed: $CaC_2 + 2H_2O = Ca(OH)_2 + C_2H_2$ (acetylene). 1 kilogram of pure carbide yields 350 liters of acetylene, while the commercial product yields only 280–300 liters.

Wöhler obtained calcium carbide in 1862; but it was Willson, at Spray, North Carolina, and Moissan, at Paris, who perfected the present method of obtaining it by the electric furnace.

Action and Uses.—For the therapeutic effects of this remedy, see Acetylenum.

OTHER CALCIUM SALTS.

Calcii Acetas.—*Calcium acetate*, E.; *Acétate de chaux*, Fr.; *Essigsaurer Kalk*, G. $Ca(C_2H_3O_2)_2.H_2O$.—The pure salt may be obtained by neutralizing 4 parts of 30 per cent. acetic acid with 1 part of precipitated calcium carbonate and evaporating to crystallization. The salt forms colorless shining needles, less soluble in alcohol than water. It dissolves lead sulphate.

Calcii Benzoas.—*Calcium benzoate*, E.; *Benzoate de chaux*, Fr.; *Benzoësaures Calcium*, G. $Ca(C_7H_5O_2)_2.4H_2O$.—Obtained by heating 43 parts of benzoic acid with 10 parts of calcium oxide in water, filtering, and crystallizing. The benzoic acid in the filtrate may be recovered by acidifying. The salt forms colorless efflorescent crystals, soluble in 20 parts of cold water. Like sodium benzoate and sodium salicylate, it is used as an internal antiseptic.

Calcii Beta-naphtol Sulphonas.—*Calcium beta-naphtol sulphonate*, E.; *Beta-Naphtolsulfosaures Calcium*, G.; *Abrastol, Asaprol.* $[C_{10}H_6(OH)SO_3]_2Ca + 3H_2O$.—A white to slightly reddish neutral powder, soluble in 1.5 parts of water or in 3 parts of alcohol. The aqueous solutions give a blue color with solution of ferric chloride. Used in preserving foods and as an intestinal antiseptic—dose 15 to 30 grains (1–2 Gm.). Also given for rheumatism, gout, typhus, and neuralgia, in daily doses of 15–60 grains (1–4 Gm.).

Calcii Boras, *Calcium tetraboricum.*—*Calcium borate*, E.; *Calciumborat*, G. $CaB_4O_7 + 6H_2O$.—This may be obtained by mixing a solution of 10 parts of crystallized calcium chloride in 100 parts of water with a solution of 17.4 parts of crystallized borax in 100 parts of water, filtering, and washing the precipitate. It is a white tasteless powder, alkaline to litmus, insoluble in cold water, soluble in glycerin with acid reaction. It is used as an antiseptic for moist eczema, burns, etc., and internally for diarrhœa of children; dose 3 to 6 grains (0.2–0.4 Gm.).

Calcii Iodas.—*Calcium iodate*, E.; *Iodate de chaux*, Fr.; *Jodsaurer Kalk*, G. $Ca(IO_3)_2.6H_2O$.—This salt may be prepared by mixing slowly an alcoholic solution of iodine with an excess of a filtered aqueous solution of bleaching-powder, and avoiding rise of temperature to prevent the formation of iodine chloride. Iodine is oxidized to iodic acid, which forms calcium iodate as a precipitate. Calcium iodate crystallizes from water in flat, colorless, shining needles, which are slowly efflorescent on exposure, require at 15° C. (59° F.) about 300 parts of water for solution, and are nearly insoluble in alcohol. The aqueous solution yields a white precipitate with ammonium oxalate, and liberates iodine on the addition of sulphurous acid. Calcium iodate has been advanced as an antiseptic and antipyretic, but it is rarely employed in medicine. It has been recommended, however, for the preservation of food-products.

Calcii Iodidum, *Calcium iodatum.*—*Calcium iodide*, E.; *Iodure de calcium*, Fr.; *Calciumjodid, Jodcalcium*, G. CaI_2.—This may be prepared by neutralizing a solution of hydriodic acid with calcium carbonate, filtering, evaporating to dryness, and fusing. It forms white deliquescent crystalline masses or pearly crystals of bitter taste. Exposed to the air or moisture, it turns yellow, due to decomposition and liberation of iodine. It is freely soluble in alcohol and water, and is very deliquescent. A syrup of calcium iodide is used in medicine (see under Syrups). Calcium iodide has been employed by M. Malem in the treatment of pulmonary tuberculosis, and is preferred by him to all the other iodides. It has never met with general favor among practitioners. The dose for internal administration is from 1 to 4 grains (0.05–0.25 Gm.), largely diluted. The latter amount, however, causes considerable irritation, but this may be due to the fact that liberated iodine is present.

Calcii Lactas.—*Calcium lactate*, E.; *Lactate de chaux purifié*, Fr. Cod.; *Calciumlactat, Milchsaurer Kalk*, G. $Ca(C_3H_5O_3)_2 + 5H_2O$.—Large quantities of this compound are obtained incidentally as an intermediate product in the preparation of lactic acid. It is desirable, however, in making small quantities, to start with pure calcium carbonate and pure lactic acid. A hot dilute solution of the acid is neutralized with the carbonate, filtered, and set aside to crystallize. The salt forms white warty, crystalline masses, having no odor and scarcely any taste, and soluble in 9.5 parts of cold water and much less hot water, difficultly soluble in cold alcohol. It becomes anhydrous at 100° C. (212° F.). Containing calcium in an absorbable form, it is used in rachitis and scrofula, in the dose of from 3 to 10 grains (0.2–0.6 Gm.), and mostly combined with calcium carbonate or phosphate, or iron lactate. It is given most often as syrup of calcium lactophosphate.

Calcii Permanganas.—*Calcium permanganate.* $Ca(MnO_4)_2.5H_2O$.—A compound crystallizing like the potassium salt and very soluble in water. Recommended in the purification of drinking-water and as an antiseptic in gastro-enteritis and diarrhœa, in doses of ½ to 1½ grains (0.025–0.075 Gm.). Also to cleanse cavities in the teeth.

Calcii Salicylas.—*Calcium salicylate*, E.; *Salicylsaures Calcium*, G. $[C_6H_4(OH)CO_2]_2Ca + 2H_2O$.—A hot 10 per cent. solution of salicylic acid is neutralized with iron-free calcium carbonate, filtered, and evaporated to crystallization. The salt forms a white, odorless, tasteless crystalline powder, almost insoluble in cold water. Used in gastro-enteritis in doses of 8 to 20 grains (0.5–1.3 Gm.).

Calcii Sulphis, *Calcium sulphurosum.*—*Calcium sulphite*, E.; *Schwefligsaurer Kalk*, G. $CaSO_3 + 2H_2O$.—4 parts of slaked lime are intimately mixed with 1 part of water; the mixture is spread in thin layers, and sulphur dioxide passed into the vessel or chamber as long as it is absorbed; or the gas is passed into milk of lime and the resulting precipitate dried. Calcium sulphite is a white powder requiring 800 parts of cold water for solution; it dissolves readily in aqueous sulphurous acid, and crystallizes from this solution in hexagonal prisms. It has a slight sulphurous taste, and on exposure is gradually converted into calcium sulphate. It is used as an antifermentative in beer and wines. Calcium sulphite has no advantage over its analogous potassium and sodium compounds. It has been employed for the purpose of limiting fermentation and putrefaction. Being a rather unstable compound, its acid radical is easily eliminated, and advantage has been taken of the fact in its local employment for the treatment of parasitic skin diseases; for example, ringworm, tinea, scabies, pityriasis versicolor, and thrush. It may also be used in the treatment of fermentative dyspepsia, but other more potent remedies are commonly employed.

Calcii Sulphocarbolas seu Sulphophenas.—*Calcium sulphocarbolate or sulphophenate*, E.; *Karbolsulfosaures Calcium*, G. $[C_6H_4(OH)SO_3]_2Ca + H_2O$.—Obtained by neutralizing para-phenolsulphonic acid with calcium carbonate. A colorless, nearly odorless, astringent, bitter powder, easily soluble in water and alcohol. Used as antiseptic, disinfectant, and astringent, internally, in doses of 1 tablespoonful of a 1 per cent. solution every 3 hours.

Calcii Thiosulphas seu Hyposulphis.—*Calcium thiosulphate or hyposulphite.* $CaS_2O_3 + 6H_2O$.—This salt occurs in large colorless hexagonal prisms, soluble in an equal weight of water. On heating this solution above 60° C. (140° F.), calcium sulphite and sulphur are formed. The salt should be protected against air and light.

CALENDULA, *U. S.*—Calendula.

Marigold, Mary-bud, Holigold, E.; *Ringelblume, Todtenblume, Warsenkraut*, G.; *Souci, Fleur de tous les mois*, Fr.

The dried ligulate florets of *Calendula officinalis* L. (Fam. *Compositæ*).

Origin.—A stout, somewhat rough-hairy annual of southern Europe and adjacent Asia, with alternate thickish leaves, the lower obovate, the upper successively narrower, entire, or serrate with few teeth, the heads solitary at the ends of the slender branches, with a saucer-shaped involucre of about 2 rows of lance-linear scales, a flat, naked receptacle, ligulate rays and tubular disk-florets, both yellow. The former only are fertile, their akenes being strongly incurved, roughened, blackish, those of the outermost row narrowly winged. Under cultivation, most of the florets become ligulate and these only are collected for the official drug. The plant has a peculiar, strong and heavy odor, largely lost in drying. The entire plant has been largely used in the fresh condition in eclectic and homœopathic medicine, and was official in the Pharmacopœia of 1880.

Description.—Lemon-yellow to orange; about 12 Mm. (½ In.) long, and 3 Mm. (⅛ In.) broad, linear-oblong, flat, with a short, hairy, delicately nerved basal tube, and an immature akene, without pappus, surmounted by a filiform style having 2 rather long branches; odor characteristic, rank; taste bitterish and slightly saline. It sometimes occurs pressed into cakes.

Fig. 72.

Calendula.

A very pale color, after exposure to sunlight, is indicative of defective quality, and such an article is excluded by the above description.

The closely related genus *Tagetes* has furnished 2 much-used substitutes, the florets of *T. erecta* L. and of *T. patula* L., of tropical and subtropical America. They are very similar, and have probably the same or very similar constituents and properties. They are cultivated under the name of *African marigold*. They can be distinguished by their possession of a pappus of several scales.

Constituents.—These are gum, sugar, a trace of volatile oil, an amorphous bitter principle, and *calendulin*, an amorphous, yellow, tasteless, neutral principle, soluble in alcohol and glacial acetic acid, insoluble in ether and oils, forming with water a transparent mucilage, and not precipitated by tannin.

Pharmaceutical Preparations.—Fluidextract of Calendula, N. F.

Action and Uses.—An infusion made from the leaves and flowers of this drug was formerly thought to be stimulant, antispasmodic, and emmenagogue. It was prescribed in the treatment of typhoid states, functional amenorrhœa, jaundice, hepatic congestion, and scrofulosis. It was given both internally and applied externally in the treatment of cancer, but without any marked results. As an embrocation, a tincture made from the flowers was recommended in the treatment of sprains and contusions, but it is probable that its virtues depended upon the menstruum and not upon the drug.

The internal dose of the extract is stated to be from 1 to 3 grains (0.06–0.20 Gm.).

CALLITRICHACEÆ.—The Water-starwort Family.

A family of a single genus, the species being estimated by different authors at from 1 to 25. *Callitriche verna* L., native of stagnant or sluggish waters in Europe and northern North America, and *C. heterophylla* Pursh.; of the southern United States, are used as diuretics. The submerged leaves of both, on the slender filamentous stems, are long and linear, the aërial ones floating in rosettes, those of the first-named species obovate and nearly sessile, those of the second broadly spatulate and petioled. The constituents are entirely unknown. These drugs have been employed in renal dropsy, and were formerly administered by veterinary surgeons to promote diuresis in horses. Callitriche has been employed to some extent in the form of a decoction or tincture in the treatment of dropsy depending upon renal disease.

CALUMBA, *U. S.*—Calumba.

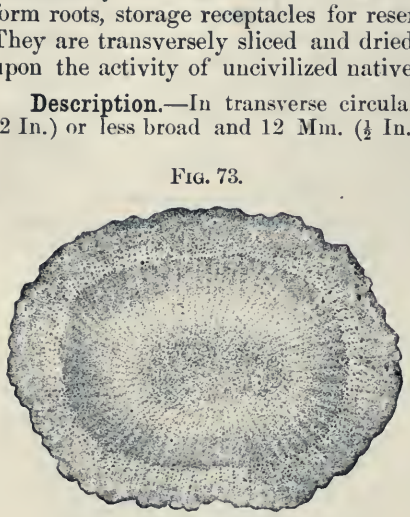
Calumbæ Radix, Br.; *Radix colombo*, P. G.; *Radix columbo. Colombo*, E.; *Colombowurzel*, G.; *Colombe*, Fr., Sp.; *Colombo*, F. It.

The dried root of *Jateorhiza palmata* (Lam.) Miers (*Menispermum p.* Lam., *Cocculus p.* DC.—Fam. *Menispermaceæ*).

Origin.—From a very high-climbing herbaceous twiner of tropical eastern Africa, especially the Zambesi region. It is cultivated to some extent, both there and in the East Indies, for the sake of its root, there called *Kalumb*, and used for dyeing, as well as medicinally. It was introduced to European use by the Portuguese. The fleshy fusiform roots, storage receptacles for reserve-food material, are attached to a stout rhizome. They are transversely sliced and dried. The supply is very irregular, being dependent upon the activity of uncivilized natives, so that the price is subject to wide fluctuations.

Description.—In transverse circular, or oblique oval, biconcave sections, about 5 Cm. (2 In.) or less broad and 12 Mm. (½ In.) or less in thickness at the circumference, less than half as thick at the center, the edge brown, occasionally greenish, roughly wrinkled, the smoothish cut surfaces pale-yellow, becoming darker or brown with age, annular, the yellow, finely radiate cortex separated by a narrow dark line from the lighter inner portion, which is radiate with its only slightly projecting rows of vascular bundles; fracture short, mealy; odor slight; taste very bitter, mucilaginous, slightly aromatic.

Fig. 73.



Calumba: transverse section (Nat.).

Underneath the cork there is an almost continuous layer of stone-cells containing crystals of calcium oxalate, which appear in the powder. The yellow powder is characterized by rather large stone-cells and abundant starch-grains almost as large as those of the potato, varying from circular to oval, or ovate, commonly flattened, the large hilum mostly excentric, entire or strongly fissured in one or more directions, and with a few strong rings.

The Ph. It. calls attention to the fact that calumba colors alcohol intensely, but ether not at all; also that the aqueous maceration does not affect litmus, gelatin, or ferric chloride.

Calumba is much subject to worminess if long kept.

Substitutions.—American calumba (see Frasera) has been frequently sold for this, but is very easily recognized. It is almost uniformly much smaller, the color is not yellow, it contains no starch, and is not mucilaginous. Its decoction is colored brownish with iodine and gives a brown precipitate with ferric chloride. The related root, also the stem, of *Coscinium fenestratum* Coleberooke, of India, has occasionally been substituted, and is largely so used in India. It is a woody root, the disks nearly equally thick at center and circumference. The stem reaches 10 Cm. (4 In.) in diameter, is yellowish-gray, or yellowish-brown by the loss of the cork, longitudinally furrowed and finely transversely fissured. The section is strongly radiate, the fracture tough-splintery.

Under the name *Calumba de Brasil* (or *de Pais*) the woody root of *Simaruba salubris* Engl. is said to be used in Brazil as a substitute for calumba.

Constituents.—The root contains *berberine*, *calumbic acid* ($C_{21}H_{22}O_6$), *calumbin* ($C_{21}H_{24}O_7$) in combination with the alkaloid *calumbine* (?) (Alessandri), and a fluorescent body which makes the infusion look turbid by reflected light; it contains no tannin. The woody portion yields 1.9 per cent. of calumbin and 0.72 per cent. of berberine, the cortex 1.42 per cent. of calumbin and 1.43 per cent. of berberine (Hilger, 1896), the older roots developing more of these principles than the younger ones. Dohme (1897) says the yield of calumbin is 0.4 to 0.8 per cent., and that there is a greater amount of berberin. Calumbin forms colorless, odorless, and very bitter prisms and needles, nearly insoluble in water, but soluble in alcohol, ether, chloroform, alkalies, and acetic acid. Calumbic acid is less bitter, amorphous, straw-yellow, almost insoluble in cold water or ether, and soluble in alcohol and alkalies. The berberine and calumbic acid are believed to be derived from calumbin, of which acid the latter is the anhydride. Other constituents are 35 per cent. of starch, 17 per cent. of pectin, 4.7 per cent. of gum, 5 per cent. of resin, and wax. The ash is about 6 per cent.

Pharmaceutical Preparations.—Fluidextract of Calumba, U. S. P.; Infusion of Calumba, Br. P.; Tincture of Calumba, U. S. P.

Action and Uses.—Calumbin is said, in small doses, to augment the secretion of the liver and the gastro-intestinal glands, but in large doses it acts as an emeto-cathart

(Roux). Kohler stated that its intravenous injection increases blood-pressure by stimulation of the vasomotor center.

Berberine is an hepatic stimulant, and in large amounts produces diarrhœa, and occasionally vomiting and tremors. When injected intravenously or subcutaneously in animals, berberine causes respiratory failure, convulsions, and paralysis of the hind extremities (Cushny).

Colombo may be classed among the simple bitters, and employed with benefit during convalescence from acute infectious fevers and serous diarrhœas. Given before meals, it at first inhibits secretion, but secondarily increases in a marked degree the flow of gastric juice; hence its value in atonic dyspepsia. The drug has also been recommended in the vomiting of pregnancy and in the nausea and vomiting incident to teething. An infusion made with ½ ounce of columbo, ½ ounce of ginger, 1 drachm of senna, 1 pint of boiling water, was highly recommended by Dr. George B. Wood in the treatment of gastro-intestinal disorders when associated with flatulence.

In substance, the dose is from 10 to 30 grains (0.60–2 Gm.), repeated 3 or 4 times a day. The fluidextract may be given in doses of from 15 minims to 1 fluidrachm (1–4 Cc.); the tincture, in doses of from ½ to 2 fluidrachms (2 to 8 Cc.). The dose of the infusion (4 drachms (16 Gm.) to 1 pint (480 Cc.) of water) is ½ to 1 fluidounce (16–30 Cc.).

CALX, *U. S., Br.*—Lime; Calcium Oxide.

Calcaria usta, P. G.; *Calcii oxidum, Calcium oxydatum, Calcaria, Calx viva, Calx usta.—Burned lime*, E.; *Chaux, Chaux vive*, Fr.; *Kalk, Aetzkalk, Gebrannter Kalk*, G.; *Ossido di calcio*, It., Sp.

Formula, CaO. Molecular weight, 55.68.

Lime, prepared by burning white marble or the purest varieties of natural calcium carbonate, and containing, when anhydrous, not less than 90 per cent. of pure calcium oxide. It should be kept in well-closed vessels in a dry place.—U. S.

Preparation.—Lime is an alkaline earth which is obtained by calcining native calcium carbonate, such as chalk, limestone, or marble, by which carbon dioxide is given off, calcium oxide remaining behind: $CaCO_3$ is decomposed into $CO_2 + CaO$. Prepared on the large scale from native carbonates, it contains also the impurities naturally existing therein, such as magnesia, ferric oxide, alkali salts, silica, and clay. If the latter is present in sufficient quantity, it will slake feebly or not at all, and is then called *poor* or *over-burnt*. To obtain pure lime, pure calcium carbonate should be employed, and if the calcining has been done in a crucible the resulting mass should be moistened with water and again calcined to expel the carbon dioxide completely. The same effect is produced on the large scale by constructing the lime-kiln in such a manner that the products of combustion pass over the limestone.

Properties.—Burnt lime is in hard white or grayish-white porous masses, of the specific gravity 3.1 to 3.2. It is fusible with difficulty only before the oxyhydrogen blowpipe, giving off a splendid red light, but is not otherwise altered. It is inodorous, and has an alkaline reaction and a caustic, burning taste. At 25° Cc. (77° F.) it requires about .760 parts of water for solution; but at 100° C. (212° F.) more than 1550 parts are necessary; hence a solution of lime saturated in the cold becomes turbid on being heated. Exposed to the air, it absorbs water and carbon dioxide, and is converted into calcium hydroxide and carbonate, known as *air-slaked* lime.

Slaked lime forms a soft white powder, of specific gravity 2.08 and of strongly alkaline taste and reaction. It does not part with its water at 100° C. (212° F.), and becomes completely anhydrous only at a dull-red heat, without melting previously. On exposure to the air, it is converted into calcium carbonate. When lime is slaked, or slaked lime is mixed with about 3 or 4 parts of water to form a thin magma, the mixture is called *milk of lime*.

Sugar and glycerin greatly increase the solubility of lime in water. Lime decomposes most of the alkali and metallic salts by combining with their acids and forming calcium salts, which are mostly insoluble. Hence it is incompatible with these, as well as with astringent vegetable infusions, alkaloidal salts, and free acids.

Lime is extensively used in the arts, generally in the form of hydroxide. It is used in the preparation of ammonia, potassium and sodium hydroxide, bleaching-powder, and potassium chlorate; also in tanning to remove hair from hides, in saponifying fats, in the purification of illuminating-gas, and in making mortar.

Tests.—If 1 part of lime be slaked, and then thoroughly mixed with 50 parts of water, and the greater portion of the milky liquid decanted, no hard, gritty particles should be found in the residue, nor should the addition of hydrochloric acid to this residue cause much effervescence (limit of carbonate), nor leave more than a slight, insoluble residue. For applying tests, 5 Gm. of the oxide are slaked, mixed with 100 Cc. of water and dissolved with a slight excess of hydrochloric acid, boiled, and cooled. Not more than 0.025 Gm. of insoluble matter should remain. In a portion of this solution neutralized with ammonia-water, ammonium oxalate solution forms a white precipitate of calcium oxalate, insoluble in acetic, but soluble in hydrochloric acid.—U. S.

Pharmaceutical Preparations.—Lime-water, U. S. P.; Syrup of Lime, U. S. P.

Calcii Hydras, Br.; *Calcaria hydrica.—Slaked lime, Calcium hydroxide, Calcium hydrate,* E.; *Chaux éteinte, Chaux hydratée,* Fr.; *Kalkhydrat, Gelöschter Kalk,* G.

Formula, $Ca(OH)_2$. Molecular weight, 73.56.

Calcium hydroxide is official in the Br. It may be prepared by moistening lime with half its weight of water, whereby, if the lime is good, much heat is generated, steam is formed copiously, and the pieces of lime become a dry powder of slaked lime: $CaO + H_2O = Ca(OH)_2$.

Action and Uses.—Lime itself is employed in medicine as an escharotic and disinfectant. When placed upon the skin and moistened, it causes rapid and deep destruction of the tissue. It has been employed in the treatment of indolent ulcers, for the removal of small nævi and of superfluous hairs, but for the latter purpose it is not recommended. An ointment containing 5 per cent. of the drug in benzoinated lard may also be tried in the treatment of favus and psoriasis. As it arrests putrefaction, it has been employed to disinfect feces and urine, cesspools, and various places where odors arise from putrefactive fermentation. Lime taken internally in overdose causes a sensation of burning in the œsophagus and stomach, followed by severe gastro-enteritis. The caustic action of the drug may produce sloughing of the stomach and intestines, followed by perforation with collapse and death. This condition should be treated early by the administration of a vegetable acid, such as vinegar and demulcent drinks. Appropriate stimulation may be given as the case demands.

Lime is never given internally except in solution. For its other therapeutic uses, see Liquor Calcis.

CALX CHLORINATA, *U. S., Br.*—Chlorinated Lime; Chlorinated Calcium Oxide.

Calx chlorata, U. S., 1890; *Calcaria chlorata,* P. G.; *Chloruretum calcis, Calcii hypochloris.—Chloride of lime, Calcium hypochlorite, Bleaching-powder,* E.; *Chlorure de chaux, Poudre de Tennant ou de Knox,* Fr.; *Chlorkalk, Bleichkalk,* G.

A compound resulting from the action of chlorine upon calcium hydroxide, and containing at least 30 per cent. U. S. (33 per cent. Br., 25 per cent. P. G.) of available chlorine. Chlorinated lime should be preserved in well-closed vessels in a cool and dry place. This preparation is often improperly called "Chloride of lime."

Preparation and Composition.—Chlorinated lime was first prepared on an extensive scale by C. Tennant and Knox, of Glasgow, in 1799, and is manufactured in essentially the same manner at the present time, the improvements introduced at various times consisting in perfecting the apparatus and the production of chlorine. Well-slaked lime, free from dampness, is rubbed through a sieve, and the powder thus obtained is spread upon shelves which are placed in several tiers in boxes or chambers, into which dry chlorine gas is conducted from the top as long as it is absorbed, care being taken to regulate the current of gas in such a manner that the temperature within the chambers does not rise higher than 25° C. (77° F.), in order to avoid the formation of calcium chlorate. According to Lunge (1881), in the presence of an excess of about 4 per cent. of moisture in the calcium hydroxide, and at a temperature of about 40° C. (104° F.), a product containing 43 per cent. of available chlorine may be obtained.

The nature of the chemical reaction taking place in the formation of bleaching-powder is as yet not perfectly clear. The main reaction is usually represented thus, $2Ca(OH)_2 + 4Cl = Ca(ClO)_2 + CaCl_2 + 2H_2O$. If it is assumed that the reaction takes place in the same way as in the action of chlorine on potassium hydroxide, the product is a mixture of calcium hypochlorite, $Ca(ClO)_2$, and calcium chloride, $CaCl_2$,

for in the case of potassium hydroxide this reaction is accepted: $2KOH + 2Cl = KClO + KCl + H_2O$. An objection to the view that calcium chloride is present as such in bleaching-powder is the fact that the latter is not deliquescent, as it should be if calcium chloride were present, and that alcohol does not dissolve one-half of the chlorine as calcium chloride, as it should if the latter were present. This has led to the suggestion that bleaching-powder in the dry form is not a mixture, but rather one compound, $Ca<^{Cl}_{OCl}$ or $CaOCl_2$. This practically is equivalent to a mixture of the two compounds above in molecular proportions, for $Ca(ClO)_2 + CaCl_2 = 2CaOCl_2$. It is difficult to decide on the nature of bleaching-powder, but at present the evidence seems to be in favor of the view that, in the dry form, it is a single compound of the composition $CaOCl_2$. When treated with water, however, it appears to be decomposed into a mixture of hypochlorite and chloride. Erdmann (*Anorg. Chemie*, 1900) states that, besides the hypochlorite, basic hypochlorite, (HO)CaOCl, and the compound $Ca<^{Cl}_{OCl}$, are assumed to be present in bleaching-powder; that $CaCl_2$ is always present, and often calcium oxychloride, Cl–Ca–O–Ca–OH. That aqueous solutions of chlorinated lime contain calcium hypochlorite was proved by Kingzett, who obtained this salt from concentrated solutions of the former placed in a freezing-mixture or evaporated in a vacuum over sulphuric acid. Schorlemmer, Lunge, and others have shown that with nitric or sulphuric acid carefully added, avoiding excess, a distillate containing hypochlorous acid is obtained; that carbon dioxide liberates in the solution hypochlorous acid; and that, after exhausting chlorinated lime with little water, the subsequent solutions contain calcium and chlorine uniformly in the proportion required by the formula $CaOCl_2$.

Nearly all the chlorine manufactured is brought into the market stored up in the form of bleaching-powder.

Properties.—Chlorinated lime is a white or whitish powder or in friable lumps, dry or but slightly damp, with a faint odor of chlorine, and a disagreeable bitter and saline taste. It is soluble in about 20 parts of water, though the commercial product always leaves a slight residue, mainly calcium hydroxide. The solution has an alkaline reaction on litmus, which is finally bleached. On exposure to the air, it absorbs and combines with carbon dioxide, liberating chlorine and becoming moist: $CaCl_2 + Ca(ClO)_2 + 2CO_2 = 2CaCO_2 + 4Cl$. It is wholly soluble in dilute acetic acid (not more than a trifling residue of insoluble matter should be left, U. S.), with the evolution of chlorine. With hydrochloric or sulphuric acid, chlorine is liberated, the action taking place presumably in two stages; thus, (1) $Ca(ClO)_2 + H_2SO_4 = CaSO_4 + 2HClO$, and $CaCl_2 + H_2SO_4 = CaSO_4 + 2HCl$; (2) $2HClO + 2HCl = 2H_2O + 4Cl$. It is evident that the amount of chlorine evolved, which is designated *available chlorine*, depends on the proportion of hypochlorite, $Ca(ClO)_2$, present. If there is a larger percentage of $CaCl_2$ than is indicated by $(Ca(ClO)_2 + CaCl_2)$, its chlorine will not be liberated, and is therefore not *available chlorine* for bleaching purposes.

A solution of bleaching-powder alone bleaches very slowly, but the action is hastened by adding such substances as will liberate chlorine; for example, carbonic, hydrochloric, or sulphuric acid. Certain salts, by producing unstable hypochlorites, also hasten the bleaching action. A concentrated solution of bleaching-powder when heated liberates oxygen; thus, $Ca(ClO)_2 = CaCl_2 + O_2$. In dilute solution, however, the hypochlorite is converted into chlorate and chloride: $3Ca(ClO)_2 = Ca(ClO_3)_2 + 2CaCl_2$. When heated in contact with certain oxides, as those of copper and iron, manganese, and mercury, and with cobalt and nickel hydroxides, the solution gives off oxygen readily. Distilled with alcohol, wood spirit, some volatile oils, etc., bleaching-powder generates chloroform, and when it is mixed with certain organic substances in the dry state, a gradual decomposition and development of heat take place, and may result at last in an explosion. The spontaneous explosions of chlorinated lime which are on record may probably be referred to such a cause.

Tests.—The only essential test to be made of bleaching-powder is for its strength in available chlorine, carried out in the U. S. as follows:

If 3.52 Gm. of chlorinated lime be thoroughly triturated with 50 Cc. of water and carefully transferred, together with the washings, into a flask, and water added to make 1000 Cc., and after thoroughly shaking, if 100 Cc. be taken, and then 1 Gm. of potassium iodide and 5 Cc. of diluted hydrochloric acid added, the reddish-brown liquid, to

which, toward the end of the titration, a few drops of starch test-solution are added, should require, for complete decoloration, not less than 30 Cc. of decinormal sodium thiosulphate solution (each Cc. corresponding to 1 per cent. of available chlorine). The Br. and P. G. methods differ from the above only in the quantities of substances employed, the required percentage being respectively 33 and 25.

In the process the liberated chlorine reacts with potassium iodide, $KI + Cl = KCl + I$, setting free an equivalent amount of iodine. This reacts with the sodium thiosulphate to form sodium iodide and tetrathionate: $I_2 + 2Na_2S_2O_3 = 2NaI + Na_2S_4O_6$. The end of the titration is reached when the blue color of the iodized starch just disappears.

Other methods of titration may be employed, and in the arts that of Penot and Mohr is generally used. In this method the hypochlorite is made to oxidize arsenous acid in a solution of potassium arsenite, the excess of arsenous acid being determined by iodine solution, and from the quantity of arsenous acid oxidized the equivalent of chlorine is calculated. The reaction is $As_2O_3 + 2Cl_2 + 2H_2O = As_2O_5 + 4HCl$.

Lunge, 1886, devised the method in which hydrogen peroxide is acted on by bleaching-powder, oxygen being liberated in equal amounts from each compound; thus, $CaOCl_2 + H_2O_2 = CaCl_2 + H_2O + O_2$ The oxygen is measured in a nitrometer, and its volume is equivalent to the volume of available chlorine.

In France, the strength of bleaching-powder is expressed in chlorometric or Gay-Lussac degrees. Each degree denotes 1 liter of chlorine gas at normal temperature and pressure obtained from 1 kilogram of bleaching-powder. The French Codex demands at least 90 degrees of chlorine, which is equal to 28.62 per cent. by weight.

Action and Uses.—When locally applied or given internally, bleaching-powder acts as a decided irritant, and if taken internally in overdose causes violent gastro-enteritis, with nausea, vomiting, and diarrhœa. Unless its effects are counteracted, it may also produce gangrene of the stomach followed by perforation. If the fumes of chlorine which it gives off are inhaled, they produce a sensation of suffocation followed by considerable bronchial irritation. Because of its property of absorbing moisture it acts as a desiccant and inhibits the growth of micro-organisms. The free chlorine contained in chlorinated lime also has the power of decomposing compounds of hydrogen sulphide, hence the preparation is largely employed as a disinfecting agent. Chlorinated lime is probably the best substance we can employ to disinfect the urine, fecal discharges, and sputa of patients suffering with infectious diseases. It is also valuable for sewers, privies, dissecting-rooms, and other places where noxious odors are present. Solutions of the drug may also be injected into the uterus containing disorganized clots and pieces of retained placenta. A 1 per cent. solution has been recommended as a mouth wash for ulcerative stomatitis, ulcerated gums, mercurial ptyalism, and as a gargle in the treatment of putrid sore throat. A 5 per cent. solution is also said to be useful in treating purulent ophthalmia, and when applied upon lint is a successful remedy for chilblains. Itch and other cutaneous eruptions are stated to be cured by the application of this lotion. An ointment made with 1 part of the drug and 3 of lard may be applied by inunction in the treatment of scrofulous enlargement of the lymphatic glands and dry sluggish ulcers. Internally the drug has been employed as a stimulant during the course of low fevers, and its administration is said to be valuable in phthisis and chronic bronchitis when the expectoration is profuse and purulent. Persons poisoned with sewer gas and hydrocyanic acid are said to be benefited by holding over the nose a cloth saturated with a solution of chlorinated lime.

The internal dose of chlorinated lime is from 1 to 5 grains (0.06–0.30 Gm.), largely diluted with water. For disinfecting purposes 1 part of the powder in 50 parts of water is usually sufficient, but because of its comparative inexpensiveness a saturated solution may be prepared, especially for use in the sick-room.

CALX SULPHURATA, *U. S.*, *Br.*—Sulphurated Lime.

Calcaria sulfurata, Hepar sulphuris calcareum, Hepar calcis.—Crude calcium sulphide, E.; *Sulfure de chaux,* Fr.; *Kalkschwefelleber,* G.

A mixture containing at least 60 per cent. of calcium monosulphide [CaS = 71.63], together with unchanged calcium sulphate [$CaSO_4 = 135.15$] and carbon, in varying proportions.—U. S.

A mixture containing not much less than 50 per cent. of calcium sulphide (CaS). — Br.

Preparation.—Dried gypsum, in fine powder, 70 Gm.; charcoal, in fine powder, 10 Gm.; starch, 2 Gm. Mix them thoroughly, pack the mixture lightly into a crucible, cover this loosely, and heat it to bright redness until the contents have lost their black color. Allow the crucible to cool, reduce the product to powder, and at once transfer it to small glass-stoppered vials.—U. S.

In place of metric weights, the following proportions may be used in avoirdupois weight: Dried gypsum, 3½ ounces; charcoal, ½ ounce; starch, 44 grains.

The reaction taking place when the mixture is heated consists in oxidation of the charcoal at the expense of the calcium sulphate, a part of the latter being converted into calcium sulphide: $CaSO_4 + C_2 = CaS + CO_2 + 2CO$; the resulting carbon monoxide and dioxide pass off as gases. The starch assists in the reduction.

The former Br. process is very similar: Calcium sulphate (nearly anhydrous), 7 ounces; wood-charcoal, 1 ounce; both in fine powder; mix thoroughly; heat to redness in an earthen crucible until the black color has disappeared; cool, and at once place the whitish residue in a stoppered bottle. The present Br. gives no quantities.

Properties.—Sulphurated lime is a pale-gray powder, gradually altered by exposure to the air, exhaling a faint odor of hydrogen sulphide, having an offensive alkaline taste and an alkaline reaction, very slightly soluble in water and insoluble in alcohol; boiling water partially decomposes it. On dissolving sulphurated lime with the aid of acetic acid, hydrogen sulphide is abundantly given off and a white precipitate (calcium sulphate) is thrown down. The filtrate yields, with ammonium oxalate test-solution, a white precipitate soluble in hydrochloric, but insoluble in acetic acid.—U. S.

Tests.—If 1 Gm. of sulphurated lime be gradually added to a cold solution of 2.08 Gm. of cupric sulphate in 50 Cc. of water, followed by 10 Cc. of diluted hydrochloric acid in small portions with constant stirring, and the mixture be digested on a boiling water-bath for 15 minutes and filtered, the addition of an excess of ammonia water should impart no color to the filtrate (presence of at least 60 per cent. of pure calcium sulphide).—U. S. The equation, $CuSO_4.5H_2O + CaS = CuS + CaSO_4 + 5H_2O$, shows that 247.85 parts of cupric sulphate require 71.63 parts of calcium sulphide for complete decomposition, and 1.73 Gm. will therefore require 0.493 + Gm., which is practically 50 per cent. of 1 Gm. The Br. process is similar.

Action and Uses.—Sulphurated lime is recommended as a useful remedy in the treatment of acne and furunculosis. It allays inflammation and hastens suppuration, so that patients taking it may be made temporarily worse. A solution of the drug has been locally applied in the treatment of itch and ringworm, and it is said that the former disease is rapidly and effectually cured by it. Baths containing this remedy are stated to be efficacious in the treatment of chronic rheumatism, chronic bronchitis, and pulmonary tuberculosis. A strong solution of the drug has also been applied locally for the purpose of removing superfluous hair. It is allowed to remain 15 or 20 minutes, after which it is removed with a wet cloth or sponge, the detached hair being removed at the same time.

The internal dose is from $\frac{1}{10}$ to ½ grain (0.005–0.03 Gm.), 3 times daily. If this remedy is not obtainable for the treatment of furunculosis, powdered baked egg-shells may be given in 1-drachm (4 Gm.) doses 3 times daily.

Allied Compounds.—Calcii Sulphidum *s.* Sulphuretum *s.* Sulfuratum. *Calcium sulphide*, E.; *Sulfure de calcium*, Fr.; *Schwefelcalcium*, G. Formula, CaS. Molecular weight, 71.63.—The pure sulphide can be prepared by heating calcium sulphate in hydrogen or by heating calcium oxide in hydrogen sulphide gas, or the carbonate in a mixture of carbon disulphide vapor and carbon dioxide. It is a white substance, smelling of hydrogen sulphide in moist air, and almost insoluble in water. It is phosphorescent in the dark after exposure to light. It is not used in pharmacy or the arts.

Calcii Oxysulphuretum, known in France as *sulfure de calcium* or *foie de soufre calcaire*. This misnomer is applied to a mixture of calcium pentasulphide and calcium thiosulphate, obtained by boiling 1 part of quicklime and 2 parts of sulphur with water: $3CaO + 12S = 2CaS_5 + CaS_2O_3$. The same reaction takes place in the preparation of

Liquor Calcii Sulphurati.—*Vleminckx's solution, Golden lotion.*—This is prepared by slaking 1 part of lime and boiling with 2 parts of sulphur and 20 parts of water until the filtrate yields 12 parts of a yellowish-red liquid which, with acids, gives hydrogen sulphide and sulphur. It should be kept in small well-filled bottles, and is useful in treating acne.

Martin's Depilatory.—A soft mass, containing calcium hydrosulphide, Ca2HS, is prepared from 2 parts of slaked lime and 3 of water, by passing into the mixture hydrogen sulphide as long as it is absorbed. The mass has a strong sulphurous odor, and on standing separates into two portions, which are to be mixed when used; if properly prepared, an application for 8 or 10 minutes is sufficient for removing the hair.

Phosphorescent Powder or Paint.—Calcined oyster-shells or cuttlefish-bone, 100 parts; caustic lime, 100 parts; calcined sodium chloride, 25 parts; mix and thoroughly incorporate from 20 to 25 per cent. (about 55 parts) of sulphur and from 3 to 7 per cent. (about 8 to 18 parts) of calcium, barium, strontium, or magnesium sulphide. The luminosity may be increased by adding incinerated marine algæ. The powder is rendered adhesive by means of varnish, collodion, etc. After exposure to sunlight it becomes luminous in the dark. A similar compound is *Canton's phosphorus* (1768), prepared from burnt oyster-shells, 2 parts, and sulphur, 1 part.

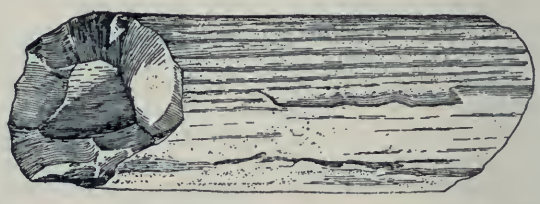
CAMBOGIA, *U. S., Br.*—Gamboge; Pipe Gamboge.

Gambogia, U. S. 1870; *Gutti*, P. G.; *Gummi-resina guttæ* (*s. gutti*), *Gutta gamba*, *Cambodia*; *Gummigutt*, *Gutti*, G.; *Gutte*, *Gomme-gutte*, Fr.; *Gomma gotta*, F. It.; *Goma guta*, *Guta Gamba*, Sp.; *Tamala*, Sansk.

A gum-resin obtained from *Garcinii Hanburii* Hook. f. (Fam. *Guttiferæ*).

Origin.—The specific distinctions in this group of plants being very difficult of diagnosis, and the genus none too well known, the specific identity of the gamboge plant is by no means certain, and a variety of names for it are found in various works. It is a rather small tree which abounds in the forests of farther India, especially the province of Cambodia, in Siam, one of the names applied to the product. Latex-tubes exist both in the bark and in the deeper tissues, and the yellowish milk-juice is obtained by making a single deep incision running spirally about the trunk, from a height of about 3 meters

Fig. 74.



Pipe gamboge (⅔ Nat.).

to the ground. The juice runs into a receptacle placed at the lower end of this incision, and is thence transferred usually to hollow bamboo-joints. Here it dries in about a month, at the same time contracting toward the sides, so as to leave a cylindrical cavity at the center, forming the official *pipe* gamboge, so highly esteemed. Upon tearing off the bamboo covering, the latter leaves impressions of its fibers upon the pipe. *Saigon* or *Cochin* gamboge is moulded into little cakes while semisolid, and wrapped in leaves, paper, or cloths until hard. It is regarded as more liable to adulteration than the pipe, but may be of perfect quality. Occasionally, the article is pressed or run into large masses, in boxes or tubs, and is then frequently of poor quality or highly adulterated, sometimes with large stones or pieces of iron, in one lot in our possession, with a large number of railroad spikes, the quality of the drug being thus greatly injured, aside from the fraud in weight. Broken gamboge frequently contains considerable fragments of rice-paper, and is then characterized as "ricey."

Description.—In cylindrical pieces, usually hollow at the center, 2 to 5 Cm. (1 to 2 In.) thick, longitudinally striate on the surface; fracture flattish-conchoidal, smooth, of a waxy luster, orange-red; inodorous; taste very acrid. The powder is bright-yellow, sternutatory, practically free from starch. Gamboge should yield not less than 75 per cent. of alcohol-soluble matter and not more than 3 per cent. of ash.

It yields with water a uniform bright-yellow emulsion, which forms with ammonia water a clear deep-red, afterward brown solution, and with potassium or sodium hydroxide an orange-red solution, the liquid decolorized by acids, and the yellow resin being precipitated.

The Russian Pharmacopœia prints a special caution against gamboge of a brownish-red color, dull fracture, and with small holes. The Italian specifies 60 to 80 per cent. of resin and 15 to 25 per cent. of gum. Pipe gamboge is almost always pure, but the powdered article very commonly contains small quantities of starch, apparently not added with intent to adulterate.

Constituents.—Gamboge contains 15 to 20 per cent. of gum analogous to arabin,

60 to 80 per cent. of resin (*cambogic acid*), a volatile oil, a phenol ester, methyl alcohol and other alcohols, isovitinic and acetic acids, and a liquid with a fruity odor having the nature of an aldehyde or a ketone. Phloroglucin is probably a decomposition-product. The resin has a deep-orange color, and turns red with alkalies, with which it forms soluble salts. It is soluble in alcohol, ether, and chloroform, and with salts of the heavy metals forms precipitates called *cambogiates*.

Action and Uses.—Gamboge is rarely prescribed in medicine except in combination with other cathartics. If employed alone in full dose, it acts as a powerful hydragogue cathartic, causing severe intestinal irritation, considerable griping, and at times nausea and vomiting. Poisonous doses cause a severe gastro-enteritis, which may be followed by death. Gamboge may be employed in the various conditions in which hydragogue catharsis is indicated; for example, in hepatic congestion, renal dropsy, uræmic conditions, and congestion of the brain. It has also been employed for the removal of tænia, but when given for this purpose is usually combined with tænicides.

The ordinary dose of gamboge is from 2 to 5 grains (0.12–0.30 Gm.), but for the removal of tænia this amount may be doubled. It may be prescribed either in pill, emulsion, or solution, made by the addition of potassium carbonate.

Related Products.—*G. collina* Vieill, of New Caledonia, yields a product very similar to gamboge, described by Heckel and Schlagdenhauffen (*Rep. de Pharm.*, [3] 5, 193). It differs in its color, which is more nearly an orange, in yielding pyrocatechin as a decomposition-product, and in yielding a white crystalline body behaving like tannin in colored solution when dissolved in alcohol. The product yields about 75 per cent. of resin and 15 per cent. of gum soluble in water. Its physiological properties do not appear to have been tested.

Inferior kinds of gamboge are also yielded by *G. venulosa* Chois. and *G. Cambogia* Desr.

CAMPHORA, *U. S., Br., P. G.*—Camphor.

Kampher, Campher, G.; *Camphre, Camphre du Japon*, Fr.; *Canfora (del Giappone, delle Laurinee)*, It.; *Alcanfor*, Sp., Port.

The dextrogyrate modification of the saturated ketone, $C_9H_{16}CO$, obtained from *Cinnamomum Camphora* (Linné) Nees et Ebermaier (Fam. *Lauraceæ*), and purified by sublimation. Camphor should be kept in well-closed vessels in a cool place.—U. S.

Origin.—A handsome evergreen tree somewhat resembling the sassafras, all parts having a strong odor of camphor, native of eastern Asia and the adjacent islands, and widely introduced into warm countries as a shade and ornamental tree. It does very well in Southern California, where trees presumably 40 years of age are 60 feet in height and 3 feet in diameter at the base, as well as in the southeastern United States. The wood is white, fragrant, and repels insects, and is highly prized. The production of camphor is carried on in China, Japan, and Formosa. An estimate in 1895 placed the Japanese product at about 300,000 pounds; the Chinese, 200,000 pounds; the Formosa, 6,000,000 to 7,000,000 pounds. The annual consumption in the United States is estimated at 2,000,000 pounds. The methods of obtaining differ slightly in different localities, but agree in their main features, as follows: The trees are not considered worth working until they have reached an age of 50 years. They are selected by a camphor-expert, who scratches into the wood and examines it for the relative amount of camphor contained. If satisfactory, the wood of the root, and about 8 feet of the trunk-base, is distilled. The wood is cut obliquely into chips about $\frac{1}{8}$ inch thick and 2 inches long and broad. These are closely packed into some sort of a steam chamber, often only inverted rude earthen pots, the steam driving off the vapor of the camphor, which is condensed, collected, and drained of its oil, then pounded or pressed into barrels as crude camphor. A Japanese laborer will collect about 230 pounds of chips daily. In Formosa, 4 laborers are said to make from 125 to 175 pounds of crude camphor in a month. The yield from the wood varies most widely. Both in China and Formosa the production is carried on in a country of savages, so that government protection is required. To provide funds for this purpose, the Chinese Government has charged a camphor tax. The oil is highly esteemed in China for external application, and is also used as a lighting and burning fluid. The crude camphor of the different producing regions presents differences, that of Japan being lighter-colored, more pinkish and coarser-grained, dry to the touch, and much more valuable than that of Formosa, although new conditions are now leading to great improvement in the quality of the

latter. The distillation of the branches, formerly reported, is not now practised. Hooper has distilled the leaves, obtaining about 0.5 per cent. of an oil, three-fourths of which was camphor.

As a result of the Japanese-Chinese War, Japan has seized the opportunity to monopolize the Formosa industry, with revolutionary results to the trade. She has established a frontier protection-force of nearly 2000 police, has undertaken to stop the destructive methods so long in vogue, and has established a system of replanting, notwithstanding that the Formosa camphor forests are practically inexhaustible, and has undertaken to raise the standard of quality. At the same time, she has arranged to steady the market as to both supply and price. All collectors are required to sell their produce to her at a fixed price, about 15 dollars a *picul* (about 133 pounds), if the article attains to her standard for crude camphor. This product is refined at the government works at Taikohu, Formosa, several thousand pounds at one charge. In refining, the water and oil are first driven off by a low heat; the aperture is then closed and another established, through which the camphor is sublimed. The product is then pressed into blocks, for export, in hydraulic presses. Sales and the selling price are equally controlled by Japan. The monopoly dates from August 5, 1899, but did not become effective until March 24, 1900, when bids were invited for taking the selling agency for the entire product, on the following terms:

The holder of the agency was to conduct the sale of the camphor at London, Hamburg, New York, and Hongkong, and be prepared to accept from the government from 30,000 to 50,000 piculs of camphor a year. The camphor was to be of two classes: "A," to be known as "cleaned and pressed," and "B," which is camphor in its ordinary crude form. When the amount of camphor to be turned over to the selling agents exceeded 50,000 piculs a year, the selling price for the excess would be determined by the Formosa government in concert with the selling agents. The government would prepare and pack the camphor for shipment, and the agents should not change the wrapping or package, nor place other materials among the contents. So far as in their power, the selling agents should send such quantities of camphor to various leading markets (London, Hamburg, New York, Hongkong, etc.) as were necessary to supply the demand. The term of the contract between the government and the selling agents was to be for 3 years. For the use of the government, and also as raw material for the purpose of manufacture in the Japanese Empire, the Formosa government might sell camphor at the same price to persons other than the selling agents. However, this extra-official sale would not affect the minimum limit of the quantity to be sold by the agents. The government required of the selling agents a substantial guaranty, this being permitted to take the form of a deposit with the local government of Formosa State bonds. Furthermore, the government reserved the right to interfere should the selling agents impair the government's camphor monopoly interests by acts of "inordinate selfishness or of an illegitimate nature."

Although the government has generally recommended the sale of the semirefined ("cleaned and pressed") grade, owing to the saving of loss in weight, etc., it has been announced that the crude form of the drug will be furnished to consumers specially applying for it through the regular channels.

An English firm was the fortunate recipient of the agency, its tender being the most favorable—that is, it was prepared to conduct the business on the cheapest basis. The prices which will be asked for the drug abroad have been announced as follows: For "A" grade camphor blocks in London, Hamburg, and New York, 107.843 yen per picul ($53.92 per 133 pounds), exclusive of import duties if any, and Hongkong 102.378 yen. For crude camphor, 99.702 yen ($49.85) will be the price abroad. The government will receive from the selling agents 85 yen ($42.50) a picul for the crude, and 95 yen ($47.50) for the "A" grade. (*U. S. Consular Report.*)

As a result of this arrangement, purchasers are now able to demand camphor at the above-named prices from the selling agents. The profits to the Japanese Government are estimated at about seventeen dollars per picul.

Much time and money have been expended in efforts to produce camphor artificially; but, although similar substances have been produced, it has been found impossible, so far as this one is concerned, to produce it upon an important commercial scale. A patent was granted April 29, 1902, to Nathaniel Thurlow, for making artificial camphor, the process being based on the interaction of anhydrous turpentine and anhydrous oxalic acid at a temperature of 120°–130° C. (248°–266° F.), the products resulting being borneol, borneol oxalate, borneol formate, camphor, and polymerization-products. The principal method heretofore has been by oxidizing oil of turpentine by means of ozone conducting chlorine gas through terebentene distilled from crude turpentine, purifying

depositing by an alkaline carbonate, heating to 120° C. (248° F.), and exposing the vapor to the action of ozone.

Properties.—Refined camphor is white, translucent, crystalline in texture, fissured in the interior, tough, and not pulverizable, except after moistening it with alcohol, ether, chloroform, or a volatile oil. It evaporates slowly at the ordinary temperature, and condenses in partly filled bottles in the form of glossy hexagonal plates or prisms. Various contrivances have been suggested to keep camphor in the powdered condition, such as precipitation by water in the presence of magnesia, trituration with a fixed oil, glycerin, or sugar; but the most satisfactory method appears to be that proposed by J. C. Lowd (1871), of condensing the hot camphor vapors in a large chamber. The powder thus obtained, which has been called *flowers of camphor*, may be preserved for some years if kept in a cool place, and even if it should cake together may readily be reduced to the pulverulent condition. Another method is that proposed by Dr. Bruno Hirsch, pouring a hot concentrated alcoholic solution of camphor into 10 times its volume of distilled water, stirring constantly, collecting the precipitate on a strainer, and after it has drained drying it over lime, calcium chloride, or sulphuric acid, without subjecting the powder to pressure.

Camphor fuses at 175° C. (347° F.), boils at 204° C. (399° F.), sublimes without residue, and when ignited burns with a luminous sooty flame; its specific gravity at 25° C. (77° F.) is 0.990; its solutions are dextrorotatory. It is sparingly soluble in water (see Aqua Camphoræ), dissolves at 15° C. (59° F.) in 0.7 part of alcohol, and is freely soluble in ethers, chloroform, glacial acetic acid, wood spirit, acetone, carbon disulphide, benzene, benzin, and volatile and fixed oils; its solutions in alcohol and ether increase the solubility of corrosive sublimate, and the presence of this salt renders camphor more soluble in these liquids (see Hydrarg. Chlor. Corros.). Camphor dissolves by trituration in 10 parts of milk, and the solution may be diluted with water without causing precipitation. When triturated with hydrated chloral, menthol, thymol, phenol or resins, the mixtures gradually become soft or liquid, and in the fused state resins dissolve a considerable proportion of camphor. It has a peculiar penetrating odor and an aromatic, somewhat cooling taste. The odor of camphor is destroyed by Tolu balsam, asafetida, and similar umbelliferous resins. Thrown upon water, camphor shows a peculiar rotatory motion, which is probably caused by its rather rapid evaporation and slow solubility. On exposure to the air, it evaporates more or less rapidly at ordinary temperatures, and, when moderately heated, it sublimes without leaving a residue. If a small piece of camphor be dropped into a small porcelain dish, the latter placed in a larger dish, and a clean beaker moistened on the inner surface with distilled water be inverted over the smaller dish, after igniting the camphor, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water, and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate test-solution (absence of chlorinated products).—U. S.

Its composition is represented by the formula $C_{10}H_{16}O$. When distilled with zinc chloride or phosphoric anhydride, it is gradually converted into cymene, $C_{10}H_{14}$, and by oxidation with nitric acid into *camphoric acid*, $C_{10}H_{16}O_4$, and finally into *camphoronic acid*, $C_9H_{12}O_5$. Schwanert's *camphresinic acid* (1863) is a mixture of these two. *Nitrosocamphor*, $C_{10}H_{15}O.NO$, was prepared by Claisen and Manasse (1889) by treating camphor and amyl nitrite, dissolved in ether, with sodium ethylate; it melts at 153° C., and is readily soluble in water, alcohol, ether, and chloroform. By the action of hypochlorous acid on camphor, Wheeler (1868) obtained several chlorine substitution-products, and by acting upon these with alcoholic solution of potassium hydroxide, *oxycamphor*, $C_{10}H_{16}O_2$, is formed, which crystallizes in needles, has the odor and taste of camphor, and sublimes without change, but melts at 137° C. (278.6° F.). Camphor combines and forms also substitution-compounds with iodine and bromine.

Camphoric acid has been synthetically prepared, beginning by chlorinizing a mixture of ethyliso-butyrate and ethyl aceto-acetate.

Pharmaceutical Preparations.—Acid Camphor Mixture, N. F.; Aromatic Camphor Mixture, N. F.; Camphor Cerate, U. S. P.; Camphor Liniment, U. S. P.; Camphor Ointment, N. F.; Camphor Water, U. S. P.; Camphorated Tincture of Opium, U. S. P.; Compound Camphor Cerate, N. F.; Parrish's Camphor Mixture, N. F.; Soap Liniment, U. S. P.; Spirit of Camphor, U. S. P.

Action and Uses.—Applied to mucous membranes in concentrated form, camphor

acts as a stimulant and irritant. If placed in the mouth, it produces a sensation of burning. Internally, its effect depends chiefly upon its dose. Large amounts cause a burning pain in the œsophagus, stomach, and abdomen, followed by vomiting, feebleness of the pulse, disturbances of vision, muscular feebleness, and pallor of the skin. If the quantities have been very large, epileptiform convulsions may develop. Death produced by camphor in a healthy person is, however, almost unknown. When taken in large dose the drug has been said to act as a sexual stimulant; but this is probably incorrect.

Camphor has been employed in medicine very largely in a number of widely different conditions. Probably its most valuable use is as a diffusible stimulant for the purpose of supporting the system during a crisis in a severe illness, or when collapse is threatened. Under these circumstances, it is best administered in sterilized oil by the hypodermic needle. It is also an efficient remedy in the treatment of serous diarrhœa accompanied by abdominal pain, and in the treatment of cholera morbus and true Asiatic cholera it is exceedingly valuable. It is also used with success in the treatment of hiccough and cardiac palpitation. Dissolved in alcohol, camphor affords a good lotion in muscular sprains and bruises, and is often sopped upon the scalp for the relief of nervous headache. Taken internally in small, frequently repeated doses, camphor is a useful remedy in the earliest stages of acute coryza.

The dose of camphor is from $\frac{1}{2}$ to 2 grains (0.03–0.12 Gm.), given in pill; of the spirit of camphor, $\frac{1}{2}$ to 2 fluidrachms (2–8 Cc.); and of camphor-water, 1 fluidrachm to $\frac{1}{2}$ fluidounce (4–16 Cc.).

Other Camphors.—The crystallizing stearoptens of volatile oils are sometimes designated as camphors.

Borneo Camphor or Borneol (*Sumatra*, *Bhimsaim*, or *Barus camphor*) is camphyl alcohol ($C_{10}H_{18}O$). It occurs in many plants of widely separated families, but has been obtained for commercial purposes from cavities in the wood of *Dryobalanops aromatica* Gaertn. (*D. Camphora* Colebrooke.—Fam. *Dipterocarpaceæ*), a large tree of Borneo and Sumatra. In young trees it exists as a liquid, in old ones as a solid. The deposits are mostly near the branch-swellings. About 11 pounds is a good yield for a tree. The natives test the trees by piercing them. To obtain the product, the wood has to be broken into small splinters. Trees which do not contain it, will usually produce it in 7 or 8 years after this piercing, which suggests that the substance is deposited as an antiseptic measure. Borneol is dextrogyre, heavier than water, and not volatilized at ordinary temperatures, so does not collect in crystals on the sides of its glass container. Nitric acid converts it into ordinary camphor. Under the name of *Ngai camphor*, it is distilled in the Himalayas from the weed *Blumea Balsamifera* DC. (Fam. *Compositæ*).

CAMPHORA MONOBROMATA, *U. S.*—Monobromated Camphor.

Bromo-camphor, *Bromated camphor*, E.; *Camphre monobromé*, Fr.; *Monobromkampher*, *Bromkampher*, *Kamphermonobromid*, G.; *Canfora monobromata*, F. It.; *Bromuro de alcanfor*, Sp.

Formula, $C_{10}H_{15}BrO$. Molecular weight, 229.34.

Monobromated camphor was obtained by Swarts (1861) by heating camphor dibromide, $C_{10}H_{16}O.Br_2$, in sealed tubes, and by W. H. Perkins (1865) by distilling "bromated oil" (Laurent, 1840) and collecting the distillate above 265° C. (509° F.).

Preparation.—Monobromated camphor may be prepared by the process of Maisch. Break 13 ounces of camphor into small pieces; put these into a quart retort, first filling the neck; raise the latter somewhat, and then introduce through the tubulure, by means of a funnel-tube, 4 ounces of bromine, washing the last down with 20 or 30 minims of alcohol. A brisk reaction will commence in about 15 or 20 minutes; after it has subsided and the retort has become cool introduce 8 to 9 ounces of bromine in 4 portions, waiting after each addition until the reaction has ceased. The addition of alcohol is not requisite, but facilitates the reaction, and the bromine may be added in larger quantities if provision be made for condensing the vaporized bromine and returning it to the retort. This is now slowly heated to about 132° C. (270° F.), allowed to cool, the contents dissolved in warm petroleum benzin, the solution allowed to crystallize, and the crystals purified by recrystallization from hot alcohol or petroleum benzin. On evaporating the mixed mother-liquors an oily mass is obtained, which, heated to 260° C. (500° F.), becomes black, and contains monobromated camphor, to be obtained by recrystallization as before. In this process, as well as the various modifications of the same, camphor dibromide, $C_{10}H_{16}OBr_2$, is first formed, and this, on being heated, is decomposed into

hydrobromic acid, HBr, and monobromated camphor, $C_{10}H_{15}BrO$, the latter representing a molecule of camphor in which 1 atom of hydrogen is replaced by 1 of bromine. During the operation one-half of the bromine used is given off as hydrobromic acid, and may be collected in water or combined with a base.

Properties.—Monobromated camphor crystallizes from alcohol in thin white or colorless prisms and needles, and from petroleum benzin in long, flat prisms or glossy scales. It has a weak but persistent camphoraceous odor and taste, and a neutral reaction. It is permanent in the air and not affected by direct sunlight. It is almost insoluble in water, slightly soluble in glycerin, freely soluble in alcohol, ether, chloroform, fixed oils, and in less than its weight of hot petroleum benzin, from which solution the greater part crystallizes on cooling. It melts at 76° C. (168.8° F.), and evaporates slowly with the vapors of boiling water, condensing in fine white interlaced needles; at 274° C. (525° F.) it boils and volatilizes completely, with partial decomposition. It dissolves without decomposition in cold sulphuric acid, and is again precipitated by water. When boiled with silver nitrate and nitric acid it is decomposed, and yields 81.2 per cent. of silver bromide. Heated with zinc chloride to near 160° C. (320° F.), it yields a hydrocarbon, C_8H_{16}, and liquid thymol, $C_6H_3.CH_3.C_3H_7.OH$ (Schiff, 1880). Sodium amalgam reduces it to camphor; heated with nitric acid bromo-nitro-camphor and camphoric acid are formed.

Tests.—Monobromated camphor should consist of colorless crystals, neutral in reaction, melt at 76° C. (168.8° F.) (U. S.), volatilize completely on heating, boil at 274° C. (525° F.) (U. S.), and when 0.5 Gm. is boiled with 1 Gm. of silver nitrate in 25 Cc. of water for 2 hours it should yield 0.406 Gm. of silver bromide. The solution from 0.5 Gm. of monobromated camphor shaken with 10 Cc. of water and filtered, should not give a turbidity on the addition of test-solution of silver nitrate.

A β-monobromcamphor is prepared by the action of bromine upon camphor in presence of alcohol, and is separated from the α-monobromcamphor by crystallization from alcohol, in which the former is the more soluble. It may be distilled in vacuo without modification, but when distilled under ordinary pressures it begins to boil at 250° C. (482° F.), and gradually changes to the α variety, its boiling-point rising to 265° C. (509° F.). The rotatory power of β-monobromcamphor is $[\alpha]_d = +34.9°$, and for α-monobromcamphor $[\alpha]_d = +139°$.

Action and Uses.—Monobromated camphor was introduced into medicine as a substitute for camphor with the idea that it would act more powerfully as a sedative upon the nervous system. As a matter of fact, it has little advantage over and above camphor itself. It is chiefly employed to allay nervous irritation and for insomnia in neurotic persons. It is also largely used in headache powders and headache tablets combined with one of the coal-tar products and caffeine.

The dose of monobromated camphor, which is best given in capsules or tablets, is 2 to 5 grains (0.12–0.30 Gm.) once, twice, or thrice daily. Sometimes it is administered in the form of a mixture. Its physiological effect is closely related to that of camphor itself.

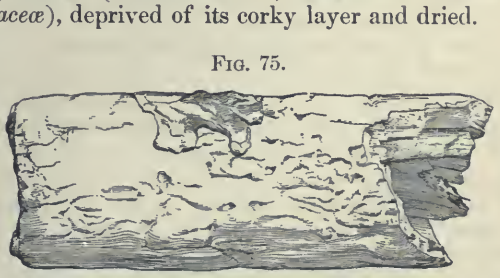
CANELLÆ CORTEX.—Canella Bark.

Canella, Costus Dulcis, False winter's bark, White cinnamon; Weisser Zimmt, Weisser Canel, G.; *Canella blanche*, Fr.; *Canela blanca*, Sp.

The bark of *Canella Winterana* (L.) Gærtn. (*Laurus W.* L.; *Winterana Canella* L.; *Canella alba* Murray.—Fam. *Canellaceæ*), deprived of its corky layer and dried.

Origin.—A small, handsome, evergreen, highly aromatic tree of the West Indies, growing also in southern Florida. The bark is originally of a silver-gray, but the corky layer is removed from the stem before collection, being loosened by beating with rude mallets. The remaining bark is then removed in quills or half-quills.

FIG. 75.



Canella alba (Nat.).

Description.—In quills or quilled strips of very variable length and breadth, sometimes nearly a yard long and 4 Cm. (1½ In.) in diameter, the bark reaching a thickness of 1 Cm. (⅔ In.) or even more; externally very hard (from a layer of stone-cells), pale-orange or

ochre-yellow, bearing transversely elongated scars, and occasionally patches of gray cork or denuded whitish spots; inner surface white, finely striate; fracture short, granular, the white middle layer dotted with numerous bright orange-yellow resin-cells, the inner layer showing wavy medullary rays; odor aromatic, somewhat cinnamon-like; taste bitterish, aromatic, and biting.

It has been used to substitute winter's bark, to which it bears little resemblance.

Constituents.—The constituents are 8 per cent. of mannit, formerly called *canellin*, mucilage, resin, a very bitter extractive, starch, and 0.5 to 1.28 per cent. of volatile oil, made up of eugenol, an oil with the odor of cajuput, and two other fractions. The ash, about 6 per cent., consists mainly of calcium carbonate. There is no tannin.

Action and Uses.—Canella is a mild aromatic stimulant and tonic. It is rarely prescribed alone, but is occasionally employed as an adjuvant to tonic and purgative remedies. It may be given in atonic dyspepsia, but is most commonly given in conjunction with aloes in the treatment of functional uterine disorders depending upon anæmia. The powdered root is given in the dose of from 10 to 40 grains (0.60–2.6 Gm.).

Very similar to canella is the nearly related bark of *Cinnamodendron corticosum* Miers, of Jamaica, there used like, and occasionally sold for it. It agrees closely in odor, taste, and constituents, but contains tannin. It is of a dark rusty brown-gray, and spotted by the scars of nearly circular warts. *C. macranthum* Baill., of Porto Rico, is also similar.

CANNABIS INDICA, *U. S., Br.*—Indian Cannabis.

Indian hemp, E.; *Indischer Hanf*, G.; *Chanvre Indien*, Fr.; *Canyama*, Sp.; *Ganja*, Ind.

The dried prepared tops of the pistillate plants of *Cannabis sativa* L. (Fam. *Moraceæ*), grown in the East Indies and gathered while the fruits are yet undeveloped, and carrying the whole of their natural resin.—U. S.

Indian hemp is official in nearly all pharmacopœias, some of which caution against the presence of fruits and brown flowers.

Origin.—From specially cultivated individuals of the ordinary hemp plant, a very tall annual which is indigenous in Asia, and is abundantly cultivated and naturalized in many countries, tropical and temperate. The rich soil and cool climate suitable for the production of hemp fiber will not develop the medicinal properties, which, moreover, are largely sacrificed by allowing the male plant to grow near, as is requisite for the production of hemp-seed. Notwithstanding these facts, large quantities of the tops of such

FIG. 76.

Cannabis Indica (¾ Nat.).

plants are marketed for medicinal use, this to a great extent explaining the weak action of much of the medicine. The following conditions, sought in the production of the Indian narcotic *ganja*, are those most favorable for the production of our drug, ganja being defined as the prepared unfertilized blossoming tops of the cultivated female plant. A hot climate, as that of Bengal, is selected, and the plants are cultivated in rows. Experts, known as "ganja doctors," examine the plants continually, marking for extraction those regarded as males, not one of which is allowed to grow in the vicinity. As maturity approaches, search is also made for male flowers growing abnormally on the female plants, and, if found, these also are removed. This exclusion of the fruiting process results in a correspondingly greater development of the active resinous exudation. The period of maturity is indicated by a brown color and the falling of the larger leaves. Harvesting must be performed within 4 days of such maturity, and the

mature plants are selected as fast as they develop. Curing consists in a series of processes for wilting, pressing, and rolling, and the shaking out of leaves and fruits, if any of the latter have formed. The rolling and treading are performed by human feet, and it is an art requiring training. Probably one object is to work the resinous matter from the stems up into the inflorescence tips. What other possible effects it may have is not known, though such have been suggested. The production of "round ganja" (*Goli*) consists in thus working each branch into a cylindrical or terete mass, and requires 4 days. That of "flat ganja" (*Chapta*) works them into a flat form, and takes but 3 days. The first-mentioned product is preferred, but our official description should include both, as it does. In both forms, the twigs are agglutinated. The Bengal or Calcutta ganja, which is the very choicest, is distinguished by its brownish or dusty, rather than the bright-green color of the Bombay. After production, Indian hemp commences at once to deteriorate. The natives say that after a year it has lost its power, and that after 2 years it is worthless. Prain reported that by the most careful possible method of preservation (close packing in boxes with perforated sides) it retained one-fourth of its power after 3½ years. Supplies of the new crop should be obtained in May or June.

Description.—Very dark-green or, preferably, slightly brownish; length 5 Cm. (2 In.) or more; densely paniculately branched, the branches compressed together and resinous-agglutinated into a terete or flattish form; bearing occasional very small, undeveloped digitate leaves of from one to several lance-linear leaflets, and numerous sheathing pointed bracts, in the axil of each of which are 2 small pistillate flowers; odor peculiar, narcotic; taste resinous and somewhat acrid; few if any small, globoidally ovoid akenes should be present, and a lens should disclose numerous resinous particles upon the surface.

The powder exhibits numerous secretion glands, on short, thick, many-celled hairs or bases, curved unicellular hairs, which frequently bear crystal masses in their bases, and rosette crystals in many of the parenchyma-cells. There should be few or no pollen-grains or stone-cells.

Quality.—The account given above of the origin of *Cannabis Indica* suffices to prove the unreliable character of much of the drug on the market. It should be added that much of this is also the product of plants which have been deprived of a great portion of their resin, before harvesting, by brushing them for the production of *churras*, as explained below. Good cannabis bears very few, if any, leaves. It is most unfortunate that in the case of such a drug we have no means of establishing a chemical standard, since the active constituent is not known. Large manufacturing houses are able to improve the standard very greatly by employing physiological tests, but the ordinary pharmacist must depend wholly upon physical examination. This requires much experience and close attention to the above description.

Constituents.—The many investigations have not yet cleared up the chemistry of cannabis. The herb contains 0.3 per cent. of a yellow aromatic volatile oil, a green resin, a bitter principle, gum, sugar, malates, potassium nitrate, etc. 10 pounds of ganja yielded 2 grains of the volatile alkaloid *cannabinine*. Hay's tetano-cannabine proved to be *choline*. Smith (1891) found a varnish-like alkaloid with the odor of coniine, and forming a sulphate which can be crystallized from alcohol. Zuco and Vignolo (1895) isolated an alkaloid, a powerful cardiac depressant, of which the hydrochloride is a colorless, deliquescent, crystalline mass. *Charras* or *Churras*, the exuded resin of cannabis, yields 33 per cent. of cannabinol, a toxic red oil claimed to be the active principle. It is, however, not a definite chemical substance, and different lots vary. Its red resin appears to be more active than cannabinol itself. By the oxidation of its cannabinol the activity of cannabis is lessened. Personne's *cannabene*, Merck's *cannabin tannate*, Bombelan's pure *cannabin*, and the *cannabindon* of Kobert (1894), are not pure active principles. The finding of nicotine by Preobroschentsky is believed to have been due to an admixture of tobacco; Dohme (1896) found that the average unselected cannabis yields 10 per cent. of resin, while the selected unfertilized tops yield 15 to 20 per cent.

Pharmaceutical Preparations.—Extract of Indian Hemp, U. S. P.; Fluidextract of Indian Hemp, U. S. P.; Tincture of Indian Hemp, U. S. P.

Action and Uses.—Cannabis indica is one of the most extraordinary drugs in the Pharmacopœia. Small doses of it are capable of producing severe and even alarming symptoms; yet, so far as we know, no case of death from an overdose of it has been reported. The drug is also extraordinary by reason of the great susceptibility of some persons to its influence, and the great insusceptibility of other persons to its effects.

These effects also vary largely with the individual, and in this respect it somewhat resembles alcohol, since its intoxication may be accompanied by hallucinations, by dreams, by pugnacity, by motiveless merriment or maudlin emotion. Perhaps its most extraordinary effect is the sensation of prolongation of time which it produces. Under its full influence, the pupils are dilated and the patient is usually in a deep sleep. Upon the general nervous system it acts as a distinct sedative.

Under the name of *haschisch*, it was taken by members of a Persian sect, the individuals of which under its influence ran amuck, killing or wounding every one in their path. In the Anglo-Saxon this homicidal mania is not developed by the drug. The habitual use of cannabis indica in excessive doses causes mental and nervous deterioration, with weak and tremulous limbs. Sometimes the cannabis indica leaves are smoked.

Cannabis indica finds its chief use in medicine as a sedative for distressing cough, the drawback being that many cases of phthisis are unduly susceptible to its cerebral effects. Combined with full doses of gelsemium, it is also largely employed for the relief of migraine and neuralgic headache. Many gynecologists also use it for its sedative influence in pelvic neuralgia, and some even assert that it has an effect upon uterine subinvolution.

Within recent years a tannate of cannabin has been introduced, and given in the dose of from 2 to 10 grains (0.12–0.60 Gm.). When it is desired to produce the therapeutic effect of the drug, it is much better to rely upon the solid or fluid extract. Much of the cannabis indica in the market has lost a large amount of its medicinal virtue, and cannot be relied upon. The physician should always employ a preparation which has been physiologically tested.

The dose of the solid extract of cannabis indica varies from $\frac{1}{4}$ to 1 grain (0.015–0.06 Gm.), according to the susceptibility of the patient; of the fluidextract, 1 to 10 minims (0.05–0.60 Cc.); and of the tincture, from 20 to 60 minims (1.3–4 Cc.).

Under the name of *cannabinon*, a substance has been introduced to take the place of the older preparations of cannabis indica, and has been used to quiet insane patients in the dose of 1 to 2 grains (0.06–0.12 Gm.), but its effects are not particularly satisfactory.

Other Products.—Although ganja is the practical equivalent of our drug, yet it is used by the natives wholly for smoking, sometimes mixed with tobacco, being entirely too powerful for habitual internal use. It is frequently used for poisoning, resulting in temporary active insanity, followed usually by recovery. The dervishes make an extremely somniferous preparation by boiling the tops in fresh butter or almond oil.

Chur is the mass of small twigs and bracts, rich with particles of resinous matter, which break off during preparation. It is the most powerful form of the cannabis drug.

Churras is the resinous matter removed from the standing plants by various methods. It is practically the active constituent. Prain declares it to be not a resin, or oil, or an oleoresin, but a peculiar substance which oxidizes into resin, like an oil.

Mom Churras (*Churras wax*) is a waxy-looking substance like churras, used in confections.

Bhang is a cheap substitute for tea, used by the poorer classes, made by drying the leaves of the wild plants of both sexes. Its composition and quality are very irregular. There is some question about its being beneficial or harmful, but certainly it possesses no active narcotic properties.

Fructus Cannabis.—*Hempseed*, E.; *Hanfsamen*, G.; *Semenes de chanvre, Chenevis*, Fr.—This is an akene, about 3 Mm. ($\frac{1}{8}$ In.) long, ovate, somewhat flattened, and somewhat 2-edged; the pericarp is thin, hard, smooth, greenish or brownish, delicately veined, and contains a single greenish seed, the embryo of which has the caulicle bent upon one of the cotyledons. The fruit is inodorous, and has an unpleasant, sweetish, and oily taste. By trituration with water it yields an emulsion. It contains 28 to 36 per cent. of a greenish- or brownish-yellow drying fixed oil, and 22 to 24 per cent. of proteid. Hempseed oil is an important commercial product.

CANTHARIS, *U. S.*, *Br.*—Cantharides.

Cantharides, P. G.; *Muscæ Hispanicæ.—Spanish flies*, E.; *Spanische Fliegen, Canthariden, Kanthariden*, G.; *Cantharides*, Fr.; *Cantaride, Cantarella, Mona di Spagna*, It.; *Cantarides*, Sp.

The beetle *Cantharis vesicatoria* (L.) De Geer (*Melæ v.* L., *Lytta v.* Fabricius.—Order *Coleoptera*, thoroughly dried at a temperature not exceeding 40° C. (104° F.).

Cantharis is official in all pharmacopœias, many of which specify that the ash should

not exceed 8 per cent. Many also specify the amount of cantharidin, some at not less than 0.4 per cent., others, 0.5 per cent. The Russian specifies about 8 per cent. of moisture and 9 to 10 per cent. of alcoholic extract, dried at 100° C. (212° F.). The Swiss specifies that they be renewed annually; others, that worm-eaten, yellowish, and broken ones, and those dressed with oil (detected by the greasy stain imparted to paper), and those with a musty or ammoniacal odor, shall be rejected.

Origin.—This beetle is indigenous to southern and central Europe and adjacent Asia, and is collected chiefly in Hungary and southern Russia. It frequents chiefly trees and shrubs of the families *Oleaceæ* and *Caprifoliaceæ*, such as the ash, lilac, elder, and honeysuckle. Its far-reaching, very penetrating, and offensive odor makes its presence known. The insects are collected early in the morning, by spreading cloths under the trees and shrubs, which are then shaken or beaten with poles; the insects are plunged into hot water, afterward spread out and dried. A better method for killing them is by means of chloroform, ether, oil of turpentine, or carbon disulphide, after enclosing them in a tight vessel. Collection is mostly in July, and they reach London and New York by way of Moscow and Hamburg, many in barrels, the finest in paper-lined boxes.

FIG. 77.

Cantharis vesicatoria.

FIG. 78.

Cantharis vittata.

FIG. 79.

Mylabris cichorii.

Description.—The beetle is from 15 to 30 Mm. ($\frac{3}{5}$ to $1\frac{1}{5}$ In.) long and 5 to 8 Mm. ($\frac{1}{5}$ to $\frac{1}{3}$ In.) broad, flattish-cylindrical in shape, of a shining brass- or copper-green color above and below, and finely punctate above. Head obtusely triangular and subcordate, with a longitudinal furrow; eyes 2, lateral; antennæ filiform, of 11 joints, the lowest 3 green, the upper black; thorax of the same width as the head, obtusely quadrangular, longitudinally channelled; wing-cases covering the body, with 2 fine longitudinal ridges; wings ample, membranous, brownish-transparent; tarsi of the hinder legs with 4, and the others with 5, joints; claws bifid. Cantharides have a strong and disagreeable odor and a slight taste, becoming strongly acrid. They yield a brown-gray powder intermixed with green shining particles.

Russian cantharides, of a coppery-green and larger than those of southern Europe, are more highly esteemed.

Constituents.—The active constituent of cantharis is *cantharidin* ($C_{10}H_{12}O_4$), the anhydride or lactone of cantharidic acid ($C_{10}H_{14}O_5$). It crystallizes in colorless prisms and scales without odor or taste, nearly insoluble in cold alcohol, soluble in 500 parts of water, in hot alcohol, ether, chloroform, and fixed and volatile oils. It sublimes at 100° C. (212° F.). Combining with water, it forms cantharidic acid, which with alkalies forms soluble crystallizable salts, the potassium cantharidate dissolving in 25 parts of water. On decomposing these salts with acid, not cantharidic acid, but cantharidin is set free. The yield of cantharidin from *Cantharis vesicatoria* is 0.17 to 1 per cent. (mostly 0.7 to 0.9 per cent.). Other constituents of cantharis are fat, an inert oil soluble in alcohol, yellow viscid matter soluble in water and alcohol, a volatile principle causing the characteristic odor, a yellow substance soluble in ether and alcohol, black extractive, chlorophyll, phosphates of calcium and magnesium, and free formic, acetic, and uric acids.

Preservation.—All blistering beetles should be kept in a well-dried condition and in close vessels, the drying to be effected at a temperature not exceeding 40° C. (104° F.), so as to avoid loss of cantharidin. If they cannot be kept in this condition, they may be protected from the attacks of mites and of small beetles and their larvæ by the addition of a little camphor, ether, chloroform, oil of turpentine, benzene, or carbon disulphide. W. E. Saunders (1883) found the vapor of chloroform to afford better pro-

tection than camphor. The blistering principle resides mainly in the soft parts of cantharides. The idea which has been sometimes advanced, that they increase in strength when thus attacked by insects, is erroneous.

Adulterants and Substitutes.—Cantharides are occasionally mixed with beetles of a similar color which have been collected with them, but evidently not for fraudulent purposes. The shape and color of the insects prevent them from being adulterated. But powdered cantharides is said to be sometimes ground together with euphorbium.

Pharmaceutical Preparations.—Cantharidal Collodion, U. S. P.; Cantharides Cerate, U. S. P.; Cantharides Liniment, N. F.; Cantharides Ointment, Br. P.; Cantharides Paper, N. F.; Tincture of Cantharides, U. S. P.

Action and Uses.—When Spanish beetles are swallowed, they produce intense burning in the throat, stomach, and bowels, with nausea and vomiting, the vomit often becoming black from the presence of blood. Bloody purging may also be developed, and death may soon take place because of the gastro-enteritis and the suppression of the urine by the intense irritation of the kidneys, as these organs endeavor to eliminate the poison. If small poisonous doses are used, the urine becomes scanty and albuminous, and finally bloody. Priapism may result, owing to the intense genital irritation, and in the female this irritation of the genito-urinary tract may result in abortion. Sometimes, as a result of the intense inflammation of the genito-urinary tract, local gangrene results. The smallest fatal dose of cantharides on record is said to be 24 grains (1.56 Gm.), but as abortion complicated the case it is not certain that this is a fatal dose in an ordinarily healthy individual.

Cantharides is employed in medicine internally in very minute doses as a stimulant for the kidneys when these organs are torpid, and also for its stimulant effect on the skin in dry, scaly cutaneous diseases. In incontinence of urine depending upon relaxation of the sphincter of the bladder it may also do good in the dose of 1 to 5 minims (0.05–0.30 Cc.) of the tincture. Externally it is employed for the purpose of producing a blister. Under these circumstances, it is commonly used in the form of cantharidal collodion or cantharides cerate. Each of these preparations usually takes about 5 hours to develop a blister. After they are applied for some time the pain may be modified and the blister increased in size by applying a poultice to the part. Blistering by means of cantharides is indicated wherever a powerful and lasting form of counterirritant is required. The blister itself should never be applied to inflamed skin, as it may cause a slough, and, as a general rule, cantharidal blisters are contraindicated in children because of the nervous irritation which they produce, while in old and feeble persons they may cause obstinate sloughing of the parts to which they are applied. Probably the most useful application of cantharides as a blister is its use at the nape of the neck in threatened effusion at the base of the brain, and upon the precordium in the treatment of pericarditis. Vomiting may sometimes be stopped by putting small blisters over the pneumogastric nerves in the neck or by placing a small blister on the epigastrium.

When irritation of the kidneys is present, a sufficient quantity of cantharides may be absorbed from a blister to increase the renal inflammation. It should therefore be used with caution in this condition.

Poisoning by cantharides is to be treated by the use of an emetic or stomach-pump, if vomiting has not taken place; by the ingestion of mucilaginous or albuminous drinks to protect and soothe the inflamed mucous membrane, and by the use of opium to allay pain and inflammation.

Oils should not be administered, as they aid in the solution and absorption of the poisonous principle of the drug.

Allied Drugs.—The number of beetles possessing similar properties, and known as "blistering beetles," is very large, and some of them have come into use as substitutes for cantharis. Among the American species may be mentioned the following:

Cantharis vittata, or potato-fly, which has a black thorax and wing-cases, with 3 yellow stripes upon the former, and the latter margined with yellow and with a yellow stripe down the middle, and which yields 0.4 to 1.3 per cent. of cantharidin; *C. cinerea*, black, closely punctured, and covered with ash-gray hairs; *C. marginata*, elytra black, with the margin ash-colored; *C. atrata*, only about ⅓ inch long, uniformly black. Attention has also been called to *C. Nuttallii*, which resembles the Spanish fly, but has golden-purple wing-cases striped with green; it is very abundant in Kansas and Colorado. A number of other species of cantharis have also been employed.

Mylabris cichorii Fabricius, and *M. Phalerata* Pallas, two vesicating insects indigenous to

eastern and southern Asia and to some parts of Africa, have been considerably imported as *Chinese blistering-flies;* the insects are black, with 2 orange-colored bands and 2 spots of the same color upon the wing-cases. They yield a blackish-gray powder destitute of the green glossy particles observable in powdered cantharides, and are quite efficient as a vesicant, containing 1 to 1.75 per cent. of cantharidin. Other species of *Mylabris* have also been used.

The East India *Lytta Gigas* Fabricius, which is longer than cantharides, and of a purplish-blue color, has likewise been occasionally met with in commerce. It contains about 0.85 per cent. of cantharidin. *Huechys sanguinaris* is said to contain no cantharidin.

Other Insects Employed in Medicine.—*Blatta orientalis*, the common cockroach, was early employed in medicine. An oily decoction of these insects was used to cure warts, scaly eruptions, indolent ulcers, contusions, boils, etc. Internally, they were given along with resin for the relief of dyspnœa (Pliny). More recently (1878) in Russia they have been employed in *albuminuria*, being said to diminish the quantity of albumin, and to increase perspiration and urine, without impairing the digestion or irritating the kidneys. The daily dose was from 4 to 5 grains (0.25 to 0.30 Gm.) of the powder obtained from the dried insect.

Antihydropin, a crystalline principle derived from the cockroach, has also been employed as a diuretic. The dose is from 3 to 5 grains (0.20–0.30 Gm.) four times daily.

Ænas Afer, a coleopterous insect that abounds in Spain, is claimed to possess over cantharides the following advantages: it is cheaper; it acts without appreciable pain; it is equally powerful, and does not irritate the urinary organs (*British Med. Jour.*, May 20, 1882).

Red ants were formerly used medicinally. A large number of them, enclosed in a linen bag, were infused in boiling water, which, with the bag, was then added to local or general baths in the treatment of chronic gout or rheumatism. The affected foot or hand was sometimes subjected for several hours to the action of the ants by being thrust into their hills. Internally, a tincture of domestic manufacture was given, and which was made by the prolonged infusion of a large amount of ants in an equal quantity of brandy. An official *spiritus formicarum* was formerly in common use, and was retained in the German Pharmacopœia for 1901. It was given internally, in doses of from 20 to 50 drops, in nervous and paralytic affections, and also applied by friction. An oil made by macerating living ants in almond oil was used for similar external purposes. A preparation of ants is said to constitute an important ingredient of some of the African arrow poisons.

CAPPARIDACEÆ.—The Caper Family.

Genera, 33; species more than 300; mostly of tropical and warm-temperate regions. They are closely related in all ways to the *Cruciferæ*, the well-known condiment capers showing this relationship in its pungent constituents, similar to those of the mustards.

Caper, Capers, or *Capparis* (*Kapper*, G.; *Caprier*, Fr.; *Alcaparro*, Sp.) consists of the unopened buds of *Capparis spinosa* L., suitably preserved in salt and vinegar. The plant is a spiny shrub of the eastern Mediterranean and adjacent regions, and is largely cultivated for this product. Leaves, bark, and seeds possess a bitter and somewhat acrid taste. The buds are roundish-oval, about ¼ inch in diameter, of a greenish color and an aromatic and pungent taste, reminding one of cresses. Upon dissection, they exhibit 4 sepals and 4 petals, numerous stamens, and a stalked ovary. Their important constituent is a volatile oil of an alliaceous odor. They also contain the yellow coloring-matter *rutin* (see RUTA). Their properties are mildly stimulant, stomachic, and antiscorbutic. The root-bark contains a saponin-like body, tannin, and an amaroid.

The genus CAPPARIS L. contains more than 150 species, of the warmer parts of both hemispheres, and a number of them are credited with similar, or even more pungent properties than those of *Caper*. The root-barks of *C. Jamaicensis* Jacq. (*C. cynophallophora* L.), *C. ferruginea* L., and of other species possess blistering properties, and, taken internally, are diuretic. All parts of the plants are reported antispasmodic and anthelmintic and the fruits antiscorbutic. The fruits of *C. Lodado* R. Br. and of other species are used in Africa as pepper-substitutes. Many species of *Cratæva* are similarly employed for their pungent properties, the bark of *C. Gynandra* L. (*Guaco*) of the West Indies, and of other species in both hemispheres, being used as antiperiodics and externally as rubefacients. A number of these have edible fruits. The fruits of a South American species have been utilized as an antispasmodic in epilepsy under the coined name of *Simulo*, this drug being at the same time referred to *Capparis coriacea* Burm. or to *C. oleoides*. In India, the entire plant of *Cleome viscosa* L. (*Polanisia v.* DC.; *Capparis isonandria* L.—known in the Philippines by the Tagalog name *Balabalanoyan* or *Apoyapoyan*) is used as a rubefacient, and the seeds as a mustard substitute. The same use is made of the seeds of the East Indian *Gynandropsis pentaphylla* DC. The seeds of *Cleome Chelidonii* L. (*Polanisia C.* DC.—*Kanthootee*), of India, are used as an anthelmintic, as are those of several other species. The hairs of *C. pruriens* Tr. et Pl., of Brazil, are irritant, like cowhage.

RESEDACEÆ.—The closely related family *Resedaceæ*, of half a dozen genera, and less than a dozen species, yields several medicinal plants, reminding us in their properties of the mustards and the capparids. The root of *Reseda luteola* L. (*Dyers' weed, Weld*, E. ; *Wau, Gelbkraut, Harnkraut*, G. ; *Herbe jaune, Gaude*, Fr.), of Europe, has the odor and taste of radish. The herbage is bitter and contains *luteolin* ($C_{20}H_{14}O_8$), occurring in yellow silky volatile needles of a faintly bitter and slightly astringent taste, sparingly soluble in water and ether, more soluble in alcohol ; acetate of lead precipitates it yellow, and ferric chloride is colored by it green, and afterward red-brown. Fused with potassium hydroxide, it yields phloroglucin and protocatechuic acid. The seeds contain a green drying oil. Dyer's weed is used to some extent in the arts as a dye-product. In medicine, it was formerly employed as a diuretic and diaphoretic, but its use has been discontinued.

The root of the common garden *Mignonette* (*R. odorata* L.) contains a pungent principle almost identical with the volatile oil of mustard. Mignonette is practically never employed in medicine.

CAPRIFOLIACEÆ.—The Elderberry or Honeysuckle Family.

Genera about 10, species about 300, chiefly shrubs, growing in the north temperate zone or extending into high and cool tropical regions. Many of them are very ornamental, and some are among our favorite decorative shrubs. Besides the VIBURNUMS and SAMBUCUS, elsewhere treated, a number have found more or less important uses in medicine, but they exhibit but little uniformity in composition or properties. *Triosteum* (*Fever-root* or *Fever-wort, White* or *Horse gentian* or *Ginseng, Bastard* or *Wild ipecac, Tinkers'-weed, Wild coffee*, E. ; *Dreisteinwurzel*, G. ; *Trioste*, Fr.) is the rhizome and root of *Triosteum perfoliatum* L. and probably also *T. aurantiacum* Bicknell. They are erect perennial herbs, the stems growing erect, in clusters, to a height of 5 to 12 M. (1½ to 4 Ft.), clammy-hairy, the large opposite leaves ranging from oblong-lanceolate to broadly oval, acuminate and acute, and narrowed at the base. The purplish-green flowers are sessile in axillary clusters, 5-merous, the calyx-teeth superior, long-linear, persistent, the corolla more or less bell-shaped or funnel-shaped, gibbous, and with an oblique and unequally lobed mouth. The 5 stamens, with long anthers and short filaments, are adherent to the corolla-tube. The orange or scarlet fleshy fruit contains usually 3 stones. The first-named species has the leaves distinctly connate in pairs, and the leaves are usually broader than in the other, in which there is little or no cohesion of the leaf-bases. The plants grow in rich woodlands or shaded locations, especially in rocky soil, in the southeastern and central United States. *T. angustifolium* L. has yellow or yellowish flowers and rougher and thicker leaves, and doubtless has also yielded a portion of the drug. The rhizome of Triosteum is 15 to 30 Cm. (6 to 12 In.) long, and about 18 Mm. (¾ In.) thick, knotty-cylindrical, sometimes branched, bearing numerous cup-shaped scars, about one-third of its breadth, upon the upper surface, and numerous coarse spreading roots about 12 to 25 Cm. (5 to 10 In.) long, chiefly on the lower side. Externally, the surface is yellowish-brown and more or less longitudinally wrinkled. The fracture of the rhizome is rather hard and tough, the color whitish, the bark thin, the wood with fine medullary rays. The odor is slight after drying, and the taste is characteristic and disagreeable. Little is known of its constituents, except that there is a small amount of the alkaloid *triosteine*. The seeds of this plant when roasted have been employed as a substitute for coffee. The fresh root has been given as an emetic, and in doses of from 20 grains to 1 drachm (1.3–3.9 Gm.) it acts as a cathartic. The emetic properties of the drug appear to reside in its alkaloid *triosteine*. The leaves are said to be diuretic and diaphoretic. The drug has been employed during convalescence from the low fevers, in hysteria and hypochondria, in intermittent fever, and in chronic rheumatism. It is not commonly given as an emetic, but may be used as a substitute for ipecac.

A dozen or more of the hundred species of *Lonicera* or *Honeysuckle* are used medicinally, the fruits generally having emetico-cathartic properties. Several of these drugs have more than a local repute. The herbage of *L. Caprifolium* L. (*Italian honeysuckle* or *Woodbine, Geisblatt, Chevrefeuille*), of southern and central Europe, cultivated for ornament, is used as a cutaneous and mucous tonic and vulnerary, and the seeds as a diuretic. *L. Periclymenum* L. (*English honeysuckle* or *Eglantine, Waldwinde*) is used similarly, and the stems as a substitute or adulterant for dulcamara. *L. brachypoda repens* is used in Japan as a drastic. *L. Japonica* Thunb. is sold in China as *Kin-yin-kwa ; L. Xylosteum* L. as *Jin-tung* or *Kin-yin-kwa.*

Diervilla, the *Bush honeysuckle*, especially *D. Diervilla* (L.) Mac. M. (*Lonicera* D., L.; *D. trifida* Moench ; *D. Canadensis* W.), has a similar repute, especially as a diuretic, and as an application to relieve itching. *D. Japonica* DC. (*Weigelia J.* Thunb.) is reputed poisonous.

Various species of *Symphoricarpus* (*Snowberry, Wax-berry, Coral-berry, Indian currant, Snap-berry, Turkey-berry, Wolf-berry*), of North America, are similary employed.

CAPSICUM, *U. S.*—Capsicum.

Capsici fructus, Br.; *Fructus capsici*, P. G.; *Piper Hispanicum, Bird pepper, Capsicum fruit, Cayenne (African or Pod) pepper, Spur pepper*, E.; *Spanischer Pfeffer, Schlotenpfeffer*, G.; *Capcique, Piment des jardins, Piment rouge. Poivre de Cayenne, P. de Espagne*, Fr.; *Aji, Chile, Pimiento*, Sp.; *Chile de Arvol (de Pajaro, Pequen, Unque, Mirasol)*, Mex.; *Pimiento dido de Dame, P. Pitango, P. Malagueti*, Bras.

The dried ripe fruit of *Capsicum fastigiatum* Blume (*C. minimum* Roxb.—Fam. *Solanaceæ*), deprived of its calyx.

Capsicum is official in nearly all pharmacopœias, though the latter differ greatly in the botanical names used and in the variety specified thereby, and by their descriptions.

Origin.—The cultivated varieties and forms of capsicum are innumerable. They vary in size from that of a cherry to twice the size of a man's fist, in form from spherical, through all ovoid forms, to horn-shaped, from nearly solid to greatly inflated, and through various shades of yellow and orange to scarlet or purplish-crimson. The plants are herbaceous and annual, or shrubby, and that which is annual in one climate may be perennial in a warmer one. They have been attentively studied by many able botanists, and the number of the species proposed reaches up to nearly a hundred, while by the latest classification (*Irish, Mo. Bot. Gard.*, 1898) they have been reduced to two, and the author has not been able to specify any character by which these can be distinguished. Under such circumstances, name-specification is of little value, and, since the varieties differ greatly in quality, the official description becomes our best reliance. The variety adopted in our pharmacopœia is undoubtedly the most active one available for medicinal use. Its nativity is not known with certainty, but is probably tropical America. It is now very widely cultivated in warm countries, but our supplies come chiefly from India and Africa, where the plant is fully naturalized.

Fig. 80.

Capsicum, slightly enlarged.

Description.—From 1 to 2 Cm. ($\frac{2}{5}$ to $\frac{4}{5}$ In.) long and usually about one-third as broad, oblong-ovoid, somewhat flattened, obtuse, covered with a scarlet or crimson, shining, translucent, wrinkled, coriaceous epicarp, through which the seeds are more or less visible; 2-celled and containing about 20 yellow, flat, reniform seeds, which are pointed at one end, about 3.5 Mm. ($\frac{1}{7}$ In.) long and 2.5 Mm. ($\frac{1}{10}$ In.) broad, and attached to a thin central placenta; odor characteristic, pleasant; taste intensely pungent and acrid. Not more than 7 per cent. of ash should be yielded. As viewed under the microscope, the powder exhibits characteristic epidermal cells, which are almost isodiametric on superficial view, and have greatly thickened and folded inner walls; collenchyma-cells from the hypoderm, and the absence of starch-grains and sclerenchymatous fibres are also characteristic.

Constituents.—The active principle appears to be 0.02 per cent. of *capsaicin* ($C_9H_{14}O_2$), found only in the inner portions, and occurring in colorless, very pungent crystals, soluble in alcohol, ether, fixed oils, and alkalies, but slowly soluble in turpentine, and very slightly in water. Capsaicin melts at 59° C. (138.2° F.), and volatilizes at 115° C. (239° F.) with very irritating vapors. Its pungency is destroyed by oxidation. Norbitz (1897) isolated 0.05 to 0.07 per cent. of crystalline *capsacutin*, which is neither alkaloid, glucoside, nor acid, and imparts a pungent taste to 11,000,000 times its weight of water. *Capsicin*, a thick yellowish-red liquid, slightly soluble in water, and *capsicol*, a red oily liquid, are oleoresinous mixtures containing the active principle. The other constituents are a volatile, non-acrid alkaloid, resembling coniine in odor, red coloring-matter, wax, resin, fixed oil, oleic, palmitic, and stearic acids, and a minute quantity of volatile oil with parsley odor.

Adulteration and Substitution.—Entire capsicum is very frequently substituted by other and larger varieties, especially *Paprika* (C. *annuum* L., official in the P. G.), and these are also very commonly ground for or with it. Their description is unnecessary, since anything not conforming to the above description should be rejected. The powdered article is enormously adulterated with other substances, such as damaged flour, corn meal, and even sawdust, these substances being often colored for the purpose. So extensive is this adulteration sometimes, that a quantity of the article may be chewed and swallowed without discomfort. Besides making a microscopical examination and an incineration, it is well to determine the amounts of oleoresin (see Oleoresina Capsici), of which there should be at least 5 per cent.

Pharmaceutical Preparations.—Fluidextract of Capsicum, U. S. P.; Oleoresin of Capsicum, U. S. P.; Tincture of Capsicum, U. S. P.; Tincture of Capsicum and Myrrh, N. F.

Action and Uses.—When applied to the skin, capsicum acts as a powerful rubefacient, and when placed in contact with mucous membranes produces vesication. Administered internally, it causes a feeling of warmth in the stomach, increases the appetite, and produces a sensation of heat over the entire body. The drug is thought by some to be a circulatory stimulant, but as such it is not commonly employed. If given internally for a long time, it may cause chronic gastritis attended with dull pain over the region of the liver and stomach; and if a very large amount is given at one time, it may produce acute gastritis with renal inflammation and strangury.

Capsicum is largely employed as a condiment, and lends itself to the control of flatulence induced by the eating of certain vegetables. It is one of the best remedies we can employ in the treatment of atonic dyspepsia, chronic alcoholism, and in delirium tremens, provided, however, that in the latter condition the stomach is not too irritable. In acute alcoholism, after the lapse of a few days, it is also given with benefit. Capsicum is largely given combined with other remedies, such as calomel and quinine, to aid in their absorption and increase their efficacy. It has been employed in the flatulent colic of the aged, relieving the pain and preventing the flatulence, and has been recommended as a stimulant in the low fevers. It is believed by some to be beneficial in the treatment of the intermittent fevers. The drug is thought to be a good remedy in chronic nephritis, as it decreases albuminuria, but it should not be given if acute nephritis is present. As a gargle, equal parts of the tincture of capsicum and glycerin may be employed in simple tonsillitis, pharyngitis, and relaxed uvula. A decoction made by boiling 1 ounce (30 Gm.) of powdered pepper, ½ ounce (16 Gm.) of table salt in 8 ounces (240 Cc.) each of vinegar and water, was formerly recommended in tablespoonful doses as a gargle in the treatment of malignant scarlatina. The tincture has been locally applied in the treatment of chilblains, and the capsicum plaster may be successfully employed for superficial neuralgia, muscular rheumatism, and lumbago.

The dose of powdered capsicum is from 5 to 10 grains (0.30–0.60 Gm.); of the tincture, from 5 to 10 minims (0.30–0.60 Cc.); of the oleoresin, from ¼ to ½ grain (0.015–0.03 Gm.).

CARBO ANIMALIS, *U. S.*—Animal Charcoal.

Carbo ossium, Ebur ustum, Spodium.—Boneblack, Ivoryblack, E.; *Charbon animal, Noir d'os*, Fr.; *Thierkohle, Knochenkohle, Beinschwarz*, G.; *Carbone animale, Nero di ossa*, It.; *Carbon de hueso*, Sp.

Charcoal prepared from bone. It is no longer official in the British Pharmacopœia.

Preparation.—Boneblack of commerce is obtained by roasting bones deprived of fat in iron cylinders until vapors cease to be given off, when charcoal is left intimately mixed with about 10 times its weight of the inorganic constituents of bone, and containing a little nitrogen, probably as nitrogen carburet. The volatile products of the dry distillation are various gases, an ammoniacal aqueous liquid called *bone-spirit*, and a blackish-brown tar called *bone-oil*.

Carbo carnis, or meat charcoal, is prepared by cutting into small pieces 3 parts of veal freed from fat, mixing it with 1 part of small bones, and roasting in a covered vessel until inflammable vapors cease to escape; the residue when cold is powdered.

Properties.—Boneblack is a dull-black, rather dense, inodorous, and rather tasteless mass, which for uses in the arts is either granulated or powdered. It is entirely insoluble in all simple solvents; hydrochloric acid dissolves a portion of the boneblack; the compounds removed are the inorganic constituents of the bones, which consist mainly of calcium phosphate, with some calcium carbonate and magnesium compounds. When ignited with free access of air, boneblack leaves a white ash, amounting to at least 85 per cent. of the original weight, which should be completely soluble in hydrochloric acid with the aid of heat. Boneblack has the remarkable property of removing organic coloring-matters from their neutral or somewhat acid solutions, and is employed for that purpose in the refining of sugar and in many chemical operations, for many of which its previous purification is requisite to avoid contamination with earthy matters, which would be dissolved by the organic acids.

Carbo Animalis Purificatus, U. S.— *Purified animal charcoal,* E.; *Charbon animal purifié,* Fr.; *Gereinigte Knochenkohle,* G.—Animal charcoal, in No. 60 powder, 100 Gm.; hydrochloric acid, 300 Gm.; boiling water, a sufficient quantity. Introduce the animal charcoal into a capacious flask, add 200 Gm. of hydrochloric acid and 400 Cc. of boiling water, and connect the flask with an upright condenser. By means of a sand-bath keep the mixture gently boiling during 8 hours. Then add 500 Cc. of boiling water, transfer the mixture to a muslin strainer, and when the liquid has run off return the charcoal to the flask. Add to it 100 Gm. of hydrochloric acid and 200 Cc. of boiling water, boil for 2 hours, again add 500 Cc. of boiling water, transfer the whole to a plain filter, and, when the liquid has run off, wash the residue with boiling water until the washings give only a faint cloudiness with silver nitrate test-solution. Dry the powder in a drying-oven and immediately transfer it to well-stoppered vials.—U. S.

Properties.—The physical properties of purified animal charcoal are the same as those of boneblack already described. If 2 Gm. of the powder be ignited at a red heat, with free access of air, in a broad, shallow porcelain or platinum dish, it should not leave a residue weighing more than 0.08 Gm. or 4 per cent. of the original weight (limit of silicates and other fixed inorganic matter). If 1 Gm. be boiled with a mixture of 3 Cc. of potassium hydroxide test-solution and 5 Cc. of water for several minutes, the filtrate should be colorless (evidence of complete carbonization).—U. S.

Purified animal charcoal removes from their aqueous solutions tannin, alkaloids, bitter principles, basic lead and other metallic salts, iodine, lime, etc.—a property which it shares more or less with boneblack, and which was first observed by Figuier (1810). This property is due to the finely divided state of the carbon and the surface-attraction resulting therefrom, and may be imparted to wood charcoal if, previous to charring, the vegetable substances are intimately mixed with flint, lime, or other earthy matters; a mixture of 10 parts of pipe-clay, 50 parts of finely powdered coal, and 2 of tar, yields, after carbonization, a charcoal possessing excellent decolorizing properties, depending in part upon the presence of alumina. By reheating purified animal charcoal with potassium carbonate, its decolorizing power, which was impaired by the treatment with acid, is greatly increased; and similar active charcoals are obtained from blood, horn, leather, etc., by mixing them with the salt mentioned, carbonizing the mixtures, and exhausting the residues with water.

The value of animal charcoal as a decolorizer is best ascertained by treating known weights of it with diluted solutions of indigo or litmus, and ascertaining the bulk which may be completely decolorized by slow percolation. Corenwinder (1853) proposed treatment of the charcoal with diluted solutions of lime and sugar, and determining by titration the amount of lime remaining in solution. The decolorizing property, however, does not appear to be strictly proportional to the lime- or salt-absorbing power of animal charcoal. When the decolorizing power of the charcoal has been exhausted, it cannot be restored by heating to redness, because a dense charcoal, resulting from the absorbed substances, will then be deposited in the pores; but if allowed to ferment, this substance will be destroyed, and by washing the charcoal with water, drying, and igniting, it becomes again a good decolorizer. Pelouze (1854) proposed to effect the revivification of spent animal charcoal by treating it with caustic alkalies or alkaline carbonates; according to Renner (1862), the process is a tedious one. Placing the decolorizing power of boneblack = 1, Bussy ascertained that of purified animal charcoal to be = 1.6; purified animal charcoal ignited with potassium carbonate = 20; blood ignited with potassium (or calcium) carbonate = 20; glue ignited with potassium carbonate = 15.5.

In purifying solutions by charcoal, loss of the principal constituent is often experienced from absorption in the charcoal.

Action and Uses.—Animal charcoal, either in its crude or purified state, is rarely employed in medicine. The purified animal charcoal has been proposed as an antidote for poisonous vegetable alkaloids, ½ ounce (16 Gm.) of charcoal to be used for each grain of alkaloid ingested.

CARBO LIGNI, *U. S.*, *Br.*—Charcoal.

Carbo ligni pulveratus, P. G.; *Carbo præparatus, Carbo e ligno, Carbo vegetabilis.*—*Wood charcoal*, E.; *Charbon végétal*, Fr.; *Holzkohle, Präparirte Kohle*, G.; *Carbone di legno*, It.; *Carbone vegetal*, Sp.

Charcoal prepared from soft wood and very finely powdered.—U. S.

Preparation.—Wood heated to about 300° C. (572° F.) leaves charcoal as a residue. On a large scale this is effected in iron retorts, in closed chambers of brick, or by the method of pile-burning, in which the heat developed by the combustion of a portion of the wood effects the charring of the rest. Two, and sometimes three, stacks of billets of wood of even length are piled up around stakes driven into the ground until a flattish cone of from 30 to 70 feet in diameter has been formed, which is covered by sod and earth, an opening being left at the top for the escape of the water which is first expelled, and several at the base. After the heap has been kindled in the center the top opening is closed, and when the wood has become perfectly dry the open spaces at the base are likewise closed and the pile left to smoulder for several weeks. The charcoal is finally withdrawn and extinguished by water, dry sand, or charcoal-dust. The yield varies with the kind and dryness of the wood. Karsten found that a wood which lost at 100° C. (212° F.) 57 per cent. and at 150° C. (302° F.) an additional 10 per cent. of its weight, would yield only 14 per cent. of charcoal, while the same wood dried yielded 25 per cent. The difference is explained by the formation of carburetted hydrogen on the passing of aqueous vapors over red-hot charcoal, and the same cause accounts for the smaller yield in the dry distillation of wood when the cylinders are rapidly heated, so that the wood near the iron is charred, while the pieces in the center still contain water.

Properties.—Charcoal has the shape and shows the texture of the wood from which it was obtained; it is black, inodorous, tasteless, very porous and brittle, insoluble and infusible. Alcohol in which charcoal has been digested should not become colored, and on evaporation should leave no residue. When charcoal is heated in the air, it is converted into carbon monoxide or dioxide, but it should not burn with flame (absence of organic compounds). Ordinary wood charcoal is usually incompletely carbonized, and requires to be again ignited in nearly closed vessels until it ceases to give off inflammable vapors, and to be reduced to a uniform, fine, non-gritty, dull-black powder before it is adapted for medicinal use. If 1 Gm. of charcoal be boiled with a mixture of 3 Cc. of potassium hydroxide test-solution and 5 Cc. of water for several minutes, the filtrate should be colorless or nearly so (evidence of complete carbonization).—U. S. Prepared by pile-burning, charcoal is considerably denser than when obtained in retorts; the latter kind is therefore preferable, particularly that made from soft wood, which is more porous than that obtained from hard wood. Charcoal made from young shoots of the willow, poplar, or linden is for these reasons most esteemed. It contains the inorganic constituents present in the wood, and these amount in well-prepared charcoal to about 1 per cent. The Br. allows 7.5 per cent. of ash.

Like other porous bodies, wood charcoal possesses the property of absorbing gases; this was observed first (1777) by Fontana and by Scheele, and Lowitz (1785) discovered the clarifying and decolorizing property of wood charcoal, in consequence of which it was used in the refining of sugar until animal charcoal was found to be better adapted for this purpose. The volumes of gases absorbed by recently ignited wood charcoal are not uniform, but vary with the nature of the gas and of the charcoal, as was shown by Morozzo (1783), the absorbing power being for oxygen 10, for carbon dioxide 35, for hydrogen sulphide 55, and for ammonia about 100 volumes, to 1 of the charcoal. Considerable heat is generated thereby, as also by the oxidation of some of the gases by the absorbed oxygen, and may increase to spontaneous ignition; and the increase in weight of pile-burned charcoal may amount to from 10 to 15 per cent. by absorption of watery vapors. This property explains the uses of charcoal as a deodorizer, for which purpose it should be freshly burned or reheated to expel the gases condensed in its pores. Odorous principles are not only absorbed by it from the atmosphere, but likewise from solutions in water and weak alcohol; its employment for the removal of the fusel oil from spirits is well known (see Alcohol). It acts in a manner similar to animal charcoal in precipitating from their aqueous solutions metallic salts, or even the metals, most bitter principles, and coloring-matters; but for the latter purpose is much inferior to the former.

Composition.—Wood charcoal is amorphous carbon mixed with inorganic constituents of the wood from which it has been prepared. If insufficiently burned, it is also contaminated with empyreumatic products resulting from partial decomposition of the organic principles.

Action and Uses.—Charcoal is a desiccant, and because of the fact that its interstices contain large quantities of oxygen, it possesses the property of oxidizing putrefactive organic matter, hence its employment as a disinfectant and deodorant. It also inhibits the growth of micro-organisms by depriving them of their normal amount of moisture. Internally it has been employed in fermentative dyspepsia with eructations, and in subacute gastric catarrh and in gastralgia. Its administration is also beneficial in the treatment of fermentative diarrhœas, but it is sometimes employed also as a useful laxative when the bowels are confined. Externally in the form of a poultice made with bread-crumb, linseed meal, and boiling water, it is applied to foul ulcers and gangrenous sores as a deodorant and emollient. Charcoal has also been largely employed as a filtering medium for the purpose of purifying water. It may be given in the form of a fine powder in the dose of from 1 to 4 drachms (4-16 Gm.) or more; or it may be taken in the form of lozenges or biscuits containing 20 per cent. of the drug. When taken internally it should be as freshly prepared as possible.

CARBONEI DISULPHIDUM, *U. S.*—Carbon Disulphide.

Carbonis Bisulphidum, Br.; *Alcohol sulfuris, Carbonei bisulphidum. Carbon bisulphide*, E.; *Sulfure de carbone*, Fr.; *Schwefelkohlenstoff, Schwefel-alkohol, Kohlensulfid*, G.; *Sulfuro di carbonio*, It.

Formula, CS_2. Molecular weight, 75.57.

Origin.—Scheele (1777) noticed the production of a very fetid gas on heating a mixture of sulphur and charcoal, but Lampadius (1796) by accident first obtained the compound in a liquid state. Clément and Désormes (1802) elaborated a process for its preparation, and stated it to be a compound of carbon and sulphur; its exact composition, however, was first proved by Vauquelin (1811) and by Berzelius (1812).

Preparation.—Carbon disulphide is made on the large scale by heating in a cylinder fragments of charcoal or coke to redness, and adding through a tube, near the bottom, pieces of sulphur, which is vaporized and unites with the red-hot charcoal. The condensed liquid contains sulphur in solution, from which it is freed by distillation on a water-bath, and the compounds having a disagreeable odor are removed by prolonged agitation with milk of lime, litharge, chlorinated lime, powdered corrosive sublimate, or copper sulphate, decanting, adding about 2 per cent. of a bland fixed oil or beeswax, and rectifying on a water-bath. E. Allary (1881) uses for the same purpose water and potassium permanganate, the latter added in small quantities, until after agitation the liquid retains its violet color; redistillation is not necessary. Carbon disulphide should be kept in well-stoppered bottles in a cool place, remote from lights or fire.

Properties.—Thus obtained, it is a very mobile colorless liquid having a high refracting power, and when pure a rather agreeable ethereal odor, and a pungent, aromatic, and cooling taste; but often it is of a more or less fetid odor from the presence of other volatile compounds. It has the specific gravity 1.290 at 0° C. (32° F.) and 1.256 to 1.257 at 25° C. (77° F.).—U. S. It boils at 46° or 47° C. (114.8° or 116.6 F.).—U. S. It evaporates rapidly at the ordinary temperature, and partly congeals on passing a rapid current of dry air over its surface. It is very inflammable—more so than ether—and burns with a blue flame, yielding sulphur dioxide and carbon dioxide or monoxide. The temperatue of a burning cigar will ignite it. It is soluble in 526 parts of water at 25° C. (77° F.), and in almost all proportions of absolute alcohol, ether, chloroform, and fixed and volatile oils, and in 1½ to 2 parts of official alcohol. It dissolves freely phosphorus, sulphur, bromine, iodine, fats, volatile oils, caoutchouc, and other compounds, and unites with some of the sulphur bases, forming *sulphocarbonates*, which correspond to the carbonates, containing sulphur in place of oxygen. Dissolved in alcohol and heated in the presence of ammonia, *ammonium sulphocyanate* and hydrogen sulphide are produced: $CS_2 + 2NH_3$ yields $NH_4CNS + H_2S$.

Tests.—Carbon disulphide should not change the color of moistened litmus-paper (absence of sulphurous acid), and when agitated with solution of lead acetate should not produce a brown or black color (absence of hydrogen sulphide). A portion evaporated

spontaneously in a glass or porcelain vessel should leave no solid residue (absence of sulphur).

Action and Uses.—Carbon disulphide is said to be both a general and a local anæsthetic, also rubefacient, antiseptic, and anodyne. Because of its disagreeable odor, however, it is rarely employed in medicine at the present time. It is largely used in the arts, and workmen when exposed to the vapor suffer from headache, vertigo, and talkative delirium. If the exposure is continued sufficiently long, it induces paralysis, with impairment of sight, hearing, and appetite. When taken internally in overdose, it acts as a powerful narcotic poison, producing deep sleep followed by coma, a running, rapid, feeble pulse, stertorous respiration, complete loss of reflex action, a cold, clammy sweat, and subnormal temperature, followed by death. A solution of 1 in 300 is said to destroy micro-organisms, and for this reason it was formerly heralded as a remedy for enteric fever, but its administration was not attended with success. When locally applied, it may give some benefit in facial and intercostal neuralgias, in sciatica, and in toothache. When applied to the spine, it is said to relieve the lancinating pain of tabes dorsalis. Its local application is also stated to reduce lymphatic enlargements and syphilitic tumors, but it is probably of little benefit in these conditions. The internal dose is stated to be from 5 to 15 minims (0.3–1 Cc.), largely diluted with water, 4 or 5 times daily.

In the arts it is largely employed for the extraction of fats and in the vulcanization of caoutchouc, and has been proposed as a solvent for obtaining the delicate perfumes of flowers. It should be kept in *cork-stoppered* bottles, away from flame and in a cool place.

CARBONEUM—Carbon.

Carbone, Fr.; *Kohlenstoff*, G.; *Carbonio*, It.; *Carbon*, Sp.

Symbol, C. Atomic weight, 11.91. Quadrivalent and in a few instances bivalent.

Carbon is very abundantly diffused in nature, and is one of the most essential elements. It occurs combined in all vegetable and animal organisms and in the products of their activity; and it was for this reason that compounds of carbon early came to be treated as a separate branch of chemistry, which was called "Organic Chemistry." In the mineral kingdom, it occurs both free and combined: combined, it occurs mainly as carbon dioxide and its salts, the carbonates, and in the hydrocarbons (hydrogen and carbon), which exist in such great quantities as petroleum and natural gas; in the free state, carbon occurs as diamond, which is the purest form, and more or less impure as graphite and the different varieties of amorphous carbon, such as coal, coke, charcoal, etc.

There are 3 allotropic varieties of carbon, two being crystallized, namely, diamond and graphite, the other being amorphous, as coal, charcoal, etc.

1. Diamond is found chiefly in India, near Golconda, Borneo, South Africa, and Brazil, and is in colorless and variously colored octahedrons of 3.5 to 3.6 specific gravity. It is a non-conductor of electricity and the hardest substance known. Lavoisier proved it to be pure carbon; when burned, it usually leaves between 0.05 and 0.2 per cent. of ash; amorphous diamond, which is used for polishing the crystalline variety, may leave up to 2 per cent. The value of crude diamonds exported in 1881 from the Cape of Good Hope was estimated to exceed £4,500,000. H. Moissan, of Paris, has succeeded in preparing diamonds by dissolving carbon in iron at the temperature of the electric arc, about 2500° C. (4532° F.), and suddenly cooling the surface of the iron, whereby the carbon crystallizes out in the interior under great pressure, forming diamonds.

2. Graphite, Plumbago, or Black Lead (*Plombagine, Crayon noir*, Fr.; *Wasserblei, Reissblei*, G.), has been found in many countries, crystallizes in hexagonal plates varying in specific gravity between 1.8 and 2.5, is of a black-gray color, unctuous to the touch, quite soft, and a good conductor of electricity, and leaves between 0.2 and 5 per cent., occasionally even as much as 46 per cent. of ash.

3. Amorphous Carbon exists in nature as *coal*, of which there are three principal varieties—namely, *lignite, bituminous coal*, and *anthracite* (lithanthrax)—which contain respectively about 66, 80, and 90 per cent. of carbon, partly in the form of organic compounds. Artificially prepared, it constitutes *wood charcoal, animal charcoal, coke*, and *lampblack*, the latter being obtained by the incomplete combustion of resinous matters; after it has been heated in covered vessels to expel the volatile organic compounds it constitutes a nearly pure carbon. Coke is the residue left from the dry distil-

lation of coal, and consists of amorphous carbon contaminated with the mineral constituents of the coal.

Oxides of Carbon.—There are two oxides of carbon, the monoxide, CO, and the dioxide, CO_2. The latter has been discussed under Acida. It is formed when carbon or any combustible carbon compound is burned with free access of air. *Carbon monoxide* is formed when carbon is burned in a limited supply of air, as in a grate; in the pure state when chloroform is treated with concentrated potassium hydroxide: $CCl_3H + 3KOH = CO + 3KCl + 2H_2O$; also by the action of cold concentrated sulphuric acid on potassium cyanide, or by warming absolute sulphuric acid with citric acid dried at 150° C. (302° F.). A mixture of CO and H, so-called *water-gas*, is formed when steam is passed through highly heated carbon. Carbon monoxide is a colorless, odorless, poisonous gas, of density 0.9672 (air = 1), and practically insoluble in water. The carbon in this gas has apparently a valence of 2, and this is one of the very few compounds in which carbon shows a valence different from the usual quadrivalence. Carbon monoxide shows some chemical activity. It unites with molten alkalies to form formates, also with metallic potassium and nickel. It burns forming carbon dioxide. Strong interest attaches to carbon monoxide, from the medical point of view, because of its affinity for the hæmoglobin of the blood, which is the cause of its highly poisonous character. Air becomes poisonous when it contains 0.05 per cent. of this oxide.

CARDAMOMUM, *U. S.*—Cardamom.

Cardamomi semina, Br.; *Fructus (semen) Cardamomi (minoris)*, P. G.; *Cardamomum minus (s. Malabaricum).—Malabar cardamoms*, E.; *Cardamomen, Kleine Kardamomen*, G.; *Cardamomes*, Fr.; *Cardamomo menor*, Sp.

The dried nearly ripe fruit of *Elettaria repens* (Sonnerat) Baillon (*Amomum r.* Sonn.; *Elettaria Cardamomum* Maton; *Alpinia C.* Roxb.; *Amomum C.* White; *Matonia C.* Smith; *Renealmia C.* Roscoe.—Fam. *Zingiberaceæ*).

Official in nearly all pharmacopœias.

Origin.—A perennial, reed-like plant of India, where, as in other tropical regions of the Old World, it is very extensively cultivated, requiring rich soil, partial shade,

FIG. 81.

Malabar cardamom.

FIG. 82.

Malabar cardamom seed (× 5).

FIG. 83.

Mysore cardamom seed: transverse and longitudinal section (× 6).

and much experience to insure success. In an experimental or desultory way, it has also been grown in Jamaica and some other parts of tropical America. The most extensive products are those of Ceylon, being not far from three-quarters of a million pounds annually. Of these, the Mysores are preferred, the Malabars, almost identical but a little smaller, coming next, and greatly predominating in amount. The latter are required by the P. G. Ceylon also exports some wild fruits, known as *Ceylons*, of somewhat different properties from those of the cultivated, and the oil distinct. Third in value are the Mangalore fruits, of Madras. Their production is declining. Dr. Henry gives the combined product of Cochin, Annam, and Tonking (*Siam cardamom*) for 1895, as upward of 200,000 pounds. Mysore and Malabar cardamoms alone are included in our official description.

The plant grows in tufts, like a small bamboo, and produces the fruits upon long scapes, which are prostrate among the stem-bases. The fruits are gathered slightly before maturing, to decrease the tendency to rupture during curing. Drying is performed either artificially or by sun-heat, after which the fruits are bleached by means of superficial moistening, that of the dew preferred, followed by sunlight. Sulphurous acid is sometimes employed. The finest looking cardamoms are prepared by washing them in a

lather made from the soap-berry (*Sapindus trifoliatus* L.), and mixed with the astringent pods of an *Acacia*, alternating with washing in ordinary soapsuds, sprinkling with water at half-hour intervals through the succeeding night, and drying in the sun. It is said that whitening is also often secured, especially to conceal defects, by the use of a paste, made of rice and wheat starch, soap, and buttermilk, well rubbed in. Cardamoms are imported in chests, of the official mostly 60 to 100 pounds, of the Mangalores about double this quantity, in each chest.

Description.—From 1 to 2 Cm. ($\frac{2}{5}$ to $\frac{4}{5}$ In.) long and about half as broad, oblong-ovoid, obtusely triangular in transverse section, rounded to truncate at the base, broadly and very shortly beaked, longitudinally striate, of a whitish or pale-yellowish color; 3-celled, the walls very thin, the pericarp thin, corky, and nearly tasteless, the placentæ in the axis; distended by the seeds, which are about 15 in number, each 4 Mm. ($\frac{1}{6}$ In.) long and rather more than half as broad, oblong-ovoid and irregularly angular, usually narrower at one end and grooved upon one side, reticulate-tuberculate, dark grayish-red or red-brown, furnished with a thin, hyaline aril, and representing about 70 to 75 per cent. of the total weight; odor strongly and pleasantly aromatic; taste similar, slightly pungent. Not more than 10 per cent. of ash should be yielded by the fruit, nor more than 7 per cent. by the seeds, which should be kept in the pericarps until required for use. Greenish gives as the normal ash percentage of average cardamom, about 12 per cent. in the pericarp, 6 per cent. in the seeds, 8 per cent. in the fruit. The inner albumin and embryo are filled chiefly with fixed oil and mucilage; the volatile oil is mostly contained in the large thin-walled cells of the testa.

The powder is characterized by cells packed with very minute starch-grains associated with crystals of calcium oxalate, and by the very thick-walled linear epidermal cells, with oblique ends, 10 to 20 mikrons in diameter, the last distinguishing them, according to Greenish, from those of Ceylon cardamom, in which these cells are 20 to 30 mikrons in diameter, but with thinner walls.

Ground cardamom is said to be often adulterated with ground peeled ginger, which is readily detected by its much larger starch-grains.

Constituents.—The seeds yield about 4 per cent. (*Hænsel*, 1897) of colorless or yellowish aromatic volatile oil, with a strongly penetrating but agreeable odor, and a burning, camphoraceous, somewhat bitterish taste. They contain also 10 per cent. of fixed oil, starch, gum, coloring-matter, and manganese compounds. The capsules yield 0.2 per cent. of volatile oil.

Pharmaceutical Preparations.—Aromatic Powder, U. S. P.; Compound Spirit of Cardamom, N. F.; Compound Tincture of Cardamom, U. S. P.; Tincture of Cardamom, U. S. P.

Action and Uses.—Cardamom is an aromatic, stomachic, and carminative. It relieves indigestion, and is employed to some extent as a condiment. It is rarely employed alone in medicine, but usually as an ingredient in the compound tinctures. It may be employed in dyspeptic disorders in the dose of 5 to 15 grains (0.30–1 Gm.); or an infusion, 1 ounce (30 Gm.) to $\frac{1}{2}$ pint (240 Cc.), may be given in doses of a wineglassful. (See also Tinctura Cardamomi Composita.)

Substitutes.—Wild Ceylon Cardamoms, referred to the var. *major* Smith, of the official species, but very likely distinct, are several times larger than the official, lanceolate, with a long, tapering, empty beak, and with a thick, brown, wrinkled pericarp. The most important substitutes for cardamom are the fruits of various species of the genus *Amomum* L., most of them sold as varieties of cardamom. Probably the most valuable of them is the Korarima cardamom (also called *Large cardamom*, *Guraji*, *Heel* or *Heil*, *Habhal-habashi*). It comes from Eastern Africa, but from an unknown plant. The fruits are large and usually perforated for drying on strings. The seeds have a flavor quite similar to that of true cardamom. Madagascar cardamom has a similar flavor, and is the product of *A. angustifolium* Sonn. India produces several similar substitutes. The Bengal cardamom (*Winged cardamom*, *Morung-* or *Buro-elachi*) is nearly an inch long, ovoid, and bears 9 ridges or wings toward the tip. Its seeds are quite distinct from ordinary cardamom, though pleasantly fragrant, the odor somewhat resembling that of camphor. They are yielded by *A. subulatum* Roxb. Nepaul cardamom is very similar, and may be only a variety. *Round* or *Cluster cardamom* also has a somewhat camphoraceous odor, but is more like the genuine than is the Bengal. It is the product of *A. Cardamomum* L. The fruits, as indicated, occur in clusters. They are hairy, nearly spherical, and about half an inch in diameter. The *Bastard* or *Wild cardamom* of Siam has a sharply tuberculate or subspiny fruit, and is yielded by *A. xanthioides* Wall. The *Chinese round cardamom* is from *A. globosum* Lour.

Grains of Paradise or Guinea Grains, also known as *Melegueta pepper*, are the product

of *A. Melegueta* Roscoe, of western Africa. The seeds are more rounded or round-ovoid than those of cardamom, though slightly angled by pressure. They have a little beak-like projection, softer and lighter colored than the remainder of the seed, which is of a rich reddish-brown and not reticulate like cardamom seed. The testa is crustaceous and brittle. The seed averages about 2.5 Mm. ($\frac{1}{10}$ In.) in diameter. It has little odor unless crushed, and a strong, peppery-biting taste.

CARTHAMUS.—Safflower.

Flores carthami, African or Dyers' saffron, False (American, Bastard, or Thistle) saffron, Parrot seed, E.; *Saflor, Färbersaflor, Falscher Safran, Deutscher Safran,* G.; *Carthame,* Fr.; *Cartamo, Azafrancillo, Alazor,* Sp.

The dried florets of *Carthamus tinctorius* L. (Fam. *Compositæ*).

Origin.—From a stout annual of India, largely cultivated for its useful properties in the Orient, and to some extent in Europe and other countries, besides occurring as an ornamental garden-flower. The flowers are in handsome, large orange-colored heads, terminating the erect branches, having spiny involucral scales and a bristly or subchaffy involucre, the chaff spiny-tipped. The whitish, somewhat 4-sided akenes were in use by the ancients as a laxative. The florets have been most extensively used for dyeing, especially for silks, and are still considerably so used. They are also used for rouge-making. Two distinct coloring-matters, a yellow and a red, are obtained from them. In collecting, the immature akenes are removed.

FIG. 84.

Carthamus: upper portion of floret, open and closed.

Description.—Deep-orange or brownish-red; about 2 Cm. ($\frac{4}{5}$ In.) long, tubular, deeply 5-lobed, the lobes linear, sub-equal; ovary removed; stamen-tube stout, long-exserted, much surpassed by the slender style; odor characteristic, not strong; taste bitterish. It sometimes occurs pressed into cakes.

Calendula has been used to adulterate or substitute safflower, but its ligulate florets are at once recognized.

Constituents.—Besides a little volatile oil and ordinary constituents, carthamus yields 24 to 30 per cent. of a yellow coloring-matter, *safflor-yellow* ($C_{24}H_{30}O_{15}$), soluble in water, and 0.3 to 0.6 per cent. of *carthamin* or *carthamic acid* ($C_{14}H_{16}O_7$), a red coloring-matter insoluble in water, soluble in alcohol with a handsome purple color, and very soluble in alkaline liquids, though the latter soon decompose and decolorize it. *Carthamin,* when dry, is a red-brown powder with metallic luster; with French chalk it forms "rouge."

Action and Uses.—Carthamus is employed for the same purposes as saffron. It is stimulant, diaphoretic, and in large doses laxative. The drug is never employed by practitioners, but hot infusions are frequently used by the laity to promote the eruption in the various exanthematous diseases.

The infusion contains from 2 to 4 drachms (8–16 Gm.) of the drug to a pint (480 Cc.) of boiling water, and is given in doses of a wineglassful frequently repeated.

CARUM, *U. S.*—Caraway.

Carui fructus ("*Semen*"), Br.; *Fructus carvi,* P. G. *Curaway-fruit (seed),* E.; *Kümmel, Garbe,* G.; *Carvi, Cumin des prés, Carvies,* Fr.; *Alcaravea,* Sp.

The dried nearly ripe fruit of *Carum Carvi* (*Carui*) L. (Fam. *Umbelliferæ*).

Origin.—A biennial plant, indigenous in the western Himalayas and the Caucasus, and found throughout Siberia and the greater portion of Europe, but scarce in the southern part of that continent. It is extensively cultivated in Norway, Russia, Germany, Holland, England, Morocco, and also in the United States, and is more or less naturalized in all of those countries. The hollow cylindrical stem is 30 to 90 Cm. (1 to 3 Ft.) high, branched; the leaves bi- and tri-pinnate, the flowers white. The crop is threshed and cleaned like ordinary grain. The yield per acre is between 8 and 10 hundred-weight. The Holland product is generally regarded as the finest, the annual crop of this being about 4000 tons.

Description.—Of 2 carpels, usually separated, each 4 or 5 Mm. (about $\frac{1}{5}$ In.) long and a quarter as broad, curved, oblong, narrowed toward each end, dark-brown, smooth, 5-ribbed, the ribs narrow and rather sharp, yellowish or pale-brown; oil-tubes 6; seed plane upon the face, nearly equilaterally pentagonal in transverse section; odor and taste strong, character-

istic, and agreeable. It is free from starch, and the ash should not exceed 8 per cent., about one-third of it insoluble in hydrochloric acid.

Fig. 85.

Carum.

Fig. 86.

Nigella seed (× 6).

Impurities.—Through imperfect cleaning, caraway may contain various seeds of weeds, and other substances, likely to be indicated by the presence of starch in the powder, or of dirt, indicated by an excess of ash. Fruits which have been exhausted of their volatile oil are frequently added. These are easily detected in the entire drug by their shrivelled appearance, but their detection in the powder is rather difficult.

Constituents.—Besides ordinary substances, fat, resin, gum, a little tannin and sugar, caraway contains, as its active constituent, about 5 to 7 per cent. of its peculiar volatile oil (see Oleum Carui).

Action and Uses.—Caraway is diuretic, carminative, and stomachic. It has been employed to some extent in the flatulent colic of infants, but other members of the same family of plants have met with greater favor; combined with purgative drugs, it acts as a corrective and prevents griping. The seeds are occasionally baked in bread, both to impart an agreeable flavor and to aid in digestion.

The dose of the powdered drug is from 20 grains to 1 drachm (1.3–4 Gm.). An infusion, made by adding 1 pint (480 Cc.) of boiling water to 2 drachms (8 Gm.) of the drug, is occasionally given in doses of from 1 to 2 fluidounces (30–60 Cm.), but it is probable that the large draughts of hot water are as efficacious as the drug therein contained; however, the trace of volatile oil present may aid in preventing nausea.

The volatile oil is most commonly employed (see Oleum Carui).

Black Caraway, so-called (*Nutmeg flower, Small fennel flower, Black cumin, Fitch, Gith, Roman coriander, Schwarzkümmel, Faux Cumin, Nielle, Toute epices, Quatre epices*), is the seed of *Nigella sativa* L. (Fam. *Ranunculaceæ*), a small annual, native of the Mediterranean region, and widely cultivated, especially in India. It is used by bakers the same as caraway, and is also used medicinally very much in the same way. These seeds are dark-brown or blackish, about 3 Mm. (⅛ In.) long, triangulate, with one convex side, a tuberculate testa, and an oily albumen. They are pleasantly aromatic in odor and taste, and somewhat pungent. Besides gum, albumin, sugar, 35 to 40 per cent. of fixed oil, and other ordinary constituents of seeds, they contain about 1.5 per cent. of a peculiar volatile oil and nearly an equal amount of *melanthin*, a glucoside resembling helleborin and saponin. It has also been claimed that an alkaloid is present. The seeds of *N. Damascena* L. (*Ragged lady, Love-in-a-puzzle*), native of the same region, are used similarly.

CARYOPHYLLACEÆ.—The Pink Family.

Genera about 70, species upward of 1000, being mostly herbs and growing chiefly in the north temperate zone of both hemispheres. Except for their highly ornamental properties, these plants are of little utility. A few, like chickweed, have been used as salads. A number are poisonous, due apparently, at least in part, to saponin, which is commonly contained in the plants of this family (see Saponaria). A number of the latter, in widely separated regions, have been used as diuretics and anthelmintics. Of these, the following are the best known: *Dianthus Chinensis* L., *Ku-mch* or *Shih-chuh*, and other species of *Dianthus; Tunica cretica* (L.) Fisch. (*Saponario c.* L.), of Europe; *Vaccaria Vaccaria* (L.) Britton (*Saponaria V.* L.; *Vaccaria vulgaris* Host.), the *Cow-herb* or *Cow-cockle, China, Spring*, or *False cockle*, the seeds of which yield an extract which appears to contain saponin, and which are found poisonous to rabbits, with the symptoms of saponin-poisoning; *Agrostemma Githago* L. (*Lychnis G.* Lam.), the *Corn, True*, or *Winter cockle, Corn-pink* or *Campion, Old-maid's pink*, the seeds of which are also poisonous. *Tissa rubra* (L.) Britton (*Arenaria r.* L.; *Spergularia r.* Presl.; *Lepigonum r.* Fries.; *Buda r.* Duwort), the *Red-sandwort* or *Sandspurrey*, appears to be diuretic by its large alkali-content. *Herniaria glabra* (L.) contains, in addition to saponin, *methyl-umbelliferon* (*herniarin*) and a minute amount of the alkaloid *paronychine*; it is used in catarrh of the bladder.

CARYOPHYLLUS, *U. S.*—Cloves.

Caryophyllum, Br.; *Caryophylli aromatica*, *Caryophylli*, P. G.; *Gewürznelken*, *Nägelein*, G.; *Girofle*, *Gérofle*, *Clous aromatiques*, Fr.; *Clavos de especia*, Sp.; *Garofani*, It.

The dried flower-buds of *Eugenia aromatica* (L.) Kuntze (*Caryophyllus a.* L.; *E. caryophyllata* Thunb.—Fam. *Myrtaceæ*).

Official in all pharmacopœias, some of which require the presence of from 18 to 20 per cent. of volatile oil.

Origin.—This handsome evergreen tree is supposed to have been indigenous only to the 5 small islands near the island of Jilolo, to which the name of Molucca or Clove islands was formerly exclusively applied. The tree has been entirely destroyed there, but it is now cultivated in many of the islands of the Indian Ocean, in tropical Africa, Brazil, and the West Indies. It attains a height of 9 to 12 M. (30 to 40 Ft.), and is considerably branched, the branches forming an elegant pyramidal crown, and being terminated by cymes composed of 15 to 25 flowers, producing berry-like fruits.

As soon as the buds change in color from green to pink, they are either picked by hand or detached from the trees by beating the branches with long bamboos, the buds being gathered upon cloths spread beneath the trees; they are afterward dried by exposure to the sun, whereby the color changes to brown. Between 1,000,000 and 1,500,000 pounds of cloves are annually consumed in the United States, the entire crop being about 8,000,000 pounds. The finest cloves come from Penang, the greatest quantity from Zanzibar. Collection begins in August or September, and the crop begins to arrive in London during the latter part of November.

Description.—About 1.5 Cm. ($\frac{3}{5}$ In.) long; the stem-like calyx-tube about two-thirds of the entire length and one-fourth to one-third as broad as long, usually slightly narrowed at the base, flattened and obscurely 4-angled or 4-grooved, granular, not rough-wrinkled, dark-brown, like the 4 spreading, thick and rigid triangular-ovate, obtuse teeth; corolla-bud light-brown, smoothish, broader than long, consisting of 4 imbricate petals and enclosing numerous curved stamens and 1 stout style; exuding volatile oil when scratched; odor strong, pleasantly aromatic; taste pleasantly pungent and followed by slight numbness. Cloves should not float in a horizontal position on water. They are free from starch and stone-cells, and should yield not more than 7 per cent. of ash, about one-seventh of it insoluble in hydrochloric acid.

Although nothing else can be mistaken for cloves in the entire condition, their quality calls for close scrutiny. The chief imperfections are due to careless picking, the

FIG. 87.

Clove: *a*, natural size; *b*, longitudinal section, magnified.

FIG. 88.

Clove-stalk Nat.).

FIG. 89.

Anthophylli (½ Nat.).

FIG. 90.

Caryophyllus: A, bast-cell from clove; B, bast-cells from *Anthophylli*; C, starch-grains from *Anthophylli*. (After Tschirch and Oesterle.)

immature green and the too old red buds being beaten off (in Zanzibar cloves) together with the pink ones, instead of being excluded by careful hand-picking; to careless dry-

ing, which should be done quickly and without exposure to bad weather; to admixture of the peduncles or flower-twigs (*Clove-stalks, Griffe de girofle, Nelkenstiele, Nelkenholz, Festuci caryophyllorum*), and to admixture of cloves which have been exhausted of the whole or a portion of their volatile oil. Too young cloves are small, their parts imperfectly developed, and deficient in oil. Those which are too old exhibit the corolla-bud partially or wholly expanded. Clove-stalks can be readily seen. They (Fig. 88) are about 2 Mm. ($\frac{1}{12}$ In.) in thickness, of a light-brown color, and have a distinct though not strong odor and taste of cloves. They are sometimes employed for adulterating powdered cloves, and sometimes for distilling the volatile oil, of which they contain about 4 per cent. The importation of clove-stalks into this country increased from 15,128 pounds in 1877, to 184,464 pounds in 1880. Exhausted cloves are heavily wrinkled and light, floating upon water in a horizontal position, and usually lack the corolla-bud, or "head." An artificial clove, moulded from a paste, has been reported as occurring.

In the powder, which is of a dark-brown color, all these and many other substances may enter, many of them being indicated by the presence of starch. The clove fruits (*Anthophylli, Mother-cloves, Mires de girofle, Clous Matricæ, Mutternelken*) are often included. They (Fig. 92) are about 2.5 Cm. (1 In.) long, oval, crowned with the 4-lobed calyx, and have 1 or 2 seeds in each cell. In the powder they are readily detected by the presence of their peculiar starch-grains (Fig. 90), as contrasted with those of cloves. Allspice is also sometimes used to adulterate powdered cloves.

Constituents.—(For volatile constituents, see OLEUM CARYOPHYLLI.) The unimportant constituents of cloves are 13 per cent. of gum, 6 per cent. of tasteless resin, a slight amount of vanillin, and green wax. Besides these, the following occur: From 16 to 20 per cent. of volatile oil, of which from 50 to 85 per cent. is eugenol; 10 to 13 per cent. of gallotannic acid; *eugenin* ($C_{10}H_{12}O_2$), in white pearly scales of slight clove odor, obtained from the watery distillate, and *caryophyllin* ($C_{10}H_{16}O$ or $C_{20}H_{32}O_2$), a neutral body without taste or odor, and crystallizing in silky needles, soluble in ether, slowly in alcohol, readily in boiling alcohol and boiling chloroform. With fuming nitric acid, caryophyllin yields crystals of caryophyllinic acid ($C_{20}H_{32}O_6$).

Action and Uses.—Cloves may be employed internally as an aromatic stimulant and carminative, but they are most commonly given as adjuncts to other remedies. They may be given either in powder or in infusion, 4 drachms (16 Gm.) to 1 pint (480 Cc.), to allay vomiting, remove flatus, and aid digestion. The drug is quite commonly used as a condiment to promote the digestion of fatty food. Externally, as an ingredient of the spice poultice—cinnamon, nutmeg, cloves, and allspice, of each 4 drachms (16 Gm.); black pepper, 2 drachms (8 Gm.)—it is largely employed over the epigastrium to cause expulsion of gas from the stomach; over the abdomen to relieve colic; and to the nape of the neck to prevent infantile convulsions. The dose in substance is from 5 to 10 grains (0.30–0.60 Gm.). A tincture made by percolating 1 part of powdered cloves with 4 parts of 25 per cent. alcohol may be given in doses of 20 minims to 1 fluidrachm (1.30–4 Cc.).

CASCARILLA, *Br.*—Cascarilla Bark.

Cortex cascarillæ, P. G.; *Cortex eluteriæ, C. thuris.—Sweetwood bark*, E.; *Kaskerillrinde*, G.; *Cascarilla*, F. It., Sp.; *Cascarille, Ghacrille, Écorce eleutherienne*, Fr.

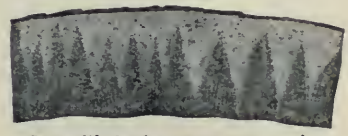
The dried bark of *Croton Eluteria* (L.) Bennett (*Clutia E.* L.—Fam. *Euphorbiaceæ*).

Cascarilla is official in nearly all pharmacopœias, some of which caution against the substitution of Copalchi bark. At least one (Ph. Belg.) has given *C. Cascarilla* (L.) Bennett (*Clutia C.* L.), of the same region, as one of the sources.

Origin.—A usually low, much-branched, fragrant flowered shrub of the Bahama Islands. It was formerly abundant in some of those islands where it is now extinct, and it is gradually becoming scarcer in the others (Eleuthera, Andros, and Long), yet the price, ordinarily about 10 dollars per hundredweight, in London, does not warrant cultivation. The annual crop is about 30,000 pounds, most of which comes first to New York. It is collected at all seasons. Besides its medicinal use, it is largely employed in scenting tobacco, flavoring liquors, and in other ways.

Description.—In quills or curved pieces of variable length and 3 to 8 Mm. ($\frac{1}{8}$ to $\frac{2}{5}$ In.) broad, the bark 1 to 3 Mm. ($\frac{1}{25}$ to $\frac{1}{8}$ In.) thick; externally silver-gray from a dense growth of lichen (*Verrucaria albissima* Ach.), or brown or gray-brown from the removal of this layer, the surface thus exposed more or less wrinkled and transversely fissured; inner surface dark red-brown, nearly smooth; fracture short and sharp, the fractured surface resinous, very dark red-brown, with thin whitish medullary rays; odor strongly aromatic, especially when burned; taste aromatic and very bitter.

FIG. 91.



Cascarilla bark: transverse section, magnified.

The powder shows an abundance of small starch-grains, mostly only 3 to 5 mikrons in diameter, elongated, prismatic crystals, and rosettes of calcium oxalate, reddish-brown resin-receptacles, and few bast-cells, about 40 mikrons in diameter and with the lumen nearly obliterated.

Constituents.—The bark yields 1 to 1.6 per cent. of greenish-yellow volatile oil (of eugenol 0.30, terpene, limonene, para-cymol, 2 sesquiterpenes, an alcohol, resin 1.1 per cent., and an oxygenated portion 10 per cent.—*H. Thoms*), 15 per cent. of resin, nauseous fatty matter, pectin, a peculiar tannin, vanillin, a basic principle, *cascarillin* ($C_{16}H_{24}O_5$, according to Naylor and Littlefield), in white odorless bitter needles or scales, very sparingly soluble in water, and sparingly in cold alcohol or chloroform. Cascarillin is not a glucoside, and is not precipitated by tannin. There is also another base allied to choline, probably *betaine*.

Pharmaceutical Preparations.—INFUSION OF CASCARILLA, Br. P.; TINCTURE OF CASCARILLA, Br. P.

Action and Uses.—Cascarilla is an aromatic stimulant and tonic, and is occasionally employed with the bitters in the treatment of gastro-intestinal disorders. It is said to be of value in atonic dyspepsia attended with flatulence, chronic diarrhœa, and dysentery. Formerly it was given as a stimulant in the low fevers and as a febrifuge in the treatment of malarial infections, but for these conditions its use has practically been abandoned. The fumes of the drug when inhaled are said to produce dizziness and intoxication.

The dose of the powdered drug is 30 grains (2 Gm.); of the infusion—1 ounce to 1 pint (30 Gm. to 480 Cc.)—a wineglassful.

Allied Barks.—MALAMBO BARK is obtained in Venezuela from *Croton Malambo* Karsten. It is in quills 12 to 25 Mm. ($\frac{1}{2}$ to 1 In.) in diameter and 15 to 20 Cm. (6 to 8 In.) long. It has a thin, soft, whitish, longitudinally fissured cork, which is easily removed, exhibiting a brown surface with fine transverse furrows; the inner surface is gray-brown, finely striate, the fracture short-splintery, the odor aromatic, and the taste unpleasantly aromatic and bitter, resembling that of cascarilla. Malambo bark does not differ materially in its action from cascarilla, and may be employed in the same dose for similar conditions as the latter remedy.

COPALCHI BARK is obtained from *Croton Pseudochina* Schlechtendal (*C. niveus* Jacquin), indigenous to Mexico. It resembles the preceding, is about 5 Mm. ($\frac{1}{5}$ In.) thick, hard and dense, has a grayish or yellowish corky layer, and beneath this is transversely fissured; the bast is reddish-brown, coarsely striate in a radial direction, and breaks with a short, irregular fracture. Copalchi bark has been given as an antiperiodic, and is said to be useful also in the treatment of diarrhœa.

Barks differing considerably from those described, and which are occasionally found in commerce as malambo and copalchi barks, are obtained from different plants. The composition of both barks is probably similar to that of cascarilla. Holmes (1874) described a bark which was probably derived from *Croton lucidus* L., and was found as an admixture in cascarilla; it had a fawn-colored, firmly adhering corky layer, was reddish and closely ridged upon the inner surface, had an astringent, slightly bitter taste, and yielded a darker-colored tincture and infusion than cascarilla.

C. PHEBALOIDES R. Br., of Australia, is there used as *Native cascarilla*, and is said to have an agreeable aromatic, bitter taste.

The bark of *C. erythœma* Mart. (*Casca de Sangue de Drago*), of Brazil, is there a favorite astringent for intestinal and urethral diseases.

CASEINUM.—Casein.

Caseinogen, E.; *Casein, Käsestoff, Milchcasein*, G.; *Caséine*, Fr.

Casein is a nucleoproteid characterized by its coagulability by acids, and particularly by rennet, and a high content of sulphur and phosphorus in organic combination. It is

acid in character, combining with alkalies and the alkali earth (lime) bases to form soluble combinations, in which latter form it constitutes the principal proteid of milk. The term *caseinogen* has been introduced to distinguish the natural soluble (as existent in milk secretions) form from the altered coagulated form, which is designated as *casein*. *Paracasein* (Hammersten) applies to the more insoluble part of the coagulum obtained by the action of rennet upon caseinogen.

Preparation.—Caseinogen may be obtained from milk by saturating centrifugated milk with sodium chloride (free from sodium sulphate, washing the precipitate thoroughly with a saturated solution of sodium chloride, dissolving the washed precipitate in a minimum of 0.1 per cent. aqueous solution of sodium hydroxide, care being taken not to leave the solution permanently alkaline, filtering, precipitating the filtrate with dilute (1.5 per cent.) acetic acid, washing the precipitate thoroughly with water, and repeating the successive treatments with alkali solution, filtering, precipitating with acetic acid, and washing with water 3 or 4 times. The final washed precipitate is pressed to express water as much as possible and then carefully dried. The caseinogen thus prepared is more readily soluble than the *casein* prepared by the following method:

Centrifugated milk is diluted with about 10 volumes of water, warmed to 35°–40° C. (95°–104° F.), and coagulated either by means of rennet * or by adding sufficient dilute acetic acid (1.5 per cent.). The coagulum is first washed carefully with water by decantation, and then thoroughly on a filter. It is then dissolved in a minimum of an aqueous dilute solution (0.1 per cent.) of sodium hydroxide, care being taken not to allow the solution to remain alkaline. The solution is filtered to remove fat and the filtrate precipitated with dilute acetic acid, the resulting precipitate carefully washed with water, redissolved in dilute alkali solution, and the successive operations of precipitation, etc., repeated 3 or 4 times. The final precipitate is compressed to remove water and then triturated with alcohol and washed with the same to remove moisture, and finally thoroughly exhausted with ether to remove the remaining traces of fat. The product is first dried at ordinary temperatures, and then transferred to a drying oven and the drying completed at a temperature not exceeding 100° C. (212° F.), and finally ground to a fine powder.

Properties.—Pure casein, according to the concentration from which it is precipitated, presents in the moist coagulated form white flakes (from dilute solution) or white stringy masses (from concentrated solution), which on drying form colorless to yellowish transparent horn-like masses, and these on being powdered produce a white or yellowish-white, odorless, tasteless powder, which is insoluble in water, alcohol, ether, or concentrated solutions of sodium chloride or magnesium sulphate. Casein is acid in reaction if placed on moist blue litmus-paper, although the aqueous extract is neutral to the same. It is soluble in aqueous solutions of alkali hydroxides or carbonates, forming caseinates, which from concentrated solutions may be precipitated by acetone (see Nutrose). It is soluble in 1 per cent. aqueous solutions of sodium fluoride, ammonium and potassium oxalate (Arthus). It forms a white opalescent solution with an aqueous solution of calcium hydroxide, and liberates CO_2 from calcium carbonate. It is soluble in dilute (0.1 per cent.) hydrochloric acid. The aqueous solutions of casein are strongly lævo-rotatory, the neutral solution showing a specific rotatory power $[\alpha]_d = -80°$ Hoppe-Seyler; dilute alkaline solutions —76°; strongly alkaline solutions —91°; dilute hydrochloric acid solutions —87°.

When casein or a neutral solution of the same is added to concentrated hydrochloric acid, *acid casein* is formed, which is soluble in water. It is acted upon by nascent chlorine, forming *chlorocasein* compounds, containing according to degree of saturation 8.32 per cent. (Panzer, *Zeit. f. Phys. Chem.*, 1901, *33*, pp. 131–150) to 14 per cent. of chlorine (Habermann and Ehrenfeld, *loc. cit.*, *32*, pp. 468–475). When casein is hydrolized with hydrochloric acid leucine, tyrosine, glutamic acid, and amino-acids result. It forms insoluble combinations with formaldehyde. Casein is distinguished from alkali-albuminates, to which it is closely related, by its neutral solutions not being coagulated by heat; by being precipitated by acetic acid; more particularly by being coagulated by the active principles of rennet *chymosin* and *rennin;* by coagulation by certain specific bacteria without the production of acid; and by its high percentage content of sulphur and phosphorus in organic combination. Its percentage composition is given by Hammersten as C 53, H 7, N 15.7, S 0.8, P 0.85, O 22.85 per cent. Lime salts are essential to the coagu-

* Note that the coagulation by rennet alters the casein more than its precipitation by acetic acid.

lation of casein by rennet, for purified casein may be acted upon by rennet at 40° C. (104° F.), the most favorable temperature for the action of rennet, without causing coagulation, but the coagulation takes place immediately upon the addition of a soluble lime salt. Neutral solutions of casein are completely precipitated by salt or magnesium sulphate apparently without alteration, but solutions of lead, mercuric nitrate, and particularly solutions of copper completely precipitate the casein by transposition as caseinates of the respective metals. Solution of corrosive sublimate does not precipitate neutral solutions of casein, but on the addition of alcohol mercury compounds of casein are precipitated, which are soluble in slightly alkaline aqueous solutions, but in which neither hydrogen sulphide nor ammonium sulphide gives a reaction for mercury. By suspending casein in strong alcohol and boiling it with a solution of salts of silver, mercury, or iron, various compounds are produced of the respective metals, more or less insoluble in water, but soluble in dilute alkaline solutions, and in none of which ammonium sulphide indicates the presence of the metal. Casein also forms combinations with iodine.

Tests.—Pure casein should meet the following requirements: a white or only faint yellowish, dry, non-hygroscopic, odorless, tasteless powder or mass; the 10 per cent. aqueous extract should be neutral (freedom from acid) and leave no residue on evaporation (albumin, milk-sugar); nor should the alcohol or ether extracts leave a residue (fat); the ash should not exceed 1 per cent.

Casein for technical purposes is prepared by precipitating centrifugated milk with dilute sulphuric, or better with acetic acid, and thoroughly washing the coagulum with water by kneading to free it from acid, milk-sugar, and albumin. The mass is then dried and finally ground to a fine powder. It is a light-yellowish colored powder, usually showing a high content of ash, and considerably less soluble than the pure casein. It is rendered soluble in the arts by treatment with sodium bicarbonate, borax, or ammonia, being used as a sizing for paper, the preparation of glues and cements, leather polishes, waterproof paints, the preparation of coloring-matters, and fixation of dyes in calico-printing.

Action and Uses.—Casein is employed in pharmacy in the manufacture of emulsions.

Pharmaceutical Preparations.—Unna has suggested the following compounds as desirable vehicles for dermic medication:

Unguentum Caseini. *Casein ointment*, E.; *Caseinsalbe*, G.—This is prepared by dissolving 14 parts of dried and powdered casein in 50 parts of a weak alkaline solution, containing 0.345 part of potassium hydroxide and 0.085 part of sodium hydroxide. To the solution are added 7 parts of glycerin and 0.5 part of carbolic acid, and finally 21 parts of vaselin. When the latter has been incorporated, sufficient water is added to bring the weight of the finished product up to 100 parts. Casein ointment has the consistence of very thick cream and loses water on exposure. It is incompatible with acids and acid salts, but is miscible with mercury, tar, balsam of Peru, zinc oxide, resorcin, pyrogallol, and ichthyol. As the latter substance has a tendency to stiffen the ointment, it should be mixed with a little water before incorporation.

Vernix Caseini. *Casein varnish*, E.; *Caseinfirniss*, G.—Two varieties of this preparation are in use, known respectively as borated and glycerinated casein varnish. Borated casein varnish is made by dissolving 25 parts of dried casein and 3 parts of borax in 125 parts of water with the aid of a moderate heat. Glycerinated casein varnish is prepared by dissolving 5 parts of dried casein in 15 parts of 28 per cent. ammonia water, adding 5 parts of glycerin, and finally driving off the excess of ammonia by heat. The residual mass is readily miscible with twice its weight of boiling water, yielding a fine creamy mixture, which permits of the incorporation of powdered substances without likelihood of separation.

COMPOUNDS OF CASEIN.

Ammonii Caseinas. *Eucasinum. Ammonium caseinate, Ammonium-casein, Eucasin*, E.; *Casein-ammonium, Casein-ammoniak, Eucasin*, G.—This preparation, which has been introduced into medicine under the name *eucasin*, is obtained by passing ammonia gas over finely powdered dry casein until the casein forms a nearly clear solution with water. Heat is developed during the absorption of ammonia. Eucasin occurs as a white or faintly yellowish-white powder, having scarcely any odor and taste. It forms a milky or opalescent solution with warm water.

Sodii Caseinas. *Sodium caseinate, Nutrose*, E.; *Casein-natrium, Nutrose*, G.—A food preparation patented in Germany and prepared from centrifugated or skimmed milk by precipitating the casein, washing it with water, and then adding just sufficient sodium hydroxide

solution to dissolve the moist casein. The solution is either evaporated in vacuo and the dry residue powdered and washed with alcohol to free it from alkali, or precipitated with acetone, and the precipitated casein washed with alcohol and finally with ether, and then dried. Nutrose occurs as a white amorphous powder, almost odorless and tasteless, insoluble in alcohol and ether, difficultly soluble in cold water, readily soluble in hot water, neutral in reaction to litmus but acid to phenolphtalein, and contains, according to Aufrecht: albuminoids, 65.2 per cent.; water, 10.5 per cent.; ash, 4.15 per cent.; nitrogen-free substances, 20.15 per cent. It is considered a valuable food-product.

CASSIA FISTULA, *U. S.*—Purging Cassia.

Cassiæ Pulpa, Br.; *Fructus Cassiæ fistulæ.—Pudding-stick (or Pipe)*, E.; *Purgiercassie, Fistelkassie, Rohrenkassie*, G.; *Casse officinale, Casse en batons*, Fr.; *Cassia*, It.; *Caña fistula*, Sp.

The dried ripe fruit of *Cassia Fistula* L. (*Cathartocarpus F.* Pers.—Fam. *Leguminosæ*).

Cassia Fistula is official in many pharmacopœias, some of which direct that it be rejected when the seeds can be heard to rattle on its being shaken. In the Br. P. the pulp alone is official.

Origin.—A tree 9 to 15 M. (30 to 50 Ft.) high, with large pinnate leaves appearing simultaneously with the long pendulous racemes of fragrant, golden-yellow, dark-veined flowers. Indigenous in the East Indies, it is now met with, spontaneously and under cultivation, in Egypt and other parts of Africa, in the West Indies, and Brazil.

Fig. 92.

Cassia fistula: part of pod (Nat.).

Description.—Cylindrical, 40 to 60 Cm. (16 to 24 In.) long, nearly 25 Mm. (1 In.) in diameter, blackish-brown, somewhat veined, the sutures smooth, forming 2 longitudinal bands; indehiscent, the cavity divided transversely into numerous cells, each containing a reddish-brown, glossy, flattish-ovate seed imbedded in a blackish-brown sweet pulp; odor resembling that of prunes.

Constituents.—Treated with water, the fruit yields about 30 per cent. of pulp, 60 per cent. of which is sugar, with mucilage, pectin, tannin, etc. It acts best if kept in the pod until required for use.

Pharmaceutical Preparation.—Confection of Senna, U. S. P.

Action and Uses.—As a laxative, Cassia Fistula may be employed with success in the treatment of habitual constipation. In doses sufficiently large to purge, it produces severe gripiug, and for this reason is rarely given alone. It is considered by some a useful drug when combined with other laxatives. The confection of senna, which contains cassia, is the usual form in which it is administered.

The dose of cassia as a laxative is from 1 to 2 drachms (4–8 Gm.). As a purge, it may be given in the dose of 1 ounce (30 Gm.).

Allied Products are obtained from *C. bacillaris* (L.) Pers. (*Cassia b.* L.) and *C. moschata* Don (*Cassia m.* Kunth), of tropical America, the fruits being very similar. *C. Brasiliana* (Lam.) Pers. (*Cassia B.* Lam.; *C. grandis* L. b.; *C. mollis* Vahl.) yields a large purging cassia, sometimes known as *Horse cassia*, which is 60 Cm. (2 Ft.) or more long, often curved, strongly laterally compressed, 38 Mm. (1½ In.) broad, rather coarsely veined, and has the dorsal suture indicated by 1 convex band and the ventral suture by 2 prominent obtuse ridges.

CASTANEA.—American Chestnut.

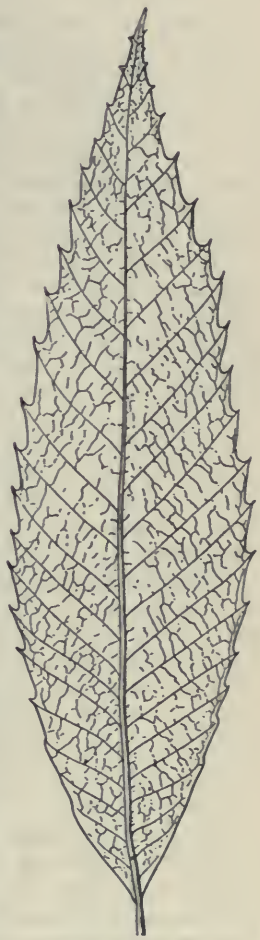
Folia Castaneæ.—Kastanienblätter, G.; *Feuilles de chataignier, F. de marronier*, Fr.; *Castaño*, Sp.

The dried leaves of *Castanea dentata* (Marshall) Borckh. (*C. vesca* Gærtn.—Fam. *Fagaceæ*), collected in September or October, while yet green.

Origin.—A well-known large forest-tree of the eastern United States, greatly valued for its light and durable timber and for its fruit.

Description.—15 to 25 Cm. (6 to 10 In.) long, including the short, stout petiole, and 5 to 8 Cm. (2 to 3 In.) broad; oblong, the base somewhat tapering, the apex attenuate; coarsely spinulose-serrate with rounded sinuses, regularly feather-veined, thickish, nearly smooth, dark-green above, pale-green and slightly yellowish underneath; almost inodorous; taste somewhat astringent.

Fig. 93.



Chestnut leaf (½ Nat.).

If collected earlier in the season, chestnut leaves are deficient in tannin. Such leaves can be distinguished by their lesser thickness and their more satiny appearance.

Constituents.—The most important constituent is about 9 per cent. of yellow tannic acid. Lloyd claims that the mucilaginous constituent, soluble in hot water, and insoluble in alcohol, is active. There are also a little fat, resin, and 5 to 6 per cent. of ash.

Action and Uses.—The effect of chestnut leaves upon the system has not been determined, but judging from their action in the treatment of whooping-cough castanea may be inferred to be a respiratory sedative. It may be given in the form of the fluidextract in doses of from ½ to 1 fluidrachm (2–4 Cc.) several times daily, or an infusion (1 ounce to a pint—30 Gm. to 480 Cc.) may be taken ad libitum.

Other and Related Products.—The leaves of the other species of the genus, *C. Castanea* (L.) Lyons (*Fagus C.* L., *C. sativa* Mill.), the *European* or *Spanish chestnut*, and *C. pumila* (L.) Miller, and other *Chinquapins* or *Small chestnuts* of our Southern States, are doubtless identical in composition and properties. The barks of all are strongly astringent, and a tanning extract made from that of the European species is an important commercial product. The nuts of all are edible and highly esteemed. Those of the chinquapin are most, and those of the European least, sweet. Chestnuts of the species here considered contain 30 to 40 per cent. of starch, 3 to 4 per cent. of proteids, about 2 per cent. of fat, 0.5 to 2 per cent. of sugar, gum, organic acids, and a bitter principle. They are a delicious luxury, and fairly digestible when thoroughly cooked, either by roasting or boiling. The *Maronnier* is one of our most delicious and expensive confections, made by a very long and tedious process of preserving the large European chestnut. Of that species, many cultivated varieties are grown for their nuts, which constitute a most important food-product in Italy, where the annual crop is estimated at 360,000 tons. They are ground into flour, which in some localities almost takes the place of other sorts. Great quantities are also made into confections, a single manufactory in Lyons being said to consume 25,000,000 pounds annually for this purpose.

CASTOREUM.—Castor.

Bibergeil, G.; *Castoreum*, Fr.; *Castoreo*, It., Sp.

The dried preputial follicles, and their secretion, obtained from the beaver, *Castor Fiber* L. (*Castor Americanus* Cuvier—class *Mammalia*, order *Rodentia*), and separated from the somewhat shorter and smaller oil-sacs which are frequently attached to them.

Origin.—This well-known animal inhabits the northern hemisphere between latitude 33° and 68°, but is fast disappearing from the southern portions of this region. The old world form is believed by many to constitute a distinct species, being larger and lighter-colored and its habits differing markedly.

Anus, genitals, and follicles communicate in both sexes with one canal or cavity located near the tail. In the male, a pair of oil-sacs, containing the formerly official *Axungia castoris*, terminates in the cloaca; the castor-sacs, located near the former, open by a common aperture in the preputial canal. The female has the castor-sacs below the os pubis on each side of the vagina. The wall of the castor-sacs consists of 4 distinct coats; the outer one is cellular, resembles hog's bladder in texture, and encloses a fibrous layer, which is followed by a vascular, and this by an iridescent glandular coat, with many folds and numerous semilunar scales upon the inner surface, the whole being

covered by a thin epithelium. J. Fuchs (1881) states that the castor is altogether separated from glands contained in the inner coat of the sac.

When fresh, castor-sacs are flesh-colored and soft, but become harder and brown in color by drying, which is performed carefully over a fire. The contents, when fresh, are yellowish, unctuous, and odorous, but by drying become brown and friable, not fusible.

Castor is commercially distinguished by the countries from which it is obtained, the most highly valued being obtained from Russia and Siberia.

Castoreum Sibiricum (Castoreum Moscoviticum, Rossicum, Germanicum, or Europæum).—These sacs are oval or globular-pyriform, united at the narrowed end in pairs, the contents of a dull, rather light-brown color, and a strong peculiar odor. The sacs vary in weight from about 3 to 8, or occasionally even 14 ounces, and if not too dry the 2 outer coats may be readily separated. This kind is mostly collected in Siberia and Eastern Russia, the sacs from Western Russia and Germany being usually smaller. It is now rarely met with in commerce.

Castoreum Canadense (Castoreum Americanum, or Anglicum).—This is the variety generally met with in commerce. The sacs are more elongated, flatter, and usually more wrinkled and folded, than those of the preceding; they vary from club-shaped to narrow pyriform, are united in pairs, mostly between 1 and 4 ounces (rarely 8 ounces) each in weight; the outer coats adhere pretty firmly; the contents are often slightly glossy; the odor is aromatic, but weaker than the preceding; the taste about the same, pungent, bitter, and rather nauseous.

Russian castor yields 60 to 68 per cent. of its weight to alcohol; American, between 40 and 45 per cent. The tincture of the former yields with much water a milky mixture, which becomes nearly clear on the addition of ammonia. The mixture obtained from the tincture of the latter is brownish, the precipitate being only partly soluble in ammonia.

Constituents.—Castoreum consists of 1 to 2 per cent. of volatile oil, with a strong odor of the drug, a dark-brown, bitter, acrid resin, osmazone, salicin (Wöhler), urates, benzoates, etc. *Castorin*, a neutral principle in long white prismatic crystals, of castor odor and little taste, and soluble in ether, benzin, and oil of turpentine, constitutes 2 per cent. of Canadian castor and 4.6 per cent. of the Russian. The inorganic constituents are phosphates and sulphates of calcium, magnesium, potassium, and ammonium. The ash should not be above 5 per cent. Some specimens (chalky castor) contain much calcium carbonate, and are said to come from diseased animals.

Pharmaceutical Preparation.—Ethereal Tincture of Castor, N. F.

Action and Uses.—Because of its variable quality, castor is at present rarely employed in medicine. In moderate doses it stimulates the nervous system. In larger amounts it increases the rapidity of the pulse and causes nervous excitement. Castor has been used in the treatment of amenorrhœa and uterine colic, and may be tried in hysteria, epilepsy, and other convulsive seizures. The drug is probably most efficacious in the treatment of the low fevers, especially where nervous manifestations are prominent.

The dose of castor varies from 10 to 60 grains (0.60–4 Gm.). Tincture of castor, made by macerating 1 ounce (30 Gm.) of bruised castor in 1 pint (480 Cc.) of alcohol, may be given in doses of from 1 to 4 fluidrachms (4–16 Cc.).

CATAPLASMA KAOLINI, *U. S.*—Cataplasm of Kaolin.

Cataplasme de terre à porcelaine, Fr.; *Porzellanthonumschlag*, G.

Preparation.—Kaolin, in No. 80 powder, 577 Gm.; boric acid, in fine powder, 45 Gm.; thymol, 0.5 Gm.; methyl salicylate, 2 Gm.; oil of peppermint, 0.5 Gm.; glycerin, 375 Gm.; to make 1000 Gm. Heat the kaolin in a suitable vessel at 100° C. (212° F.) for 1 hour; mix it intimately with the boric acid, and then incorporate the mixture thoroughly with the glycerin; finally, add the thymol, which has been dissolved in the methyl salicylate and the oil of peppermint, and make a homogeneous mass. It should be kept in an air-tight container.

If apothecaries' weight is more convenient, the following quantities may be used,

the finished product weighing somewhat over 1 pound: Heat 4432 grains of kaolin at 100° C. for 1 hour; mix it intimately with the boric acid, and then incorporate the mixture thoroughly with 2880 grains of glycerin; finally, add 4 grains of thymol, which have been previously dissolved in a mixture of 4 grains of oil of peppermint and 16 grains of methyl salicylate.

Cataplasm of kaolin is a smooth dark-gray paste, rather soft when freshly made, but gradually becoming firmer. It resembles soft putty in appearance and has a pleasant odor due to the mixture of thymol, methyl salicylate, and peppermint. It is essential that the kaolin be passed through a No. 80 sieve, as directed, in order to obtain a satisfactory product.

Action and Uses.—This preparation depends for its virtue principally upon the hygroscopic power of the glycerin contained. The boric acid, thymol, and methyl salicylate render it mildly antiseptic. It acts as a mild counterirritant and exosmotic, and is designed to replace the flax-seed and mustard poultices, liniments, stupes, and other counterirritants.

By inducing superficial hyperæmia, it relieves congestion and pain of inflammations situated deeply beneath the area of application, as in pneumonia, pleurisy, bronchitis, peritonitis, etc. Its beneficial effect is exhibited also in superficial inflammations, as sprains, boils, periostitis, synovitis, mastitis, orchitis, etc., in which it tends to bring about depletion of the congested vessels and absorption of the inflammatory exudate, and to lessen pain.

The cataplasm should be applied freely and as hot as can be borne. It is brought to the desired temperature by immersing the container in hot water.

After being spread freely upon the skin surface it should be covered with cotton and a bandage.

Its hygroscopic property is impaired if it be exposed for a long time to the air or be brought in contact with water, hence the container should be kept tightly closed.

CATAPLASMATA.—Cataplasms.

Poultices, E.; *Cataplasmes*, Fr.; *Umschläge, Breiumschläge*, G.

Poultices are soft pasty or mushy preparations composed of coarse or fine powders, capable of absorbing large quantities of fluids, either water or watery or oily solutions. They are intended as emollient, discutient, stimulating, or relaxing applications, and are made by forming a soft paste of the substance, usually meal or flour, with the hot liquid and spreading this thickly on cloth. While the ingredients for poultices are generally furnished by the pharmacist, their preparation is left to the nurse, since their action usually depends upon the moist heat they are capable of imparting to the skin, and they must be applied immediately after they have been made. In order to prevent loss of heat and evaporation of moisture, it is customary to cover poultices with thick cloths and oiled silk or sheet rubber.

The solid ingredients of poultices being chiefly useful for holding large quantities of fluid, a convenient substitute has been introduced, known as spongiopiline, both for absorbing excessive moisture and applying water or medicated solutions to the affected parts. Spongiopiline consists of a thick cloth containing small pieces of sponge on one side and covered with some waterproof substance, rubber or varnish, on the other.

Cataplasms have been discarded in nearly all modern pharmacopœias, notably those of the United States, Great Britain, and Germany. The formulas appended have been collected from different sources:

UNOFFICIAL CATAPLASMS.

Cataplasma Aluminis. *Alum Poultice.* A cooling and astringent preparation made by coagulating the albumin or white of 2 eggs by addition of 60 grains of powdered alum. The effects and properties of the alum poultice are fully described under *Alumen.*

Cataplasma Carbonis. *Charcoal Poultice.*—This is prepared by macerating 2 ounces of bread crumbs for 10 minutes in 10 fluidounces of boiling water, gradually adding 1½ ounces of linseed meal and afterward ¼ ounce of finely powdered wood charcoal. Before application another ¼ ounce of wood charcoal is sprinkled over the surface of the poultice.—Br. P. 1885. Charcoal poultice is applied to gangrenous and fetid ulcers as a deodorant and emollient. It should be frequently changed.

Cataplasma Dauci, vel Carotæ. *Carrot Poultice.*—Prepared by mixing 4 ounces of garden carrot, scraped, 1 ounce of corn meal, and sufficient boiling water to make a soft poultice.

Cataplasma Fermenti. *Yeast Poultice.*—The Br. P. (1885) directed that 6 fluidounces of beer yeast be mixed with an equal volume of water heated to 38° C. (100.4° F.) and 14 ounces of wheaten flour then added. The mass is placed near the fire till it rises, which occurs speedily.

Another formula calls for a mixture of ½ pint of tepid milk, 2 fluidounces of yeast, and sufficient powdered elm bark to make a soft poultice. Yeast poultice is sufficiently active to induce considerable pain at times. It hastens the removal of sloughing tissues and overcomes and prevents the fetor of gangrenous and cancerous ulcers. It is also occasionally applied as a gentle stimulant to chronic ulcers.

Cataplasma Lini. *Linseed or Flaxseed Poultice.*—This very popular poultice is made by adding 4 ounces of linseed meal gradually and with constant stirring to 10 fluidounces of boiling water. If ½ ounce of lard be added to the soft paste, it will retain its soft consistence for a longer time. Flaxseed poultice is employed to hasten the suppuration of boils, felons, etc.; its application, however, is quite painful and it may be the cause of a double infection. It is also employed to relieve inflammation in its earlier stages, but the hot antiseptic fomentation is much superior. This poultice causes the skin to become white and wrinkled, and occasionally induces a vesicular or pustular eruption. This may be prevented, however, by coating the skin with lard or olive oil prior to its application.

Cataplasma Lobeliæ. *Lobelia Poultice.*—The American Dispensatory (1898) recommends a mixture of equal parts by weight of powdered lobelia and ground elm bark to be added to sufficient warm weak lye to form a poultice. The employment of the lobelia poultice is discussed under *Lobelia.*

Cataplasma Sinapis. *Mustard Poultice.*—This is readily made by mixing ground mustard seed with sufficient warm (tepid) water to form a moderately soft paste. If a weaker poultice be desired, the mustard may be diluted with an equal quantity of corn meal or flour. Vinegar should never be added to mustard poultice. Mustard poultices, at one time a favorite remedy, have been almost wholly superseded by ready-made mustard plasters (see CHARTA SINAPIS), a more convenient and cleanly mode of application. Only warm, not hot, water should be used for making mustard poultices, as their virtue lies in the volatile oil generated by the interaction of the constituents of mustard in the presence of water, and which latter are injured by very hot water. The mustard poultice not only acts as a rubefacient, but, if applied sufficiently long, also as a vesicant. It may also be sufficiently active to produce sloughing. Its application produces almost from the first a sense of burning which continues for some time after its removal. In persons with delicate skin it should be diluted with equal parts of flour, or linseed meal, and for children the poultice should contain 1 part of mustard to 3 parts of flour or linseed meal. Care should be taken that a mustard poultice is not applied to exposed portions of the body, as it frequently leaves a permanent brown stain upon the skin. If the burning of the mustard becomes excessive it may be relieved by applying lint which has previously been soaked in a mixture of equal parts of lime water and olive oil. This poultice is employed for the purpose of relieving flatulent colic, acute inflammation of the abdominal or thoracic viscera, neuralgia, and muscular rheumatism. It has also been applied at the nape of the neck for the relief of headache and cerebral congestion.

Cataplasma Sodæ Chlorinatæ. *Chlorinated Soda Poultice. Chlorine Poultice.*—The Br. P. (1885) directed that 4 ounces of linseed meal be mixed with 8 fluidounces of boiling water and afterward 2 fluidounces of solution of chlorinated soda (Labarraque's solution) be added. This poultice may be employed as a stimulant and deodorant to offensive and sloughing ulcers.

Cataplasma Stramonii. *Stramonium Poultice.*—This preparation, in favor among eclectic physicians, may be made by bruising fresh stramonium leaves and adding a small quantity of hot water to form a moist poultice. Stramonium poultice affords a sedative application which may be employed in superficial neuralgias and myalgias. For further uses of the drug, see *Stramonium.*

Cataplasma Syrupi Fusci. *Molasses Poultice.*—This popular application for burns and scalds is prepared by adding enough wheaten flour to New Orleans molasses to form a soft easily spreading mass.

CATARIA.—Catnep.

Herba Nepetæ (or Catariæ); *Catmint, Catrup*, E.; *Katzenminze, Katzenkraut*, G.; *Cataire, Chataire, Herbe aux chats, Menthe de chats*, Fr.

The dried leaves and flowering tops of *Nepeta Cataria.* L. (*Cataria vulgaris* Moench.—Fam. *Labiatæ*).

Origin.—A tall, widely pyramidal-branching perennial herb of Asia and Europe, extensively naturalized in the United States, where it grows near dwellings, in waste places, and along roadsides. It is named from the peculiar fondness of cats, shared by other feline animals, for it.

FIG. 94.

Cataria: leaf, under surface (× ¾); flower (× 2).

Description.—Softly gray-hairy throughout, the branches quadrangular; leaves opposite, exstipulate, petioled, the blades 2.5 to 7.5 Cm. (1 to 3 In.) long and nearly as broad, triangular-ovate, rounded or subcordate at the base, acute, crenate-serrate, thin, grayish-green, hairy above and downy underneath; flowers panicled, pedicelled or subsessile; calyx tubular, 15-nerved, obliquely 5-toothed; corolla whitish with purple spots, the tube slender below, dilated upward, the limb strongly 2-lipped, the upper lip 2-lobed, the lower 3-lobed, with the lobes crenate, the middle one much larger; stamens 4, perfect, the lower pair longer, the anthers divergent; fruit of 4 ovoid, obtuse, compressed, smooth nutlets; odor peculiarly aromatic; taste aromatic and pungent, slightly bitter.

Constituents.—The plant contains a small quantity of oxygenated volatile oil, fixed oil, wax, gum, some tannin, sugar, and a bitter principle of acid reaction. It yields about 12 per cent. of ash.

Action and Uses.—Catnep is employed in infusion, made with 1 ounce (30 Gm.) of the whole plant in 1 pint (480 Cc.) of boiling water, in domestic practice as an emmenagogue and antispasmodic. It has been recommended as a carminative in the flatulent colic of infants, and is supposed to be a useful remedy in hysteria. The plant is largely eaten by cats. It is thought by some to excite sexual activity. The dose of the infusion is from 1 to 4 fluidrachms (4–16 Cc.).

CATECHU, *P. G.*—Catechu.

Catechu nigrum; Black catechu, Cutch, E.; *Ketechu, Pegu-Catechu*, G.; *Cashoultie* (*Cachou de Pégu*, Cod.) Fr.; *Succus Catechu, Bombay-Catechu*, Russ.; *Cato, Tanoma Cato*, Port.; *Terra Catu, Pegy*, It.; *Catecu*, Sp.

An extract prepared from the heart-wood of *Acacia Catechu* (L. f.) Willd. (*Mimosa C.* L. f.—Fam. *Leguminosæ*).

Catechu is official in nearly all pharmacopœias, though not all agree in specifying this substance. Some admit also the product of *A. Suma* Kurz, of southern India. The Port. Ph. makes Gambir Catechu known as *Pale catechu* or *Terra japonica* (see GAMBIR), an allowable substitute, while the U. S. and Br. P. specify this only, but retain the name Catechu. In reply to criticisms, Dr. Attfield declares it the intention of the Br. P. to destroy the official distinction between the two, in spite of their different origin, because of their chemical identity.

Origin.—A rather small tree, distributed widely and abundantly in dry localities through the East Indies, and presenting several varieties, or species as regarded by some authors. It has become naturalized to some extent in the West Indies, but the commercial product is wholly from the Orient.

When about a foot in diameter, the trunk is regarded as mature, although smaller ones are much used. After passing 25 or 30 years of age, they are considered much better. The trunks are preferred in proportion as they show a larger number of white spots in cross-section. These spots consist of the large pores filled with a white substance, which is more or less impure catechin. Their proportion ranges from 1 per 1000 to 1 in 3. In cavities of the wood are found masses of almost pure catechin, eagerly sought by the collectors and used under the name *khirsal*, like the *kath* to be presently described, for chewing with betel. The bark and sap-wood being carefully removed, the remainder, of a deep-red or nearly red-black color, is cut into chips and boiled in water for about 12 hours, or until the water is reduced to a half. Over-boiling injures the product, changing part of the catechin to catechutannic acid. The chips are removed and the liquid

evaporated to a syrupy consistency. It is meantime vigorously stirred or beaten, this being deemed essential to its quality. It is then allowed to cool until it can be handled, when it is spread on leaves or ashes of cow-dung, in moulds, chiefly of clay, and left until morning, when it is hard and dry, and is broken or cut into suitable pieces for marketing. In different localities and by different makers, various minor modifications of this general method are introduced. A very fine product, rich in catechin, made by the vacuum process, from trunks imported to Glasgow, was rejected by dealers on its appearance, which differed markedly from that of the native product. The yield of catechu varies from 3 to 10 per cent. of the weight of a good wood.

Description.—In irregular masses, containing fragments of leaves, dark-brown or blackish, brittle, somewhat porous and glossy when freshly broken. It is nearly inodorous, and has a strongly astringent and sweetish taste.

If a portion of catechu be digested with 10 times its weight of alcohol, and the liquid filtered, the undissolved matter, after being dried at 100° C. (212° F.), should not exceed 15 per cent. of the original weight.

The tincture, diluted with 100 parts of water, acquires a green color on the addition of ferric chloride test-solution.

If 2 parts of catechu be boiled with 20 parts of water, a brownish-red, turbid liquid will be obtained which turns blue litmus-paper red.

Upon incineration, catechu should not leave more than 6 per cent. of ash.

Constituents.—*Catechutannic acid* (catechu-red or mimotannic acid, $C_{36}H_{34}O_{15}$), the chief constituent, is a dark-red, amorphous powder, soluble in water, alcohol, and ether, and is, unlike most tannins, not a glucoside. It does not yield pyrogallic acid when heated. It yields a greenish-gray precipitate with ferric chloride. It constitutes 20 to 25 per cent. of catechu, which also contains 13 to 34 per cent. of catechin (catechuin or catechuic acid), gum, extractive, and quercetin. Catechin ($C_{19}H_{18}O_8$ or $C_{21}H_{20}O_9 + 5H_2O$) crystallizes in long silky needles, is bitter, slightly acid, and soluble in about 1100 parts of cold water, 3 parts of boiling water, 6 of cold alcohol, 3 of boiling alcohol, and in ether, glacial acetic acid, turpentine, and alkaline solutions. It does not precipitate alkaloids or gelatin, but is rendered available for tanning, etc., by the action of heat or acid, which changes it into catechutannic acid, and another tannin ($C_{38}H_{32}O_{14}$). Continued boiling with dilute sulphuric acid produces *catechuretin* ($C_{38}H_{28}O_{12}$) and an anhydride ($C_{38}H_{30}O_{13}$). By dry distillation, it yields pyrocatechin, and fused with potassa it yields phloroglucin and protocatechuic acid.

Protocatechuic acid, $C_7H_6O_4$, is formed from certain tannins, numerous resins, gum resins, and other substances by adding them to melted potassa. It crystallizes in colorless shining needles or scales containing a molecule of water, dissolves readily in ether, alcohol, and hot water, melts at 199° C. (390.2° F.), and at a higher heat is decomposed into carbon dioxide and pyrocatechin. Its solution is colored dark-green by ferric chloride, the color changing to blue, and subsequently to red, on the gradual addition of a very dilute solution of sodium carbonate.

Pyrocatechin or *catechol*, $C_6H_6O_2$, is contained among the products of destructive distillation of several tannins and vegetable extracts. It crystallizes in short rectangular prisms, melts at 104° C. (219.2° F.), and boils at 245° C. (473° F.). It sublimes in thin laminæ, and dissolves easily in water, alcohol, and ether. Its aqueous solution is colored dark-green by ferric chloride, the color changing to violet on the addition of ammonia, sodium bicarbonate, or tartaric acid. The methyl ether of pyrocatechin is guaiacol.

Rubinic and japonic acids are names indefinitely applied to oxidation-substances of catechu and catechutannic acids.

Adulterants and Substitutes.—Cutch is subject to the most extensive adulteration. Although this exists chiefly in the tanning grades, we have seen some of the most disgusting specimens, of putrid and sickening odor, sold for pharmaceutical purposes. The official description should be rigidly applied. The chief adulterants, aside from the allowable 15 per cent. of accidental vegetable tissue, etc., are Than (see below), dried blood, ashes, sand, clay, and starch, and their detection is provided for in the official tests.

An *artificial catechu*, proposed by Rave (1873), may be obtained by slightly roasting powdered mahogany or allied woods, and then boiling with water; it is said to be serviceable in dyeing.

Pharmaceutical Preparations.—Compound Powder of Catechu, N. F.; Compound Tincture of Catechu, U. S. P.; Troches of Catechu, U. S. P. (See Gambir.)

Action and Uses.—Both the dark and the light catechu are employed in medicine; the former is more astringent, but the latter, being sweeter, is less disagreeable. It depends almost entirely for its virtues upon the tannic acid which it contains, hence it may be employed as an astringent to overcome relaxation of mucous membranes in general. It is an excellent remedy, especially when combined with chalk mixture, in the treatment of serous diarrhœa, and also in mucous diarrhœa after the patient has been thoroughly purged. It is also beneficial in the treatment of spongy gums, relaxation of the uvula, and simple pharyngitis attended with hoarseness. When thrown into the nostrils in the form of an infusion, it lends itself to the control of epistaxis, and when introduced into the uterus it may overcome passive hemorrhages from that viscus. In the form of an injection it is recommended in the treatment of uterine and vaginal leucorrhœa and in chronic gonorrhœa. Gambier catechu is largely used in the arts for dyeing purposes, and so possesses a value over and above its medicinal properties. "Cutch is an important dyestuff, yielding a color known as 'cutch-brown.' In this both the catechu and the catechutannic acid are active, but mostly the latter, with which a single process results in a color about as deep as that from the double process of the former."

The dose of catechu, in substance, is from 5 to 30 grains (0.30–2 Gm.); of the tincture, from ½ to 2 fluidrachms (2–8 Cc.).

Other Products.—Kath is obtained from the same wood-syrup which yields catechu, but is obtained by crystallization on twigs placed in the liquid, the pots being laid upon their sides, and is afterward pressed into cakes. It is largely catechin, and is entirely consumed in India, mostly for chewing with betel. As sold in the bazaars, it is in rectangular cakes, about 2 inches long. The outer hard crust, about ¼ inch thick, is mostly catechutannic acid. The inner soft and earthy portion contains about 36 per cent. of catechin and about 3 per cent. of wood and sand. A lot specially made for Dr. Watt, with the utmost care, yielded 62 per cent. of catechin, but yet contained 2 per cent. of sand and 4 per cent. of wood.

The bark of this tree and an extract obtained from it, are used for tanning.

The number of substances extracted from woods, barks, leaves, and fruits, used like catechu, and more or less resembling it, is now large. Those consisting of inspissated juices will be considered under Kino; those obtained from barks, because the barks themselves are articles of commerce, will be considered under Quercus. A number of astringent leaves and their extracts will be considered under their respective families. We here consider several wood-extracts closely allied in nature to catechu.

Than or *Thansha* is an extract obtained by boiling the bark of *Buceras Oliverii* (Brandis) Rusby (*Terminalia O.* Brandis.—Fam. *Combretaceæ*), and is considerably used in India to adulterate cutch. It is of a lighter and more brilliant color and semitransparent, and is very astringent in taste. Its composition appears extremely variable, the tanning material in different samples having been estimated at from 14 to 68 per cent. It may be detected by obtaining a precipitate from the suspected cutch by adding a solution of gelatin and then alum, and treating this precipitate with boiling water. That from pure cutch should yield but a faint-yellow color, while, if Than is present, a dark-red coloring-matter is extracted.

The barks of *B. pyrifolia* (Kurz.) Rusby (*Terminalia p.* Kurz.) and *B. tomentosa* (Mart.) Rusby (*Terminalia t.* Mart.) have also been used for the same purpose.

An extract of the bark of *Bruguiera gymnorhiza* Lam. (Fam. *Rhizophoraceæ*) has been recommended as a suitable substitute for catechu.

CAULOPHYLLUM.—Blue Cohosh.

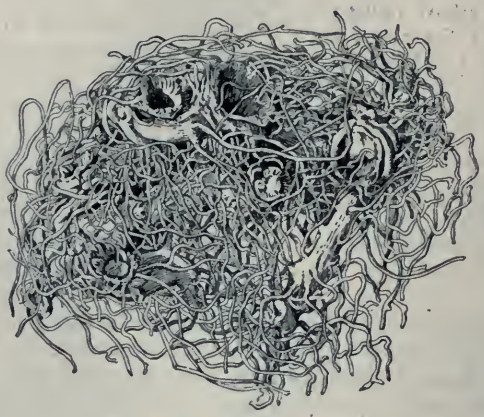
Pappoose-root, Squaw-root, Blueberry-root, Blue (or Yellow) ginseng.

The dried rhizome and roots of *Caulophyllum thalictroides* (L.) Mx. (*Leontice t.* L. —Fam. *Berberidaceæ*).

Origin.—A smooth and glaucous perennial with a simple stem, bearing near its apex a large sessile triternately compound leaf, with obovate 3- or 5-toothed or lobed leaflets. The greenish-yellow flowers, about 12 in number, form a terminal raceme, and produce capsules which are soon ruptured by the 2 globular seeds, these remaining enclosed in a blue fleshy integument, the mass resembling a blueberry. The plant is found in rich woodlands from Canada south to Carolina and Kentucky. It flowers in April and May.

Description.—Horizontal, 10 to 15 Cm. (4 to 6 In.) long and about 5 to 15 Mm. ($\frac{1}{5}$ to $\frac{3}{5}$ In.) thick, crooked and branched, usually slightly compressed from above downward; upper surface bearing broad, shallow cup-shaped scars, which are either slightly elevated or impressed; lower surface bearing very numerous elongated fine roots, which are crooked and matted, so as often nearly to conceal the rhizome; fracture tough and woody; sternutatory, but nearly inodorous; taste sweetish, bitterish, and acrid.

FIG. 95.



Caulophyllum (¾ Nat.).

Constituents.—The active principle is *leontin*, a saponin-like glucoside occurring in white feathery or silky crystals, soluble in boiling alcohol, slightly in cold alcohol, and freely in alkaline solution, and insoluble in water or chloroform. It is tasteless at first, but leaves an acrid after-taste. The drug contains also gum, starch, 2 resins, and *caulophylline*, a colorless, odorless, feebly tasting alkaloid, crystallizing with difficulty.

Substitutes.—*Jeffersonia* (see under BERBERIDACEÆ) is sometimes mistaken or substituted for caulophyllum.

Pharmaceutical Preparation.—FLUIDEXTRACT OF CAULOPHYLLUM (BLUE COHOSH), N. F.

Action and Uses.—This remedy is rarely employed by regular physicians. It is said by the eclectics to be an antispasmodic, diuretic, emmenagogue, and oxytocic, and is employed by them in the treatment of hysteria and uterine diseases. It is claimed by them that the drug will prevent threatened abortion, and again that it will cause normal uterine contractions when uterine inertia is present. A decoction made with 1 ounce (30 Gm.) of the root and 1 pint (480 Cc.) of water may be given in the dose of 1 or 2 fluidounces (30 or 60 Cc.). Its active principle, *leontin*, may be prescribed in doses of from $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015–0.03 Gm.).

CELASTRACEÆ.—The Spindle Tree Family.

Genera about 40, species about 400, consisting of shrubs and trees, widely distributed, except in the Arctic regions. Their economic importance is due chiefly to the medicinal properties, many being largely employed in domestic practice, several in professional medicine. A few species, like the *Gymnosporias* and *Parilla Malabarica* Dennst., contain sufficient tannin to render them useful as astringents. More, like EUONYMUS, contain glucosides, which impart to them highly important laxative or cathartic properties. A third and large group, represented by *Celastrus*, described below, contains glucosides of a saponin-like character, with corresponding properties.

Celastrus (*False* or *Climbing bittersweet*, *Staff-vine*, *Fever-twig*, *Waxwork*; also incorrectly called *Yellow-root* or *Orange-root*, E.; *Celaster*, G.; *Celastre*, Fr.) is the bark, especially of the root, of *Celastrus scandens* L., a tough woody twiner of eastern North America. It grows in the edges of thickets, especially in rocky and sunny situations and in fence-rows. The alternate, estipulate leaves are borne upon short, slender petioles, and are mostly 2 to 3 inches in length by 1½ to 2 inches broad, ranging from ovate to obovate, rounded at the base, shortly and abruptly acuminate and acute, finely and irregularly serrate with the teeth inturned, and reticulate-veiny. The short branchlets of the season terminate in racemes of small yellowish-green flowers, followed by globose fruits of the size of peas, which in the autumn rupture to

display the brilliantly scarlet-arilled seeds, and are much used in country districts for the decoration of picture-frames, mirrors, etc. The stem-bark is brownish or purplish-gray. The root-bark is of a dark orange-brown color, nearly smooth, and occurs in small quills. Internally, the surface is whitish and finely striate. The transverse section exhibits an outer tough, pale-brown band, a middle bright orange-red band, and an inner nearly white fragile band in concentric layers. The outer band separates readily. The bark possesses little odor and a bitter-sweet taste, afterward acrid. Besides ordinary plant-constituents, starch, gum, a little volatile oil, an acid and a neutral resin, it contains a white crystalline body, the nature of which has not been determined. The yellow coloring-matter is related to carotin. There is also a slight amount of a caoutchouc-like substance.

There are nearly 30 species in the genus *Celastrus*, several of them similarly employed, while others have fanciful uses. The seeds of *C. paniculata* W., of the East Indies, are stimulant, and are employed as an aphrodisiac. The leaves of the African species *C. serratus* Hochst. (*C. obscurus* A. Rich), *Add-add*, are used as an antiperiodic. In Arabia and adjacent parts of Africa, the leaves of *Catha edulis* Forsk. (*Celastrus e.* Vahl.) are used as a substitute for tea, under the names *Khat*, or *Kat*, and *Cafta*. They have been found to contain the peculiar alkaloid *katrine*, which is said to have a poisonous action, similar in many respects to that of cocaine. It is present in very small quantity, leaves from Aden yielding only 0.076 per cent., those from Harrar 0.034 per cent. It was extracted by ammoniated chloroform and purified with difficulty by conversion into the hydrobromide and regeneration. Its salts give precipitates with the usual alkaloidal reagents, but only when present in fairly strong solution. Associated with it is a new caoutchouc substance ($C_{10}H_{17}O$), which softens at 50° C. (122° F.), also traces of a volatile oil which has a powerful odor, darkens on keeping, and ultimately deposits small crystals. The oil is lighter than water. In the Argentine, a number of empirical uses are made of the leaves of *Maytenus vitis-idæa* Griseb. (*Colquiyuya, Capia Gangona, Chalpan*, etc.). Celastrus is not commonly employed in medicine, but in domestic practice is recommended as an emetic, diaphoretic, and antisyphilitic. It has been used also in the treatment of chronic hepatic affections attended with obstruction.

CERA, *U. S., Br., P. G., Fr., It., Port.*—Wax.

Wachs, G.; *Cire*, Fr.; *Cera*, It., Sp.

Official Varieties.—1. Cera Flava, U. S., Br., P. G. (*Yellow wax, Gelbes Wachs*, G.; *Cire Jaune, C. d'Abeilles.* Fr.; *Cera Citrina*, Russ.; *Cera Vergine, C. Gialla*, It.; *Cera amarilla*, Sp.; *Cera animalis, C. de Abolhas*, Port.). A solid substance prepared from the honeycomb of the hive-bee or honey-bee—*Apis mellifica* L. (Order *Hymenoptera*).

2. Cera Alba, U. S., Br., P. G.—*White wax* (*Weisses Wachs*, G.; *Cire blanche*, Fr.; *Cera bianca*, It.; *Cera blanca*, Sp.; *Cera Branca*, Port.). Yellow wax bleached.

The common honey-bee presents a number of well-marked varieties, or species as regarded by some zoölogists, in different countries, but the differences in the wax produced, except from incidental causes, are unimportant. The wax, of which the comb is made, is secreted between the rings of the animal's body. After the removal of the honey, by draining or by a centrifugal machine, followed by expression, the comb is melted in hot water, and most of the impurities allowed to separate by subsidence, the decanted product being *yellow wax*. A superior article is produced by filtering the melted wax. To prepare yellow wax for bleaching into *white wax*, it is reduced to a very thin bulk by rolling or grating, and is then kept exposed, in a moistened condition, to light and air. That bleached by chlorine and other chemicals is classed as inferior.

Description.—*Cera Flava:* A yellowish to brownish-yellow solid, having an agreeable, honey-like odor, and a faint, balsamic taste. Specific gravity, 0.951 to 0.960 at 25° C. (77° F.). Melting-point, 62° to 64° C. (143.6°–147.2° F.). It is brittle when cold, and when broken presents a dull, granular, not crystalline fracture. By the heat of the hand it becomes plastic. Yellow wax is insoluble in water, sparingly soluble in cold alcohol, but almost completely in boiling alcohol. It is completely soluble in ether, chloroform, and in fixed and volatile oils; partially soluble in cold benzene or carbon disulphide, and completely in these liquids at a temperature of 25° to 30° C. (77°–86° F.). If 1 Gm. of yellow wax be boiled for half an hour with 35 Cc. of a 15 per cent. aqueous solution of sodium hydroxide, the volume being preserved by the occasional addition of water, the wax should separate on cooling without rendering the liquid opaque, and no precipitate should be produced in the filtered liquid by hydrochloric acid (absence of fats or fatty acids, Japan wax, resin); nor should the same reagent produce a precipitate in water which has been boiled with a portion of the wax (absence of soap). If 5 Gm. of yellow wax be heated in a flask for 15 minutes with 25 Cc. of sulphuric acid to 160° C. (320° F.), and the mixture then diluted with water, no solid,

wax-like body should separate (absence of paraffin). Yellow wax saponified by alcoholic potassium hydroxide test-solution should show a saponification value of from 90 to 96.

Cera Alba: A yellowish-white solid, somewhat translucent in thin layers, having a slightly rancid odor and an insipid taste. Specific gravity, 0.950 to 0.960 at 25° C. (77° F.). Melting-point, about 64° to 65° C. (147.2°–149° F.). In other respects white wax has the characteristics of, and should respond to, the reactions and tests given under yellow wax (see Cera Flava).

Constituents.—Yellow wax contains some aromatic and coloring-matters, which vary somewhat in wax from different localities, and are destroyed by the bleaching process; they are partly dissolved by cold alcohol, together with a very small quantity of *cerolein*, which resembles a fat in appearance. Boiling 90 per cent. alcohol dissolves 10 to 20 per cent. of *cerin* or *cerotic acid*, $C_{27}H_{54}O_2$, which exists likewise in Chinese wax, is crystalline, and fuses in its pure state at about 81° C. (177.8° F.). Schalfeief (1876) succeeded, by fractional precipitation with lead acetate, in separating it into several acids, one having the composition $C_{34}H_{68}O_2$. Repeated boiling of wax with alcohol leaves yellow *myricin* behind, which is *myricyl palmitate*, $C_{30}H_{61}.C_{16}H_{31}O_2$; when pure, it forms feathery crystals, has the fusing-point at 72° C. (161.6° F.), is very sparingly soluble in alcohol, more freely in ether and oil of turpentine, and is with difficulty saponified by boiling with concentrated solution of potassium hydroxide. The principle to which bleached wax owes its rancid odor has not been ascertained.

Action and Uses.—Wax possesses no truly medicinal properties, but was formerly employed as a protective and soothing agent to the mucous membranes in the treatment of diarrhœa and dysentery. At present it is used to some extent for the same purposes. Its principal use now is in the preparation of elegant pharmaceuticals and surgical dressings.

Vegetable Waxes.—These are very numerous, being responsible for the whitish "bloom" on grapes, pumpkins, and other fruits, and for the glaucescence of the herbage of very many plants. The exudation is usually too scanty to allow of collection, but the reverse is true in a number of cases, in which such waxes are important commercial products. Their composition is similar to that of cera, and they may be successfully substituted for many of the uses of the latter. They have been recommended in the treatment of diarrhœa and dysentery. They are also used to prepare wax candles. The internal dose is stated to be 1 drachm (4 Gm.), several times daily.

Japan Wax is produced by a number of species of *Rhus*. It is moulded into cakes which appear of a whitish or pale-yellowish color, the surface being netted with fine cracks. T. Wall gives the specific gravity as about 0.980, the melting-point 54° C. (129.2° F.), and the saponification number 220.98. This article also is subject to much adulteration, especially with starch, often to the extent of 25 or 30 per cent.

Carnauba Wax is a very peculiar substance, the product of *Copernicia cerifera* (Arruda) Mart. (*Corypha c.* Arruda.—Fam. *Palmaceæ*), the Brazilian *Wax palm*, one of the most useful of trees, supplying, as do so many of the palms, a great variety of products. It was reported that during the first half of 1894 the following products of this tree were exported from Aracaty, Brazil: 443,500 hats, 73,360 mats, 120,000 brooms, 20,000 pieces of cordage, nearly 25,000 pounds of wax, and about 30,000 pounds of candles made from the same, and nearly 150,000 pounds of fruit-stones, the pulp having been consumed at home, besides some minor products. Starch, sugar, and a cork-substitute are also yielded. The root is a valued diuretic and reputed alterative in its own home, and has been so offered in this country. The wax is exuded by the young leaf-surfaces, and collects upon the trunk in drops and masses. It is also collected by beating off, in the form of powder, from the young leaves. It occurs in cakes of a pale-yellow, sometimes greenish color, and is hard and brittle, with a resinous fracture and luster. It requires a heat of about 85° C. (185° F.) to melt it. It consists chiefly of melyssyl alcohol ($C_{30}H_{62}O$). It is too hard for the ordinary uses of wax, unless mixed with some other substance. For candle-making, it is mixed with tallow, and for other purposes with beeswax.

Ceroxylon andicolum Humb., an Andean palm, and others of this genus, yield a similar wax (*Ocuba wax*).

Myrica Wax is obtained from the fruits of several very similar species of *Myrica* (illustrated under Myrcia), especially from *M. cerifera* L. and *M. Carolinensis* Mill., the American *Vegetable wax* or *Bayberry tallow*, and *M. Jalapensis* (*Arbol de la Cera*), much used for candle-making in tropical America under the name of *Cera vegetal*, but very little exported. It is a pale-green wax, with a distinct aromatic odor and a bitterish taste, and melts at about 45° C. (113° F.), the melting-point rising as it ages.

Ocotilla Wax is derived from the bark of *Fouquiera splendens* Eng. (Fam. *Tamariscineæ*), the *Arbol de Cera* of the Mexicans.

CERATA.—Cerates.

Cérats, Céréolés, Elaeocéréolés, Fr.; *Cerate, Wachssalben*, G.

The term cerate is applied to a class of unctuous preparations which in consistence are about intermediate between ointments and plasters, sufficiently soft to be spread at the ordinary temperature, and at the same time firm enough to adhere to the skin without melting. They are composed of wax, united with a fatty or oleoresinous substance, and to obtain them of proper consistence 2 parts of wax require about 3 parts of fixed oil, 4 parts of lard, or 1 part of soft turpentine. In preparing cerates, the wax or resin should be melted first by the aid of a water-bath or otherwise carefully regulated heat. When thoroughly melted, the warm oil or lard should be added in quantities small enough not to congeal the melted portion, and after all the ingredients have been liquefied and the vessel removed from the fire the mass should be well stirred or beaten with a spatula, to prevent the partial separation of the least fusible substances and to insure perfect homogeneousness of the preparation. It is well to continue this manipulation until the temperature has been reduced to that of the room, but artificial refrigeration should not be applied until after the mass has thickened, and then only if vigorous stirring (or, better still, trituration) is kept up. With this in view, the soft cerate may be transferred to a mortar previously warmed by hot water, or the whole process may be completed in a well-enamelled iron vessel with a rounded bottom if a pestle fitting the curve of the latter be used. Straining is best avoided, and all the materials should therefore be free from dust and other foreign bodies. Powders, cantharides excepted, are gradually added while the cerate is merely soft enough to permit the whole to be uniformly mixed, and liquids should be previously warmed to 40° or 45° C. (about 110° F.). In dispensing cerates with extracts, the latter should be previously rubbed with water in a mortar to a uniform thin paste, which should then be mixed with the cerate, added in small portions until the extract has been thoroughly incorporated; the remaining cerate may then be added in larger quantities.

Cerates should be kept in a cool place, where the temperature is not likely to rise much above 15° C. (59° F.), but even then those made with white wax, owing to its incipient rancidity, are liable to become rancid, while such as contain yellow wax keep unaltered for a much longer period. Some cerates, which are sufficiently firm, may be conveniently kept and dispensed in the form of square cakes, which are easily made by pouring the fused and nearly cool cerate into square moulds made of oiled or paraffin-paper and placed upon a flat slab. After the cerate has solidified, it is without difficulty removed from the paper and cut into pieces of any desired size or weight.

The name *steatina, steatins*, has been suggested by Mielck (1881) for a class of preparations which are of about the same consistence as cerates, but the base of which is suet, combined with either expressed oil of nutmeg, with wax, or with lead plaster deprived of glycerin and water.

Of late years, cerates have been largely superseded, especially in Europe, by *dermatologic pastes and glycerogelatins*. The former are mixtures of the medicinal agents with starch, dextrin, or kaolin, and glycerin, soft soap, petrolatum, or lard, and are intended chiefly for antiseptic, astringent, or germicidal effects. As a general vehicle for the preparation of these pastes, a mixture of dextrin, glycerin, and distilled water, equal parts by weight, may be brought into solution with the aid of heat, and sufficient water finally added to restore any loss by evaporation. Ichthyol, naphtol, resorcin, salicylic acid, sulphur, and zinc oxide are the more important remedial agents used in the form of pastes, the proportions being varied to suit particular cases. The glycerogelatins are firmer than the pastes, and require to be melted before they can be applied to the affected parts, which latter is done by means of a soft brush. The vehicle consists of a mixture of gelatin, glycerin, and water, made in proportions ranging from 5, 20, and 65 parts to 15, 45, and 25 parts of the respective constituents. As medicating agents, chrysarobin, ichthyol, iodoform, resorcin, salicylic acid, and zinc oxide are added singly or in combination.

Another form of modern dermic medication is by means of *pencils*, of which the following formula serves as an example: salicylic acid, 10 parts; powdered tragacanth, 5 parts; starch, 30 parts; dextrin, 35 parts; sugar, 20 parts; distilled water, sufficient to make a paste, which is rolled out into rods about 5 Mm. ($\frac{1}{5}$ In.) in diameter and 5 Cm. (2 In.) in length. The pencils are dried at ordinary temperature on parchment-paper and wrapped in tin-foil.

CERATUM, *U. S.*—Cerate.

Unguentum cereum, P. G.; *Ceratum simplex, Ceratum adipis.—Simple cerate*, E.; *Cérat simple*, Fr.; *Einfaches Cerat, Wachssalbe*, G.

Preparation.—White wax, 300 Gm.; white petrolatum, 200 Gm.; benzoinated lard, 500 Gm.; to make 1000 Gm. Melt the white wax, add the white petrolatum, then the benzoinated lard, continuing the heat until the mixture is liquefied, and stir it constantly until it congeals.—U. S.

If 3 ounces of white wax, 2 ounces of white petrolatum, and 5 ounces of benzoinated lard be used, the official proportions will be preserved. The simple cerate of the French Codex is composed of 1 part of white wax to 3 parts of expressed oil of almonds; and the wax ointment, P. G., of 3 parts of yellow wax to 7 parts of olive oil.

In southern latitudes, and during the heated season elsewhere, 10 per cent. of the benzoinated lard should be replaced by an equal quantity of white wax.

Action and Uses.—Simple cerate is used as a base for applying medicinal substances to the skin, and as a soothing, emollient dressing.

CERATUM CAMPHORÆ, *U. S.*—Camphor Cerate.

Unguentum (Pomatum, Fr. Cod.) *camphoratum. Pommade camphrée*, Fr.; *Kampfersalbe*, G.; *Cerata alcanforada*, Sp.

Preparation.—Camphor liniment, 100 Gm.; white wax, 350 Gm.; white petrolatum, 150 Gm.; benzoinated lard, 400 Gm.; to make 1000 Gm. Melt the white wax with the aid of a gentle heat; add the white petrolatum, then the benzoinated lard, and continue the heat until the mixture is liquefied. While the mixture is cooling, add the camphor liniment, and stir the mixture occasionally until it has become cold.—U. S.

If 3½ ounces of white wax, 1½ ounces of white petrolatum, 4 ounces of benzoinated lard, and 1 ounce of camphor liniment be used in place of the prescribed metric weights, the proportions will not be changed.

Melt at a moderate heat white wax 1 part and lard 9 parts; add powdered camphor 3 parts, and stir until the camphor is dissolved and until the ointment becomes cool.—Fr. Cod.

The consistence of the camphor cerate, U. S. P., is softer than that of most other cerates. It contains 2 per cent. of camphor.

Medical Uses.—Camphor cerate is commonly employed as a basis for other remedies. It may be applied alone as a stimulating dressing to chronic ulcers.

CERATUM CANTHARIDIS, *U. S.*—Cantharides Cerate.

Emplastrum cantharidis, Br.; *Emplastrum vesicans*, Fr. Cod.; *Emplastrum cantharidum ordinarium*, P. G.; *Emplastrum epispasticum s. vesicatorium. Emplastrum lyttæ. Blistering cerate or plaster*, E.; *Emplâtre de cantharides, Emplâtre vésicatoire*, Fr.; *Spanischfliegen-Pflaster, Blasenpflaster*, G.; *Pomalum di cantaridi*, It.

Preparation.—Cantharides in No. 60 powder, 320 Gm.; yellow wax, 180 Gm.; rosin, 180 Gm.; lard, 170 Gm.; liquid petrolatum, 150 Gm.; to make 1000 Gm. Mix the cantharides with the liquid petrolatum, and set the mixture aside, well covered, in a warm place, for 48 hours. Then add it to the yellow wax, rosin, and lard, previously melted and strained through muslin, and keep the mixture in a liquid condition by means of a water-bath, stirring occasionally for 1 hour. Then remove it from the bath and stir it occasionally until it is cool.—U. S.

If avoirdupois weight is more convenient, the following quantities should be used: Cantharides in No. 60 powder, 4 ounces; yellow wax, 2¼ ounces; rosin, 2¼ ounces; lard, 2 ounces; liquid petrolatum, 2 ounces; to make 12½ avoirdupois ounces.

Take of cantharides, in powder, 3½ ounces; yellow wax, 2 ounces; lard, 2 ounces; resin, 2 ounces; soap plaster, ½ ounce. Melt the resin, add the soap plaster, and afterward the wax and lard. Sprinkle the cantharides into the melted mixture and stir continuously while cooling.—Br.

The object of previous treatment of the cantharides with liquid petrolatum is to facilitate the subsequent solution of cantharidin in the fats, as liquid petrolatum is known

to exert a ready solvent effect upon the active blistering agent. The process of the U. S. P. always insures an effectual blistering cerate, provided the cantharides are of good quality. It is important that the heat be not raised above 100° C. (212° F.), since cantharidin would volatilize with the watery vapors extricated from the powder, and, while weakening the cerate, vesication of the operator's face and hands would be apt to occur.

The blistering cerate of the U. S. P. contains 32 per cent., that of the Br. P. 35 per cent., of the Fr. Cod. 33⅓ per cent., and that of the P. G. 25 per cent. of powdered cantharides.

Action and Uses.—The medical uses and properties of this remedy are discussed under Cantharides.

CERATUM CETACEI.—Spermaceti Cerate.

Unguentum Cetacei, Br.; *Emplastrum spermatis ceti, Ceratum labiale album.*—*Spermaceti ointment*, E.; *Cérat de blanc de baleine, Onguent blanc*, Fr.; *Walrat-Cerat*, G.; *Cerato de Bell*, Sp.

Preparation.—Take of spermaceti, 20 ounces; white wax, 8 ounces; almond oil, 72 ounces; benzoin, in coarse powder, 2 ounces. Melt together the spermaceti, wax, and almond oil; add the benzoin, and continue the application of heat for 2 hours, frequently stirring the mixture. Strain and stir the ointment until cold.—Br.

Spermaceti cerate is no longer official in the U. S. P. The 1890 formula called for spermaceti, 10 Gm.; white wax, 35 Gm.; and olive oil, 55 Gm.; to be melted together, and then constantly stirred until cool.

The following preparation is often used for chapped lips:

Ceratum Rosatum.—*Rose cerate, Lip salve*, E.; *Cérat à la rose, Pommade pour les lèvres*, Fr.; *Lippenpomade*, G.—Melt together at a moderate heat white wax, 50 Gm., and expressed oil of almond, 100 Gm.; when partly cooled add carmine, 0.5 Gm., previously rubbed up with a little of the oil; stir well, and finally add essential oil of rose, 0.5 Gm.—Fr. Cod.

Medical Uses.—Spermaceti cerate is employed as a basis for active remedies, and as a mild dressing for abrasions, blisters, and ulcers.

CERATUM PLUMBI SUBACETATIS, *U. S.*—Cerate of Lead Subacetate.

Unguentum glycerini plumbi subacetatis, Br.; *Unguentum plumbi*, P. G.; *Ceratum cum subacetate plumbico*, Fr. Cod.—*Goulard's cerate, Ointment of glycerin of lead subacetate*, E.; *Cérat de saturné, C. saturné, C. de Goulard*, Fr.; *Bleisalbe, Bleicerat*, G.

Preparation.—Solution of lead subacetate, 20 Gm.; wool-fat, 20 Gm.; paraffin, 20 Gm.; white petrolatum, 38 Gm.; camphor, 2 Gm. To the melted wool-fat in a warm mortar gradually add the solution of lead subacetate, and incorporate it by slow trituration. To the mixture add the white petrolatum and paraffin, previously melted, and in which the camphor has been dissolved; mix thoroughly until homogeneous.—U. S.

If the above weights be considered as grains and multiplied by 5, the resulting product will weigh a trifle over 1 troy ounce.

The Br. P. directs that 1 ounce of glycerin of lead subacetate be incorporated with a previously prepared mixture of 1½ ounces of hard paraffin and 3½ ounces of soft paraffin, whereas the P. G. orders 1 part each of solution of lead subacetate and wool-fat to be mixed with 8 parts of paraffin ointment (solid paraffin, 1; liquid paraffin, 4).

The official formula will yield an unobjectionable preparation and is a great improvement on that of 1890, inasmuch as the tendency to become rancid has been overcome by elimination of the cerate. It must not be overlooked that the wool-fat directed in the formula is the anhydrous variety. The finished product contains about 5 per cent. of lead subacetate and 2 per cent. of camphor.

Medical Uses.—This remedy is employed as an astringent application to abrasions, blisters, ulcers, burns, chilblains, and inflammatory eruptions of the skin. It should not be applied over extensive raw surfaces, lest a poisonous amount be absorbed.

CERATUM RESINÆ, *U. S.*—Rosin Cerate.

Unguentum resinæ, Br.; *Unguentum basilicum*, P. G.; *Unguentum tetrapharmacum.*—*Resin ointment, Basilicon ointment*, E.; *Cérat de résine anglais, Onguent basilicum*, Fr.; *Harzsalbe, Königssalbe, Zugsalbe*, G.

Preparation.—Rosin, 350 Gm.; yellow wax, 150 Gm.; lard, 500 Gm.; to make 1000 Gm. Melt them together at a moderate heat, strain the mixture through muslin, and allow it to cool without stirring.—U. S.

If 7 ounces of rosin, 3 ounces of yellow wax, and 10 ounces of lard be melted together, the official proportions will be preserved.

Take of resin in powder, 8 ounces; yellow wax, 8 ounces; olive oil, 8 ounces; lard, 6 ounces.—Br.

The impurities always present in the rosin necessitate the straining of this and the following cerate. By melting and straining the rosin alone the purified rosin may be kept on hand and subsequent straining avoided. The formulas of the French and German pharmacopœias differ considerably from the foregoing, the former ordering black pitch, the latter turpentine, among the ingredients.

Medical Uses.—Rosin cerate is locally applied as a stimulant to sluggish ulcers following burns, scalds, and blisters. It may also be applied to excoriations and chilblains. The compound rosin cerate is employed for the same purposes, but is somewhat more stimulating than the former.

CERATUM RESINÆ COMPOSITUM, *U. S.*—Compound Rosin Cerate.

Deshler's salve, E.; *Cérat de résine composé*, Fr.; *Zusammengesetzte Harzsalbe*, G.

Preparation.—Rosin, 225 Gm.; yellow wax, 225 Gm.; suet, 300 Gm.; turpentine, 115 Gm.; linseed oil, 135 Gm. Melt the rosin, yellow wax, turpentine, and suet; to this add the linseed oil, and continue the heat until the mixture is liquefied; then strain through coarse muslin, and stir until it begins to congeal.—U. S.

To make about 1 troy ounce of the cerate, use 113 grains of rosin, 112 grains of yellow wax, 150 grains of suet, 58 grains of turpentine, and 67 grains of linseed oil, and proceed as directed above.

Compound rosin cerate was official in the U. S. P. of 1870, but was omitted from the editions of 1880 and 1890. It has a tendency to become tough in consequence of oxidation of the linseed oil, and should not be kept on hand in large quantities. As pointed out by S. A. D. Sheppard in 1878, the cerate keeps better if made with olive oil or liquid petrolatum in place of linseed oil.

Uses.—Compound rosin cerate is used for similar conditions as rosin cerate when a more stimulating effect is desired than that produced by the latter preparation.

CEREVISIÆ FERMENTUM.—Beer Yeast.

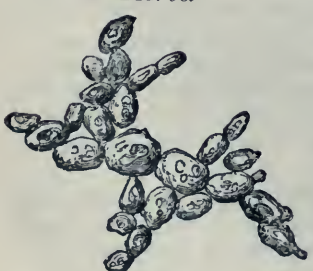
Yeast, Brewers' yeast, E.; *Bierhefe*, G.; *Levûre de bière*, Fr.; *Levadura de cerveza*, Sp.

The ferment obtained in brewing beer.

Origin.—The history of the discovery of the vegetable nature of yeast is too well known to require review.

There are two varieties of brewers' yeast—the *upper* or *top yeast*, and the *lower* or *bottom yeast* (*Oberhefe* and *Unterhefe* of the Germans). The former is the kind most generally met with in the United States, and is a viscid, semifluid, frothy mass of a peculiar odor and bitter taste, and containing oval or globular microscopic cells from which smaller ones are developed by budding; it appears upon the surface of the fermenting liquid, kept at a temperature ranging between about 15° and 20° C. (59° and 68° F.). But wort fermented with top yeast at a temperature near or below 10° C. (50° F.) will produce both top and bottom yeast, the latter being reproduced solely by the fermentation from below (*Untergährung*, G.) at a temperature of about 9° C. (48° F.) and less. It consists of various-sized cells, differing from those of the top yeast in not having any small cells attached, and appears to be reproduced from isolated spores instead of by budding. The cell-membrane consists of a kind of cellulose, and encloses protein compounds.

Fig. 96.



Yeast-cells.

At a temperature below 5° C. (41° F.) the yeast-plant ceases to vegetate, but it

may be exposed to a cold of —60° C. (—76° F.) without being killed. At a temperature of 75° C. (167° F.) and above, it loses its vitality unless water be absent, when it will not be destroyed by a temperature of 100° C. (212° F.) or more. On removing most of the water by pressure the *dry yeast* of commerce is obtained, which may be kept in this condition without material alteration. *Vienna yeast* is the same article, and is stated by Vigla (1871) to be made by fermenting a wort obtained from a mixture of maize and rye with barley malt, skimming off the froth, draining, and subjecting it to pressure. So-called *artificial* or *patent yeast* is made either of flour dough with the addition of a little yeast, or of an infusion of hops to which malt is subsequently added. Soxhlet and Pasteur (1876) proved that the only effect of hops, when thus used, is to impart bitterness to the mass and somewhat delay the spoiling of the product.

When yeast is added to a solution of pure sugar, active fermentation takes place, the yeast being gradually rendered inert, but in the presence of albuminous matters in the saccharine liquid the yeast-plant is continually reproduced and augmented.

Constituents.—The researches of Büchner have proved that the entire activity of yeast depends upon enzymes or ferments, in which it is very rich. Other investigators showed the presence of *invertase* (of which *invertin* was a very impure form), diastase, and maltase; but Büchner discovered the most important one, *zymase*, which differs from the others in its inability to escape outside of the cell through the pores in its wall. It therefore has to be extracted by the most laborious and thorough physical disintegration of the cell body, followed by very high pressure. For a long time its enzymic nature was questioned, it being claimed that it consisted of the living, even though disintegrated protoplasmic substance. But the activity was found to be preserved after various forms of treatment entirely destructive to such vitality, with chloroform, by high desiccation, and by heat. Zymase after extraction (of course, in an impure form) very quickly disappears, apparently through the indirect effects of the one or more proteolytic ferments present. This loss has been found very difficult of prevention, though thorough desiccation has been found capable, under the most favorable conditions, of preserving its activity for several months. Many experimenters are now (1902) at work in attempts to manufacture a stable form of it for use as a yeast substitute.

Action and Uses.—Because of its highly stimulant properties, yeast was at one time strongly recommended in the typhoid state occurring during the course of many of the acute infectious fevers. It was usually prescribed in the dose of from ½ to 1 pint daily. At present its use has largely been abandoned.

In the dose of 1 ounce (30 Gm.), 3 times daily, the drug has also been employed in scurvy, purpura, furunculosis, dysentery, and infantile diarrhœa, but many more efficient remedies for these conditions have succeeded it. It has been used in the treatment of diabetes mellitus.

As a local application to phagedenic sores, gangrene, and similar conditions, it is still employed to some extent, but antiseptic fomentations have largely taken its place.

The yeast poultice is somewhat stimulating, and is thought to possess slight antiseptic properties which are due to the generation of carbon dioxide.

CERII OXALAS, *U. S., Br.*—Cerium Oxalate.

Cerium oxalicum.—*Oxalate de cerium*, Fr.; *Oxalsaures Ceroxydul, Ceroxalat*, G.

Formula, $Ce_2(C_2O_4)_3.9H_2O$. Molecular weight, 701.34.—Br.

It consists chiefly of a mixture of cerium, didymium, praseodymium, and lanthanum oxalates, and other rare earths of this group.—U. S.

Origin.—The metal cerium was discovered in 1803 in a Swedish mineral simultaneously by Klaproth and by Berzelius and Hisinger. The last-named chemists called the mineral *cerite*, after the planet Ceres, then recently discovered, and the metal *cerium*. Mosander (1839 and 1840) observed in the supposed pure cerium oxide the oxides of 2 other hitherto unknown metals, which received the names of *lanthanum* and *didymium*. The 3 metals exist together as silicates in cerite and allanite, the latter mineral being found in Scandinavia and in the States of New York and Pennsylvania. Cerium also exists along with a small per cent. of thorium in the mineral *monazite*, which occurs in considerable quantity in North Carolina and Brazil. Monazite, which is essentially a phosphate, has become of great industrial importance, and it is the chief source of thorium oxide, which, with 1 per cent. of cerium oxide, constitutes the Welsbach mantles, now so generally employed because of the intense light given out when heated. It is probable

that the cerium oxalate of commerce, which, although used medicinally, consists of a mixture of oxalates of cerium, lanthanum, and didymium, is more or less a by-product in the preparation of thorium salts. Cerium forms two series of salts, known as cerous and ceric. In the former, the salts are derived from *cerous oxide* or cerium sesquioxide, Ce_2O_3, in which the metal is trivalent; in the latter they are derived from *ceric oxide* or cerium dioxide, CeO_2, in which the metal is tetravalent. The dioxide is yellow and stable at high heat. The atomic weight of cerium is 140 (Brauner, *Chem. News*, 1895; and Muthmann, *Ber.*, 1898). The chemistry of the cerite earths is fully treated in an article, "Beiträge zur Kenntniss der Ceriterden," by O. N. Witt and Walter Theel (*Ber.*, 1900).

Preparation.—To obtain cerium oxalate, F. F. Mayer (1860) recommended the following process: The powdered mineral is heated with concentrated sulphuric acid, the dry mass ignited, then dissolved in dilute nitric acid, and treated with hydrogen sulphide to remove copper, etc. A little hydrochloric acid is added to prevent precipitation of calcium salt, and the cerite metals are precipitated as oxalates by oxalic acid. The precipitate is mixed with magnesium carbonate, the mixture calcined to decompose the oxalates, the residue dissolved in a small portion of concentrated nitric acid, and the solution thrown into a large quantity of water containing about 0.5 per cent. of sulphuric acid. Lanthanum and didymium remain in solution, together with the magnesium and a little cerium, most of which is precipitated as yellow *ceric* sulphate; the latter is dissolved in sulphuric acid and reduced to cerous sulphate by sodium thiosulphate, when the oxalate may be precipitated by oxalic acid. Ouvrard has succeeded in freeing cerium entirely from lanthanum and didymium by fusing the nitrates with 10 times their weight of saltpeter. In the technical separation of cerium from other earths, ammonium persulphate is used.

Properties and Tests.—Cerium oxalate is a white, granular, inodorous, and tasteless powder, permanent in the air, insoluble in the simple solvents, but soluble in diluted sulphuric and hydrochloric acids without effervescence (absence of carbonates); and the solution of the salt (1 in 20) in diluted hydrochloric acid, should not be colored or made turbid by an equal volume of fresh hydrogen sulphide solution, when standing corked at 35° C. (95° F.) for at least half an hour (absence of heavy metals). When heated to redness, it is decomposed, leaving a residue of reddish-brown ceric and other rare earth oxides, equal to not less than 47 per cent. of the salt. On boiling the salt with potassium hydroxide test-solution, white hydroxides are left as insoluble residue, which gradually turns yellow by oxidation, while in the filtrate, supersaturated with acetic acid, calcium chloride test-solution will produce a white precipitate insoluble in acetic, but soluble in hydrochloric acid. If the brown residue left after heating be dissolved in concentrated sulphuric acid, and a small crystal of strychnine added, a deep-blue color appears, which rapidly changes to purple and then to red. Ammonium carbonate test-solution precipitates white cerous carbonate, which is somewhat soluble in an excess of the reagent. If 0.1 Gm. of cerium oxalate be dissolved in 1 Cc. of sulphuric acid, and 2 Cc. of potassium sulphate test-solution be added, small colorless crystals of cerium-potassium sulphate will be deposited after some time. The other rare earths are precipitated as double sulphates at the same time. 5 Cc. of a 10 per cent. solution in diluted hydrochloric acid should not respond to the modified Gutzeit's test for arsenic (given under ARSENI TRIOXIDUM). On boiling the salt with potassium hydroxide test-solution and filtering, no precipitate should be produced in the filtrate either by ammonium chloride test-solution (absence of aluminum) or by ammonium sulphide test-solution (absence of zinc).—U. S. When incinerated, it loses 53 per cent. of its weight.—Br. Power and Shedden state that pure cerium oxalate crystallizes with 10 molecules of water, instead of 9 molecules as given in the pharmacopœias (*Jour. Soc. Chem. Ind.*, vol. xix. No. 7). Knorre has observed a characteristic and very delicate test for cerium, which consists in gently heating 0.1 Gm. of cerium oxalate with 0.5 Cc. of concentrated sulphuric acid till effervescence ceases, adding 10 Cc. of water and 1 Gm. of ammonium persulphate when the liquid is cool, then heating to boiling for a minute or so, when a bright-yellow color will be produced (oxidation to ceric salts).

Action and Uses.—This drug was first proposed as a remedy for the vomiting of pregnancy. Given either alone or in conjunction with bismuth subnitrate, it is useful in the treatment of reflex vomiting; for example, that resulting from severe paroxysms of coughing or associated with uterine disorders and displacements. It may also be of value

in simple gastric acidity, and is believed by some to be of service in the treatment of gastric ulcer and cancer. Prof. Simpson also recommended this drug as a nerve tonic, and employed it with asserted success in the treatment of chorea. The dose is from 2 to 10 grains (0.12–0.60 Gm.) several times a day. It may be prescribed in pill or in powder.

Cerium nitrate is believed to be a nerve tonic, and in doses of 1 or 2 grains (0.05–0.10 Gm.), gradually increased, is employed in chorea, chronic vomiting, gastrodynia, and pyrosis.

Other Salts of Cerium.—Cerii Carbonas, $Ce_2(CO_3)_3.9H_2O$ (molecular weight, 617.97), is prepared by precipitating cerous sulphate (see above) with ammonium carbonate. The white flocculent precipitate changes to scales of a silvery luster, which are insoluble in water and contain 52.4 per cent. of cerous oxide and 26.2 per cent. of water of crystallization.

Cerii Bromidum.—On dissolving cerous carbonate in hydrobromic acid and evaporating the solution, Bullock (1871) obtained a chocolate-colored, sweet, styptic mass which is freely soluble in alcohol, but leaves an insoluble residue of cerous compound on treatment with water. Cerium chloride and iodide are likewise readily decomposed, the former becoming yellow, the latter brown, on exposure to the air.

Cerii Nitras. $Ce(NO_3)_3.6H_2O$. Molecular weight, 431.19.—It is conveniently made by the mutual decomposition of cerous sulphate and barium nitrate, and filtering the cerous nitrate from the insoluble barium sulphate. The salt is very deliquescent, crystallizes in colorless prisms or scales, contains 37.9 per cent. of cerous oxide, and is freely soluble in water and alcohol.

CETACEUM, *U. S., Br., P. G.*—Spermaceti.

Blanc de baleine, Cétine, Ambre blanc, Fr.; *Walrat*, G.; *Cetina, Cianco di balena*, It.; *Esperma de ballena*, Sp.; *Espermaceti*, Port.

Nearly pure cetin, obtained from the head of the sperm whale, *Physeter macrocephalus* (*Catodon m.* Lacep.—Order *Cetaceæ*).

A peculiar, concrete, fatty substance obtained from the head of the sperm whale, *Physeter macrocephalus*.—U. S.

Cetaceum is official in nearly all pharmacopœias.

Origin.—The sperm whale, or great-headed cachalot, is principally met with in the Pacific and Indian oceans and the seas of Australia. It is 15 to 21 M. (50 to 70 Ft.) long, with a head fully one-third of its entire length and correspondingly thick. Anterior to the cranium the upper jaw has a large cavity containing an oily liquid, which is removed with buckets soon after the animal has been killed, and then congeals into a yellow mass. This is drained in suitable bags, and then strongly expressed to remove the oil; the pressed cake is purified by melting it in water, skimming off the impurities, boiling with weak potassa solution, and washing with water; it is finally allowed to congeal into the substance under consideration.

Description.—Spermaceti is in white, translucent, scaly-crystalline masses somewhat unctuous to the touch, of a slight fatty odor, a mild, bland taste, a laminated pearly fracture, and a neutral reaction. Its specific gravity is 0.943 at 15° C. (59° F.); 0.938–0.944 at 25° C. (77° F.) or 0.842 at 100° C. (212° F.).—U. S. It melts near 50° C. (122° F.) (between 50° and 54° C., P. G.) to a clear and nearly colorless liquid, which congeals at about 45° C. (113° F.). The U. S. P. gives the melting-point at between 45° and 50° C. (113° and 122° F.). It contains variable, but small quantities of oil, which causes spermaceti to become yellowish on exposure to air, and to acquire a rancid odor and acid reaction. It is insoluble in water and nearly so in cold alcohol, is slightly soluble in cold benzin and benzene, but dissolves in chloroform, ether, carbon disulphide, warm methyl and ethyl alcohol, about 50 parts of boiling alcohol (U. S.), and in fixed and volatile oils. An alcoholic solution of spermaceti is neutral to litmus-paper. On dry distillation an oily liquid, a solid fatty compound, and various gases and volatile acids are obtained. Spermaceti is readily inflammable, and burns with a bright, somewhat sooty flame.

Constituents.—When repeatedly recrystallized from boiling alcohol the fat is removed and Chevreul's *cetin* is obtained, which crystallizes in soft white pearly scales, melts between 50.5° and 53.5° C. (123° and 128.3° F.), and is slowly decomposed by aqueous solution of potassa, but readily saponified on fusion with potassium hydroxide or on boiling with its alcoholic solution. It consists mainly of cetyl palmitate, $C_{16}H_{33}.C_{16}H_{31}O_2$, which melts between 54.5° and 55° C. (130° and 131° F.), and yields on saponification palmitic acid and cetyl alcohol, or *ethal*, $C_{16}H_{34}O$. Heintz (1854) obtained also small quantities of myristic, lauric, and stearic acids, and of the alcohols methal, $C_{14}H_{30}O$, and

stethal, $C_{18}H_{38}O$. When boiled with nitric acid spermaceti is slowly oxidized, œnanthylic, succinic, and other acids being found among the products.

Spermaceti has been found adulterated with stearic acid, and the following test given in the U. S. P. serves to detect its presence: If 1 Gm. of spermaceti be boiled with 1 Gm. of anhydrous sodium carbonate and 50 Cc. of alcohol, and the mixture cooled and filtered, the filtrate, upon being supersaturated with acetic acid, may become turbid, but should not afford a precipitate.

Action and Uses.—Spermaceti is practically devoid of medicinal properties, but is employed as a lenitive and protective in early inflammations of mucous membranes. It is said to be useful in irritable conditions of the gastro-intestinal and genito-urinary tracts, and of some value in acute pharyngitis and bronchitis. 1 part of the drug finely powdered may be mixed with 3 parts of sugar and employed in this manner; or the drug may be dissolved in an equal amount of expressed oil of almond and emulsified with yolk of egg or acacia.

CETRARIA.—Cetraria.

Lichen Islandicus, P. A., P. G.—*Iceland moss*, E.; *Isländisches Moos, Isländische Flechte, Lungenmoos*, G.; *Lichen (Mousse) d'Islande*, Fr. Cod.; *Liquen islandico*, Sp.; *Muscayo Islandico, M. amargo, Licken*, Port.

The dried plant, *Cetraria Islandica* (L.) Acharius (*Lichen I.* L.; *Parmelia I.* Spreng.—Class *Lichenes*).

Cetraria is official in nearly all pharmacopœias, most of which provide for treating it with alkali carbonates to remove the bitterness. Several note that diluting the jelly with water, precipitating with alcohol, and treating the still moist precipitate with iodine, impart a blue color.

Origin.—The plant is indigenous to the northern hemisphere; in its southern limits it is found in mountainous regions, and further north in the plains. In North America it is met with southward to the mountains of North Carolina, northward throughout British America, and westward to the Rocky Mountains as far south as Colorado; in Europe it grows as far south as Spain and Italy, and in Asia throughout Siberia and in the Himalaya Mountains; it is plentiful in Iceland, from which island its name is derived.

Fig. 97.

Cetraria Islandica.

Description.—From 5 to 10 Cm. (2 to 4 In.) long and of very irregular breadth, thin and leaf-like, much and irregularly branched, the lobes about 5 Mm. (¼ In.) broad, channelled by the upcurving of the margins, shortly and finely fringed; brown or greenish-brown above; silvery-gray with depressed whitish spots underneath, forming an elastic mass, brittle when dry, cartilaginous when damp; almost inodorous when dry; bitter and somewhat mucilaginous. The 5 per cent. decoction becomes gelatinous when cold. The ash should not exceed 2 per cent.

Cetraria is very apt to contain vegetable forest débris in the form of pine-needles, twigs, leaves, etc.

Constituents.—This lichen depends for its nutritive value on the starchy principles, *lichenin* or *lichen-starch* ($C_{12}H_{20}O_{10}$) and *isolichenin* (lichenoid), which constitute together 30 to 70 per cent. of the drug, the lichenin predominating. The drug contains also 2 to 3 per cent. of cetrarin, which occurs in very bitter, white, odorless crystals, soluble in absolute alcohol and ether, and slightly in water. It has been split up into *cetraric acid* ($C_{18}H_{16}O_8$), intensely bitter and crystallizable; *lichen-stearic acid* ($C_{14}H_{34}O_3$); and *thallochlor*, a green coloring-matter. The other constituents are 3.6 per cent. of uncrystallizable sugar, 3.7 per cent. of gum, and fumaric (lichenic), tartaric, and oxalic acids.

Action and Uses.—Iceland moss is stated to possess tonic properties, but it is principally employed as a demulcent and nutrient. It aids digestion, improves nutrition, and increases the appetite. Cetraria has been used in chronic affections of mucous membranes, such as chronic bronchitis, tuberculosis with profuse expectoration, chronic diarrhœa, and dysentery. It has also been recommended in hæmoptysis, but in this condition is of doubtful efficiency. Its bitter principle, cetrarin, is said to increase peri-

stalsis, and may be used in chronic constipation. It may also be of benefit in the treatment of chlorosis.

Iceland moss is usually employed in the form of the decoction in doses of 1 fluidounce (30 Cc.), several times daily. Cetrarin has been given in doses of 1½ grains (0.075 Gm.). The dose of the drug in substance is from ½ to 1 drachm (2–4 Gm.).

GYROPHORA ESCULENTA Miyoshi is known as the edible lichen of Japan, where it grows on moist granite rocks, and is collected in great quantities, and used generally in Japanese cooking, more or less being also exported. It contains apparently nutritive constituents similar to those of Cetraria, but lacks the bitter principle and taste.

CHARTA POTASSII NITRATIS.—Paper of Potassium Nitrate.

Charta nitrata, P. G.—*Saltpeter paper*, E.; *Papier nitré*, Fr.; *Salpeterpapier*, G.; *Carta nitrata*, It.

Preparation.—Potassium nitrate, 200 Gm.; distilled water, 800 Cc. Dissolve the potassium nitrate in the distilled water. Immerse strips of white, unsized paper in the solution and dry them. Preserve the paper in securely closed vessels.—U. S.

If 4 avoirdupois ounces and 75 grains of potassium nitrate be dissolved in 1 pint of distilled water, the solution will be of the strength directed by the Pharmacopœia, which is very nearly saturated.

The German Pharmacopœia uses a somewhat weaker solution, 1 part of potassium nitrate to 5 parts of water.

Ordinary saltpeter will answer if the paper is to be used for moxas, but for the preparation of *medicated cigarettes* potassium nitrate free from chloride should be used, and the paper should also be free from chlorine compounds. Such cigarettes are made either in the same manner as ordinary cigars, except that stramonium, belladonna, hyoscyamus, or other leaves are substituted for tobacco, or the nitrated paper is impregnated with other solutions, or simply rolled into a thin tube having the edges fastened with a trace of gelatin; the substance whose smoke is to be inhaled is then introduced and the paper tube ignited at one end, when combustion without flame takes place. The following is a formula for *cigarettes antiasthmatiques* which is much employed in France: A decoction is made of 5 Gm. each of the leaves of belladonna, stramonium, digitalis, and sage, with 1000 Gm. of water, and strained. 75 Gm. of potassium nitrate and 40 Gm. of tincture of benzoin are added, and into this solution is then introduced, sheet by sheet, one quire of red-tinted absorbent paper, the whole remaining in contact for 24 hours; after which time the paper is dried and cut into rectangular pieces of 10 by 7 Cm., which are formed into tubes by rolling them around a cylinder about 1 or 1½ Mm. in diameter and fastening the edge with gelatin.

For forming *moxas* of nitrated paper, it is rolled into pretty firm cylinders having a diameter of about ¼ inch, which are afterward cut into pieces of suitable length.

Medical Uses.—Papers of potassium nitrate are intended to be burned in front of the patient, who inhales the fumes. They are considered an efficient remedy in the treatment of asthma.

CHARTA SINAPIS, *U. S.*, *Br.*—Mustard Paper.

Charta sinapisata, P. G.; *Papier moutarde*, *Moutarde en feuilles*, Fr.; *Senfpapier*, G.; *Charta senapata*, It.

Preparation.—Black mustard, in No. 60 powder, 100 Gm.; rubber, 10 Gm.; benzin, carbon disulphide, each a sufficient quantity. Pack the mustard in a conical percolator, and gradually pour petroleum benzin upon it until the percolate ceases to produce a permanent greasy stain upon blotting-paper. Remove the powder from the percolator and dry it by exposure to the air. Having meanwhile dissolved the rubber in a mixture of 100 Cc. each of petroleum benzin and carbon disulphide, mix the purified mustard with a sufficient quantity of the solution to produce a semiliquid magma, and apply this, by means of a suitable brush, to one side of a piece of rather stiff, well-sized paper, so as to cover it completely, and then allow the surface to dry. A surface of 60 square Cm. should contain about 4 Gm. of black mustard deprived of oil. Before it is applied to the skin, mustard-paper should be dipped in warm water for about 15 seconds.—U. S.

The British Pharmacopœia directs the removal of the fixed oil from a mixture of equal proportions of black and white mustard seeds by percolation with benzene. The residue is dried by exposure to warm air and reduced to No. 60 powder, of which 5 Gm. are mixed with 18 Cc. of solution of India-rubber and spread over 20 square Cm. of one side of a piece of cartridge-paper. It is allowed to dry by exposure to air. This preparation contains nearly 4 times as much mustard to the square inch as that of the U. S. P.

The German Pharmacopœia directs that 100 square Cm. (about 16 square inches) of mustard paper shall yield at least 0.0236 Gm. (nearly 0.5 grain) of volatile oil of mustard, and gives a method for determining the value which involves conversion of the volatile oil obtained into thiosinamine by means of ammonia.

Action and Uses.—Mustard papers should be immersed in lukewarm water for an instant before being applied to the skin. They are more convenient and more cleanly than the ordinary mustard poultice, and are employed for the same purposes. When it is desirable to modify the action of these papers, a piece of thin gauze may be placed between them and the skin. This also prevents particles of mustard from adhering to the skin after removal of the paper. As a rule they should not be allowed to remain longer than 15 minutes.

CHELIDONIUM.—Chelidonium.

Herba chelidonii.—*Garden or Great celandine, Tetterwort, Wart-weed, Cock-foot,* E.; *Schöllkraut,* G.; *Chélidoine, Herbe à l'hirondelle,* Fr.; *Celidonia mayor,* Sp., Port.; *Herva Andorinha,* Port.

The dried plant, *Chelidonium majus* L. (*C. umbelliferum* Stokes.—Fam. *Papaveraceæ*).

Chelidonium is official in several pharmacopœias.

Origin.—This perennial, yellow-juiced herb, described below, the only species of its genus, is native of Europe, and commonly naturalized in waste places in the United States.

Fig. 98.

Chelidonium; small upper leaf, flower, and fruit (¾ Nat.).

Fig. 99.

Chelidonium: root (Nat.).

Description.—Root several-headed, elongated, branching, reddish-brown; stem 30 to 60 Cm. (1 to 2 Ft.) long, loosely and widely branched, hairy, green; leaves 10 to 20 Cm. (4 to 8 In.) long, petioled, glaucous underneath, lyrate-pinnatifid, the pinnæ ovate-oval, obtuse, coarsely crenate or incised; flowers pedicelled in loosely peduncled umbels, yellow, of 2 sepals, 4 petals, indefinite stamens and a lance-linear pistil with entire stigma; capsule linear, 2-celled, completely dehiscent, many-seeded; odor narcotic, disagreeable; taste very acrid.

Constituents.—The active principles consist of chelidonine, chelerythrine, protopine (as in opium and sanguinaria), alpha- and beta-homochelidonine ($C_{21}H_{21}NO_5$), and chelidoxanthin. *Chelidonine* ($C_{19}H_{17}N_3O_3$ or $C_{20}H_{19}NO_5$), identical with stylophorine, occurs in bitter, afterward acrid, colorless, shining plates, insoluble in water, and soluble in chloroform, volatile and fatty oils, and scarcely soluble in alcohol. *Chelerythrine* (pyrrhopine, methyl-sanguinarine, $C_{21}H_{17}NO_4$) forms bitter, fluorescent, optically inactive needles, soluble in alcohol, ether, chloroform, and oils, but not in water. Orlorr found it in all parts of the fresh plant, but none in the dried, 0.001 to 0.005 per cent. in the fresh root, and 0.06 per cent. in the fruit. *Chelidoxanthin* is a neutral bitter principle, crystallizing in yellow needles. Orlorr found 0.005 to 0.01 per cent. when the plant was in bloom, but none in the early spring. He believed it to be an alkaloid. The acids are a succinic acid derivative, malic, and chelidonic ($C_7H_4O_6$), which crystallizes in colorless silky needles and is soluble in water and alcohol. The other constituents are gum, extractive, chlorophyll, etc.

Action and Uses.—Chelidonine closely resembles morphine in its effect upon the central nervous system. It is a violent purgative, and in overdose acts as a powerful local irritant with a special narcotic action upon the central nervous system. The yellow juice of the fresh plant was formerly employed in the treatment of catarrhal jaundice, ascites, and intermittent fever, and at present meets with favor among some practitioners. Because of its irritant action upon the skin, it has been used to a limited extent in the treatment of certain chronic cutaneous affections, especially those attended with severe itching. The juice is also a popular remedy for the removal of warts.

An infusion made with 1 ounce (30 Gm.) of the drug to 1 pint (480 Cc.) of boiling water is given in the dose of from ½ to 1 fluidounce (15–30 Cc.). The dose of the drug in substance is from ½ to 2 drachms (2–8 Gm.), ; of the extract, from 5 to 15 grains (0.30–1 Gm.).

Allied Drugs.—Several related and similar drugs are considered under PAPAVERACEÆ. Under the name *Wild eclandine* (*Wild balsam* or *Wild ladies' slipper, Jewel-weed, Silver-weed, Slipper-weed, Touch-me-not, Quick-in-the-hand, Snap-weed*), the herbage of *Impatiens aurea* Muhl. (*I. pallida* Nutt.), the pale *Touch-me-not*, etc., and of *I. biflora* Walt. (*I. fulva* Nutt.), the *Spotted touch-me-not*, etc. (Fam. *Balsaminaceæ*), of eastern and central North America, are largely employed in domestic practice and by homœopaths and eclectics. The plants are tall and branching, but tender and delicate succulent annuals, with swollen joints, growing beside streams and in similar damp localities. They are smooth and somewhat glaucous, the stem somewhat translucent, the foliage showing a brilliant silvery surface when immersed in water, which will not adhere to the surface. The leaves are thin, ovate-oval, more or less toothed. The slipper-shaped yellow flowers have long recurved tails, those of the first-named species being of a uniform pale-yellow, those of the second orange-yellow and spotted. The oblong capsules, when ripe, explode upon the slightest disturbance, scattering the seeds widely. The chemical constituents are not known, though the leaves apparently contain tannin. The medicinal applications are wholly questionable, except that the fresh juice appears to relieve cutaneous irritation of various kinds, especially that due to rhus-poisoning.

CHENOPODIACEÆ.—The Spinach Family.

Genera about 75, species about 600, contributing many troublesome weeds, as well as the drug CHENOPODIUM (which see), and the highly important food-plants, beet, spinach, and quinoa. These plants, besides their nitrogenous value, are noted for their large content of iron in the form of digestible organic compounds. The *Beet*, *Beta vulgaris* L. (*B. maritima* L.—*Runkelrübe, Zuckerrübe*, G.; *Bettarave*, Fr.), is a native of southern Europe and is most extensively cultivated, especially for the production of cane-sugar (see SACCHARUM), and presents many varieties. Its juice is considerably used for the production of coloring-matter for wine. This is sometimes used also as a substitute for litmus. The tops are an excellent substitute for spinach. The *Spinach*, *Spinacea oleracea* L. (*Epinard*, Fr. ; *Espinacea*, Sp.), is a native of northern Asia, and is well known in cultivation. The *Shammum* of Asia is very similar. An excellent substitute for spinach is the young tops of the common garden-weed, *Chenopodium album* L. (*Lamb's-quarters* or *Pigweed*). The seeds of *C. Quiona* W. (*Quinoa* or *Quinua*, *Pettyrice*), of the Andean region, there constitute the staple and principal food of millions of people. They contain also an amaroid, in specially large amounts in the bitter variety, which is reputed anthelmintic and emetic. By repeated washings, the substance is removed, and the seeds used as a food like the sweet variety.

CHENOPODIUM.—Chenopodium.

Fructus chenopodii anthelmintici.—American worm-seed, Mexican, Spanish, Jerusalem, or Jesuit tea, Jerusalem oak, E.; *Amerikanischer Wurmsamen, Wohlriechender Gänsefuss, Mexicanisches Traubenkraut,* G.; *Ambrosie du Mexique,* Fr.; *Anserine vermifuge (plante fleurie),* Fr. Cod.; *Epazote, Te de Espāna,* Sp.

The dried ripe fruit of *Chenopodium ambrosioides* L. or of *C. anthelminticum* L. (*C. Ambrosioides anthelminticum* Gray.—Fam. *Chenopodiaceæ*).

Chenopodium is official in most pharmacopœias.

Origin.—Viscid-glandular, rankly and offensively smelling, perennial herbs, the former native of tropical America, the latter of Europe, both widely naturalized and growing abundantly in America, especially in the eastern United States, as coarse weeds of the roadside and waste places.

Fig. 100.

Chenopodium ambrosioides (¾ Nat.).

Description.—Nearly 2 Mm. ($\frac{1}{15}$ In.) broad, depressed globular, brown or greenish-brown, the pericarp membranaceous and friable, inflated, the single seed black and shining, lenticular through its spiral curvature; aromatic, somewhat terebinthinate; taste bitterish, pungent.

Constituents.—Its medicinal importance is due to the volatile oil (see Oleum Chenopodii). Betaine and choline have also been reported. The fresh plant yields the alkaloid *chenopodine*, $C_6H_{13}O_4$, a white tasteless and odorless crystalline powder, soluble in 11 parts of cold water, 3 of boiling water, and 202 of alcohol.

Action and Uses.—Chenopodium is a very active anthelmintic, and is frequently employed for the expulsion of lumbricoid worms, especially in children. The bruised fruit may be given in doses of 20 grains (1.3 Gm.), in the form of an electuary. The expressed juice of the fresh plant is also employed in tablespoonful (16 Cc.) doses. A decoction made by boiling 1 ounce (30 Gm.) of the fresh plant with 1 pint (480 Cc.) of milk or water, is sometimes given in doses of a wineglassful (60 Cc.). The dose of the volatile oil is from 5 to 10 minims (0.3–0.6 Cc.). When employed, the drug should be given 3 times daily for a period of 3 or 4 days, and then be followed by calomel or castor oil.

Other Species.—Of the 60 or more widely distributed species, several of tropical America belong to the same section with the official, and share its peculiar odor and doubtless its properties, but are not commercial articles, with the exception of *C. Botrys* L., the *Mexican tea, Jerusalem oak, Feather geranium, Traubenkrant* or *Chenopode à grappes. C. vulvaria* L., the *Fetid* or *Stinking goosefoot, Notchweed, Stinkender Meede, Vulvaire, Ansérine puante,* has also a fetid odor, though somewhat different from that of Chenopodium, and is used as an antispasmodic. Other species possess very different properties and are considered under Chenopodiaceæ.

CHIMAPHILA, *U. S.*—Chimaphila.

Pipsissewa, Prince's pine, Bitter wintergreen, Ground holly, King's cure, Love in winter, E.; *Doldenblüthiges Harnkraut, Wintergrün,* G.; *Herbe de pyrole ombellée,* Fr.

The dried leaves of *Chimaphila umbellata* (L.) Nutt. (*Pyrola u.* L.—Fam. *Ericaceæ*).

Chimaphila is not official in any other pharmacopœia.

Origin.—An herb-like undershrub, a few inches long, bearing several leaves crowded near the summit, and an umbel of 5 or 6 wax-like flowers, nearly a half-inch broad, having 5 petals, 10 stamens with the filaments enlarged in the middle and the anthers conspicuously 2-horned, a short style, with the disk-like and 5-lobed stigma nearly immersed in the top of the ovary, and a 5-celled and many-seeded capsule. It is indigenous in North America, northern Asia, and northern and central Europe, growing in dry woods and flowering in June and July.

Description.—From 2.5 to 5 Cm. (1 to 2 In.) long and 1 to 1.5 Cm. ($\frac{2}{5}$ to $\frac{3}{5}$ In.) broad, oblanceolate, the lower half cuneate and entire, the upper coarsely and sharply serrate, acute or obtusish, thick and rigid, brittle, above dark-green or brownish-green, and slightly shining, the veins strongly impressed, underneath paler, the veins very prominent; odor very slight, tea-like; taste astringent and bitterish.

The leaves of *C. maculata* (L.) Pursh (*Pyrola m.* L.) the *Spotted pipsissewa*, *S. Wintergreen* or *S. piperidge*, of the eastern United States, is used similarly, and is sometimes substituted for it, but the leaves are lanceolate and pointed, and have a large whitish spot or blotch on the upper surface.

Constituents.—Chimaphila yields odorless, tasteless, golden-yellow needles of *chimaphilin* ($C_{24}H_{21}O_4$), *arbutin* ($C_{12}H_{15}O_7$, see Uva Ursi), another body ($C_{10}H_{19}O$), 3 other crystalline principles, and 4 or 5 per cent. of tannic acid; also volatile oil, fat, resin, starch, and gum.

Pharmaceutical Preparation.—Fluidextract of Chimaphila, U. S. P.

Action and Uses.—Chimaphila is slightly astringent, and has been employed as a tonic and diuretic. It is a stimulant to the mucous membranes of the genito-urinary tract, and may be employed in any depraved condition arising therein. It has been especially recommended in renal dropsy, and is said to be of service in scrofulous conditions and in chronic ulcers and skin lesions presumably the result of a strumous diathesis. It is employed both internally and as an embrocation.

The drug is administered in the dose of from 1 to 2 drachms (4–8 Cc.), of the fluidextract, 3 times daily.

Fig. 101.

Chimaphila (Nat.).

CHINOIDINUM.—Chinoidine.

Chinioidinum, *Chinoidina*, *Quinoidina.*—*Quinoidine*, E., Fr.; *Amorphous quinine*, E.; *Quinine amorphe*, Fr.; *Chinoidin*, G.

Chinoidine is a resinous substance consisting of the natural or artificial (obtained by the action of heat and acids upon the crystalline alkaloids) *amorphous* alkaloids of cinchona bark.

Preparation.—The mother-liquor obtained in the preparation of quinine, cinchonine, etc., from cinchona bark, and freed as much as possible from the crystallizable alkaloids, is precipitated with sodium hydroxide, and the precipitated chinoidine purified by dissolving it in dilute hydrochloric acid, precipitating by ammonia, washing with water, and drying.

The alkaloidal nature of chinoidine was first observed by Sertürner. Subsequently, Henry and Delondre, Duflos, Winckler, and others showed that this amorphous mass still contained quinidine (then confounded with quinine) and cinchonine. Freed from the crystallizable alkaloids, Liebig regarded chinoidine as quinine rendered amorphous by the influence of heat and of chemicals. Hesse (1877) has shown that aside from the crystallizable bases which may be present, chinoidine has been formed by the condensation or polymerization of their molecules.

The two principal amorphous alkaloids present are *diconchinine*, $C_{40}H_{46}N_4O_3$, and *dicinchonine*, $C_{38}H_{44}N_4O_2$, the former being the principal constituent of chinoidine when the cinchona bark contains much quinine and quinidine, resembling these two alkaloids in the fluorescence of the sulphuric acid solution and in the thalleioquin reaction. Much *dicinchonine* is present if the bark contained much cinchonine and cinchonidine.

Properties.—Chinoidine is met with in commerce in cylindrical rolls or in deep-brown to brownish-black masses of a resin-like appearance, which at low temperatures are brittle and break with a glossy conchoidal fracture. Exposed to summer heat, it becomes plastic, readily melting when heated to higher degrees, and when ignited burns with a sooty flame. Chinoidine has a feebly bitter taste, is almost insoluble in water, becomes plastic in hot water, soluble in water acidulated with mineral acids, soluble in alcohol and chloroform, the solutions reacting alkaline and tasting very bitter, and are dextrorotatory. Chinoidine gives the thalleioquin reaction as well as the red color when chlorine water, potassium ferrocyanide, and ammonia are added successively as in the test for quinine.

Tests.—1 Gm. dissolved in 10 Cc. of 3 per cent. acetic acid, or in 10 Cc. of diluted alcohol (49 per cent. by volume), should give a clear solution, or when ignited and burned should not leave more than 0.6 per cent. of ash (Hager).

Pharmaceutical Preparations.—Tinctura Chinoidini. *Tincture of Chinoidine*, E.; *Chinoidintinktur*, G.—Dissolve 10 parts of chinoidine in a mixture of 85 parts of alcohol specific gravity 0.894 and 5 parts of hydrochloric acid. It is dark-brown, transparent in thin layers, very bitter, and without distinctive odor; on mixing it with an equal volume of water and of ammonia the chinoidine is precipitated and the liquid becomes yellowish.—P. G. 1882.

Action and Uses.—Chinoidine is tonic and antiseptic. It has been recommended in the treatment of intermittent fever, and also of chronic malarial conditions attended with cachexia. Small doses may also be administered for its tonic effect during convalescence from acute disease. The drug is slower in its action and less powerful than the cinchona alkaloids, and ordinarily is much inferior to them, but it may be employed in those cases in which idiosyncrasy prevents the use of quinine. The dose to an adult is stated to be from 10 to 20 grains (0.60–1.3 Gm.), but as much as 1 drachm (4 Gm.) has been given. To a child the beginning dose is 2 or 3 grains (0.12–0.20 Gm.). Care should be taken in its employment, because of its liability to produce gastric disturbances.

COMPOUNDS OF CHINOIDINE.

Chinoidini Citras. *Chinoidine citrate*, E.; *Chinoidincitrat*, G.—Prepared by saturating a 15 per cent. aqueous solution of citric acid with chinoidine at a gentle heat, and evaporating the solution to dryness. Transparent reddish-brown scales soluble in water.

Chinoidine Hydrochloride, Chinoidine Acetate, and **Chinoidine Sulphate** may be prepared in a similar manner with the respective acids.

Chinoidini Tannas. *Chinoidine tannate*, E.; *Gerbsaures Chinoidin*, G.—Prepared by dissolving 10 parts of chinoidine in 500 Cc. of water containing 7.5 parts of hydrochloric acid (25 per cent.) and precipitating this with a solution of 40 parts of tannic acid in 400 Cc. of water, and then adding a solution of 20 parts of crystallized sodium acetate in 200 parts of water, which causes an additional precipitate. The precipitate is collected, thoroughly washed, and then dried over dehydrating agents. An amorphous brownish-colored powder having a bitter and astringent taste, difficultly soluble in water and alcohol, but soluble in acidulated water or alcohol.

CHIRATA, *U. S., Br.*—Chirata.

East Indian balmony, E.; *Chiretta*, E., G.; *Ostindischer Enzian*, G.; *Chirette*, Fr.; *Chirayta*, Port.

The dried plant, *Swertia Chirayita* (Roxb.) Ham. (*Swertia C.* Ham.; *Ophelia C.* Griseb.; *Agathotes C.* Don.—Fam. *Gentianaceæ*).

Origin.—A large annual of the Himalaya mountains.

Description.—Smooth; stem yellowish- or purplish-brown, about 1 M. (3 Ft.) long, slender, cylindrical below, above quadrangular and lightly winged, with numerous slender, opposite, ascending branches, the woody zone narrow, the pith large, yellowish-white, continuous, easily detached; leaves opposite, sessile, ovate, acute, entire, 5-nerved; flowers small, 4-merous; capsule ovoid, acute, 2-carpelled, 1-celled, many-seeded; nearly inodorous, very bitter.

Adulterants and Substitutes.—Several species of *Swertia* (subgenus *Ophelia*), *Exacum*, and allied genera, are known in India as Chirata, and are distinguished from the official drug as *puharee* (hill), *dukhunee* (southern), *ooda* (purple), and *meetha* (sweet) chirata; they appear to be indiscriminately collected and sent to Bombay, where, according to Dymock, the drug is garbled. From all these, the official species is to be distinguished in the entire condition by its large and continuous pith, its yellowish or brownish stem, and its greater bitterness. In the powdered state they would be difficult, even if possible, of detection. *Erythæa Roxburghii* has also been detected. It is but a few inches in height. Madder (which see) has sometimes been used as an adulterant. Perhaps the most noteworthy substitute has been the herb *Andrographis paniculata* Nees (Fam. *Acanthaceæ*). It is readily distinguished, the stems being strongly quadrangular and furrowed, the leaves

Fig. 102.

Gland from Andrographis (enlarged).

elongated and narrow, and the corolla 2-lipped. The powder is equally well characterized by numerous cystoliths, pith-cells containing crystals of calcium oxalate, and stalked glands (Fig. 105) from stems and leaves.

Constituents.—This plant yields a very little tannin, wax, and 2 bitter principles, *ophelic acid* ($C_{13}H_{20}O_{10}$) and *chiratin* or *chirettin* ($C_{26}H_{48}O_{15}$). Ophelic acid forms a brown, very hygroscopic, amorphous mass which is readily soluble in water, alcohol, and ether, has a slightly acidulous, afterward intensely bitter taste, precipitates cuprous oxide from Trommer's Solution, and produces yellow precipitates with the lead acetates. Chiratin is bitter, pale-yellow, indistinctly crystalline, soluble in ether, and precipitated by tannin. Dilute acids split chiratin into ophelic acid and *chiratogenin* ($C_{13}H_{24}O_3$), a brown, amorphous, bitter substance, soluble in alcohol but nearly insoluble in water.

Pharmaceutical Preparations.—Fluidextract of Chirata, U. S. P.; Infusion of Chirata, Br. P.; Tincture of Chirata, U. S. P.

Action and Uses.—Chirata is a tonic and hepatic stimulant, and may be prescribed in cases of impaired digestion, especially when hepatic torpor or constipation is present. Its properties are practically the same as those of gentian and calumbo, and it may be prescribed interchangeably with them. In Hindostan it is highly esteemed as an antispasmodic and deobstruent, and is said to be a valuable remedy in chronic bronchitis and in the depression during convalescence from acute infectious diseases. The dose of the powdered drug is 20 grains (1.3 Gm.); of the tincture, from 1 to 4 fluidrachms (4–16 Cc.); of the extract, from 3 to 4 grains (0.20–0.25 Gm.); and of the infusion, a wineglassful several times daily.

CHLORALFORMAMIDUM, *U. S.*—Chloralformamide.

Chloralum formamidatum, P. G.—*Chloralamide*, E.; *Chloralformamid*, G.

Formula, $CCl_3CH(OH)NH.(HCO)$. Molecular weight, 190.96.

A crystalline solid made by the direct union of formamide and anhydrous chloral. It should be kept in amber-colored, well-stoppered vials.—U. S.

Preparation.—147 parts of anhydrous chloral (CCl_3CHO) and 45 parts of formamide ($CHONH_2$) are intimately mixed at ordinary temperatures and the mass allowed to crystallize, after which it is purified by recrystallizing from water or 30 per cent. alcohol, care being taken not to heat it above 60° C. (140° F.).

Properties and Tests.—Chloralformamide occurs as colorless, lustrous crystals, without odor, and having a somewhat bitter taste. It is soluble in about 18.7 parts of water and in 1.3 parts of alcohol at 25° C. (77° F.), and is readily soluble in glycerin, ether, acetone, and acetic ether. When heated to 60° C. (140° F.) with water, it is decomposed into its component parts, chloral and formamide. When heated to 114°–115° C. (237.2°–239° F.) it melts, but at a higher temperature is decomposed. It is not affected by diluted acids, but is decomposed on warming with alkali hydroxides, the solution becoming at first turbid, and then clear, while chloroform separates. If 0.2 Gm. be heated carefully in an open dish, it should not give off inflammable vapors, and should volatilize without leaving a weighable residue (absence of inorganic impurities and distinction from chloral alcoholate and ethyl carbamate). 1 Gm. of chloralformamide dissolved in 10 Cc. of alcohol should yield a solution which does not redden blue litmus-paper (absence of formic, hydrochloric, or other free acids). If 1 Gm. of chloralformamide be dissolved in 10 Cc. of alcohol, the addition of a few drops of silver nitrate test-solution should not at once produce turbidity (absence of decomposition-products).—U. S. The description and tests of the German Pharmacopœia are identical with the above, except that the solubility is stated to be 1 part in 20 parts of water and in 1.5 parts of alcohol at 15° C. (59° F.).

Chloralformamide dissolves in water slowly at the ordinary temperature, and a moderate heat may be employed to hasten solution, but care should be taken not to exceed a temperature of 55° C. (131° F.), since decomposition occurs at 60° C. (140° F.), as stated above.

The name *chloralamide*, under which this compound was first introduced, is a misnomer, but is still used commercially (see Chloral-ammonium). It is easily confounded with *chloralimide*, CCl_3CHNH, a product obtained by the action of heat on chloral-ammonium, which is insoluble in water.

Action and Uses.—Chloralformamide is purely a hypnotic, and may be employed for the relief of hysteria and insomnia which is not accompanied by pain. It is somewhat slower and less certain in its action than is chloral, but its effect resembles that of the latter remedy. It has practically no effect upon the circulation, and for this reason is considered a safer remedy than chloral if cardiac lesions are present. Its effect upon the spinal cord and nerves is not marked, but upon the intellectual centers of the brain it acts as a powerful depressant, producing sleep in from 15 to 30 minutes, which lasts for 6 to 8 hours. It rarely causes disagreeable after-effects, but occasionally headache, vertigo, and delirium have followed its administration. The drug is rapidly absorbed from the stomach and intestines, and is eliminated by the kidneys as urochloralic acid. Poisonous doses are said to depress the heart muscle, the motor side of the cord, motor nerve-trunks, and muscles. The ordinary dose of chloralformamide is from 20 to 40 grains (1.3–2.6 Gm.), but as much as 1 drachm (4 Gm.) may occasionally be required. It may be given in capsules, in aqueous or in alcoholic solutions.

CHLORALUM HYDRATUM, *U. S.*, *P. G.*—Hydrated Chloral.

Chloral hydras, Br.; *Chloral*, U. S., 1890; *Aldehydum trichloratum.*—*Chloral hydrate, Hydrous chloral, Trichloraldehydehydrate, Trichlorethylidene glycol*, E.; *Hydrate de chloral*, Fr.; *Chloralhydrat*, G.; *Cloralio idrato*, It.; *Cloral hidratado*, Sp.

Formula, $C_2HCl_3O + H_2O$ or $CCl_3.COH + H_2O$. Molecular weight, 164.12.

A crystalline solid, composed of trichloraldehyde or chloral with 1 molecule of water.—U. S.

Chloral hydrate, or trichlorethylidene glycol, $CCl_3.CH(OH)_2$, is obtained by the addition of water to the liquid chloral produced by the action of dry chlorine gas on ethyl alcohol.—Br.

It should be kept in glass-stoppered bottles, in a cool and dry place.

Chloral was discovered by Liebig (1832), and its composition soon after determined by him and Dumas. Its hypnotic properties were discovered by Dr. O. Liebreich, Berlin (1869), and within 10 years its consumption as a remedial agent increased to about a ton per day in England and America alone.

Preparation.—Chloral (anhydrous) is first prepared by conducting a current of dry chlorine gas into cooled absolute alcohol until hydrochloric acid gas ceases to distil. At this stage the temperature is gradually increased to near 100° C. (212° F.), and the current of chlorine continued until the crude chloral dissolves quite clear in water. The liquid which congeals on cooling is thoroughly washed with concentrated sulphuric acid to decompose chloral alcoholate and remove alcohol and other impurities, and the colorless oily layer which separates is then removed and rectified either direct or over lime and calcium carbonate. The final rectified distillate, *anhydrous chloral*, C_2Cl_3HO, is mixed with water (82 parts of chloral requiring 10 parts of water), and the mixture, which has become warm through the chemical reaction, is poured upon plates, covered with a bell glass, and allowed to crystallize, forming hydrated chloral or chloral hydrate, $C_2HCl_3O.H_2O$. For further purification the crystals are dissolved in benzin or chloroform and recrystallized.

According to the quantity of alcohol operated upon, the current of chlorine may require several days or weeks to complete the reactions (for 600 Gm. of alcohol 3 days, Dumas; for 92 pounds of alcohol 28 days, Dr. Squibb). Although the reactions in the formation of chloral, C_2HCl_3O, may be summarized in the substitution of 3 atoms of Cl for 3 atoms of H in aldehyde, C_2H_4O, the researches of Liebig, Dumas, Lieben, Trillat, and others indicate a series of very complicated interreactions between the products formed at various stages of the process, in which the following compounds have been shown to occur at different stages: Aldehyde, C_2H_4O; acetal (ethylidene-diethyl-ether), $CH_3.CH(OC_2H_5)_2$; trichloracetal, $CCl_3.CH(OC_2H_5)_2$; ethyl chloride, C_2H_5Cl; chloral alcoholate, $CCl_3.CHOH.OC_2H_5$; and the latter on the addition of concentrated sulphuric acid decomposing into chloral and ethyl sulphuric acid according to $CCl_3.CHOH.OC_2H_5 + H_2SO_4 = C_2HCl_3O + C_2H_5HSO_4 + H_2O$. Butyl-chloral, $C_4H_5Cl_3O$, and the chlorides of ethylene, $CH_2Cl.CH_2Cl$, and ethylidene, $CH_3.CHCl_2$, have been found as by-products in the manufacture of chloral.

Properties.—*Anhydrous chloral* is a colorless thin oily *liquid* of a peculiar pungent, irritating odor and caustic taste, having a density of 1.502 at 18° C. (64.4° F.), 1.544

at 0° C. (32° F.), boils at 94.5° C. (202° F.) and distils unchanged, and is easily soluble in ether and chloroform. It has a great affinity for water, alcohol, ammonia, and formaldehyde, the combinations resulting respectively in the formation of hydrated chloral, chloral alcoholate, chloral ammonium, $CCl_3CH.(NH_2)OH$, and chloralformamide, $CCl_3.CHOH.NH(HCO)$. On long keeping, chloral (anhydrous) is gradually polymerized, or more rapidly in contact with concentrated sulphuric acid, into *parachloral* (*metachloral*, *trichloral*), $C_6H_3Cl_9O_3$, which is a hard white substance insoluble in water, ether, and alcohol, but which may be reconverted into chloral by distillation at 180° C. (356° F.). The change into the insoluble variety is prevented by the addition of a little chloroform.

Hydrated chloral occurs in white crystalline masses or in separate colorless, oblique-rhombic crystals of a saccharoid aspect, having a peculiar aromatic and somewhat irritating odor, the pungency of which is increased with the temperature, and a bitterish, caustic taste; slowly volatile when exposed to the air; ordinarily not deliquescent, but much so if the water of hydration is excessive. If underhydrated, it is inclined to polymerize to the insoluble form, a phenomenon which may take place with explosive violence under suitable conditions. At 58° C. (136° F.), U. S., P. G., hydrated chloral fuses to a clear colorless liquid having the specific gravity 1.575, and congeals again to a crystalline mass between 35° and 50° C. (95°–122° F.) (48.9° C. (120° F.), Br.), the congealing-point being an indicator of the degree of hydration, a low congealing-point indicating overhydration and a high congealing-point—over 50° C. (122° F.)—underhydration.

At about 78° C. (172° F.) hydrated chloral begins to yield vapors of water and anhydrous chloral, boils at 97.5° C. (207.5° F.), and evaporates without residue. It is neutral in reaction to litmus, and freely soluble in water, alcohol, or ether; also in chloroform, benzene, petroleum benzin, carbon disulphide, fixed and volatile oils (U. S.). Soluble in 1½ parts of water (Allen); in less than its own weight of water, 90 per cent. alcohol or ether, and in 4 parts of chloroform (Br.); slowly in 5 parts of chloroform (P. G.). A freshly prepared aqueous solution of hydrated chloral should be neutral to litmus-paper, but it gradually acquires an acid reaction. A neutral alcoholic solution remains neutral permanently. In aqueous solution it is a solvent of morphine and quinine. Hydrated chloral liquefies when triturated with about an equal weight of camphor, menthol, thymol, or phenol. When warmed with a small quantity of aniline and sodium hydroxide solution an intensely disagreeable, mercaptan-like odor of phenyl-isocyanide (isonitril reaction) should be produced. Alkali carbonates slowly and alkali hydroxides rapidly decompose hydrated chloral into chloroform (of forensic importance) and alkali formates, the reaction proceeding with quantitative accuracy according to the equation $C_2HCl_3.H_2O$ (hydrated chloral) + KOH (potassium hydroxide) = $CHCl_3$ (chloroform) + $KCHO_2$ (potassium formate) + H_2O. In concentrated solutions it is oxidized by potassium permanganate to *trichloracetic acid*, $HC_2Cl_3O_2$, and in the system converted to *trichlorethyl alcohol*, $CCl_3.CH_2OH$ (Mering). It reduces Fehling's Solution, as well as solution of silver nitrate after the addition of ammonia. It gives a reddish-brown precipitate with solution of ammonium sulphide, and forms a sulphydrate with hydrogen sulphide. If hydrated chloral has acquired an acid reaction, it should be purified by washing with concentrated sulphuric acid and recrystallization from benzin or carbon disulphide.

Tests.—Hydrated chloral should be dry and not readily attract moisture. An aqueous solution of hydrated chloral (1 in 20), acidulated with nitric acid, should remain unaffected by silver nitrate test-solution (absence of hydrochloric acid and chlorides). If 1 Gm. of hydrated chloral be placed in a porcelain dish and be covered with 1 Cc. of nitric acid (specific gravity 1.38) no yellowish coloration of the mixture should be produced at ordinary temperatures, or even after warming the mixture 3 or 4 minutes, nor should yellowish fumes be produced after 10 minutes' warming (absence of chloral alcoholate).—U. S. 5 per cent. alcoholate reacts immediately after warming, and 1 per cent. after 3 to 4 minutes' heating (E. Hirschsohn). If 1 Gm. be dissolved in 6 Cc. of warm distilled water, and 0.5 Cc. of solution of potassium hydroxide added, the mixture filtered clear through wet filter-paper, and the filtrate treated with test-solution of iodine until it is deep brown, no yellow crystalline precipitate (iodoform) should appear even after standing 1 hour (absence of chloral alcoholate).—Br.

Chloral or hydrated chloral may be assayed quantitatively by conversion into *chloro-*

form by means of alkali hydroxide (see above), or by estimating the formic acid produced. 20.65 Gm. decomposed with strong solution of potassium hydroxide will yield 10 Cc. of chloroform specific gravity 1.491 measured at 17° C. (62.6° F.). A correction of 0.3 Cc. should be made for every 100 Cc. of aqueous liquid. 1 part of chloral hydrate yields 0.7218 part of chloroform by weight. The volumetric method of M. Meyer is convenient and accurate. About 2 Gm. of the sample are dissolved in water and shaken with calcium carbonate to remove free acid, filtered, and the filtrate mixed with a moderate excess of normal sodium hydroxide solution and the mixture shaken and set aside to allow the reaction to proceed to completion. The excess of alkali is then titrated with normal acid, using litmus as an indicator, each Cc. of normal alkali neutralized by the sample corresponds to 0.16497 Gm. of chloral hydrate. The Br. summarizes the test into "If 4 Gm. of chloral hydrate be heated with 30 Cc. of the volumetric solution of sodium hydroxide, not more than 6 Cc. of the volumetric solution of sulphuric acid should be required to neutralize the soda which remains free on the completion of the reaction." Care should be taken not to overheat the solution. It is better to simply mix them and set the mixture aside after a thorough shaking to complete the reaction.

Pharmaceutical Preparations.—Chloral and Camphor, N. F.; Compound Mixture of Chloral and Potassium Bromide, N. F.

Action and Uses.—Applied in its pure state to the sound skin, hydrated chloral produces redness, but upon the broken skin it acts as a powerful irritant. It is also a distinct irritant to mucous membranes when in concentrated form, a fact which should be remembered when administering it by either the mouth or the bowel.

Taken internally, hydrated chloral acts as a pure hypnotic. It does not produce sleep in cases suffering from severe pain unless the dose is so large as to be unsafe, but the sleep produced by it is as nearly normal as the sleep produced by any drug. The respiration and the circulation are somewhat slowed and the temperature is slightly lowered by medicinal amounts. The pupils are usually contracted. If full doses are given, or the patient is unduly susceptible to it, there may be some congestion of the conjunctiva and swelling of the eyelids. Curiously enough, with due regard to their weight, children can be given larger doses of hydrated chloral proportionately than adults. When sufficiently large doses are given to produce death, the end comes by failure of the respiratory centre with associated diminution in cardiac power. All the vital forces become greatly impaired, the breathing becomes distant and shallow, and the pulse exceedingly feeble. Like chloroform, hydrated chloral is a dangerous drug when there is fatty degeneration of the heart muscle. Death has resulted from as small a dose as 10 grains (0.60 Gm.).

When hydrated chloral is taken continuously, so that the "chloral habit" is formed, it produces mental hebetude, hallucinations, insanity, emotional disturbances, loss of memory, and extreme physical prostration, and sometimes small sores develop on the skin of the face and elsewhere.

The conditions in which hydrated chloral is best used in medicine are nervous insomnia and insomnia due to nervous irritation, but in both of these classes of patients it should be given with caution lest the habit be produced. In tetanus and strychnine-poisoning it is practically a physiological antidote, since it acts as a powerful depressant upon the motor tracts of the spinal cord, and combined with one of the bromides it is the remedy above all others to be employed in these two conditions.

In the treatment of tetanus and strychnine-poisoning it may be given by the rectum in starch-water, the patient being chloroformed until sufficient time has elapsed for the remedy to be absorbed from the bowels. It may also be used with advantage by the rectum in cases of obstinate vomiting, when it acts by quieting the vomiting centre. Hydrated chloral has often been employed for the control of puerperal convulsions, but it is probably not the best remedy for this condition. Small doses may also be put in cough mixtures.

The treatment of poisoning by this drug consists in the administration of strong black coffee, the hypodermic injection of strychnine, and the administration of Hoffmann's anodyne as a rapidly acting diffusible stimulant. As under the influence of poisonous doses of hydrated chloral there is a great fall of bodily temperature, external heat should be freely applied.

The dose of hydrated chloral varies from 5 to 20 grains (0.30–1.3 Gm.), best given in capsule, followed by a glass of milk, or in equal parts of syrup and water.

Derivatives and Allied Compounds. — CHLORAL-AMYLENE HYDRATE, *Amylene-chloral, Dormiol.* $CCl_3CHOHOC_5H_{11}$.—This compound is obtained by mixing 10 parts of anhydrous chloral with 6 parts of amylene hydrate, and occurs as a colorless oily fluid, having a camphoraceous odor and cooling taste. It is immiscible with cold water, but dissolves with decomposition in boiling water. Alcohol, ether, acetone, and fixed oils dissolve amylene-chloral in all proportions. It is used as a hypnotic. Dose : ½ to 1 drachm (2–4 Cc.) of a 10 per cent. solution.

CHLORAL-AMMONIUM, *Chloralamide* or *Trichloramidoethyl alcohol*, $CCl_3CH(OH)NH_2$, has been suggested as a hypnotic in doses of 15 to 30 grains. It may be obtained by passing a rapid current of dry ammonia through a solution of anhydrous chloral in chloroform as long as it is absorbed, pouring off the chloroform from the crystalline deposit, pressing this between bibulous paper, and drying in vacuo. It occurs as small needle-shaped crystals, which are soluble in alcohol and ether, difficultly soluble in cold water, melt at 83° C. (181.4° F.), and are decomposed at the temperature of boiling water into *Chloralimide*, CCl_3CHNH, and water.

CHLORALOSE. *Anhydro-gluco-chloral.* $C_8H_{11}Cl_3O_6$.—A compound resulting from the union of chloral and glucose, with the elimination of water; thus, $CCl_3CHO + C_6H_{12}O_6 = C_8H_{11}Cl_3O_6 + H_2O$. It is prepared as follows : Equal parts of anhydrous chloral and glucose are heated in a sealed tube or autoclave to 100° C. (212° F.) for about 1 hour, resulting in the production of 2 isomeric compounds, chloralose and parachloralose. The mass after cooling is treated with a little water, and then boiling ether. After distilling the ether-soluble portions 5 or 6 times with water to remove chloral, the isomers are purified and separated by crystallization from water. *Chloralose* was produced by A. Heffter in 1889 and termed *anhydro-gluco-chloral*, and later introduced as the hypnotic chloralose by Hanriot and Richet. It occurs as thin colorless crystals having a bitter taste, soluble in 170 parts of water at 15° C. (59° F.), freely soluble in alcohol, ether, glacial acetic acid, and hot water. Melting-point, 185° C. (365° F.). *Parachloralose* occurs in the form of small colorless scales, insoluble in cold water, slightly soluble in hot water, more soluble in hot alcohol and ether. Melting-point, 229° C. (444.2° F.). It is used as a hypnotic. Dose : 2 to 8 grains (0.1–0.5 Gm.).

CHLORAL-PHENOL, *Carbolated chloral, Chloral-carbol*, is made by triturating equal weights of chloral hydrate and carbolic acid ; it forms a colorless viscid liquid, specific gravity 1.289 at 20° C. (68° F.) ; it possesses prominently the odor of chloral hydrate, has a sweet caustic taste, and produces blisters when placed upon the skin. It is miscible with alcohol, acetic acid, chloroform, carbon disulphide, and ether. Chloral-phenol in small quantities coagulates albumin ; an excess redissolves it. Cotton impregnated with it has been recommended for relief in toothache. J. B. Garrison (1881) prefers for this purpose the firm and short cotton from the cottonwood tree, *Populus canadensis* Michaux ; when saturated with the liquid it is known as *chloro-carbolated cotton.*

SOMNAL. *Ethylated chloral-urethane.*—Under this name a hypnotic was introduced in 1889, which is made by union of chloral, alcohol, and urethane. It melts at 42° C. (107.6° F.), does not react with silver nitrate, and is not acted upon by acids. It is administered in doses of 2 Gm. (30 grains) in aqueous solution flavored with syrup. Half an hour after its administration a sound sleep, lasting from 6 to 8 hours, is produced without any unpleasant after-effects.

CHLORAL-URETHANE. *Ural, Uralium, Uraline.* $C_5H_8Cl_3O_3N$ or $CCl_3COHNH_2COOC_2H_5$. —Melted chloral hydrate is capable of dissolving urethane ; if to such a solution concentrated hydrochloric acid is added, it solidifies within 24 hours to a mass insoluble in water. This is then treated with concentrated sulphuric acid and washed with water, by which an oily liquid results, which subsequently crystallizes. The product is insoluble in cold and decomposed by boiling water ; it is soluble in alcohol and ether, and reprecipitated by water ; its melting-point is 103° C. (217.4° F.). The average dose as a hypnotic is 1 Gm. (15 grains), but its sparing solubility has operated against its use.

CHLORAL HYDROCYANIDE. *Chloral cyanhydrin, Chloral hydrocyanin*, E. ; *Blausäure-Chloral, Chloralcyanhydrat*, G. $CCl_3.CHOHCN$.—This compound was first obtained in 1872 by treating chloral with anhydrous hydrocyanic acid at an elevated temperature. Pinner (1884) suggested to prepare it by dissolving chloral hydrate in a 10 or 12 per cent. solution of hydrocyanic acid obtained from potassium ferrocyanide, equal in weight to that of the chloral hydrate ; the solution after 24 hours is digested for several hours, and finally evaporated on a water-bath. It crystallizes from water in white rhombic plates, melts at 61° C. (141.8° F.), boils with partial decomposition between 215° and 220° C. (419°–428° F.), has an odor recalling that of hydrocyanic acid and chloral, and is readily soluble in water, alcohol, and ether. An aqueous solution of chloralcyanhydrin will remain unchanged for some time, and is not precipitated by silver nitrate, except after heating ; alkalies decompose the salt, yielding chloroform, hydrocyanic and formic acids. It has been recommended as a substitute for hydrocyanic acid, of which it yields 15.5 per cent. ; 1.29 Gm. of chloralcyanhydrin dissolved in 9 Gm. of distilled water furnishes a solution equal in strength to the official 2 per cent. hydrocyanic acid. On adding 0.1 Gm. of "chloral hydrocyanate," 0.2 Gm. of ferric sulphate, and 1 drop

of ferric chloride, to about 5 Cc. of an aqueous solution of sodium hydroxide, the mixture will after a few minutes produce a blue precipitate on acidulating with hydrochloric acid (Hager). The purity of the compound may be determined by estimating the per cent. of hydrocyanic acid. 2 Gm. of the sample with 8 Gm. of a 33.3 per cent. solution of potassium hydroxide and 8 Gm. of sodium thiosulphate are evaporated to dryness on a water-bath, the residue taken up with water, slightly acidulated with sulphuric acid, a sufficient quantity of cupric sulphate added, the solution heated, and the precipitated copper sulphocyanate dried at 110° C. (230° F.). The precipitate multiplied by 0.2077 gives the weight of the hydrocyanic acid (Kaiser and Scharges). Free hydrocyanic acid may be detected in the compound by adding it to a freshly prepared solution of guaiac and copper sulphate (1 part of guaiac resin in 100 parts of absolute alcohol, to which are added a few drops of a dilute aqueous solution of cupric sulphate, 1 part in 8000 of water), a blue color being developed if free hydrocyanic acid is present. It is recommended as a substitute for hydrocyanic acid.

CHLORAL-CAFFEINE.—Prepared by mixing 10 parts of caffeine and 7.8 parts of chloral hydrate in concentrated aqueous or alcoholic solution and evaporating at a moderate temperature. Colorless glistening scales soluble in water and alcohol.

BROMAL HYDRAS. *Bromal hydrate, Tribromaldehyde hydrate.* $C_2HBr_3O+H_2O$. Molecular weight, 298.14.—Bromal (anhydrous) and bromal hydrate are analogous to chloral and chloral hydrate in their preparation and general properties. *Bromal* is prepared by conducting a current of bromine into absolute alcohol, kept cold during the first stage of the operation, and on completion of the reaction the mixture is distilled, and the distillate coming over between 150° and 180° C. (302°–356° F.) collected separately and fractionated by subsequent distillation, yielding the oily liquid *bromal* (tribromaldehyde, C_2HBr_3O), which boils without decomposition at 172°–173° C. (341.6°–343.4° F.), and when mixed with the requisite amount of water forms *bromal hydrate*, $C_2HBr_3O + H_2O$, which is crystallizable from water in the form of large, colorless rhombic crystals, or scales, having a peculiar, pungent, irritating odor and disagreeable, pungent taste. Bromal hydrate melts at 53.5° C. (128.3° F.), is soluble in water, alcohol, ether, chloroform, and carbon disulphide, and is readily decomposed by alkali hydroxides into bromoform and alkali formate. Its aqueous solution (1 in 10) should be clear (absence of bromal alcoholate) and show no turbidity with solution of silver nitrate (absence of bromides). Bromal should not be confounded with *bromol*, a name given to tribromophenol, $C_6H_2Br_3OH$, which is obtained as a colorless or white crystalline powder by the action of bromine on carbolic acid. It is used as a hypnotic and antispasmodic in the dose of from 2 to 15 grains (0.10–1 Gm.).

CHLOROFORMUM, *U. S., Br.*—Chloroform.

Chloroformum purificatum, U. S. 1880; *Trichloromethane, Methenyl trichloride*, E.; *Chloroformium*, P. G.; *Chloroform*, G.; *Formylum trichloratum, Trichlorure de formyle, Chloroforme*, Fr.; *Chloroformio*, It.; *Chloroformo*, Sp.

Formula, $CHCl_3$. Molecular weight, 118.45.

A liquid consisting of 99 to 99.4 per cent. by weight of absolute chloroform, and 0.6 to 1 per cent. of alcohol.—U. S.

Chloroform, or trichloromethane, $CHCl_3$, to which has been added sufficient absolute alcohol to produce a liquid having a specific gravity not less than 1.490, and not more than 1.495.—Br.

It should be kept in dark, amber-colored glass-stoppered bottles, in a cool and dark place.

Chloroform was discovered and prepared in a pure form in 1831 by Samuel Guthrie, Sackett's Harbor, N. Y., and, independently, about the same time, by Liebig, in Germany, and Soubeiran, in France. The pharmacopœias give no process for its preparation. Commercially, it is prepared from alcohol, and in recent years more particularly from acetone by treatment with chlorinated lime, and rarely from chloral by action of an alkali hydroxide.

Preparation.—Chloroform may be prepared from alcohol by mixing 6 parts of chlorinated lime (assaying 30 to 35 per cent. of chlorine) with 24 parts of water, straining the mixture into a still, adding 1 part of stronger alcohol, and heating the mass to 45°–50° C. (113°–122° F.). At this temperature the reaction proceeds rapidly, and as the temperature rises, a mixture of chloroform, alcohol, and water distils over, the distillate on completion of the distillation consisting of two layers, the lower of which is removed and thoroughly washed with water, and then repeatedly with concentrated sulphuric acid, until the acid is no longer discolored. The washed chloroform is then treated with a solution of sodium carbonate, again washed with water, and finally dehydrated with suitable dehydrating agents (fused calcium chloride, fused potassium carbonate, or phos-

phoric anhydride, etc.) and subjected to fractional distillation, the first fractions separated and the fractions distilling between 59° and 62° C. (138.2–143.6 F.) collected as chloroform, and, if desired, subjected to further purification by redistillation, refrigeration (process of Pictet), or crystallization with salicylide, etc. (process of Anschütz).

The reaction taking place between the alcohol and the chlorinated lime is a very complex series of chemical reactions, but may be summarized into the successive productions of aldehyde, chloral, and chloroform, as illustrated in the following equations: $2C_2H_6O$ (alcohol) + $Ca(OCl)_2$ (calcium hypochlorite) = $2C_2H_4O$ (aldehyde) + $CaCl_2$ + $2H_2O$; $2(C_2H_4O)$ (aldehyde) + $3Ca(OCl)_2 = 2(C_2HCl_3O)$ (chloral) + $3Ca(OH)_2$ (calcium hydrate); $2(C_2HCl_3O)$ (chloral) + $Ca(OH)_2$ (calcium hydrate) = $2(CHCl_3)$ (chloroform) + $Ca(CHO_2)_2$ (calcium formate).

For papers on the manufacture of chloroform, see *Am. Jour. Pharm.*, 1862, pp. 25, 42; 1868, p. 289; 1889, p. 321; Squibb's *Ephemeris*, vol. iv. No. 4, pp. 1743–1757; *Proc. Am. Pharm. Assoc.*, vol. xli. p. 909; xliv. p. 757; xlv. p. 660; xlvii. p. 535; xlviii. p. 767.

Preparation from Acetone.—Although Liebig had shown in 1832 that chloroform could be made from acetone by treatment with chlorinated lime, and the condition of its formation were well understood (Bonnet, 1837; Böttger, 1848), it appears that the commercial manufacture of chloroform from acetone or acetates did not come into prominence until about 1885, since which time acetone and acetates have been the most economical source of commercial chloroform. Acetone when treated with chlorinated lime under the proper conditions yields 180–200 per cent. by weight of chloroform. 10 parts of acetone diluted with 30 parts of water are gradually and with constant stirring introduced into a mixture of 100 parts of chlorinated lime (30 to 35 per cent. of available chlorine) and 300 parts of water contained in a suitable retort, and the whole subjected to distillation. The resultant product is purified as above. The chemical reaction is explained in the intermediate formation of trichloracetone as follows: $2C_3H_6O$ (acetone) + $3Ca(OCl)_2$ (chlorinated lime) = $2C_3H_3OCl_3$ (trichloracetone) + $3Ca(OH)_2$; $2(C_3H_3Cl_3)$ (trichloracetone) + $Ca(OH)_2 = 2CHCl_3$ (chloroform) + $Ca(C_2H_3O_2)_2$ (calcium acetate).

An electrolytic process has been devised (L. Lambellati, *L'Elettricita*, 1899, p. 664) in which an electric current of about 5 or 6 ampères is passed through carbon stirrers, serving as an anode, into a hot aqueous 20 per cent. solution of sodium or calcium chloride, while acetone is being introduced into the bottom of the leaden still which serves as the cathode. Chlorine and sodium hydroxide are generated by the electric current. The chlorine converts the acetone into trichloracetone, and this in turn is decomposed by the alkali hydroxide, producing chloroform and acetate, according to the equation: $C_3H_3OCl_3$ (trichloracetone) + NaOH = $CHCl_3$ (chloroform) + $NaC_2H_3O_2$ (sodium acetate).

At the present time but little chloroform is obtained on a commercial scale by the action of sodium hydroxide on chloral hydrate. 165 parts of the latter are capable of yielding 119 parts of chloroform, as shown by the equation: $C_2HCl_3O.H_2O$ (chloral hydrate) + NaOH = $CHCl_3$ (chloroform) + $NaCHO_2$ (formate) + H_2O.

A new (1896) method has been introduced for making chloroform from tetrachlormethane, CCl_4. 75 parts of tetrachlormethane are subjected to the action of nascent hydrogen generated from the action of 60 parts of hydrochloric acid (22° B.) and 50 parts of zinc, the reaction being as follows: CCl_4 (tetrachlormethane) + 2H = $CHCl_3$ (chloroform) + HCl.

Chautart proposed to prepare chloroform from oil of turpentine, but Soubeiran proved that chlorinated lime diffused in water acts violently upon the oil, and that but a little chloroform having a turpentine odor is obtained. Damoiseau (1881) suggested that pure chloroform may be advantageously prepared by passing a mixture of methyl chloride, CH_3Cl, and chlorine in proper proportion through a long tube containing animal charcoal and heated to between 250° and 350° C. (482°–662° F.).

Purification.—Chloroform which fails to respond to the pharmacopœial tests, may be purified by the following process: Chloroform, 400 Gm.; sulphuric acid, 80 Gm.; dried sodium carbonate, 20 Gm.; deodorized alcohol, 4 Cc.

Add the sulphuric acid to the chloroform, contained in a glass-stoppered bottle, and shake them together occasionally during 24 hours, avoiding exposure to bright daylight. Separate the lighter chloroform layer, add to it the dried sodium carbonate, previously rendered anhydrous by heating it in a porcelain capsule on a sand-bath until it ceases to give off aqueous vapor, and shake them together frequently and thoroughly during half

an hour. Then transfer the chloroform to a dry retort, add to it the alcohol, and distil, by means of a water-bath, at a temperature not exceeding 67.2° C. (153° F.), into a well-cooled receiver, until the distillate measures 255 Cc.

Special methods have recently been proposed for the preparation of chemically pure chloroform, notably that of Pictet by means of refrigeration to —82° C. (—147.6° F.), at which point the pure chloroform is obtained in solid form, to be subsequently distilled at a low temperature under reduced pressure. R. Anschütz (1892) proposed the formation of a salicylide-chloroform, to be obtained in crystallized form by allowing salicylide, C_6H_4COO, and also ortho-homosalicylide, $CH_3C_6H_4COO$, to remain in contact with chloroform for 24 hours; the compounds, which contain 33.24 and 30.8 per cent. of chloroform respectively, may be kept in closed vessels for a long period, and readily yield the chloroform by distillation, the union being a feeble one and comparable with water of crystallization. None of the impurities have been found to form crystallizable compounds with salicylide or ortho-homosalicylide, and the latter substances may be used repeatedly in this process.

The chloroform manufactured by the different methods when properly purified cannot be distinguished one from the other, so that we are limited to chemical tests to determine its fitness for anæsthetic and other purposes.

Properties.—Pure (absolute) chloroform is a heavy, colorless, mobile, and diffusible liquid, not inflammable, of an agreeable characteristic ethereal odor, a hot sweetish taste, of neutral reaction, volatilizes at ordinary temperature, and boils at 62° C. (143.6° F.). Its specific gravity at 15° C. (59° F.) is 1.502. It is soluble in about 200 parts of water, to which it imparts its taste and odor, and is miscible in all proportions with alcohol, ether, benzene, benzin, and fixed and volatile oils. It is a solvent for paraffin, guttapercha, camphor, caoutchouc, many resins, most alkaloids, iodine (with violet color), bromine (with brown color), and considerable phosphorus and sulphur. Concentrated sulphuric acid or nitric acid at ordinary temperatures does not affect chloroform, but a mixture of these acids will, on heating them with chloroform, produce *nitrochloroform*, CCl_3NO_2, an oily liquid boiling at 112° C. (233.6° F.), and of a strong, irritating odor. Heated with alcoholic potassium hydroxide and a little resorcin, chloroform yields a reddish-yellow solution with strong greenish fluorescence. Boiled with a concentrated aqueous solution of potassium hydroxide and α- or β-naphtol, a blue color is produced which on exposure to air turns green and finally brown.

On heating chloroform with strong aqueous solution of potassium or sodium hydroxide, it is slowly decomposed, rapidly in presence of much alcohol, into chloride and formate of the alkali metal. It reduces Fehling's Solution. Heated with alcoholic potassium hydroxide solution and a little aniline, it produces "isonitril" (benzo-isonitril, phenyl-isonitril), recognized by its peculiar odor. and readily distinguishing chloroform from ethylene chloride, $C_2H_4Cl_2$, which fails to give the reaction. The vapor of chloroform passed through a red-hot tube yields chlorine, and, in conjunction with hydrogen under the same conditions, hydrochloric acid. Chloroform solidifies, or crystallizes, when cooled to —80° C. (—112° F.), the crystals melting again at —70 C. (—94° F.). It forms crystalline compounds with salicylide (see above) and homosalicylide; with *colchicine* ($C_{22}H_{25}NO_6.2CHCl_3$), Zeisel; with *berberine* (E. Schmidt), and with *lebrain* ($C_{19}H_{18}O_9$-$CHCl_3$), G. Kassner, *Arch. d. Pharm.*, 239, 47. Chloroform does not coagulate albumin. It acts as an antiseptic and bactericide, and has for this reason been used as a test to distinguish chemical and living ferments, the former not being affected, while it checks the action of the latter (*Pharm. Jour.*, 1874, pp. 441, 442, 455). It is a powerful anæsthetic, and as such has some advantage over ether, as its vapors are not inflammable, although on coming in contact with a naked flame a disagreeable and irritating odor may be developed on account of the liberation of chlorine. Paper saturated with chloroform and ignited burns with a green flame along the line of charring of the paper.

In the pure state chloroform is very prone to decompose when exposed to air and light, liberating chlorine, hydrochloric acid, phosgene ($COCl_2$), and other products. Oxygen is essential to its decomposition by light. Its tendency to decompose is overcome by the addition of oxidizable substances. Thus, sulphur (L. Allain, *Jour. de Pharm* (6), xv. 252), and poppy-seed oil (V. Masson, loc. cit. (6), ix. No. 12), in quantities as small as 0.1 per cent., were found sufficient to keep chloroform unchanged for months. Alcohol acts similarly as a preservative.

Pharmacopœial Chloroform.—Owing to the tendency of pure chloroform to decompose on exposure to light, commercial and pharmacopœial chloroform contains alcohol a

a preservative. 0.5 to 1 per cent. of alcohol suffices to prevent decomposition, and its addition within these limits has been adopted by the various pharmacopœias (0.4 to 0.7 per cent., Br.; 0.6 to 1 per cent., U. S. P.; 0.7 to 1 per cent., G. P.) for this purpose, although various observers have shown that 0.6 per cent. of alcohol will suffice to keep chloroform for over a year without perceptible evidence of decomposition. The addition of alcohol lowers both the specific gravity and the boiling-point. Biltz gives the following for additions of alcohol up to 2 per cent.:

Alcohol added.	Specific gravity at 15° C.	Boiling-point.
0.25 per cent.	1.4977	61.3°–61.9° C.
0.50 "	1.4939	61.07–61.8
1.0 "	1.4854	60.27–61.6
2.0 "	1.4705	59.7 –61.2

The pharmacopœial requirements are for specific gravity: U. S. P., not below 1.476 at 25° C. (77° F.); the P. G., 1.485 to 1.489; the Br. P., 1.490 to 1.495; and the boiling-points being: U. S. P., 60° to 61° C. (140°–141.8° F.); P. G. and Br. P., 60° to 62° C. (140°–143.6° F.).

The solubilities and general properties of pharmacopœial chloroform differ but very slightly from those given under pure (absolute) chloroform (see above), the slight differences being due to the small percentage of added alcohol. The purity of commercial chloroform is readily determined by the U. S. P. tests, and chloroform which does not pass these tests should not be used for anæsthetic purposes.

Tests.—If 10 Cc. of chloroform be poured upon a clean odorless filter laid flat upon a warmed porcelain or glass plate, and the plate be rocked from side to side until the liquid is all evaporated, no foreign odor should become perceptible as the last portions disappear from the paper, and the paper should be left odorless. If 10 Cc. of chloroform be well shaken with 20 Cc. of distilled water, and the liquid be allowed to separate completely, the water should be neutral to litmus-paper, and should not affect silver nitrate test-solution (absence of chlorides) nor potassium iodide test-solution (absence of free chlorine). If 40 Cc. of chloroform be shaken with 4 Cc. of colorless, concentrated sulphuric acid (absolutely free from chlorine compounds) in a 50 Cc. glass-stoppered cylinder during 20 minutes, and the liquids be then allowed to separate completely, so that both are transparent, the chloroform should remain colorless, and the acid should appear colorless or very nearly colorless when seen in a stratum of not less than 15 Mm. in thickness (absence of impurities decomposable by sulphuric acid). If 2 Cc. of the sulphuric acid, separated from the chloroform, be diluted with 5 Cc. of distilled water, the liquid should be colorless and clear, and, while hot from the mixing, should be odorless or give but a faint vinous or ethereal odor (absence of odorous decomposition-products). When further diluted with 10 Cc. of distilled water it should remain clear, and should not be affected by silver nitrate test-solution (absence of chlorinated decomposition-compounds).—U. S.

The decomposition by alkali hydroxide solution may be used as the basis for the quantitative estimation of chloroform in liquids. Puckner (*Proc. Am. Pharm. Assoc.*, 1901, pp. 294–297) gives the following method: To 10 Cc. of an approximately normal alcoholic solution of potassium hydroxide, either free from chloride or else of a known chloride content, and contained in a vial, add a measured volume of the chloroform mixture representing from 0.05 to 0.2 Gm. of chloroform, stopper with a sound cork, cover with cloth and tie this down firmly, mix the liquids by rotation, then place the vial in boiling water in such a way that at no time the contents come in contact with the cork, and maintain the temperature for 3 hours. Remove the vial from the bath, let cool, add phenolphtalein, and then sufficient sulphuric acid to exactly neutralize the liquid, then add 2 drops of potassium dichromate test-solution and titrate with decinormal silver nitrate. 1 Cc. of decinormal nitrate represents 0.003969 Gm. of $CHCl_3$. Chloroform may readily be recovered from blood, tissues, and liquids for identification by adding a few Cc. of alcohol to the test-object, and, after acidulating with tartaric acid, subjecting the whole to gentle distillation, and applying to the distillate the tests given above under *Properties*, for its identification.

Action and Uses.—Locally applied to the skin and prevented from evaporation by a cloth or a watch-glass, chloroform is capable of producing a blister, and, given hypodermically, of causing a slough. Taken internally in overdose, it is capable of producing death in the same manner as it causes death when taken in overdose by inhalation. Much discussion has arisen as to the mode by which chloroform produces death when taken by inhalation. When it is taken by inhalation for the production of surgical

anæsthesia and an accident occurs, there can be no doubt that its primary influence is exercised as a depressant upon the vasomotor system, causing the patient to be bled into his own bloodvessels, so that the vital centers are starved of blood. In unduly susceptible persons or in those having myocardial disease, it probably causes death by direct depression of the heart muscle, and in still others it may cause death by respiratory failure, for chloroform is a depressant poison to all living protoplasm with which it comes in contact in concentrated form. As its odor is not disagreeable and its vapor is not irritating when mixed with a proper amount of air, it is a more agreeable anæsthetic than ether, and it is possible sometimes to anæsthetize a sleeping patient without awaking him. Properly administered, chloroform is capable of producing surgical anæsthesia within a few moments after its inhalation commences. This anæsthesia depends upon its influence upon the peripheral centers in the posterior portions of the brain. The influence of the drug ought never to be carried to the point of complete muscular relaxation. The fact that it is a much more agreeable anæsthetic than ether has led many practitioners to employ it, but the death-rate from accidents under its use is about 1 in 3000; while the death-rate from accidents in the use of ether is about 1 in 13,000. While, therefore, it is our belief that ether is the anæsthetic of choice in the majority of instances, there can be no doubt that chloroform has a very large field of usefulness, and ought to be employed for all persons who are known to take ether badly and in cases of Bright's disease, since it does not irritate the kidney as much as does ether, because of the small quantity of it which is necessary to produce anæsthesia. Because of the rapidity of its action and its small bulk, it is the anæsthetic of choice on the battlefield.

Chloroform has been largely used by obstetricians for relieving the pains of labor, and has rarely produced death when used for this purpose, so that many practitioners regard it as the anæsthetic of choice during parturition. In puerperal convulsions, when they are exceedingly severe and cannot otherwise be controlled, chloroform may be used as a rapidly acting relaxant, and the bromides or veratrum viride may also be employed. Whiffs of it may be used in cases of severe angina pectoris, although this practice is not without danger.

It is a noteworthy fact that many of the accidents with chloroform have occurred during the first inhalations of the drug.

When chloroform vapor in the air comes in contact with a gas-flame, it is decomposed and sets free fumes of chlorine and hydrochloric acid, which cause great irritation of the respiratory passages. The drug should always be kept in dark bottles, well corked, as it is capable of undergoing decomposition-changes which increase its dangerous properties. The best inhaler for its use is that which is known as Esmarch's inhaler.

Taken internally, chloroform, in the dose of from 3 to 5 minims (0.20–0.30 Cc.), well diluted with water, is an excellent remedy for wind colic and abdominal pain; or the spirit of chloroform may be used in the dose of from 1 to 2 fluidrachms (4–8 Cc.), well diluted with water or with equal parts of spirit of camphor and water, for the same purpose.

Allied and Derivative Compounds.—BROMETONE, or TRIBROM-TERTIARY-BUTYL-ALCOHOL, $C_4H_7OBr_3$ or $(CH_3)_2COHCBr_3$.—This compound is said to be obtained as a condensation-product by the action of caustic alkalies on a mixture of bromoform and acetone. It occurs in fine white prismatic crystals having a camphoraceous odor and taste. Brometone melts at about 167° C. (332.6° F.) and is slightly soluble in cold and more soluble in hot water; also quite soluble in alcohol, ether, benzin, etc.

CHLORETONE, or TRICHLOR-TERTIARY-BUTYL-ALCOHOL, $C_4H_7OCl_3$ or $(CH_3)_2COHCCl_3$.—This is prepared in a manner similar to the preceding compound, except that chloroform is used in place of bromoform. Like bromoform, it occurs in beautiful snow-white crystals with camphor-like odor and taste. It is very soluble in alcohol, ether, and chloroform, also freely soluble in glycerin, volatile and fixed oils, benzin, and acetone. Warm water dissolves chloretone to the extent of 1 per cent., but on cooling a portion crystallizes out, leaving a saturated solution of about 0.8 per cent. strength. Chloretone is unaffected by heat or light and under ordinary conditions of exposure its solutions are permanent. Chloretone is a hypnotic and local anæsthetic. It produces sedation of the central nervous system, and is non-irritant, non-toxic, and without effect upon the heart. It is a useful remedy in nausea, especially that of chloroform or ether anæsthesia and seasickness. Combined with an equal quantity of boric acid it forms an excellent dusting-powder for wounds, ulcers, bedsores, etc.; and its solution in liquid petrolatum along with menthol and aromatic oils affords relief in irritable conditions of the nasal, pharyngeal, and bronchial mucous membranes. The dose as a hypnotic is from 5 to 20 grains (0.30–1.30 Gm.).

CHONDRUS, *U. S.*—Irish Moss.

Carrageen, P. A., P. G.; *Killeen, Pig-wrack, Pearl-moss*, E.; *Fucus crispus, Lichen Hibernius*, Russ.—*Carragaheen, Mousse perlée*, Fr. Cod.; *Irländisches Moos, Perlmoos, Knorpeltang*, G.; *Fuco carrageo*, F. It.; *Musgo d'Irlande, Fuco crispa*, It.; *Caragaheen, Musco marine perlado*, Sp.; *Alga perlada, Musgo Branco*, Port.

The dried plant of *Chondrus crispus* (L.) Lyngbye (*Fucus c.* L.—Fam. *Gigartinaceæ*).

Chondrus is official in nearly all pharmacopœias.

Origin.—The plant grows on submerged rocks along the north Atlantic, and is collected on both the European and American coasts. It is dried and bleached on the sand, the operation requiring about two weeks. Meantime, it has to be daily sprinkled with sea-water and turned over, and to be kept from contact with fresh water. Two grades are recognized, respectively, from the spring and summer collections, the former being superior. The later crop is apt to be attacked by a sort of black mildew.

Description.—Usually less than 15 Cm. (6 In.) long, repeatedly forking from a short, cylindraceous base, the ultimate segments either linear or short and broad, blunt, scarcely acute, the summit notched or slightly 2-lobed; mass light-yellow or yellowish-white, highly elastic, cartilaginous, of a slight saline odor and taste, very mucilaginous, not astringent or bitter. Not more than 17 per cent. of ash should be yielded upon incineration.

1 part boiled for 10 minutes with 30 parts of water yields a gelatinous mass, when cold, which is not colored blue by iodine test-solution.

Fig. 103.

Chondrus crispus: broad form.

Fig. 104.

Narrow form, with fruit.

Fig. 105.

Gigartina mamillosa: with fruit.

Constituents.—Chondrus gives from 55 to 90 per cent. of a pectin-like mucilage, called *carrageenin*, of which only part is soluble in cold water; also traces of iodine and bromine, and some sulphur. Starch is absent. There is about 1 per cent. of nitrogen, chiefly in the mucilage.

Pharmaceutical Preparations.—Compound Syrup of Chondrus (Irish Moss), N. F.; Mucilage of Irish Moss, N. F.

Action and Uses.—Irish moss is demulcent and slightly nutritious. It was at one time largely employed in the treatment of chronic pulmonary and bronchial affections and in disordered conditions of the intestinal tract. It was also recommended in chronic disorders of the kidneys and bladder, but is now rarely used.

Carrageen is usually administered in the form of a decoction. The drug should be macerated in cold water for 15 minutes in order to separate any impurities which may be present. One-half ounce (16 Gm.) is then added to 1½ pints (720 Cc.) of water and boiled down to 1 pint (480 Cc.). This is flavored with lemon and sugar, and given in doses of 1 fluidounce (30 Cc.) several times daily.

Allied Drugs.—Dulse is the name given to *Halymenia* (*Fucus* L., *Rhodomenia* Greville, *Sphærococcus* Kützing) *palmatus* and *edulis* Agardh, 2 florideous algæ growing on the coasts of the Atlantic and Mediterranean. Both are of a deep blood-red, or after drying dark-purple, color, and have flattened fronds, that of the first species being palmately divided into oblong, wedge-shaped lobes. Stenhouse (1844) found it to contain mannite, and Magin-Bonet proved the presence of bromine and iodine.

Helmintiiochorton, Corsican Moss; *Mousse de Corse*, Fr. Cod.—This consists partly of *Sphærococcus* (*Fucus* L., *Ceramium* Willd., *Gigartina* Lamouroux, *Alsidium* Kützing) *Helminthochorton* Agardh, which grows in the Mediterranean, but as found in commerce is always a mixture, sometimes of 20 or 30 different species of algæ. The drug is cartilaginous, filiform, repeatedly forked, varies in color between brown, yellowish, and whitish, and has the odor of seaweeds and a strongly saline and mucilaginous taste. It contains mucilage and various salts, among them bromides and iodides, but its anthelmintic principle, if any, is unknown.

Fucus amylaceus, Ceylon Moss, also called *Jaffna* and *Edible moss*, comes from the Indian Ocean, and consists of *Sphærococcus* (*Plocaria* Montag, *Gracilaria* Greville) *lichenoides* Agardh. It is about 10 Cm. (4 In.) or more long, about 1.5 Mm. ($\frac{1}{16}$ In.) thick, cylindrical, irregularly forked, filiform above, and has in the fresh state a reddish color, but on drying becomes nearly white and rather brittle. It has a slight seaweed odor and a mucilaginous taste. H. G. Greenish (1882) found in it moisture 15, ash 10.2, albuminoids 7.5, and matter soluble in alcohol 0.1 per cent., and determined the absence of mannite and the presence of various carbohydrates differing in their behavior to water and alkalies and in the sugar they yield with acids, namely, metarabin 1.32, and others soluble in soda solution 3.12, gelose and others soluble in hot water 36.7, paramylon 6.5, wool-gum 3.2, and cellulose 10.2 per cent.

CHROMII TRIOXIDUM, *U. S.*—Chromium Trioxide.

Acidum chromicum, U. S., 1890, Br., P. G.—*Chromic acid, Chromic anhydride*, E.; *Acide chromique*, Fr.; *Chromsäure*, G.; *Anidride cromica*, F. It.; *Acido cromico*, It., Sp.

Formula, CrO_3. Molecular weight, 99.34.

Chromium trioxide should contain not less than 90 per cent. of chromic anhydride. It should be kept in glass-stoppered bottles, and great caution should be observed to avoid bringing it in contact with organic substances, as cork, tannic acid, sugar, alcohol, etc., since dangerous accidents are liable to result.—U. S.

Preparations.—This acid was discovered by Vauquelin in 1797, but its chemical composition was determined by Berzelius.

When a concentrated solution of potassium dichromate is acted upon by strong sulphuric acid, chromium trioxide is set free, as shown by the following equation: $K_2Cr_2O_7 + 2H_2SO_4 = 2CrO_3 + 2KHSO_4 + H_2O$; this is due to the fact that chromic acid proper (H_2CrO_4) cannot exist in a free state. When prepared by the ordinary methods, chromic acid usually is contaminated with sulphuric acid and potassium salts, the former rendering it very hygroscopic. Inasmuch as the U. S. and German Pharmacopœias demand chromic acid free from sulphuric acid, it is likely that the following plan, first suggested by Bunsen (1868), is now more generally used: 30 parts of potassium dichromate, 50 parts of water, and 77.5 parts of concentrated sulphuric acid are heated together to complete solution and let stand for 12 hours. The crystals of potassium bisulphate formed are removed on an asbestos filter and the liquid heated to 85° C. (185° F.). 27.5 parts of concentrated sulphuric acid are then added in small portions while stirring, and just sufficient water to redissolve any crystals of chromic acid that may be formed; the whole is left standing 12 hours in a cool place. The crystals are then drained on an asbestos filter, dried on a porous plate, washed with small quantities of nitric acid, dried again on plates, and finally at 60°–80° C. (140°–176° F.), to remove nitric acid.

Properties.—Chromium trioxide forms small, needle-shaped crystals or rhombic prisms, of a dark purplish-red color and metallic lustre; odorless; destructive to animal and vegetable tissues; deliquescent in moist air. Very soluble in water, forming an orange-red solution. When brought in contact with alcohol, ether, glycerin, and other organic solvents, decomposition takes place, sometimes with dangerous violence. When chromium trioxide is heated, its color darkens, and finally becomes black, but is restored on cooling. At 192° to 193° C. (377.6°–379.4° F.) it fuses to a reddish-brown liquid, which, on cooling, forms a dark red, brittle mass (often enclosing cavities filled with crystals), furnishing a scarlet powder. Above 250° C. (482° F.) it begins to decompose into green chromic oxide and free oxygen, and, after protracted heating, leaves a

residue of pure chromic oxide, which should yield nothing soluble to water (U. S.). When contaminated with sulphuric acid, the color of chromium trioxide is scarlet red.

A concentrated solution is of a red-brown color, which changes to orange yellow on being diluted; the dilute solution reddens blue litmus-paper and bleaches it on drying. If strong alcohol is dropped upon chromium trioxide, a vigorous action takes place, accompanied with increase of temperature and ignition of the alcohol. A rapid ignition is observed likewise with benzene; but ether which is free from both alcohol and water dissolves this compound, and on spontaneous evaporation yields it again in minute crystals. Chromium trioxide dissolved in diluted alcohol is deoxidized gradually at the ordinary temperature, the alcohol being converted into aldehyde and acetic acid. Reduction takes place also in the presence of arsenous and sulphurous acids, hydrogen sulphide, and of organic compounds and deoxidizing agents generally. When heated with hydrochloric acid, chlorine and green chromic chloride are produced. In all these cases the CrO_3 passes into Cr_2O_3 or its salts.

Dissolved in water, chromium trioxide forms chromic acid, H_2CrO_4, the salts of which have mostly a yellow or yellowish-red color; those of the alkalies—magnesium, calcium, zinc, and copper—are soluble in water; all others dissolve in nitric acid.

Tests.—A solution of 1 Gm. of chromium trioxide in 100 Cc. of water, previously acidulated with a few Cc. of hydrochloric acid, should not be rendered turbid on the addition of 1 Cc. of barium chloride test-solution (absence of sulphuric acid). If 1 Gm. of chromium trioxide be dissolved in 100 Cc. of water, and 8.3 Cc. (8.28 Cc.) of this solution measured into a glass-stoppered bottle of about 100 Cc. capacity, followed by 20 Cc. of water, 2 Cc. of hydrochloric acid, and about 1 Gm. of potassium iodide, after securely closing and shaking for a few minutes, and adding 1 Cc. of starch test-solution, not less than 22.5 Cc. of tenth-normal sodium thiosulphate test-solution should be required to discharge the blue color, the remaining solution retaining a greenish color (each Cc. of the volumetric solution indicating 4 per cent. of pure chromium trioxide). —U. S.

Action and Uses.—Chromium trioxide is practically never employed internally, but may be given in doses of ¼ grain (0.015 Gm.). It has been used largely as an antiseptic and caustic, but at present its use is confined almost exclusively to the removal of small growths, such as warts, from the skin and condylomata from the external genitals. For this purpose it may be applied in the form of a solution containing 100 grains (6.6 Gm.) of the acid to 1 fluidounce (30 Cc.) of water. Care should be exercised in its application, for if applied over too large a surface it may cause poisoning and death, or produce sloughing. Deliquesced chromium trioxide may be applied to hypertrophied turbinated bones, but at present is used less largely than formerly for this purpose, because of the violent headache which sometimes follows its application. A solution of the drug applied to the bases of nasal and post-nasal polypi, after their removal by mechanical means, is said to prevent recurrence.

CHROMIUM.—Chromium.

Symbol, Cr. Atomic weight, 51.7. Valence variable: 2 in chromous salts, 3 in chromic salts, 6 in chromic acid.

Chromium was isolated in 1797 by Vauquelin in native lead chromate which had been discovered in 1762 in Siberia by Lehman. The name is derived from *χρωμα*, color, and was assigned because all the compounds of chromium were found to be highly and variously colored. The chief ore of chromium is chrome-iron ore, $Cr_2O_3.FeO$. It was formerly difficult to reduce the oxide to the metallic state, but it can now be readily done by igniting a mixture of the oxide and aluminum filings (Goldschmidt), or by reducing the oxide with carbon in the electric furnace.

Chromium is a steel-gray metal, fusible only in the oxyhydrogen flame or electric arc, and very hard, soluble in hydrochloric and hot sulphuric acids, but not in nitric acid. Several alloys of chromium are valuable, particularly ferro-chrome, which is used in the manufacture of steel. Chromium forms 2 well-defined oxides: chromic oxide (sesquioxide), Cr_2O_3, which is dark-green and gives rise to the chromic salts; and chromium

trioxide, CrO_3, which has been described under CHROMII TRIOXIDUM. Although chromous oxide, CrO, does not exist in the free state, salts derived from it are known. Chromium salts as well as soluble chromates are used extensively in the industries; at present, chromium hydroxide is the most important mordant for fixing dyes on fabrics, since chrome lakes are much superior to aluminum lakes in color and fastness. The chromium hydroxide is precipitated on the fibers either from chromium salts by an alkali or from chromates by reducing agents, and there forms an insoluble compound with dyes. Chromates or dichromates are also used in a new process for tanning by which the time is very much shortened.

Action and Uses.—Chromium is never employed in medicine. For its properties and uses, see CHROMII TRIOXIDUM and POTASSII DICHROMAS.

COMPOUNDS OF CHROMIUM.

Chromii Acetas.—*Chromium acetate*, E.; *Chromiacetat*, G. $Cr(C_2H_3O_2)_3$.—This occurs in commerce as a dark-green solution, which decomposes into chromium hydroxide and acetic acid when heated. It is employed in dyeing.

Chromii Chloridum.—*Chromium chloride*, E.; *Chrom-chlorid*, G. $CrCl_3$.—Obtained as a green solution when chromium hydroxide is dissolved in hydrochloric acid. From very concentrated solution, the salt crystallizes with varying quantities of water.

Chromous Chloride, $CrCl_2$, is obtained by heating chromic chloride in hydrogen, or chromium in hydrochloric acid gas. In the anhydrous state it is white, but in solution it is sky-blue. It is a marked reducing agent, and hydrochloric acid solution is used to absorb oxygen.

Chromii Fluoridum.—*Chromium fluoride*, E.; *Chrom-fluorid*, G. $CrF_3 + 4H_2O$.—This salt and other double salts containing it are of commercial value as mordants in dyeing because they easily decompose in aqueous solution, giving chromium hydroxide.

Chromii Sulphas.—*Chromium sulphate*, E.; *Chromi-sulfat*, G. $Cr_2(SO_4)_3 + H_2O$.—This is obtained by dissolving chromium hydroxide in sulphuric acid. It forms bluish-violet octahedra, which dissolve with a violet color. On heating the solution, it turns green, and on evaporation a green amorphous mass is obtained. This green modification, on long standing in solution, passes into the violet form.

Chromii et Potassii Sulphas.—*Alumen Chromicum.*—*Chrome alum*, *Chromium-potassium sulphate*, E.; *Chrom-Alaun*, *Chromi-Kaliumsulfat*, G. $CrK(SO_4)_2 + 12H_2O$.—This very important and much used salt is obtained generally as a by-product in industries where organic compounds, as anthracene, etc., are oxidized by potassium dichromate. For experimental purposes, it may be made by dissolving 10 parts of potassium dichromate in 40 parts or more of water, adding 14 parts of concentrated sulphuric acid, and passing sulphur dioxide through the solution until it is in excess. The temperature should not rise above 40° C. (104° F.), otherwise the green chromium sulphate noted above will be formed, which prevents crystallization of the chrome-alum. The reaction is $K_2Cr_2O_7 + H_2SO_4 + 3H_2SO_3 = 2KCr(SO_4)_2 + 4H_2O$; the change consists in a reduction of chromium trioxide in the dichromate to chromium sesquioxide: $2CrO_3 + 3H_2SO_3 = Cr_2O_3 + 3H_2SO_4$. The sesquioxide in the presence of sulphuric acid forms chromium sulphate, which with potassium sulphate, formed at the same time, gives chrome-alum, a double salt analogous to ordinary alum. Chrome-alum forms dark-violet, large, octahedral crystals, soluble in 5 parts of water, the solution turning green when heated. Ammonia water added in excess to the solution precipitates bluish-green chromium hydroxide, $Cr(OH)_3 + 2H_2O$, which is the starting-point for making various chromium salts. When heated to a high temperature, the hydroxide forms a green oxide. This is manufactured as a green pigment.

Gingnet's Green, $Cr_2O_3.2Cr(OH)_3$, is obtained by heating potassium dichromate and borax and extracting the mass with water.

CHRYSAROBINUM, *U. S., Br., P. G.*—Chrysarobin.

Araroba Depurata; *Chrysarobin*, G.; *Chrysarobine*, Fr.; *Crisarobina*, It.; *Chrysarobina*, Sp.

A neutral principle extracted from Goa powder, a substance found deposited in the wood of *Vouacapoua Araroba* (Aguiar) Druce (*Andira a.* Aguiar, Fam. *Leguminosæ*).

Chrysarobin is obtained from Araroba by extraction with hot chloroform, evaporating the solution to dryness, and powdering.—Br.

Origin.—The *Po' de Bahia*, *Araroba* or *Arariba tree*, is closely allied to the West Indian cabbage tree, and is common in the damp forests of Bahia, Brazil, where it is

locally known as *Angelim Amargoso*. It is a large forest-tree, with pinnate leaves and panicles of purple bean-like flowers, and much resembles the copaiba tree. The native name araroba is applied to a number of related Brazilian trees of this and other genera, and is subject to confusion.

The araroba is contained in the large porous vessels, and in clefts or cavities which traverse the wood in the direction of the diameter and are prolonged through the entire trunk. It is apparently deposited as an antiseptic preservative provision by the plant, and results from chemical changes in the cell-walls. It is obtained by cutting down the tree, splitting the trunk, and scraping the powder from the clefts, and is seen in commerce as a rough powder or in small irregular pieces, originally of a light-yellow color, but usually darkened by exposure to light and moisture to a dull-ochrey, pale-brown, or even umber-brown or deep-purple color. It has a bitter taste. When carefully heated, it yields a moss-like sublimate, which is colored red by alkalies.

Araroba is recognized in the Br. P., and is also there designated as crude chrysarobin. It received its name of "Goa powder" from having been originally shipped by the Portuguese settlers in Brazil to their countrymen in the province of Goa, East Indies.

Properties and Tests.—Chrysarobin occurs as a pale orange-yellow, microcrystalline powder, tasteless, odorless, and irritating to the mucous membrane. Its specific gravity varies between 0.920 and 0.922. At 25° C. (77° F.) it is soluble in 4812 parts of water, 308 parts of alcohol, 25 parts of benzene, 18 parts of chloroform, 114 parts of ether, 30 parts of amyl alcohol, and 230 parts of carbon disulphide; also soluble at 80° C. (176° F.) in 2170 parts of water, at 60° C. (140° F.) in 275 parts of alcohol. With dilute or concentrated solutions of potassium hydroxide, it forms a red-colored liquid with green fluorescence. Chrysarobin contracts and forms a dark mass at 148° C. (298.4° F.) and melts at 157° C. (314.6° F.). When ignited it is partly sublimed and finally entirely consumed. It dissolves in sulphuric acid, forming a deep-red solution. On pouring this liquid into water, chrysarobin is deposited unchanged. On mixing 0.001 Gm. of chrysarobin with 2 drops of fuming nitric acid, a red-colored mixture is produced, which turns violet on the addition of a few drops of ammonia-water (distinction from chrysophanic acid, which produces a yellow-colored liquid). On shaking chrysarobin with lime-water for a few minutes, the liquid acquires a violet color (distinction from chrysophanic acid, which produces a yellow-colored liquid). On adding a crystal of potassium dichromate to a solution of chrysarobin in sulphuric acid, the red color is changed at first to green, then to purple, and finally to brown.—U. S. When boiled with about 2000 parts of water (which produces only partial solution), the light reddish-brown filtrate does not affect litmus-paper, and is not altered by ferric chloride test-solution.—P. G.

The chrysarobin of the Br. P. should be completely soluble in hot chloroform, almost entirely in hot 90 per cent. alcohol, and partially in a solution of potassium hydroxide with the production of a deep reddish-brown color, and should not leave over 1 per cent. of ash when incinerated.

If 0.001 Gm. ($\frac{1}{64}$ grain) of chrysarobin be sprinkled upon a drop of fuming nitric acid, the red solution extended to a thin layer, and a little ammonia added by means of a glass rod, a violet color should be produced.—P. G. If sprinkled on concentrated sulphuric acid, chrysarobin should give a reddish-yellow solution.

Constituents.—Commercial Goa powder has contained from 2.65 to 75 per cent. of chrysarobin ($C_{30}H_{26}O_7$), with a small amount of chrysophanic acid, 0.8 to 66 per cent. of ash, and 14 to 32 per cent. of water. A good sample yields 60 to 75 per cent. of chrysarobin (70 to 85 per cent. of dried araroba), and not more than 20 per cent. of water and 3 per cent. of ash. The powder contains also 2 per cent. of resin, about 5.5 per cent. of woody fiber, and 7 per cent. of bitter extractive. Chrysarobin, purified by repeated crystallization from glacial acetic acid, occurs in small yellow scales, which are fusible and partly sublimable, nearly insoluble in water and ammonia, sparingly soluble in alcohol, more freely so in amyl alcohol, ether, collodion, chloroform, and various hydrocarbons. It is inodorous and tasteless. It dissolves in concentrated sulphuric acid with a yellow color, is nearly insoluble in very diluted potassium hydroxide solution, and yields with melted potassa a brown mass. (Chrysophanic acid dissolves in concentrated sulphuric acid and in very dilute potassium hydroxide solution with a red color, and yields a blue mass when fused with potassa.) Its solution in strong

potassium hydroxide solution has a yellow color and strong fluorescence, and on being agitated with atmospheric air rapidly acquires a red color.

Liebermann and Seidler (1878) established the identity of chrysarobin as a compound represented by the formula $C_{30}H_{26}O_7$, and that it is essentially different from chrysophanic acid, into which by absorption of oxygen it may be converted in alkaline solutions; thus $C_{30}H_{26}O_7$ (chrysarobin) + $2O_2$ yields $2C_{15}H_{10}O_4$ (chrysophanic acid) + $3H_2O$. Inversely, chrysarobin may result from chrysophanic acid $2(C_{15}H_{10}O_4) + 8H = C_{30}H_{26}O_7 + H_2O$. As prepared from araroba, chrysarobin is mixed with varying percentages of *methyl chrysarobin*. Boiled with glacial acetic acid, chrysarobin yields a number of acetyl derivatives. The *monacetyl* derivative forms yellow leaflets, which melt at 188°–190° C. (370.4°–374° F.); the solution in alcohol and acetic acid exhibiting a strong blue fluorescence. The *diacetyl* derivative forms yellow rhombic leaflets, which melt at 216° C. (420.8° F.), and the *β-diacetyl chrysarobin* yellow needles melting at 265°–270° C. (509°–518° F.). *Eurobin*, the triacetyl, and *lenirobin*, the tetracetyl derivative of chrysarobin, are commercial substitutes for chrysarobin. When chrysarobin is distilled with zinc-dust it yields *methyl anthracene*, $C_{14}CH_3H_9$. The researches of Liebermann have shown chrysarobin to be a reduced quinone.

Pharmaceutical Preparation.—Chrysarobin Ointment, U. S. P.

Action and Uses.—Chrysarobin is seldom employed internally, but it may be given in psoriasis in doses of $\frac{1}{8}$ grain (0.008 Gm.). If larger quantities are administered, it acts as a gastro-intestinal irritant, increases the flow of bile, and produces copious watery stools, and nausea and vomiting. The urine of persons using chrysarobin turns red on the addition of alkalies, and slight albuminuria is sometimes present when it is taken.

The local application of chrysarobin is not uncommon, and it has met with some success in the treatment of psoriasis and other chronic affections of the skin. Great care should be exercised in its employment, however, as it may cause pain, swelling, and inflammation in the tissue. If the cuticle is broken, sufficient of the drug may be absorbed to produce nausea and vomiting. It is commonly employed in the form of an ointment containing 10 grains (0.60 Gm.) of the drug to 1 ounce (30 Gm.) of ointment or benzoinated lard; but a weak solution made with water, vinegar, or chloroform is sometimes painted over the affected area, and when dry covered with collodion.

Chrysarobin has been employed in the form of a suppository, containing 1 grain (0.06 Gm.), in the treatment of hemorrhoids.

Chrysarobin leaves a dark-brown stain upon the skin, which may be removed by washing the part with a weak solution of chlorinated lime. Clothing with which it comes in contact is permanently discolored.

Allied Compounds.—Anthrarobinum, Anthrarobin, Dioxyanthranol, Leukoalizarin, Desoxyalizarin. $C_{14}H_{10}O_3$. Molecular weight, 224.38.—Anthrarobin is prepared from *alizarin* by dissolving the latter in warm ammonia water, adding zinc dust to the solution and heating the mixture until the blue color is changed to yellow; the solution is filtered into water strongly acidulated with hydrochloric acid, and the precipitate formed is washed by decantation until free from acid, and then dried on porous tiles at 100° C. (212° F.). The reaction is based on the reducing action of hydrogen, $C_{14}H_8O_4$ (alizarin) + $4H = C_{14}H_{10}O_3$ (anthrarobin) + H_2O. Commercial anthrarobin occurs in the form of an odorless, tasteless, yellowish-white powder. It is difficultly soluble in water, dilute acids, benzene, chloroform, and ether, somewhat more soluble in hot water, soluble in glycerin, fats and oils, in 5 parts of hot alcohol, and readily soluble in aqueous solutions of alkali hydroxides to brownish-yellow solutions, which on contact with air rapidly absorb oxygen and turn green, blue, and finally violet-colored, alizarin being again formed. The aqueous solution yields a reddish-brown precipitate with lead acetate solution and a brownish-violet precipitate with a solution of ferric chloride. On incineration, anthrarobin should not yield more than 0.3 per cent. of ash, and 0.1 Gm. should dissolve in 1 Cc. of sodium hydroxide solution and assume a violet color when air is forced through the solution. Anthrarobin is used like chrysarobin in the treatment of skin diseases.

Hydroxylaminæ Hydrochloridum, Oxyammonium Hydrochloricum.—*Hydroxylamine hydrochloride*, E.; *Salzsaures Hydroxylamin*, G. NH_2OHHCl. Molecular weight, 69.99.—The base, hydroxylamine, NH_2OH, which may be looked upon as ammonia in which an atom of hydrogen has been replaced by the hydroxyl group, is only known in its free state in the form of solution. By a rather complicated process hydroxylamine sulphate is obtained by the interaction of sodium nitrite and acid sodium sulphite. The hydrochloride,

which is obtained from the sulphate by treatment with barium chloride, occurs as colorless hygroscopic crystals, soluble in an equal weight of water, also in glycerin and in 15 parts of alcohol. It possesses strong reducing properties, precipitating metallic gold, silver, and mercury from solutions of their salts; it also reduces Fehling's Solution in the cold. From ammonium chloride, which it resembles in appearance, hydroxylamine hydrochloride is distinguished by its alcoholic solution not giving a precipitate with platinum chloride.

Tests.—Its aqueous solution (1 in 10) reddens blue litmus-paper, but does not react acid to congo test-paper (filter-paper saturated with a solution of 1 Gm. of congo-red in 1 liter of water and dried). The solution should not react for iron when tested with test-solution of potassium sulphocyanide and potassium ferricyanide, nor give a turbidity with dilute sulphuric acid (barium). 1 Gm. should dissolve clear in 20 Gm. of absolute alcohol. The salt should be kept in well-closed bottles. On account of its non-staining properties, hydroxylamine hydrochloride has been suggested as a substitute for other reducing bodies, chrysarobin, pyrogallol, and anthrarobin, in the treatment of skin diseases; but by some authorities it is pronounced dangerous if absorbed, being a powerful blood-poison and generally destructive to vegetable and animal life. It is used commercially as a developer in photography.

CIMICIFUGA, *U. S.*—Cimicifuga.

Cimicifugæ rhizoma, Actææ racemosæ radix, Br.—*Black snakeroot, Black cohosh, Bugwort, Rattletop*, E.; *Schwarze Schlangenwurzel*, G.; *Racine d'actée à grappes*, Fr.

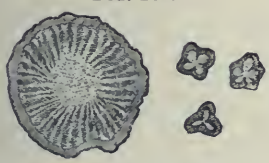
The dried rhizome and roots of *Cimicifuga racemosa* (L.) Nutt. (*Actæa r.* L.; *C. serpentaria* Pursh; *Macrotys actæoides* Raf.—Fam. *Ranunculaceæ*).

Origin.—A very handsome perennial herb of eastern and central North America, growing in rich woodland soil, especially among rocks. The slender stem is 1.8 to 2.4 M. (6 to 8 Ft.) high, is leafless below and above, and bears near the middle several large, petiolate, thrice-ternate leaves, with ovate-oblong, acute, and deeply toothed leaflets. The white flowers are in terminal branched racemes 20 to 30 Cm. (8 to 12 In.) long, have small, clawed, 2-horned petals, numerous stamens on slender filaments, and usually 1 pistil, producing a dry capsular fruit containing many flat seeds. It flowers in June and July and ripens its fruit in September, after which time the rhizome should be collected.

Fig. 107.

Cimicifuga (½ Nat.).

Fig. 106.



Cimicifuga racemosa: transverse section through a branch of the rhizome and through roots.

Description.—From 6 to 15 Cm. (2 to 6 In.) long and 1.5 to 2.5 Cm. (½ to 1 In.) thick, horizontal, with numerous crowded, short, thick, erect or ascending branches which are about 2.5 Cm. (1 In.) long, and half or more as thick as the rhizome, each terminating in a deeply cup-shaped scar; roots coarse, brittle, obtuse, quadrangular, about 2 Mm. ($\frac{1}{12}$ In.) thick; odor slight, heavy; taste bitter and acrid; fracture smooth, the rhizome exhibiting a rather large pith, surrounded by numerous sublinear whitish wood-rays and a thin firm bark, the roots with a thick bark and a 3- to 5- (mostly 4-) rayed wood.

The starch-grains are either simple or compound, the simple ones mostly less than 10 mikrons broad, round or oval, with a nearly central hilum, the rings wanting or faint.

Both black and green hellebore bear considerable resemblance to cimicifuga, but can be distinguished by the small number and greater breadth of the wood-bundles of the rhizome, and the nearly cylindrical wood-zone of the roots (see Helleborus).

Constituents.—Cimicifuga contains gum, starch, 2 resins, fat, wax, cane-sugar, an uncrystallizable sugar, a crystalline neutral body, and a resinous amorphous body, probably the active principle. Trimble found no tannin, though other analysts mention both tannic and gallic acids.

The seeds yield the same constituents.

Pharmaceutical Preparations.—Extract of Cimicifuga, U. S. P.; Fluidextract of Cimicifuga, U. S. P.; Compound Syrup of Cimicifuga, N. F.; Tincture of Cimicifuga, U. S. P.

Action and Uses.—Full doses of cimicifuga when given to the lower animals paralyze the sensory side of the cord. In man it depresses the sensory side of the cord and depresses reflex action. Its effect upon the circulation is that of a depressant both to the heart muscle and the vasomotor center; the pulse becoming somewhat slower and blood-pressure decreased. Very small doses are said to act as a cardiac stimulant. Lethal doses cause death by respiratory paralysis. Full doses occasion violent frontal headache, dimness of vision, and at times nausea and vomiting. Overdoses produce headache, vertigo, tremors, and great depression. The employment of this drug is entirely empirical, as its known physiological action bears no relation to its use as a remedy. Cimicifuga is a uterine tonic producing normal contractions, and may be employed during labor when uterine inertia exists. If given during pregnancy it may produce abortion. It has also been highly recommended in the treatment of ovarian neuralgia, uterine tenderness, subinvolution, and amenorrhœa. By some it has been given as a substitute for digitalis in the treatment of fatty or irritable heart, but is rarely employed except as a last resort after other remedies have failed. Black cohosh is, after arsenic, the best drug for the treatment of chorea, especially if rheumatic tendency exists. This remedy has also been recommended in the treatment of headache due to eye-strain.

The dose of the extract is from 1 to 5 grains (0.06–0.30 Gm.); of the fluidextract, from 10 to 30 minims (0.60–2 Cc.); of the tincture, from 1 to 2 fluidrachms (4–8 Cc.).

Allied Drugs.—The rhizomes and roots of several species of the closely related genus *Actæa* L. (*Baneberry*) are quite similar in appearance, composition, and properties to *Cimicifuga*. That of *A. spicata* L., the *European baneberry*, *Herb Christopher*, *Christopherwurz*, *Racine de St. Christophe*, or *Wolfwurz*, has been most used. This drug is smaller than *Cimicifuga*, as well as darker and less tough and woody, and with less prominent stem-scars, otherwise closely resembling it. The *West American red baneberry*, *Red cohosh*, or *Coral and pearls*, is *A. arguta* Nutt., the East-American being *A. rubra* (Ait.) Willd. (*A. spicata rubra* Ait.). The *White baneberry* or *White cohosh* is *A. alba* (L.) Mill. (*A. spicata alba* L.). The rhizomes of all closely resemble that of *A. spicata*.

CINCHONA.

Peruvian bark, E.; *Chinarinde*, G.; *Quinquina*, Fr.; *China*, It.; *Quina*, Sp., Port.

The dried bark of several species of *Cinchona* L. (Fam. *Rubiaceæ*).

Official Kinds.—1. Cinchona, U. S.—*Cinchona flava*, U. S. 1880; *Cinchonæ flavæ cortex; Cortex chinæ calisayæ; Cortex chinæ regiæ; China regia.*—*Yellow cinchona*, *Calisaya bark*, E.; *Calisayarinde*, *Königschina*, G.; *Quinquina calisaya*, *Quinquina jaune royal*, Fr.; *China gialla*, It.; *Quina Calisaya*, *Quina Amarilla Real*, Sp.; *Quina Amarella*, Port.

The dried bark of *Cinchona Ledgeriana* Moens, *Cinchona Calisaya* Weddell, *Cinchona officinalis* L., and of hybrids of these with other species of Cinchona (Fam. *Rubiaceæ*), yielding, when assayed by the U. S. P. process, not less than 5 per cent. of anhydrous cinchona alkaloids, of which at least four-fifths should be soluble in ether.

2. Cinchona Rubra, U. S.—*Cinchonæ Rubræ Cortex*, Br.; *Cortex Chinæ*, P. G.; *Cortex chinæ ruber*, *China rubra.*—*Red cinchona*, *Red Peruvian bark*, *Red bark*, E.; *Rothe Chinarinde*, G.; *Quinquina rouge*, Fr.; *China rossa*, It.; *Quina roja*, Sp.; *Quina Vermelha*, *Quina de Chimborazo*, Port.

The dried bark of *Cinchona succirubra* Pavon (Fam. *Rubiaceæ*), yielding, when assayed by the U. S. P. process, not less than 5 per cent. of anhydrous cinchona alkaloids.

In framing the first of the above definitions, the Pharmacopœia seeks the two objects of qualifying as to kind of bark included, namely, that in which quinine is the important alkaloid, and the strength or percentage of alkaloid to be contained. At the present time, we know only the two first-named species and a probable hybrid of one or the other of them with the third-named, which can answer to these requirements. *C. officinalis* itself answers the first requirement but not the second. Yet it is well known that

there are other species of the quinine-group which may at any time exhibit satisfactory hybrids, hence the provision as to "other species." In framing the second definition, the object is merely to secure a sufficient percentage of bitter alkaloid for tonic purposes, without regard to the ratio of quinine.

Cinchona is official in all pharmacopœias and both the above barks in most of them, but the definitions and specifications, as to species, gross and microscopical appearance, reactions, and assays, are too varied for full discussion in this article. The B. P. entirely omits the quinine barks, depending upon the quinine itself, but makes red bark from cultivated plants official, requiring that it yield between 5 and 6 per cent. of alkaloid, not less than half of it quinine and cinchonidine. This is in accordance with the British medical view, that these two alkaloids are of equivalent medicinal value.

Origin.—*C. Calisaya* is a large and beautiful forest-tree of northern Bolivia and southern Peru, and is one of the most extensively cultivated kinds. Excessive collection previous to the era of cultivation so nearly exterminated it that its reappearance in the native forests, since its cultivation almost stopped its collection there, has been very slow and inconsiderable.

C. Ledgeriana is a very similar and closely related species to the last, and is by many regarded as a mere variety of it. It was discovered, its superior quality recognized, and its cultivation urged and secured by a faithful native collector in the employ of Mr. Ledger, to whom the latter noble-minded gentleman always accorded full credit. It is from the same region as *C. Calisaya*, but has always been scarce and local, and it is only through cultivation that any adequate supply has become available. It is probably the most extensively cultivated kind, and is steadily replacing the others, because of its greater richness in quinine, absolutely, though the ratio of this to other alkaloids is about the same as in *C. Calisaya*.

C. succirubra is a large tree which originated upon the high slopes of Mt. Chimborazo, and which has been cultivated upon a very extensive scale. Owing to its present recognized inferiority to the quinine barks, and to its lower price, its cultivation has been largely abandoned.

C. officinalis, though very important, is not itself official, and must be considered under *Unofficial Barks*. Though named in the definition, it has never yet yielded the required percentage of total alkaloid.

Our present supply of the wild barks is, as stated, entirely unimportant. Cultivated commercial supplies come chiefly from Java, though there are extensive plantations in India which also supply commercial bark, besides much more extensive ones worked to supply the needs of the British Government. Some rather extensive plantations exist in Bolivia, but transportation across the Andes handicaps their success. Ceylon formerly produced a very large quantity, but the substitution of tea-planting, and a disease very fatal to the cinchona trees, have pretty nearly eliminated this source of supply. The Straits Settlements produce a moderate quantity. In Africa, Jamaica, Brazil, Mexico, the Fijis, and some other countries, unsuccessful attempts to establish plantations have been made. The United States is without any locality in which cinchona could be produced, though this is doubtless possible in some of its newly acquired tropical territory.

The trees thrive upon well-drained mountain slopes, with an equable temperature, abundant rainfall, and humid climate. In 18° south, an altitude of 4500 to 5500 feet is found most congenial. Although the calisaya of the native forests used to attain a trunk diameter of 2 or 3 feet, it is found economical in cultivation to collect the bark as soon as it is "ripe," that is, containing its normal alkaloidal percentage, a condition determined, in Calisaya and Ledgeriana barks, by the "chicken-leg" appearance of the bark, due to its profuse reticulation of intersecting fissures (see *Description*). This occurs at about 6 to 9 years of age, the trunk being then about 6 or 8 inches in diameter. The trunk-bark is removed and dried in quills. For pharmaceutical purposes, it is mostly marketed in this condition, and is known as *Druggists' bark*. Some very handsome bark of this form comes from the South American plantations. For manufacturing purposes, the quills are broken up and pressed, to save transportation charges. *Manufacturers' bark* is purchased entirely upon its assay, at a price per unit, the unit being each 1 per cent. of quinine in a pound of bark. To this class of barks belongs also the root-bark, which is richer

than the stem-bark. The bark of the branches is very inferior, as to both yield and appearance, and is found difficult of sale, the cost of manufacture being excessive in proportion to the weight of alkaloid recovered. Such young bark is very thin, and becomes much wrinkled in drying (Fig. 109). Owing to an increase in the production of alkaloid, with a corresponding decrease in that of coloring-matter, when light is

Fig. 108.

Old, mature calisaya, from cultivated trees (Nat.).

Fig. 109.

Young calisaya.

Fig. 110.

Mossed officinalis (Nat.).

excluded from the growing bark, the practice of "mossing" has been more or less followed, consisting of binding upon the trunk, moss, leaves, straw, paper, rags, or similar substances. Bark so grown is denominated "mossed" (Fig. 110). By taking the bark off in vertical strips, which alternate with other strips left unbroken, the places so denuded being then mossed, a new covering is produced which is abnormally rich, and is known as *Renewed bark*. Both this and the mossed bark are classed among manufacturers' barks. Flat bark or *Tabla bark* is still occasionally called for by old-fashioned pharmacists. It was formerly a natural product, resulting from the exfoliation upon large trees of all but the bast-layer, this drying naturally in flat pieces. It is now produced to supply the limited demand by the artificial removal of the outer bark and drying flat under pressure. With mossing, renewing, and hybridization, other influences have combined to increase the alkaloidal yield of cultivated bark.

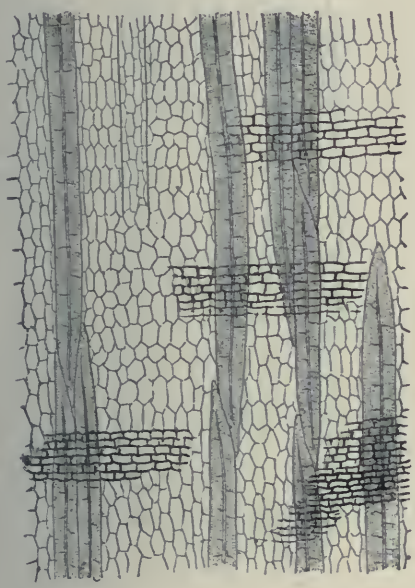
Description.—Cinchona.—In quills or curved pieces of variable size, usually 2 or 3, sometimes 5 Mm. ($\frac{1}{12}$ to $\frac{1}{8}$ or sometimes $\frac{1}{5}$ In.) thick; externally gray, preferably a bluish- or steel-gray, rarely brownish-gray (or cinnamon-brown when the outer bark is wanting), with numerous intersecting transverse and longitudinal fissures having nearly vertical sides; inner surface light cinnamon-brown, finely striate; fracture of the outer bark short and granular, of the inner finely splintery; powder light-brown or yellowish-brown; odor slight, aromatic; taste bitter and somewhat astringent.

Cinchona succirubra.—In quills or curved pieces of variable size, the bark 2 to 5 Mm. ($\frac{1}{12}$ to $\frac{1}{5}$ In.) thick; externally gray or gray-brown, more or less rough from longitudinal rows of warts, or from warty ridges which are sometimes fissured, and with few, mostly short and not intersected transverse fissures; inner surface reddish- or orange-brown, distinctly striate;

fracture short and granular in the outer, shortly and rather coarsely splintery in the inner bark; slightly odorous, bitter and astringent; powder reddish-brown.

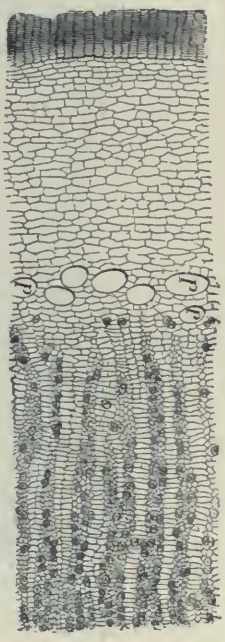
The distinguishing characteristic of calisaya bark (Fig. 108), in the entire condition, is its profuse reticulation of fine intersecting fissures with vertical sides and the absence of strong ridges. On transverse section (Fig. 112), its bast-fibers are seen to be scattered, mostly singly, a few in twos and threes. The medullary rays are narrow. On longitudinal

FIG. 111.



Calisaya bark: radial longitudinal section through liber, showing cinchona bast-fibers; magnified 60 diameters.

FIG. 112.



Young calisaya bark: transverse section; magnified 30 djameters.

section (Fig. 111), the bast-fibers are seen to be spindle-shaped and of medium size. Laticiferous ducts can be seen only in young bark. Its powder is of a yellow color, even though the entire bark was not so, as it usually is. Owing to the effects of hybridity, these microscopical characters are often not clear in the commercial bark of the present day.

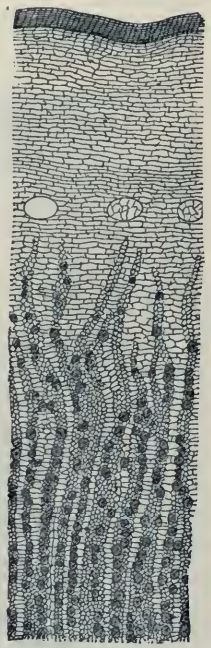
Red bark, being now quite scarce, is very frequently substituted in whole or in part by yellow bark. The practice is reprehensible, and is very readily detected by attention to the following characteristics: The distinguishing characteristics of red bark (Fig. 114) are its strong longitudinal ridging, these ridges, when very large, becoming longitudinally fissured, and the total or relative absence of other fissures, those which are present only rarely intersecting. On transverse section (Fig. 113), the bast-fibers are seen to be mostly aggregated in groups of 2 to 5, often more. A row of laticiferous ducts, usually more or less filled up with cells, can commonly be seen in the outer bark. On longitudinal section, the spindle-shaped bast-fibers are seen to be very coarse. These microscopical characters are but little modified by hybridity in red bark. Its powder is of a brownish-red, and is characterized by the strong tendency of its splintery bast-fibers to accumulate upon the surface.

In both species, the bast-fibers are simple—that is, not branched—and present a somewhat quadrangular appearance under the microscope, the cavity almost obliterated. Both species are conspicuously wanting in a peculiar variety of cell which occurs in many of the spurious barks. This is a form of stone-cell, laterally elongated, and frequently filled either with a brownish resinous-looking mass, or with granular crystals of calcium oxalate.

In both the official barks the alkaloids are found chiefly in the cortical tissue and to a considerable extent in the cork. The localization of the alkaloids becomes less characteristic in older barks. Whereas in the young bark, alkaloid is entirely wanting in the bast-layer, it is found richly deposited there in the ancient *tabla* or flat barks, those trees having lost by exfoliation all of their outer and middle layers.

Adulterants and Substitutes.—Adulteration and substitution of the cinchonas, once prevalent upon an enormous scale (see *History*), are now reduced to the smallest

Fig. 113.



Cinch. succirubra; transverse section of bark; magnified 30 diameters.

Fig. 114.

Red cinchona (Nat.).

proportions, except as to the selling of one of the leading kinds when another is called for. This is very common indeed. It results mostly through the ignorance of dealers, which is great and general; sometimes because there happens to be only one kind in stock. A single spurious bark is sold upon a rather large scale, though quite irregularly, as a fraudulent substitute for calisaya, under the name of *Yellow bark*. It is technically known as *Maracaibo bark* (Fig. 115), and its botanical derivation is uncertain. It occurs in flat, chip-like, warped pieces rarely so large as the hand, and about 3 to 9 Mm. ($\frac{1}{8}$ to $\frac{3}{8}$ In.) thick. Externally, it bears patches of a soft and friable silver-gray cork, easily scraped off with the finger-nail, and is of a dingy-yellow color where these are wanting. The inner surface is of a pale-yellow or light yellowish-brown and rather coarsely striate. Its fracture is short-splintery, yellowish, and shows a rather broad band of dark resin-tissue at the outside of the bast-layer. It is bitter from its resin, but contains only a trace of alkaloid.

Fig. 115.

Maracaibo bark (Nat.).

Fraudulent red barks have been offered which had been made by exposing inferior cinchona barks to ammonia, whereby cinchona-red is produced. Such barks were found by Thomas and Guignard (1882) to be deep-red in the parenchyma, to have pale-yellow bast-fibers, to yield red-colored infusions and decoctions, and these to give brown-red precipitates with Nessler's reagent, while the infusion of normal cinchonas gives a white precipitate with the same reagent; the chloroplatinate precipitate was found to contain 22 per cent. of Pt, while that with the cinchona alkaloids contains only between 16.8 and 17.8 per cent. of this metal.

Powdered cinchona is doubtless more or less adulterated with the residual stocks of the various inferior barks here named and those to be mentioned under *History.*

General Chemical Characteristics.—Grahe (1858) showed that if about 10 grains of the bark are heated in a test-tube, characteristic red vapors are evolved, which condense to an oily carmine-red liquid. Cinchona barks which have been deprived of their alkaloids by treatment with dilute acids do not show this reaction, but ligneous tissue which has been impregnated with a solution of cinchona alkaloids does so; and the reliability of the reaction is increased, according to Hesse, by incorporating an alcoholic tincture of cinchona with a powder of the same bark. This reaction, in connection with the presence of cinchona bast-fibers, noticed above, may be regarded as conclusive proof of the genuineness of cinchona barks; in the absence of the peculiar bast-fibers, merely as evidence of the presence of cinchona alkaloids; for Flückiger (1871) observed a white bark which contained cinchona bast-fibers and an alkaloid (*paytine*), but yielded a brown tarry instead of a red oily sublimate; and the latter is obtained from *Cuprea bark* (see below), which contains cinchona alkaloids, but is destitute of cinchona bast-fibers.

Constituents.—The important constituents of the official cinchona barks are their alkaloids and the cinchotannic, kinic, and kinovic acids, with one or more of which these alkaloids are combined. The alkaloids may be classed, according to their importance, as primary, secondary, and unimportant. The primary ones are quinine, quinidine, cinchonine, cinchonidine, and quinamine, all of which are considered elsewhere under these titles. The secondary alkaloids are hydroquinine, hydrocinchonidine, hydroquinidine, and homocinchonidine. The unimportant ones are dicinchonine, diquinidine, paricine, javanine, conquinamine, cincholine, etc., which are considered below. South American cultivated calisaya usually contains 3.5 to 4.5 per cent. of total alkaloid, occasionally up to 6 per cent.; that of the East Indies runs about a third richer. Ledger bark averages a little higher than calisaya, and is occasionally very rich, running up to 12 or even 14 per cent. Of this alkaloid, in both species, about two-thirds to four-fifths is quinine. Quinidine is next in importance, reaching sometimes to more than 0.5 per cent. With these are hydroquinine, hydroquinidine, and diquinidine. Cinchonine and cinchonidine are not present in appreciable amounts. Javanine and cincholine have been found in these two species.

Red bark ordinarily contains 5 or 6 per cent. of total alkaloid, occasionally 9 to 11 per cent. in Java cultivated bark, of which about one-fifth to two-fifths is quinine, with a relatively corresponding amount of quinidine. Cinchonidine is here the important alkaloid, reaching often to 3 or 4 per cent. Cinchonine is also abundant, but its percentage is very irregular. It is apt to be especially abundant in the root-bark. Other alkaloids found in red bark are quinamine, conquinamine, dicinchonine, hydrocinchonidine, homocinchonidine, and paricine.

The characteristic properties of the 4 principal cinchona alkaloids may be compared as follows:

	QUININE.	QUINIDINE.	CINCHONINE.	CINCHONIDINE.
Rotary power,	Lævogyre.	Dextrogyre.	Dextrogyre.	Lævogyre.
Soluble in water,	167 parts.	2000 parts.	3740 parts.	1680 parts.
Soluble in 80 per cent. alcohol,	6 "	26 "	133 "	20 "
Soluble in ether,	23 "	30 "	371 "	76.4 "
Sulphuric acid solutions,	Are fluorescent, 1 in 200,000.		Not fluorescent.	
Chlorine water and ammonia,	Emerald-green thalleioquin.		White precipitates.	
Chlorine water, ferrocyanide of potassium, and ammonia,	Dark-red solutions.		No coloration.	
Anhydrous sulphate, soluble in chloroform,	1000 parts.	19.5 parts.	60 parts.	1000 parts.
Hydriodate,	More soluble than next.	Soluble in 1270 parts water, or 110 parts alcohol.	Readily soluble in chloroform, alcohol, ether, and water.	Slightly in water, readily in alcohol.
Iodosulphate,	Green in reflected, colorless in transmitted light; soluble in 1000 parts boiling water.	Similar to preceding, but different tint.	Purplish-black; in transmitted light yellow or reddish.	Purplish garnet-red; in transmitted light like preceding.

The iodosulphates are obtained by dissolving the sulphates in weak alcohol, acidulating with sulphuric acid, precipitating with tincture of iodine, and crystallizing the precipitate from alcohol.

Hydroquinine ($C_{20}H_{26}N_2O_2$) melts at 168° C. (334.4° F.), and is soluble in ether.

Hydrocinchonidine (*Cinchamidine*, $C_{19}H_{24}N_2O$) is lævogyre, melts at about 230° C. (446° F.), and is sparingly soluble in chloroform, ether, and water.

Hydroquinidine (*Hydroconchinine*, $C_{20}H_{26}N_2O_2$) melts at 167° C. (332.6° F.); is dextrogyre, and soluble in hot alcohol and in chloroform, with difficulty in ether; and yields fluorescent solution and thalleioquin, like quinine.

Homocinchonidine ($C_{19}H_{22}N_2O$) is lævogyre, and its sulphate crystallizes with 6 molecules of water in delicate needles of a gelatinous aspect and which fuse near 30° C. (86° F.). Its anhydrous monobasic sulphate yields homocinchonicine.

Paricine ($C_{16}H_{18}N_2O$) is pale-yellow, amorphous, soluble in ether, and converted by strong nitric acid into a dark-green resinous mass.

Javanine is readily soluble in ether, and dissolves in dilute sulphuric acid with an intense yellow color.

Conquinamine is isomeric with quinamine, and melts at 123° C. (253.4° F.).

Quinamidine is isomeric with quinamine, from which it is obtained by boiling with dilute sulphuric acid.

Quinamicine is obtained by heating quinamine to 100° C. (212° F.), and is also isomeric.

Protoquinamicine is similarly obtained at 120° C. (248° F.).

Apoquinamine is obtained by treating quinamine or conquinamine with concentrated hydrochloric acid.

Cincholine occurs as a pale-yellow liquid, soluble in ether, alcohol, and chloroform and nearly tasteless in neutral solutions. Flückiger suggested that it may have originated from the hydrocarbons employed in manipulation.

The relation of the cinchona alkaloids, of both the official and unofficial barks, to each other in regard to their ultimate composition will be observed from the following:

$C_{23}H_{26}N_2O_4$: cusconine and aricine.

$C_{21}H_{24}N_2O$: paytine.

$C_{20}H_{26}N_2O_2$: hydroquinine, hydroquinidine (hydroconchinine).

$C_{20}H_{24}N_2O_2$; quinine, quinidine, quinicine, and $2(C_{20}H_{24}N_2O_2) - H_2O$: dicinchinine.

$C_{19}H_{24}N_2O_2$: quinamine, conquinamine, quinamidine, and quinamicine.

$C_{19}H_{24}N_2O$: hydrocinchonine (cinchotine), hydrocinchonidine (cinchamidine), and cinchonamine.

$C_{19}H_{22}N_2O_2$: homoquinine, apoquinine.

$C_{19}H_{22}N_2O$: cinchonine, cinchonidine, cinchonicine, apoquinamine, homocinchonine, homocinchonidine and homocinchonicine, and $2(C_{19}H_{22}N_2O)$: dicinchonicine.

$C_{17}H_{20}N_2O$: protoquinamine.

$C_{16}H_{18}N_2O$: paricine.

Not analyzed: cusconidine, cuscamine, cuscamidine, javanine, cincholine.

Other Constituents.—*Kinic* or *quinic acid* (*Chinasäure*, $C_7H_{12}O_6$) is found in cinchona barks and in many plants of the natural orders *Rubiaceæ*, *Vacciniaceæ*, etc. According to Hesse, it is not present in Cuprea bark. In the preparation of quinine it is contained in the filtrate from the precipitated alkaloids. It appears to be present to the amount of 5 to 7, or even 9, per cent., and when pure forms transparent colorless oblique rhombic prisms which fuse at 162° C. (323.6° F.), are readily soluble in water, less in strong alcohol, and slightly in ether. On treating it or one of its salts with manganese peroxide and sulphuric acid it yields, besides carbon dioxide and formic acid, a golden-yellow crystalline sublimate of *kinone* or *quinone*, $C_6H_4O_2$. On being heated with hydriodic acid it is converted into benzoic acid, and when fused with potassium hydroxide it yields protocatechuic acid.

Kinovic or *quinovic acid* ($C_{24}H_{38}O_4$) is met with in the East Indian barks, and forms a tasteless shining crystalline powder which is insoluble in water and chloroform, slightly soluble in ether and cold alcohol, but soluble in alkalies and alkaline carbonates. It was discovered by Hlasiwetz (1859) as a product of the decomposition of kinovin.

Kinovin or *quinovin* ($C_{30}H_{48}O_8$) was discovered by Pelletier and Caventou (1821), and at first named *quinovic acid*, afterward *quinova bitter*; its glucosidal nature was determined by Hlasiwetz (1859). It is an amorphous mass of a disagreeable bitter taste, sparingly soluble in cold water, soluble in ether, acetone, chloroform, fixed and volatile oils, and freely soluble in alcohol. Its compounds with the alkalies, lime, and magnesia are soluble in water. Its solution in alcohol, treated with hydrochloric acid gas, yields kinovic acid and uncrystallizable mannitan (kinovin sugar), $C_6H_{12}O_5$. It has been found in different cinchona barks in quantities varying between 0.11 and 1.74 per cent., and is contained also in the barks of *Esenbeckia febrifuga* and *Buena magnifolia* (*China* or *Cuina nova*, hence its name).

Cinchotannic (or *quinotannic*) *acid* appears to be present in the best cinchona barks to the amount of 2 to 4 per cent. By treating the decoction with magnesia, precipitating the filtrate with lead acetate, decomposing with hydrogen sulphide, and repeating this process, it is obtained as a pale-yellow mass of an acidulous and astringent taste, readily soluble in water, alcohol, and ether, turning greenish with salts of iron, and yielding cinchona-red with alkalies or on being boiled with water. According to Rembold (1867), by boiling with dilute sulphuric acid it is split into sugar and

Cinchona-red, $C_{28}H_{22}O_{14}$, which is nearly insoluble in water and ether, but dissolves readily in alkaline solutions and alcohol. It yields protocatechuic acid when treated with fusing potassa. Though contained in all cinchona barks, those having a red color contain it in largest proportion,—thick red bark containing more than 10 per cent.

The odor of cinchona barks is due to a minute quantity of a butyraceous *volatile oil*, which was first obtained by Fabbroni. Trommsdorff obtained 2 grains from 20 pounds of pale bark. The remaining constituents are of no importance either medicinally or pharmaceutically; they comprise starch, gum, sugar, resin, fat, wax, ammonium salts, and calcium oxalate, all in small quantities. Kerner's *cinchocerotin*, $C_{27}H_{48}O_2$, according to Helms (1883), appears to be related to betulin. The ash amounts to between 1 and 3 per cent., and consists mostly of the carbonates of calcium and potassium.

History.—Cinchona bark and its medicinal properties became known to science before the plants which produced them. This knowledge appears to have been possessed by the natives at an earlier period, though they made little use of it, and they were able to render assistance by indicating the most active species. The new medicine was received in Europe without either interest or favor, and these were not awakened until it had effected a notable cure of royalty in the person of the Countess de Chinchon. With this favor, antagonism also developed, and proved to be remarkably strong, persisting for generations. Yet the drug gained steadily and surely in favor, and at length came into the most general use; so much so as to make it of first importance among vegetable drugs. Its collection became the most important industry of the producing countries, involving extensive special legislation and much political intrigue and corruption, while its commerce engaged the close attention of the most important business interests. The use of *C. officinalis*, the bark first discovered, was followed rapidly by the discovery of other species, several of them superior, a much larger number inferior to it. Steady and excessive collection of the better kinds, without any accompanying measures, honestly designed and executed, toward preserving a future supply, resulted in very great scarcity, and finally in exorbitant prices, as much as 4 dollars per pound being charged for good bark, between the years 1880 and 1885, and 8 and 9 dollars per ounce for quinine. These high prices stimulated to the utmost the production of substitutes, both legitimately and fraudulently employed. Every cinchona bark that contained any quinine was eagerly collected. Even related barks, not of this genus, were utilized, some of them containing alkaloids or other bitter constituents, others without value except for fraudulent substitution. Since selection by assay was then scarcely practised, it became necessary to identify all of these products by physical examination, and, since some of the worthless ones closely resembled the better, this involved great skill and experience. A distinct class of experts thus grew up whose services were highly valued and who became persons of great importance.

Two highly important results developed from this condition of affairs. The first was an attempt to corner the supply of the quinine-yielding barks; the second was the introduction of the trees to cultivation. The former object was undertaken by buying up and accumulating in London all obtainable supplies. So extensive was this operation that the resulting accumulations are not yet exhausted, and still affect commerce to some extent, as will be shown presently. It bade fair to become one of the most successful operations of its kind until, through the discovery and marketing in immense quantities of Remijia or Cuprea bark, the corner was broken. The market value of much of the accumulated supply sank below cost and never recovered, until now it amounts to almost nothing.

Long before the period of greatest scarcity, intelligent foreigners had become alarmed by the rate of extermination in progress, and the apathy, or venality, of the administration in the producing countries, which prevented the execution of protective measures, and had come to realize the necessity for transplanting the producing industry to some country where it could be controlled. The first efforts were made by La Condamine, in 1737, but his plants were lost through shipwreck. Subsequent efforts were made by the

Dutch and English, and some of them proved successful. Through imperfect knowledge of the plants, much time and money were wasted in the propagation and culture of worthless species, but many valuable ones were also introduced, the best of them being, besides the above-named official ones, *C. officinalis* L., in several varieties, and which afterward entered into the production of a number of hybrids, *C. micrantha* R. et P., *C. lancifolia* Mutis, and *C. scrobiculata* H. et B. At first, the products of all these were in great demand, but as the supply increased and prices declined, opportunity was offered for increasing the stocks of the better kinds to the neglect of the others, with the final result stated under *Origin*. After the establishment of plantations in the East Indies, and when the native supply had become so far exhausted that even seeds for propagation could not be secured, the native countries, especially Bolivia (through the activity of foreigners residing there), obtained supplies of seeds from the foreign plantations and established cultivation. These plantations were for some years very profitable, but at length prices declined so far that the marketing of the South American barks, involving expensive transportation upon the backs of men over the mountains, precluded a profitable trade, and supplies have now almost ceased to come from there. The South American cultivated bark has always been more subject to inferiority, due to hybridity with the worthless species which abound in the vicinity of the plantations, especially *C. ovata* R. et P. (*Cocola*) and *C. Josephiana* Willd. (*Pajinal*), or *C. Calisaya*, var. *Josephiana*, as it was long known. Foreign barks are also subject to such hybridity, and probably most of the bark commonly considered as thoroughbred is of mixed parentage, yet this parentage is itself valuable, and instead of degrading, has enriched much of the bark.

Aside from this effect of cultivation upon the bark market, concurrent developments have brought about important modifications in manufacturing. The British Indian Government, desiring to avoid the heavy expense of exportation of bark and reimportation of alkaloid, has successfully established manufacturing, especially of an impure alkaloidal mixture called *Febrifuge*, immediately at the plantations. This febrifuge sometimes represents the alkaloidal constituents of red bark, sometimes the residual alkaloids of the quinine barks after the removal of the quinine, more often a mixture from these two sources. *Quinetine* was a substitute manufactured in London in imitation of febrifuge. More recently, the Dutch planters in Java have established quinine manufactories which bid fair to render them to a great extent independent of the bark market.

Assay of Cinchona.—Cinchona, in No. 80 (or finer) powder, 15 Gm.; ether, specific gravity not above 0.720 at 25° C. (77° F.), chloroform, ammonia-water, distilled water, normal sulphuric acid, each a sufficient quantity. Introduce the cinchona into an Erlenmeyer flask or bottle of about 200 Cc. capacity, and add a mixture of 125 Cc. of ether and 25 Cc. of chloroform; then insert the stopper securely, shake the flask vigorously, and allow it to stand for 10 minutes. Then add 10 Cc. of ammonia-water, and allow it to stand for 5 hours, shaking at frequent intervals (or continuously with the aid of a mechanical shaker). Next add 15 Cc. of distilled water, and shake the flask vigorously for a few minutes, so as to cause the powder to settle readily on standing. When the supernatant fluid is quite clear, decant into a measuring flask, or cylinder, exactly 100 Cc. of the supernatant liquid (representing 10 Gm. of cinchona), transfer this to a separator, and add 15 Cc. of normal sulphuric acid, or sufficient to make the liquid distinctly acid. Shake the separator vigorously for 1 minute, and allow the two layers of liquid to separate completely. Draw off the lower aqueous layer into a flask. Then add 5 Cc. of normal sulphuric acid and 5 Cc. of distilled water to the separator, and shake it vigorously for about 1 minute, allow the liquids to separate as before, and again draw off the lower aqueous layer into the flask. Repeat the operation, using 5 Cc. of distilled water in the separator (without acid), drawing off the aqueous liquid into the flask. Filter the combined acid liquids into a measuring cylinder, and wash the filter and flask with enough distilled water to make the contents of the cylinder measure exactly 50 Cc. Pour half (25 Cc.) of the acid liquid into a separator marked No. 1, and the remaining half (25 Cc.) into another separator marked No. 2, which set aside.

1. *For Anhydrous Cinchona Alkaloids.*—To separator No. 1 (see above) add 25 Cc. of a mixture of chloroform 3 volumes and ether 1 volume, and add 5 Cc. of ammonia-water, or sufficient to render the liquid alkaline. Insert the stopper and shake the separator carefully for 3 minutes, and then draw off the lower layer into a tared flask or beaker. Add 20 Cc. more of the chloroform-ether mixture to the separator, insert the stopper, and shake the liquid carefully for 2 minutes, again drawing off the lower layer into the tared flask. Repeat the operation with 10 Cc. of chloroform, and draw this off into the tared flask. Reject the aqueous liquid in the separator, and with the aid of a water-bath evaporate the chloroform-ether solution in the tared flask or beaker, slowly and carefully, to dryness. Add 3 Cc.

of ether to the dry residue, and again evaporate to dryness. Then place the flask or beaker in an air-bath and heat at 110° C. (230° F.) until the weight after cooling remains constant. The weight of the residue multiplied by 20 will give the percentage of anhydrous cinchona alkaloids (total alkaloids) in the cinchona.

2. *For Ether-soluble Alkaloids.*—To separator No. 2 (see above), containing the other 25 Cc. of acid liquid, add 25 Cc. of ether and 5 Cc. of ammonia-water, or sufficient to render the liquid slightly alkaline. The temperature of the liquid should be kept below 15° C. (59° F.) by cooling it if necessary. Shake the separator moderately for 2 minutes, and allow the liquid to stand for 10 minutes at 15° C. (59° F.); after the liquids have separated, draw off and reject the lower aqueous layer and transfer the ethereal liquid to a tared beaker. Add 5 Cc. more of ether to the separator, rinse carefully, and add the rinsings. Evaporate the ether carefully by the aid of a water-bath, dry the beaker and contents in an air-bath at 120° C. (248° F.) for two hours, cool, and weigh. The weight of the residue multiplied by 20 gives the percentage of the anhydrous ether-soluble alkaloids contained in the cinchona.

Note.—Anhydrous ether-soluble alkaloids include quinine, quinidine, and cinchonidine.

Pharmaceutical Preparations.—Compound Tincture of Cinchona, U. S. P.; Detannated Tincture of Cinchona, N. F.; Detannated Elixir of Cinchona, N. F.; Elixir of Cinchona, N. F.; Elixir of Cinchona and Hypophosphites, N. F.; Elixir of Cinchona and Iron, N. F.; Elixir of Cinchona, Iron, and Bismuth, N. F.; Elixir of Cinchona, Iron, and Calcium Lactophosphate, N. F.; Elixir of Cinchona, Iron, and Pepsin, N. F.; Elixir of Cinchona, Iron, and Strychnine, N. F.; Elixir of Cinchona, Iron, Bismuth, and Strychnine, N. F.; Elixir of Cinchona, Pepsin, and Strychnine, N. F.; Fluidextract of Cinchona, U. S. P.; Tincture of Cinchona, U. S. P.

Action and Uses.—The action and uses of cinchona will be found described in the article dealing with the various alkaloids of this bark, notably under the heading Quininæ Sulphas.

Unofficial and Allied Barks and Products.—The genus *Cinchona* contains about 40 species, natives of the eastern Andes from about 18° south to 10° north. Besides the bark, their wood, leaves, and fruits have been found to contain unimportant amounts of their peculiar alkaloids. The barks of most of them have entered commerce, though many of them only as substitutes or adulterants recognized as worthless. Besides the cinchonas, related and similar barks have also been collected. Of these, nearly all are worthless, but at least one, *Remijia*, contains considerable quinine. In all of them our interest is chiefly historical. It would be folly to cultivate them when rich barks can be produced with equal ease and expenditure, while in the wild state, growing as they do in remote and inaccessible regions, the cost of collecting and marketing is greater than that of producing the cultivated varieties. The pharmaceutical use of most of them is everywhere barred by official requirements and intelligent custom, while it is unprofitable to extract their quinine, owing to the relatively large amount of bark which must be worked over. In spite of these facts, however, there are various reasons why they possess some degree of commercial interest.

Fig. 116.

Officinalis bark, Jamaica-grown: small quill (Nat.).

C. officinalis (*Cinchona pallida; Cinchonæ pallidæ Cortex; Cortex chinæ fuscus; China fusca, grisea, pallida*, or *cinerea.—Pale Peruvian bark, Loxa, Huanuco* (in part), *Cuenca, Guayaquil* or *Crown bark*, E.; *Quinquina gris de Loxa*, Fr.; *Braune* (*Graue*) *Chinarinde, Loxarinde, Kronchina*, G.; *Quina gris de Loja, Quina charhuarguera*, Sp.) is probably of more importance than all the other unofficial barks combined. It is fairly rich and its alkaloid is of good quality. It has been official up to a recent date, and is now excluded solely by reason of its deficient alkaloidal percentage, although its preparations have become favorites with many physicians. It is especially valued in France, Spain, and other countries of southern Europe. There are still quite extensive stocks of it in various plantations, and there is a small but steady collection in the wild state. It was the first species discovered, and upon it the genus was founded. It comes from Ecuador, and has been introduced to cultivation in nearly all cinchona plantations, and in Jamaica has escaped and become thoroughly naturalized. It presents a number of distinct forms or varieties, if indeed they be not species, and their barks exhibit very marked differences. The wild forms are all in quills rarely thicker than a man's thumb. Under cultivation, it grows as a tree, and it seems almost certain that this must be due to hybridization with other species.

Description.—Typical pale cinchona occurs in well-formed quills of variable length, usually 1 to 1.5 Cm. ($\frac{2}{5}$ to $\frac{3}{5}$ In., rarely reaching 1 In.) in diameter, and the bark mostly 2 to 4 Mm. ($\frac{1}{12}$ to $\frac{1}{8}$ In.) thick, always notable for its thickness as compared with the size of the quill; periderm varying from gray-brown (in the *Huanuco*) to nearly black

(in the best *Loxa*), longitudinally wrinkled, the wrinkles rather strong but short, and irregular in direction, commonly shaggy with gray and yellowish-green lichens, without fissures, or sparsely transversely fissured, the fissures short and of a gaping character, dot intersecting; inner surface of a light or yellowish rust-brown, nearly smooth; fracture short, the fibrous zone narrow, the bast-fibers rather few, mostly arranged in groups of from 3 to 6, of medium size; stone-cells rare, laticiferous ducts wanting except in the youngest bark; taste only moderately bitter. Powder pale-brown.

As this bark now comes to us from cultivated sources, it is in very much larger quills, apparently coming from good-sized trees, and preserves its relative thickness. It is much more fissured, its inner surface and powder more reddish, and its bast-fibers are wanting in the specific characters. For these reasons and because of its very different alkaloidal yield, it appears almost certain that it is a hybrid of *C. officinalis* with one or more other species.

Fig. 117.

Officinalis: forest-grown and lichen-covered (Nat.).

Fig. 118.

Brown Huanuco bark (Nat.).

The distinguishing characteristic of this bark is found in the character of its fissures, if these be present. They are never in the pure bark so numerous nor so much intersecting as in calisaya, but are more so than in the rubra. Most important are their slanting sides, the width much greater at the top than at the bottom, imparting a gaping appearance to them. As the bark grows in its nativity, there is the greatest difference in its covering of lichens. Those lots which are shaggy from this growth have always been preferred, and examination shows that they are uniformly richer.

The different varieties of pale bark differ greatly in composition, the total amount of alkaloid varying from about 1 to 3½ or even 4 per cent. From one-half to two-thirds of this alkaloid is quinine. Indian-grown bark has been reported to contain upward of 8 per cent. of total alkaloid, but there is no sufficient evidence that this was pure *officinalis*.

Other cinchona barks formerly important articles of commerce, but now scarcely ever seen, may be briefly mentioned. *Fibrous Calisaya* was derived from *C. lancifolia* Mutis and *C. scrobiculata* H. et B., and was so called because of its long-fibrous fracture. It is intermediate in color between succirubra and calisaya, but the cork is very soft. It contains large stone-cells. That of *C. scrobiculata* contains laticiferous ducts, that of *C. lancifolia* does not. Somewhat similar was that of *C. Boliviana* Wedd., but this more closely resembled calisaya, and was often called a "gray bark." It showed large whitish spots on fracture. *Gray* or *Huamalies bark* was mostly the product of *C. micrantha* R. et P., a Bolivian species. It was of an ashy-gray, had no or very few stone-cells and no laticiferous ducts, and its medium-sized bast-fibers were mostly in pairs or threes, occasionally in groups of 5 to 8. Two Bolivian barks, quite worthless, were of commercial importance as frequent admixtures of gray and calisaya barks. One was *C. ovata* or *Arica bark*, the *Cocola* of the natives, ashy-gray, very thin considering the large size of the quill, and disposed to wrinkle. It contained *aricine* or *cinchovatine* ($C_{23}H_{36}N_2O_4$), which is crystalline and gives a dark-green solution with nitric acid. The other was *C. Josephiana* Wedd., long called var. *Josephiana* of *C. Calisaya*, an entirely worthless bark, called *Pajinal* by the natives. It grows upon a large shrub, and is very thin and much wrinkled in drying, and is usually of a purplish-gray color. *Cusco bark*, from *C. pubescens* Vahl, has a pale brownish-yellow, usually warty periderm, cinnamon-colored within and of a coarse-splintery fracture. It contains *cuscovatine*, very similar to aricine, but many of its salts take a gelatinous form. Other alkaloids reported in it are *cusconadine* and *cuscamine*. *Pitaya bark* was from *C. Pitayensis* Wedd., and had a smooth, ochre-colored periderm, a reddish-brown inner surface, and a short-splintery fracture. Some Pitaya bark is said to have come from a species of *Ladenbergia*.

Of related barks not in the genus *Cinchona*, by far the most important was *Cuprea bark*, so called from its coppery-red surface, the product of *Remijia Purdieana* Wedd. and *R. pedunculata* Tri. (*Cinchona* P. Karst.), of central and southern Colombia. It is in quills or curved pieces with a brown-red inner surface, externally with fragments of gray or brownish cork, and copper-red in the interior; the transverse fracture is coarsely granular, the longitudinal fracture rather splintery; the transverse fracture shows thick-walled cork-cells;

sometimes scattered laticiferous ducts, many transversely elongated stone-cells, both in the outer bark and bast-layer, and in the latter numerous wavy medullary rays and radial lines of closely packed, thin, elongated, obtuse bast-fibres, with the central cavity usually large; these bast-rays are less numerous in the inner than in the outer portion of the liber. The bark is very compact, hard, and heavier than water; that from southern Colombia is denser, more compact, and shows a more horny fracture. Cuprea bark varies considerably in the amount of alkaloids, which in bark from high elevations sometimes reaches 3 or even 6 per cent., or 2 per cent. of quinine, the remainder being quinidine and cinchonine, sometimes cinchonamine, but never cinchonidine. Koerner obtained from the mother-liquor resulting from the extraction of quinine from Cuprea bark a considerable amount of caffeate of quinine, yielding caffeic acid, about 0.5 per cent., practically identical with that obtained by splitting up caffeotannic acid derived from coffee.

Peckolt states that the bark of *R. ferruginea* DC. is used by the Brazilian natives in the treatment of malaria, and a number of other species are similarly used.

Most of the wholly spurious barks were obtained from trees belonging to the genera *Cascarilla, Ladenbergia, Nauclea, Buena,* and *Exostemma;* some of these are quite similar to cinchona barks in appearance, while others have not the slightest resemblance to them. In those barks most nearly allied to cinchona, a cinchona bast-fiber is occasionally met with, but nearly all the bast-fibers have large central cavities. Others (*Nauclea*) have the thin fibers nearly filled up, but regularly arranged in radial and tangential rows. Grahe's test—and, more reliable still, the microscope—will at once prove their distinctiveness.

Pinckneya Pubens Mx. (*Cinchona caroliniana* Biret) is a small tree growing in swampy localities from South Carolina to Florida. The bark is employed as a tonic and febrifuge under the name of *Georgia bark.* Farr claims having detected a considerable amount of cinchonine in the bark (Porcher, *Resources,* p. 442), which is probably incorrect, though the plant is likely to contain an alkaloid. *Arariba bark,* from *P. rufescens,* contains *aribine* ($C_{23}H_{20}N_4 + 5H_2O$), crystalline like its salts, neutral, optically inactive, and with a melting-point of 229° C. (442.2° F.).

Crossopteryx febrifuga Benth. (*C. Kotschyana* Fenzl.) is a tree of tropical Africa having febrifuge properties, and, like the preceding, belonging to the suborder *Cinchoneæ.* Hesse (1879) isolated from the bark 0.018 per cent. of an amorphous white liquid alkaloid, *crossopterine,* which is easily soluble in alcohol, ether, and ammonia, and yields bitter salts. The aqueous infusion of the bark shows blue fluorescence, which disappears on acidulation with sulphuric acid, and even after boiling reappears on the addition of an alkali.

Pambotana bark, from a leguminous tree of Mexico, probably a *Dalbergia,* has been proposed as a cinchona substitute. It contains neither alkaloid nor glucoside.

CINCHONIDINA.—Cinchonidine.

Cinchonidine, F.; *Cinchonidin,* G.[1]

Formula, $C_{19}H_{22}N_2O$. Molecular weight, 292.03.

An alkaloid obtained from the bark of various species of cinchona. Cinchonidine was discovered by Pasteur (1853) in commercial quinidine, and its present formula, $C_{19}H_{22}N_2O$, definitely established by Skraup (1879). It is an isomer of cinchonine. The cultivated British-India and Javanese red barks, and the Columbian (South American) varieties yield large proportions of the alkaloid. The free alkaloid is not official.

Preparation.—The mother-liquors obtained in the manufacture of quinine sulphate are precipitated with a solution of Rochelle salt, and the precipitated tartrates washed with water and then dissolved in dilute hydrochloric acid. The solution is made strongly alkaline with water of ammonia and the precipitated alkaloids exhausted with ether until the precipitated alkaloid fails to give the thalleioquin test (absence of quinine and quinidine). The residual alkaloid, *cinchonidine,* is dissolved in dilute hydrochloric acid, again precipitated by water of ammonia, and after washing with water crystallized from alcohol.

Properties.—Cinchonidine crystallizes from alcohol in lustrous short anhydrous prisms, or from dilute alcohol in thin plates. It has a bitter taste, melts at 202.5° C. (396.5° F.), and congeals again to a crystalline mass at 190° C. (374° F.). It is soluble in about 1600 parts of cold water, in about 20 parts of alcohol, and 188 parts of ether. The presence of quinine increases the solubility in ether. It is easily soluble in amyl alcohol and chloroform, and slightly soluble in ammonia. It is strongly lævorotatory, the specific rotatory power being affected by the concentration and the nature of the solvent. The maximum rotation in alcoholic solutions occurs in 50 per cent. alcohol and the minimum in absolute alcohol, while the least variation

[1] Also termed in German Cinchonidin II., α-Chinidin.

occurs in aqueous solutions (C. A. Schuster, *Monatsh.*, 14, 573–595). Cinchonidine is a strong base, of alkaline reaction; bibasic in valency, and forms basic, neutral, and acid salts. The solutions of its salts are precipitated by the alkali hydroxides and carbonates, and the general reagents for alkaloids. Its crystalline forms and microscopic characteristics distinguish it from homocinchonidine (Behrens, *Fr. Z. f. A. C.*, 35, pp. 133–143). It is separated from the other cinchona alkaloids by precipitating with normal tartrate solution and following the course for its preparation indicated above.

Action and Uses.—Cinchonidine and its various salts have been employed as substitutes for the quinine salts in those diseases in which the latter drugs are indicated. It is less powerful than quinine and must be given in larger doses.

UNOFFICIAL SALTS OF CINCHONIDINE.

Cinchonidinæ Hydrobromidum.—*Cinchonidine hydrobromide (basic). Cinchonidinbromhydrat.* $C_{19}H_{22}N_2O.HBr. + H_2O$. Molecular weight, 390.27.—It is prepared by adding a hot solution of 4.5 parts of crystallized barium bromide in 40 parts of water to a hot solution of 10 parts of cinchonidine sulphate in 60 parts of water, filtering out the precipitated barium sulphate and concentrating the filtrate and crystallizing. It forms long colorless needles soluble in about 40 parts of cold water, and easily soluble in hot water.

Cinchonidinæ Hydrobromidum Acidum. *Cinchonidine hydrobromide. Saures, bromwasserstoffsaures Cinchonidin.* $C_{19}H_{22}N_2O.2HBr + 2H_2O$. Molecular weight, 488.51.—It is prepared by adding a solution of 9 parts of crystallized barium bromide in 25 parts of water to a hot solution of 10 parts of cinchonidine sulphate in about 50 parts of water and 8.1 parts of dilute sulphuric acid (specific gravity 1.112), filtering, and after concentrating the filtrate sufficiently allowing to crystallize. Long, slightly yellowish crystals, soluble in 6 parts of water.

Cinchonidinæ Hydrochloridum.—*Cinchonidine hydrochloride (basic). Cinchonidinhydrochlorid.* $C_{19}H_{22}N_2O.HCl + H_2O$. Molecular weight, 346.09.—It may be prepared by dissolving 10 parts of cinchonidine in the proper equivalent of dilute hydrochloric acid (34.1 Cc. of normal test-solution) and crystallizing the solution. Lustrous, monoclinic pyramids or octahedra, soluble in about 20 parts of water, and soluble in alcohol and chloroform.

Cinchonidinæ Hydrochloridum Acidum.—*Cinchonidine hydrochloride. Saures Cinchonidinchlorhydrat.* $C_{19}H_{22}N_2O.2HCl + H_2O$. Molecular weight, 382.27.—It is easily prepared by dissolving 10 parts of cinchonidine in 68.2 Cc. of normal test-solution of hydrochloric acid and crystallizing. Long, colorless, monoclinic crystals, soluble in water and alcohol.

Cinchonidinæ Salicylas.—*Cinchonidine salicylate. Salicylsaures Cinchonidin.* $C_{19}H_{22}N_2O.C_7H_6O_3$. Molecular weight, 429.04.—100 parts of finely pulverized cinchonidine and 43.51 parts of pure salicylic acid are mixed in about 2500 parts of distilled water and boiled for several hours under a reflux condenser. The solution is then set aside to crystallize. The mother-liquor may be concentrated for a further crop of crystals. The crystals are insoluble in cold water, but easily soluble in alcohol.

Cinchonidinæ Tannas.—*Cinchonidine tannate. Gerbsaures Cinchonidin.*—10 parts of pulverized cinchonidine and 17 parts of tannic acid are mixed and ground in a porcelain or glass mortar with 25 parts of alcohol, and the resulting mass allowed to dry spontaneously A white to yellowish-white powder, insoluble in water and difficultly soluble in alcohol.

CINCHONIDINÆ SULPHAS, *U. S.*—Cinchonidine Sulphate.

Cinchonidinum sulfuricum.—*Sulphate of cinchonidine*, E.; *Sulfate de cinchonidine*, Fr.; *Cinchonidinsulfat*, G.; *Solfato di cinconidina*, It., Sp.

Formula, $(C_{19}H_{22}N_2O)_2H_2SO_4 + 3H_2O$. Molecular weight, 735.05.

The neutral sulphate of an alkaloid prepared from the bark of several species of Cinchona.—U. S.

Origin.—Certain cinchona barks, notably those obtained from *Cinch. succirubra* Pavon, *Cinch. officinalis* Hooker, cultivated in India, and the South American barks from *Cinch. lancifolia* Mutis, and *Cinch. tacujensis* Karsten, contain cinchonidine. A very similar alkaloid, called *homocinchonidine*, is rarely, and then only in minute quantities, found in these barks; but in certain lots of South American red barks the second alkaloid named is present in considerable proportion, wholly or partly replacing the first named (Hesse, *Berichte*, 1881, p. 1890). These alkaloids were at first described by Winckler (1847) and others as *quinidine* or *chinidine*, a name which was retained for them long after Pasteur's investigations in 1853 by several chemists, and for many years by several manufacturers in Germany and Austria.

Preparation.—In the process of manufacturing quinine sulphate, and while recrystallizing this salt, mother-liquors are obtained containing mainly cinchonidine sulphate. On concentrating the solutions the salt crystallizes and requires purification by recrystallization from water in order to obtain it free from quinine and quinidine sulphate. Formerly it could be prepared from commercial chinoidine, which sometimes contained notable quantities of this alkaloid. It may be prepared by dissolving 10 parts of cinchonidine in about 150 parts of water and adding just sufficient dilute sulphuric acid to neutralize it, then evaporating to about 100 parts and crystallizing.

Properties.—Commercial cinchonidine sulphate resembles quinine sulphate in appearance. It occurs as white, glistening, silky needles or prisms, which are permanent in the air, without odor, and have a very bitter taste. When crystallized from alcohol it contains 2 molecules of water of crystallization, if from dilute aqueous solutions 3 molecules, and if from concentrated solutions 6 molecules of water. It is soluble at 25° C. (77° F.) in 63 parts of water, 72 parts of alcohol, 900 parts of chloroform, or 4400 parts of ether; at 80° C. (176° F.) in 21 parts of water, and at 60° C. (140° F.) in 32 parts of alcohol (U. S.). Also soluble in 70 parts of water or 1316 parts of chloroform at 15° C. (59° F.), and in 1.42 parts of boiling water or 8 parts of boiling alcohol. The salt dissolves readily in diluted acids, the solutions being free from fluorescence. Its solubility in ether and chloroform is increased by the presence of the sulphates of other cinchona alkaloids. "When heated to 100° C. (212° F.) cinchonidine sulphate loses its water of crystallization, and at 203° C. (397.4° F.) it darkens, and

FIG. 119.

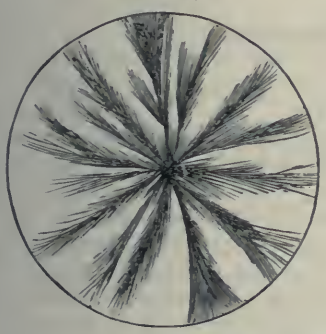
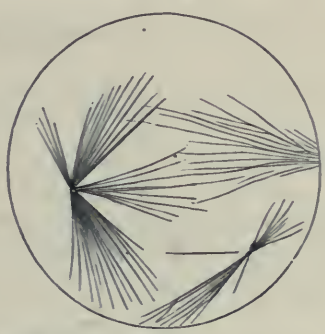


FIG. 120.



Cinchonidine sulphate with KSCy: microscopic crystals.

then melts at 205.3° C. (401.5° F.). At higher temperatures it ignites and is consumed without leaving a residue. The aqueous solution is neutral or only faintly alkaline to phenolphthalein or litmus test-solutions, and is lævogyrate. It yields with barium chloride test-solution a white precipitate, insoluble in hydrochloric acid. On adding ammonia-water to the aqueous solution of the salt, a white precipitate (cinchonidine) is produced, which is but slightly soluble in ammonia, but which, when freshly precipitated, dissolves in 10 parts of ether, the greater part afterward separating in crystals." —U. S. On mixing a drop of an aqueous solution of the salt with a drop of solution of potassium sulphocyanate, microscopical crystals are formed, which are either feathery and stellately arranged around a centre, or are spike-like and united in star-like or fan-shaped groups. According to Hesse (1878), cinchonidine sulphate is so completely precipitated by an excess of potassium sulphocyanate that the filtrate is not rendered turbid by ammonia.

Homocinchonidine sulphate has the composition and properties described above, but crystallizes either in dull-white prisms or in delicate white needles, requires at 22° C. (71.6° F.) 69 parts of water for solution, and its aqueous solution, saturated at 50° C. (122° F.), congeals on cooling to a gelatinous mass consisting of delicate crystals and enclosing the mother-liquor, while under the same conditions the cinchonidine salt yields glossy needles, from which the mother-liquor may be readily drained. Both salts on being treated with potassium permanganate yield *cinchotenidine*, $C_{18}H_{20}N_2O_3$, which was discovered by Skraup (1879), crystallizes with $3H_2O$ in colorless prisms, melts at 256° C. (492.8° F.), and is not fluorescent in acid solutions (Hesse, 1881).

Tests.—The solution of the salt (1 in 1000) in dilute sulphuric acid should not show more than a slight blue fluorescence (absence of more than traces of sulphate of quinine or of quinidine). If sulphuric acid be added to a small quantity of the salt, not more than a faintly yellowish color should be developed (limit of readily carbonizable organic impurities). Upon adding to this solution a crystal of potassium dichromate the liquid should become yellowish green, gradually changing to grass green in color. If 1 Gm. be dried at 100 C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.92 Gm. (absence of an undue amount of water). If 0.5 Gm. of the salt be digested with 20 Cc. of cold distilled water, 0.5 Gm. of potassium sodium tartrate added, the mixture macerated, with frequent agitation, for 1 hour at 15° C. (59° F.), then filtered, and a drop of ammonia-water added to the filtrate, not more than a slight turbidity should appear (absence of more than small proportions of sulphates of cinchonine or quinidine).—U. S.

Action and Uses.—This alkaloid may be employed as a substitute for quinine. It is only about one-third as strong as quinine in its medicinal influences, and therefore, to be efficacious in malarial fever, much larger doses of it are required. The only advantage that it possesses over quinine is the claim made for it by some practitioners that it is less apt to produce fulness in the head and the other characteristic symptoms of the full physiological action of the more active alkaloid. Perhaps this lessened cerebral effect depends more upon the size of its dose and its inherent feebleness than upon any true variation in the susceptibility of the patient to the influence of these two alkaloids of cinchona. The dose is from 10 to 20 grains (0.60–2 Gm.).

CINCHONINA.—Cinchonine.

Cinchoninum.—Cinchonine, Fr.; *Cinchonin*, G.; *Cinconina*, It., Sp.

Formula, $C_{19}H_{22}N_2O$. Molecular weight, 292.03.

An alkaloid prepared from the bark of different species of cinchona. It was discovered by Pelletier and Caventou in 1820, and has been found in the largest proportions in some of the pale cinchonas.

Preparation.—Cinchonine is obtained commercially as a by-product in the manufacture of quinine after quinidine and cinchonidine have been removed from the mother-liquor, by precipitation with sodium hydroxide. The washed resinous precipitate is dissolved in dilute sulphuric acid and the sulphate purified by repeated crystallization. It is readily prepared by precipitating the aqueous solution of cinchonine sulphate with ammonia water, washing with water until free from ammonium sulphate, and crystallizing from alcohol.

Properties.—Cinchonine occurs as anhydrous, transparent white, somewhat lustrous prisms or needles, permanent in the air, odorless, at first nearly tasteless, but developing a bitter after-taste, and having an alkaline reaction; soluble in 3760 of water, and in 116 parts of alcohol at 15° C. (59° F.), in 3500 parts of boiling water, in 26.5 parts of boiling alcohol, 526 parts of ether, 163 parts of chloroform, and readily soluble in diluted acids, forming salts having a very bitter taste. At 240° C. (464° F.) the crystals fuse together, and at 258° C. (496.4° F.) they melt, forming a brown liquid. On ignition, the alkaloid is dissipated without residue.

Cinchonine is insoluble in solutions of ammonia and potassa, but dissolves in 108 parts of amyl alcohol, in warm fixed oils, volatile oils, benzene, and benzin. Its solutions are dextrogyrate; its acid solutions are not fluorescent, and do not give the thalleioquin reaction, but with chlorine-water and ammonia yield a white precipitate. Its alcoholic solution gives a yellow precipitate with picric acid which is insoluble in acids. The aqueous solutions of its salts are not precipitated by bicarbonates in the presence of tartaric acid, but yield precipitates with ammonia and other alkalies, their carbonates, with tannin, potassio-mercuric iodide, gold chloride, platinum chloride, phosphomolybdic acid, picric acid, and other reagents for alkaloids; also, by potassium ferrocyanide (Dollfus, 1848). This last reaction is to be applied in the following manner: If enough solution of potassium ferrocyanide be added to a neutral or not more than faintly acid solution of cinchonine, or any of its salts, to redissolve the precipitate first formed, and afterward an acid, a golden-yellow precipitate will occur, which

when slightly warmed will dissolve in the liquid, and on cooling separate in minute scales or needles.

By the action of potassa on cinchonine, Gerhardt (1842) obtained quinoline, and Greville Williams (1855, 1864) showed that in addition to this base the distillate also contained lepidine, cryptidine, and other bases. By long-continued boiling of its chloride with alcohol and potassa, König (1881) produced from cinchonine a crystallizable volatile base, *cinchene*, $C_{19}H_{20}N_2$. Michael (1886) obtained an oily, non-volatile base, $C_{20}H_{26}N_2$, by exposing sodium hydroxide, cinchonine, and absolute alcohol to a temperature of 130° C. (266° F.) in a closed tube. On oxidizing cinchonine or its salts by the action of lead dioxide and sulphuric acid, E. Marchand (1844) obtained *cinchotenine*, which is more readily obtained, according to Caventou and Willm, by the action of potassium permanganate, formic acid being formed at the same time. Cinchotenine, $C_{18}H_{20}N_2O_3$, by the further action of oxidizing agents yields Weidel's (1874) *cinchonic* (quinoline-carbonic acid), $C_{10}H_7NO_2$, *cinchomeronic*, $C_7H_5NO_4$, and other acids.

By the prolonged action of 50 per cent. sulphuric acid upon cinchonine at 120° C. (248° F.), Jungfleisch and Léger (*Compt.-rend.*, cxix. 1268) obtained *β-oxycinchonine*, $C_{38}H_{22}N_2O_4$, a strong base soluble in alcohol and dextrogyre. Cinchonine is an isomer of cinchonidine. By the action of sulphuric and hydrochloric acids, O. Hesse obtained 10 of the theoretically possible isomers of cinchonine (*Annalen*, 276, 88–124). Of these, *a-isocinchonine* ($S_d = +51.6$) is identical with the isocinchonine of Comstock and König and Jungfleisch and Léger's cinchoniline. *Benzoyl cinchonine*, a strong base forming neutral salts, was obtained by Léger (*Jour. Phar. Chim.*, 1893, 405) by heating cinchonine with benzoyl chloride.

Commercial cinchonine is frequently contaminated with a very similar alkaloid, which is not affected by cold potassium permanganate, is freely soluble in alcohol, yields a sulphate crystallizing in sharp needles, and is freed from cinchonine by fractional precipitation; Skraup proposed to call it *cinchotine*, and found it to be identical with Caventou and Willm's *hydrocinchonine*, $C_{19}H_{24}N_2O$.

Tests.—A solution of the alkaloid (1 in 1000) in diluted sulphuric acid should not exhibit more than a faint blue fluorescence (absence of more than traces of quinine or quinidine). On precipitating the alkaloid from this solution by water of ammonia it is very sparingly dissolved by the latter (difference from and absence of quinine), and requires at least 300 parts of ether for solution (difference from quinine, quinidine, and cinchonidine). It should not be colored, or but very slightly colored, by the addition of sulphuric acid (absence of readily carbonizable, organic impurities).

Action and Uses.—As a remedy this alkaloid differs in no particular from quinine except that it is about one-third weaker. In large overdose, however, it is a convulsive, producing contractions, followed by exhaustion, and exciting præcordial pain and oppression. Its effect upon the nervous system is less marked than that of quinine, as it rarely produces vertigo, tinnitus aurium, or visual disturbances. As a tonic it may be given in doses of 1 or 2 grains (0.06–0.12 Gm.) several times daily. As an antiperiodic the dose is from 15 to 30 grains (1–2 Gm.), to be given as is quinine, in relation to the paroxysm.

CINCHONINÆ SULPHAS, *U. S.*—Cinchonine Sulphate.

Cinchoniæ sulphas, Cinchoninum sulfuricum.—Sulfate de cinchonine, Fr.; *Schwefelsaures Cinchonin, Cinchoninsulfat*, G.; *Solfato di cinconina*, It., Sp.

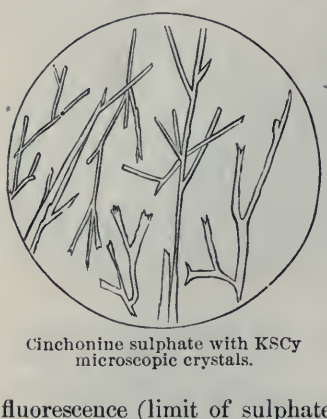
Formula, $(C_{19}H_{22}N_2O)_2H_2SO_4 + 2H_2O$. Molecular weight, 717.17.

Preparation.—Cinchonine sulphate is prepared from cinchonine by dissolving the alkaloid in the proper equivalent of dilute sulphuric acid. Neutralize 10 parts of cinchonine in about 200 parts of water with 10 parts of sulphuric acid, specific gravity 1.112, applying a gentle heat to hasten the combination. The solution is filtered while hot and the cinchonine sulphate obtained in crystallized form on cooling. If crystallized from water it will contain 2 molecules, and if from alcohol, 1 molecule, of water of crystallization.

Properties.—Cinchonine sulphate crystallizes in the form of colorless, transparent or white, lustrous, odorless, hard, clinorhombic prisms, which are permanent in the air, lose their water of crystallization (4.98 per cent.) at 100° C. (212° F.), and when heated to 198.5° C. (389.5° F.) fuse to a liquid and gradually decompose, forming a reddish

colored liquid, which at a higher temperature may be burned without residue. Cinchonine sulphate is soluble at 25° C. (77° F.) in 58 parts of water, 10 parts of alcohol, 69 parts of chloroform or 2300 parts of ether; at 80° C. (176° F.) in 32 parts of water, and at 60° C. (140° F.) in 5.2 parts of alcohol (U. S.). It is also soluble at 15° C. (59° F.) in 66 parts of water, in 13.5 parts of boiling water, and in 3.25 parts of boiling alcohol. Its aqueous solutions are neutral to litmus-paper, non-fluorescent, have an intensely bitter taste, and are strongly dextrorotatory. Its aqueous solutions are precipitated by the general alkaloidal reagents; by barium chloride (sulphate); by ammonium hydroxide, the precipitate being but sparingly soluble in excess of the reagent and suitable for the quantitative estimation of the alkaloid. When a drop of a saturated aqueous solution of the salt is mixed with a drop of solution of potassium sulphocyanate, crystals will be formed, which under the microscope will appear long, radiating, and considerably branched, resembling antlers or equisetum. Cinchonine sulphate contains 82.8 per cent. of cinchonine. By repeated crystallization of some of the commercial cinchonine sulphate, Skraup obtained *cinchotine*, $C_{19}H_{24}N_2O$, an alkaloid very similar to cinchonine, and identical with Caventou's and Willm's (1869) *hydrocinchonine*. It is more freely soluble in alcohol than cinchonine, yields a sulphate crystallizing in sharp needles, and is not affected by a cold solution of potassium permanganate.

Fig. 121.



Cinchonine sulphate with KSCy microscopic crystals.

Tests.—A solution of the salt (1 in 1000) in diluted sulphuric acid should not show more than a faint blue fluorescence (limit of sulphate of quinine or of quinidine). If 1 Gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.95 Gm. If 1 part of the salt, reduced to powder, is macerated, with frequent agitation, with 80 parts of chloroform at ordinary temperature, it should wholly, or almost wholly, dissolve (limit of sulphate of quinine or cinchonidine). The salt should not impart more than a faintly yellowish tinge to concentrated sulphuric acid (limit of readily carbonizable organic impurities).—U. S.

Mixed with pulverized sodium chloride and heated on platinum-foil, purple fumes are developed.

Action and Uses.—Cinchonine sulphate may be employed in place of quinine in the treatment of malarial fever, and as a bitter tonic. It has no advantages over the more powerful alkaloid, and is very rarely used. It is about one-third as strong as quinine. The dose is the same as of cinchonine.

Other Salts of Cinchonine.—Cinchoninæ Sulphas Acidus. *Acid cinchonine sulphate, Cinchonine bisulphate.* $C_{19}H_{22}N_2O.H_2SO_4.3H_2O$. Molecular weight, 443.02.—Obtained by dissolving the official sulphate in dilute sulphuric acid and crystallizing; forms octahedral crystals, which become opaque in dry air, and dissolve in about half their weight of water and in 90 parts of alcohol. They are insoluble in ether, and contain 59.2 per cent. of cinchonine.

Cinchoninæ Hydrochloridum. *Cinchonine hydrochloride.* $C_{19}H_{22}N_2O.HCl.2H_2O$. Molecular weight, 363.97.—Made by treating an excess of cinchonine with dilute hydrochloric acid; crystallizes in needles closely resembling sulphate of quinine, dissolves in 24 parts of water at 10° C. (50° F.), in 3.2 parts of boiling water, in 22.2 parts of chloroform, in 1.3 parts of 80 per cent. alcohol, and in 273 parts of ether specific gravity 0.730 at 15° C. (59° F.). The salt melts above 130° C. (266° F.). It has been occasionally used for adulterating, or fraudulently sold for, quinine sulphate, from which it is readily distinguished by the absence of fluorescence of its acidulated solution, by the white precipitate occasioned with silver nitrate, and by the sparing solubility in ether of the white precipitate with ammonia. It contains 80.24 per cent. of cinchonine.

Cinchoninæ Iodosulphas. *Cinchonine iodosulphate, Antiseptol*, E.; *Cinchonin Herapathit*, G.—Antiseptol is prepared by adding a solution of 10 Gm. of iodine and 10 Gm. of potassium iodide in 1000 Cc. of water to a solution of 25 Gm. of cinchonine sulphate in 2000 Cc. of water. The precipitate is washed with water until the washings are free from iodine. The compound is somewhat variable in composition, but usually contains about 50 per cent. of iodine, and has been recommended by Yvon as a substitute for iodoform. It is a light-reddish-brown powder, insoluble in water, but soluble in alcohol and chloroform.

CINNALDEHYDUM, *U. S.*—Cinnamic Aldehyde.

Aldehydum cinnamicum.—Phenylacrolein, E.; *Aldéhyde cinnamique*, Fr.; *Zimmtaldehyd, Zimmtsäurealdehyd*, G.

Formula, C_9H_8O or $C_6H_5.CH:CH.COH$. Molecular weight, 131.07.

An aldehyde obtained from oil of cinnamon or prepared synthetically, containing not less than 95 per cent. of pure cinnamic aldehyde. It should be kept in small amber-colored, well-stoppered bottles.—U. S.

Preparation.—The natural product is obtained by shaking oil of cassia with an excess of concentrated aqueous solution of acid sodium sulphite, sodium cinnamal-hydroxy-sulphonate, $C_6H_5CH:CHCH(OH)SO_3Na$, being first formed, which latter is soluble and combines with a second molecule of the acid sulphite to form the sparingly soluble compound $C_6H_5CHSO_3Na.CH_2.CH(OH)SO_3Na.2H_2O$. The crystalline magma is separated by filtration, washed with cold alcohol, and decomposed with dilute sulphuric acid, cinnamic aldehyde being regenerated. Being but sparingly soluble in water the final product is readily separated from the aqueous liquid, and may then be rectified by distillation under reduced pressure.

Synthetically cinnamic aldehyde may be obtained by careful oxidation of cinnamyl alcohol, by dry distillation of a mixture of calcium cinnamate and formate, or as a condensation-product by acting on a mixture of benzaldehyde and acetaldehyde with hydrochloric acid gas. In place of the latter reaction a mixture of 10 parts of benzaldehyde, 15 parts of acetaldehyde, and 10 parts of 10 per cent. sodium hydroxide solution may be diluted with 900 parts of water and set aside for several days, when the two aldehydes will condense to form cinnamic aldehyde with elimination of water, as follows: $C_6H_5COH + CH_3COH = H_2O + C_6H_5.CH:CH.COH$.

Properties and Tests.—Cinnamic aldehyde is a colorless liquid having a cinnamon-like odor and a burning, aromatic taste. It boils at about 250° C. (482° F.) with partial decomposition. Its specific gravity is about 1.047 at 25° C. (77° F.) (at 15° C. (59° F.) 1.054–1.056, Swed. Pharm.). It is optically inactive. When the temperature is reduced by a freezing mixture, cinnamic aldehyde should solidify, and should melt again at —7.5° C. (18.5° F.). It is sparingly soluble in water, but soluble in all proportions in alcohol, ether, and fixed and volatile oils. If a small strip of filter-paper be folded in the form of a taper, saturated with cinnamic aldehyde, placed in a small porcelain dish and the latter in a larger dish, and if a clean beaker, moistened on the inner surface with distilled water, be inverted over the smaller dish, after igniting the taper, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity upon addition of a few drops of silver nitrate test-solution (absence of chlorinated products).—U. S. The Swedish Pharmacopœia requires that an alcoholic solution of cinnamic aldehyde (1 in 50) should not be changed by addition of 1 drop of ferric chloride test-solution; also that a yellow crystalline nitro compound shall result when an equal number of drops of cinnamic aldehyde and fuming nitric acid are mixed in the cold.

Assay of Cinnamic Aldehyde.—Introduce into a counterpoised 150-Cc. flask, by means of a pipette, 12 drops of cinnamic aldehyde, and note the exact weight; add 5 Cc. of distilled water and a few drops of phenolphthalein test-solution, and then neutralize the solution exactly by the cautious addition of tenth-normal sodium hydroxide solution. Add 50 Cc. of a solution of sodium sulphite (1 in 5), and immerse the flask in a water-bath containing boiling water. From a burette add just sufficient half-normal hydrochloric acid to maintain the neutrality of the mixture, keeping the flask continuously heated and frequently agitated, and adding a drop or two of phenolphthalein test-solution. When a permanent condition of neutrality is reached, note the number of cubic centimetres of the half-normal hydrochloric acid consumed. Carry out a blank test identical with the foregoing, except that the cinnamic aldehyde is omitted, and note the amount of half-normal hydrochloric acid consumed.

Subtract the number of cubic centimetres required in the blank test from the number required in the original test; each Cc. of this difference corresponds to 0.033 Gm. of cinnamic aldehyde. To find the percentage, multiply the above difference by 0.033 and the product by 100, and divide by the weight of the cinnamic aldehyde taken.—U. S.

Rosolic acid test-solution is better suited as an indicator for this test than phenolphthalein.

Action and Uses.—Cinnamic aldehyde is the active medicinal ingredient of oil of cinnamon, and may be employed for the same purposes as the latter drug. (See OLEUM CINNAMOMI.)

CINNAMOMUM, *U. S., Br., P. G., Fr., It.*—Cinnamon.

Canelle, Fr.; *Zimmt*, G.; *Canella*, It., Sp.

The bark of several species of *Cinnamomum* Blume (Fam. *Lauraceæ*), as follows:

(1) CINNAMOMUM CASSIA, P. G.—*Cortex cinnamomi chinensis, Cortex cinnamomi cassiæ, Cinnamomum chinense, C. Indicum, Cassia cinnamomea.—Cassia cinnamon, Chinese cinnamon, Cassia bark, Cassia lignea, Cassia vera*, E.; *Zimmtkassie, Chinesischer (Gemeiner) Zimmt*, G.; *Canelle de chine*, Fr.; *Canella*, It., Sp.—The dried bark of the shoots of *C. Cassia* (Nees) Blume (*Laurus C.* Nees; *C. aromaticum* Nees) deprived of most of its corky portion.

(2) CINNAMOMUM SAIGONICUM, U. S.—*Saigon cinnamon, Annam cinnamon, China cinnamon, God's cinnamon*, E.; *Saigonzimmt*, G.; *cannelle de Saigon*, Fr.—The dried bark of an undetermined species of *Cinnamomum*.

(3) CINNAMOMUM ZEYLANICUM, U. S.—*Cinnamomi Cortex*, Br.; *Cortex cinnamomi zeylanici, Cinnamomum acutum, C. verum.—Ceylon cinnamon, Cinnamon bark*, E.; *Zeylonzimmt*, G.; *Canelle de Ceylon*, Fr.; *Canella del Ceylon*, It.—The dried inner bark of the shoots of *C. Zeylanicum* Breyne.

Cinnamon is official in all pharmacopœias, though they differ much as to the varieties recognized. The Br. P. recognizes only the Ceylon bark.

Origin.—The genus *Cinnamomum* is credited with upward of 50 species, of tropical Asia, including the East India islands, but relatively few of them yield cinnamon. *C. Zeylanicum*, the best known, is native of Ceylon and perhaps of adjacent regions, but the present bark of commerce is almost all the product of cultivated plants. If allowed to grow, it forms a small evergreen tree, but it is pollarded so as to form a dense mass of slender straight branches. These are cut off when about 2 years of age and 1 or 2 inches in diameter, and before the astringent corky layer has a chance to form. The bark is removed in quills or strips, and after being allowed to wilt for a day, so as to become soft and pliable, is laid with the inner surface down and scraped off to the layer of stone-cells, the outer bitter or astringent portion being thus rejected. Care is taken not to use iron tools, as they cause blackening of the bark. A number of the strips are then peeled and rolled together to form the compound quills of commerce, and are carefully dried, for a day in the shade and afterward in the sun. They are marketed in large cylindrical bundles resembling rolls of carpet in size and form.

Saigon cinnamon appears to be derived wholly from wild trees, growing over a very limited area of mountainous territory in Annam. The entire bark of the trees, which are reported as being sometimes several feet in circumference and up to 200 years of age, is taken, though most of the bark which reaches us is from branches or stems apparently of less than the thickness of a man's arm. This sort is highly prized by the Chinese, who, with their usual superstition, attribute magical powers to certain pieces, for which fabulous prices are charged. It is cut into quills about a foot in length and dried entire, then tied in cylindrical bundles nearly a foot in diameter, each bundle representing quills of one of three sizes, the medium size (Fig. 123) being first in quality. It sometimes comes in chips of thick trunk-bark; the whole of it, if of good quality, even to the outermost cork, being sweet, aromatic, and nearly free from bitterness and astringency. The botanical origin of this bark has been much discussed. British writers have persistently connected it with cassia bark, and Pfister has distinctly stated that it is "unscraped cassia," but we must utterly reject this view. *C. Cassia*, being cultivated, is well known. Its cork is removed because of its highly objectionable qualities, from which that of the Saigon variety is commonly free. The Saigon pertains to a distinct floral area, and, unless we arbitrarily apply to it the name of cassia, as Pfister has done, its structure is distinct from that of cassia. There appears little doubt that it represents a less excellent grade of that distinctively Chinese cinnamon which is so highly prized by the Chinese, and which represents a species, perhaps several, distinct from *C. Cassia* (Nees) Blume. Certainly, its quality is quite distinct from that of any known to come from *C. Cassia*, so that it is convenient and practical to hold it apart from cassia, while recognizing its relation to this, rather than to Ceylon cinnamon.

C. Cassia is cultivated in southern China for the better quality of the cassia bark of commerce. The stems are allowed to reach the age of 5 or 6 years before being cut. The bark is removed in pieces about 16 inches in length and representing half the circumference of the stem. These strips, after wilting, are laid face down and the outer

layers imperfectly removed by planing. It is then tied into bundles for exportation. There is a form cultivated in Java, and known as *Batavian cassia*, from which the outer bark is scraped, of light color and excellent flavor, which perhaps is not from this species. The limitations of the above view obviously exclude a large part of the barks commonly known as Cassia. These will be considered under *Substitutes and Adulterants.*

FIG. 122.

Cinnamon.
a, *b*, *c*, Cassia. *d*, *e*, Ceylon.

FIG. 123.

Saigon cinnamon (Nat.).

Description.—CEYLON CINNAMON.—Long, closely rolled quills, each composed of 8 or more layers of bark of the thickness of paper; pale yellowish-brown, the outer surface smooth, marked with wavy lines of bast-bundles, the inner surface striate; fracture short-splintery; odor fragrant; taste sweetish, aromatic, faintly pungent, with little or no astringency.

Ceylon cinnamon exhibits the following structures, from without inward: (1) small scattered bast-fibers lying upon the surface of (2) a zone, mostly of 3 layers of stone-cells which are tangentially elongated, much and not very unequally thickened, and contain numerous pores; (3) some scattered sieve-tissue, with occasional bast-fibers in the cortical parenchyma; (4) bast-wedges alternating with medullary rays. In this bast-parenchyma are very large oil- and mucilage-cells; also, in both the medullary rays and bast-parenchyma, especially the former, cells containing acicular raphides, and large quantities of starch in very small grains. The bast-fibers taper acutely to both ends. Pfister names as the characteristics of this variety the relatively large number of bast-fibers, the markedly tangential elongation of the stone-cells, the isodiametric cells of the secondary parenchyma, and the acicular raphides, especially abundant in the medullary ray-cells. Tschirch has demonstrated the intimate relations, as to derivation, between the oil and the mucilage, and indicates the probability that the former is produced, at least in part, at the expense of the latter.

SAIGON CINNAMON.—In quills or quilled strips about 25 to 30 Cm. (10 to 12 In.) long and mostly from 0.8 to 2.5 Cm. ($\frac{1}{3}$ to 1 In.) in diameter, the bark 1 to 6 Mm. ($\frac{1}{25}$ to $\frac{1}{4}$ In.) thick; outer surface of the thinnest bark deep-brown or red-brown, of the thicker, gray or brownish-gray, with or without lighter patches, and more or less rough from scale-like warts, fine longitudinal wrinkles and, except in the thinner quills, some transverse ridges; inner surface cinnamon-brown to dark or reddish-brown, finely granular and very finely and indistinctly striate; fracture short, granular, exhibiting an almost continuous whitish middle layer between two brown ones, the outer indistinct in thick barks; odor fragrant; taste sweet, aromatic and pungent, with very little or no astringency.

Structurally, this is distinguished from the preceding by the presence of a periderm overlying the zone of stone-cells, the latter being nearly isodiametric, the starch-grains about a half larger. In the powder, the dark color, the great abundance of cork-cells, and the small number of bast-fibers as compared with the Ceylon variety, the isodiametric stone-cells, and larger starch-grains, furnish a ready means of distinction.

Cassia Cinnamon.—In quills of variable length and 0.5 to 2 Cm. ($\frac{1}{5}$ to $\frac{4}{5}$ In.) in diameter, the bark 1 to 2 Mm. ($\frac{1}{25}$ to $\frac{1}{12}$ In.) thick; yellowish-brown, the outer surface often marked with grayish patches, which are more or less warty- or scaly-roughened, the inner nearly smooth, faintly striate; fracture nearly smooth, exhibiting an interrupted middle whitish layer between two reddish-brown ones, the outer of these usually nearly or quite wanting; odor somewhat fragrant; taste sweetish, aromatic, more or less pungent and astringent.

The structure of cassia may be distinguished by the varying presence or partial or entire absence of the cork-tissue; as compared with the Ceylon or Saigon, by the wider but much more irregular zone of stone-cells, the greater abundance of bast-fibers and of tannin masses. In the powder, the abundance of stone-cells and bast-fibers and tannin-cells, and the medium percentage of cork-cells are characteristic.

Constituents.—All the cinnamons contain volatile oil, mucilage, resin, tannin, mannite, and bitter substance, in varying relative proportions. In typical samples, the Saigon variety contains the most volatile oil (1 per cent. or more) and mannite, the cassia variety coming next, and the Ceylon last, the oil of the last ranging from 0.5 to nearly 1 per cent. Cassia contains the most and Saigon the least, of both tannin and bitter substance. The percentage of mucilage is apt to vary inversely with that of the oil. The oil of cinnamon (see Oleum Cinnamomi) is not identical in the different barks, that of Ceylon cinnamon being generally recognized as of finer and more permanent flavor, while the Saigon, being sweeter, is more aromatic, but the aroma is less permanent. In a first-class Saigon bark, bitterness and astringency are scarcely appreciable. This is true also of the Ceylon bark as to bitterness, though more or less astringency is usual. The tannin in the Ceylon bark ranges from about 3 to 5 per cent. (*Thornton*). It is either a phlobaphene in the drug or acquires a phlobaphene character when brought into contact with water. It is very similar to the tannin of white oak bark, yet shows distinct reactions. The bitter constituent, sometimes present in appreciable amount in cassia, is unknown. The mannite has been called *cinnamanin*. Ceylon cinnamon yields up to about 3 per cent. of ash, cassia about 4 per cent.

Adulterants and Substitutes.—Those of the entire barks are first considered. Ceylon cinnamon, in the entire state, is scarcely capable of substitution.

Saigon cinnamon is sometimes substituted by cassia, and regularly by a bark closely resembling itself in appearance and slightly in taste, of unknown derivation. This is of a lighter gray and a coarser structure, and is at once identified by its very weak odor and taste. This may be the use made of the large unscraped Guava bark quills, which are said to be soaked in cinnamon water, dried, and the ends touched up with cinnamon oil. Only the greatest carelessness could admit of mistaking anything other than the best grades of cassia for Saigon cinnamon.

Cassia bark, as already indicated, is subject to the most extensive and varied substitution; or, this might be differently stated by saying that commercial cassia bark is of very varied origin, with the result of a corresponding variation in quality. To so great an extent is this true that even in the better drug trade there are more or less regularly different interpretations of the term "cassia," "cassia vera," "cassia lignea," etc., in different countries, depending upon different commercial relations. Pfister states that Sumatra cassia (*C. vera Padang*), as well as a portion of that of Java and perhaps of China, that of Timor and the red-brown Vogl sort, is from *C. Burmanni* (agreeing in structure with those from *C. dulce* Nees and *C. Kianus* Nees); that some from Calcutta, grown in northern India, as well as some from Cochin China, is from *C. Tamala* (the same as *C. albiflorum* Nees); and that part of that from the East Indian archipelago is from *C. iners*. He also states that the bark called *Cassia vera* in England is the *C. lignea* of the Continent (from *C. Burmanni* and *C. Tamala*), while these applications of the names are exactly reversed as to the product of *C. Cassia*, the American *Saigon cinnamon* going as *China cinnamon* in London. Pfister has also published the following structural characteristics of these unofficial barks: *C. obtusifolium* has acicular raphides, numerous bast-fibers, and the stone-cells tangentially elongated, as are the secondary parenchymatic cells. The last is the only particular in which it differs from Ceylon cin-

namon. *C. iners* differs from both the last only in having its stone-cells radially elongated. *C. Loureiri*, *C. Burmanni*, and *C. Tamala* have the raphides tabular, the first-named with porous thickening of the medullary ray-cells, the others little if at all so, and *C. Tamala* having porous thickening of its secondary parenchymatic cells, *C. Burmanni* not. *C. Sintok* has well-defined zones of stone-cells in the secondary bast; *C. Culilawan* (probably the so-called *Mountain cinnamon*), with a clove-like odor, has them in numerous groups. *Massoi bark*, with the odor and taste of cocoanut oil, from an unknown species, has the stone-cells containing raphides singly or in pairs, while false Massoi bark has the clove-like odor of Culiliwan bark.

Aside from these differences in the origin of cassia, it is subject to other adulteration. The common Chinese mats are packed with good, perfect quills upon the outside and broken and poor pieces within, and a small handful of sand thrown into each.

Commercial powdered cinnamon of all kinds is rarely, if ever, strictly pure. As to the Ceylon variety, there is scarcely a pretence of supplying it as a ground cinnamon. In 1894 the Division of Chemistry, U. S. Department of Agriculture (*Bulletin No. 13*, p. 2), published the statement that "not a particle of ground cinnamon" (referring to Ceylon cinnamon) "can be found upon the market." "Not a particle of material labelled ground cinnamon proved to be anything other than cassia."

Besides this use of cassia, cinnamon and cassia chips (see *Allied Products*) and the siftings are regularly ground for cinnamon. Its wood-fibers and vessels are clearly visible. The weak odor and taste thus produced are then strengthened by adding cassia buds, which add to the powder small conical thick-walled hairs, long thick-walled cells, and spiral vessels much smaller than those of the wood. Walnut shells are said to be used for the same purpose, and are readily detected by their well-known stone-cells. It goes without saying that many ordinary vegetable tissues, as those of beans and grains, have been used. They are recognizable by the character of their starch-grains.

Pharmaceutical Preparations.—Syrup of Cinnamon, N. F.; Tincture of Cinnamon, U. S. P.

Action and Uses.—Cinnamon is employed as an aromatic, carminative, hæmostatic, and intestinal stimulant. Both the oil and the drug itself are useful remedies in the treatment of nausea and vomiting, flatulent colic, and serous diarrhœa. The oil is especially useful as a hæmostatic, and when given internally lends itself in the control of passive uterine hemorrhages. It has also been recommended by J. Chalmers Da Costa, in the proportion of from 1 to 3 minims (0.05–0.20 Cc.) of the oil to 1 fluidounce (30 Cc.) of benzoinol, as an injection for the early stages of gonorrhœa. Cinnamic acid may be given for all of the above conditions, but it has been especially recommended as a palliative for the cough of tuberculosis. For this purpose it is injected hypodermically deep into the muscular structures. The beginning dose is 2 minims (0.10 Cc.), which may be gradually increased to 15 minims (1 Cc.). Its injection, however, is quite painful, and for this reason the employment of the drug has never been largely practised. The dose of powdered cinnamon is from 10 to 20 grains (0.60–1.3 Gm.), and of the oil from 1 to 5 minims (0.06–0.3 Cc.).

Allied Products.—Cassia Buds (*Flores cassiæ*, *Clavelli Cinnamomi*) are the small, stem-like, immature fruits of various species. They bear some resemblance to cloves, but are smaller and the structure less prominent. They consist of the thick perigone, its 6 small lobes folded over the depressed ovary. The best of these have a powerful and fine cinnamon odor and taste, and they contain oil of cinnamon and tannin in exceedingly variable proportions in different lots. *Cinnamon leaves* also enjoy a very considerable trade. Under the name of *Tej pat*, the Sanskrit equivalent of cinnamon leaf, those of *C. Tamala*, native and abundant in the Himalayas, are very largely dealt in as a condiment and aromatic medicine in Assam, where they are also produced by cultivation. It is said that a portion of the product is derived from other species, *C. albiflorum* Nees, *C. obtusifolium* Nees, *C. impressinervium* Nees, and wild plants of *C. Zeylanicum* being so named. The odor of these leaves has been compared to that of a mixture of cloves and cinnamon. Their volatile oil, present in very variable amount, is mostly eugenol. They have also been used in India for dyeing.

Cassia Caryophyllata (*Cortex caryophyllatus*), or *Clove-bark* (*Nelkenzimmt*, G.), is from *Dicypellium caryophyllatam* Nees, of Brazil. It usually comes in quills 2 to 4 Cm. ($\frac{3}{4}$ to $1\frac{1}{2}$ In.) thick, and about 60 Cm. (2 Ft.) long, which are made up of about 6 to 10 pieces of bark rolled up together. The bark is about 1.5 M. ($\frac{1}{16}$ In.) thick, smooth or slightly wrinkled, chestnut-brown, often with a bluish tinge, fracture short, showing a whitish line near the outer margin; odor clove-like; taste mucilaginous, resembling cinnamon.

CISTACEÆ.—The Rock-rose Family.

A small and unimportant family of 4 genera and about 150 species, occurring mostly in Europe, and especially in the Mediterranean region. The most common constituent is tannin, usually associated with volatile oil, for which many species are used as astringents, tonics, and vulneraries, and some as emmenagogues, notably *Cistus Cyprinus* Lam., *C. Monspeliensis* L., and *C. salviæfolius* L. (*Berber* or *Burbur* of the Arabs), *Helianthemum vulgare* (L.) Gærtn. (*Cistus v.* L.), of Europe, and the American species *H. corymbosum* (L.) Mx. (*Cistus c.* L.) and *H. Canadense* (L.) Mx. (*Cistus C.* L.), the *Frostweed* or *Frost-wort*. All these plants are commonly known in their respective localities as *Rock roses* or *Roses*, though they are recognized as being in no way related to the true roses. The last-named species (*Canadian rock rose, Canadisches Sonnenröschen*) is considerably used and is an article of commerce. Its description is as follows: stem slender, rigid, about 25 to 35 Cm. (10 to 15 In.) long, pubescent; leaves alternate, varying from narrowly lanceolate to elliptical, entire, obtuse or acutish, hairy underneath, about 2.5 Cm. (1 In.) long; flowers of early summer solitary, stalked, 5-merous, with large yellow petals; those of later summer in axillary clusters, nearly sessile, small and without petals; stamens numerous, hypogynous; fruit a 3-valved, 1-celled capsule, shorter than the calyx and containing a few brown seeds. This drug contains about 10 per cent. of tannin, fat, a very small amount of volatile oil, and a white crystalline bitter substance, probably a glucoside. *Helianthemum canadense* is an aromatic bitter possessing astringent properties. It is not largely employed at the present time, but was formerly considered a useful alterative in the treatment of constitutional syphilis and scrofula. Because of its astringency it was administered as a useful remedy in diarrhœa, and in the form of a gargle was employed in the sore throat occurring in scarlatina. A wash prepared from the plant has also been used locally in the treatment of prurigo. Internally, the extract is commonly employed in the dose of from ½ to 2 grains (0.03–0.13 Gm.), but the latter amount sometimes produces vomiting.

Probably the most important product of the family is the peculiar resinous substance, *labdanum* or *ladanum* (E., G., Fr., Sp.), which is obtained in the Mediterranean region as an exudation from *Cistus Creticus* L., *C. Ladaniferus* L., and other species of *Cistus*. The substance is gathered either by whipping the plants with leather thongs, to which it adheres, or by collecting it from the wool of sheep which have been made to travel among the plants. It occurs either in dark-brown or blackish masses, gray upon fresh fracture, or in cylindrical rolls like stick licorice or in flat pieces. The heat of the hand is sufficient to soften and make it glutinous. It is insoluble in water, almost completely soluble in alcohol, fusible, burns with a bright flame, and has a pleasant balsamic odor and a bitter taste. Being a distinctly expensive article, it has been much subjected to adulteration. Guibourt found it to consist of 86 per cent. of resin and volatile oil, 7 per cent. of wax, 1 per cent. of extractive matter, and 6 per cent. of insoluble impurities. Pelletier found a sample to contain 72 per cent. of sand, with only 20 per cent. of resin. Labdanum, on account of its aromatic properties, is occasionally employed as an ingredient of plasters, but it is no longer given in internal medicine. Formerly it was employed internally and by fumigation in the treatment of chronic bronchitis. Its internal administration was also considered useful in dysentery and dropsy.

COCA, *U. S.*—Coca.

Erythroxylon, U. S. P. 1880; *Cocæ Folia*, Br.; *Coca leaves*, E.; *Cocablätter*, G.; *Feuilles de coca*, Fr.; *Ipadu*, Sp.; *Ypadu*, Port.; *Cuca, Acullico*, Peruv.

The dried leaves of *Erythroxylon Coca* Lamarck (Fam. *Erythroxylaceæ*), known commercially as Huanuco Coca, or of *E. Truxillense* Rusby, known commercially as Truxillo Coca, yielding, when assayed by the process given below, not less than 0.5 per cent. of the ether-soluble alkaloids of coca.

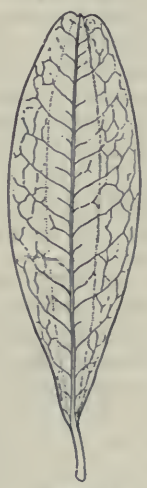
Origin.—The coca plants are large cultivated shrubs of the eastern Andes, now introduced to some extent into other parts of tropical South America, Central America, Mexico, and the West and East Indies, though relatively little of the commercial product originates outside of Peru, Bolivia, and Ecuador. Neither of the species is known in a wild state in the same form as that of cultivation, except as a recent escape. The *E. Coca*, at least, after such escape, quickly begins to undergo marked changes in leaf-characters. It is very probable that both are forms developed by long cultivation, since prehistoric times, from wild species either now living under different forms or already extinct. The *E. Coca*, grown mostly in Bolivia and Southern Peru, thrives best and produces the best product at from 3500 to 6000 feet, in 18° south, and at elevations with a corresponding climate in other latitudes. It can be produced, and grows fairly well, at lower elevations, but the product is inferior. The relative quality, as here and elsewhere considered in this article, is that determined by the native chewers, using it for the systemic support that it affords, and mostly independent of the percentage of

crystallizable cocaine. The Truxillo variety, which is a more northern product, does well at lower elevations. The shrubs are usually cultivated on terraces of the steep slopes, and do best with a few shade-trees (usually of *Inga*) scattered through the plantations; but if grown in deep shade, they develop a bitter taste, as they also do when grown at very low elevations. They require a very humid atmosphere. There are minor differences in quality, both as to the native standard and the yield of cocaine, according to the character of season, soil, exposure, and other conditions. The leaves are picked by hand when fully grown, but before approaching closely to the condition of falling. A plant yields 2, sometimes 3, harvests in the year. Although April and September yield the principal crops, yet picking is not confined to any season, going on continuously upon different plantations. Sixty to eighty pounds per acre of dried leaves at a picking is a fair yield. The leaves are dried quickly, within 2 or 3 hours, in hot sunshine, and not the least moisture is allowed to reach them. After lying in a loose pile in the coca-house for 2 or 3 days, they are again briefly exposed to the sun, to dry off the perspiration which has developed, and are then powerfully compressed into small bales called "cestos," nominally of 25 pounds each, but almost invariably short in weight. Two cestos are then sewn into a rawhide, and when this has thoroughly dried are ready for transportation. The chief differences in quality of properly cured coca

Fig. 124.

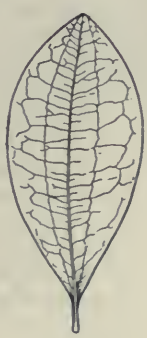
Huanuco coca
(Nat.).

Fig. 125.



Java coca
(Nat.).

Fig. 126.



Truxillo coca
(Nat.).

leaves result from their relative freshness and the care exercised in keeping them. Proper drying makes practically no difference in the constituents, but immediately thereafter deterioration begins. Leaves which have been preserved for a few months are regarded as distinctly inferior, and long before a year they are regarded as unfit for use. Assay determines that there is also a gradual loss of cocaine on keeping them, greatly increased by dampness.

Description.—Huanuco Coca.—Greenish-brown to clear brown, smooth and slightly glossy, thickish and slightly coriaceous, stoutly and very shortly petioled, the blade 2.5 to 7.5 Cm. (1 to 3 In.) long and about half as broad, oval and nearly elliptical, with a very short, very abruptly narrowed basal portion and a very slight point, entire, the midrib traversed by a slight ridge above, very prominent underneath, the venation rather obscure, especially above; underneath, 2 conspicuous lines of collenchyma tissue run longitudinally upon either side of the midrib and at about one-third of the distance from it to the margin, the enclosed areola being of a slightly different color from the adjacent surface; odor characteristic; taste bitterish, faintly aromatic, and followed by a numbness of the tongue, lips, and fauces. Huanuco coca should yield not less than 0.5 per cent. of crystallizable cocaine.

Truxillo Coca.—Pale-green, thin, brittle, and usually much broken; smooth, not shining; shortly and stoutly petioled, the blade 1.6 to 5 Cm. ($\frac{2}{3}$ to 2 In.) long and one-third to one-half as broad, obovate to oblanceolate, narrowed from near the middle into the petiole, usually with a slight projecting point at the summit, entire; upon the lower surface 2

irregular lines of collenchyma tissue, frequently wanting and usually incomplete or obscure, run beside the midrib, their middle portions arching away to about one-third of the distance from the midrib to the margin ; odor characteristic, tea-like ; taste bitterish, faintly aromatic, followed by a numbness of the tongue, lips, and fauces. In our illustration of this variety, the lateral lines are more distinct than is usual.

The powder is characterized by the peculiar epidermal cells of the inferior surface, with their papillose-thickened outer walls. Efforts to distinguish the two varieties in the powdered form, except by the yellowish-green color of the Huanuco and the pale-green color of the other, have proved unsuccessful, though the papillæ of the Truxillo variety are usually higher than in the other.

Inferior leaves are generally to be recognized by their color, odor, and weaker anæsthetic effect upon the tongue, lips, and palate. One who is experienced can determine the cocaine percentage pretty closely by the latter test. As to color, the Huanuco variety, if of a bright-green, has usually been collected before maturity. A brownish-green or brown color is typical, but the brown should be clear and rich, and with a slight glossiness. A smudgy brown or a very dull surface indicates damage in curing or in transit, to which latter coca is very subject.

Adulterants and Substitutes.—Adulteration, in the strict sense of the term, is almost unknown in the case of entire coca leaves, and nothing can be mistaken for them, even upon casual examination. In a single instance, a considerable (40 to 50 per cent.) addition of small jaborandi leaves, evidently effected in Europe, was reported. Small quantities of Inga or Pacay flowers frequently occur, by accident. Among the natives, recourse has been had, in times of scarcity, to the leaflets of a native tree, under the name of *Chinchicoca*, but these have never been exported.

Constituents.—The constituent or constituents of native coca leaves, representing their physiological value to the coca-chewers, are entirely unknown, or, at least, this connection has never been established. It may be found, or indicated, by a physiological study of the secondary alkaloids referred to below. The important constituent of the Huanuco, and to a lesser extent of the Truxillo leaves, from our present therapeutic standpoint, is crystallizable cocaine (see COCAINA), of which there is from 0.4 to 0.8 per cent. in the Huanuco variety, and about a half or two-thirds as much in the Truxillo. It has been claimed that in some cases the latter yields as much as the former, but we doubt the identity of those leaves, unless other alkaloid has been converted into cocaine during manufacture. A Huanuco leaf of satisfactory quality will yield as much as 0.5 per cent. By careful assay, nearly twice this amount has been obtained. Besides the secondary alkaloids, there is cocatannic acid, giving a green color with iron salts, wax, and a very slight amount of volatile oil or similar aromatic principle. The secondary alkaloids are *cinnamyl-cocaine*, in which cinnamic acid takes the place of the benzoic acid of cocaine, and *truxilline*, in which the corresponding acid is *truxillic*. Both these, as well as cocaine, upon hydrolysis, yield methyl alcohol and *ecgonine*, which latter is therefore found to some extent in the leaves. Cinnamyl-cocaine ($C_{19}H_{23}NO_4$) occurs in needle-shaped crystals, which melt at 121° C. (249.8° F.). Truxilline (truxil-cocaine, isotropyl-cocaine, or cocamine—$C_{19}H_{23}NO_4$) occurs in large crystals, melts at about 120° C. (248° F.), and has been synthetically prepared from ecgonine and cinnamic anhydride. The truxillic acid which it yields appears to be a mixture, or the term is applied indefinitely to *cocaic*, *isococaic*, and *homo-isococaic acids*. Truxilline is much more abundant (sometimes 0.5 per cent.) in the Truxillo leaves, where it was first discovered. Ecgonine ($C_9H_{15}NO_3$—very similar to tropine) is soluble in water, slightly in alcohol, and insoluble in ether. It occurs in prismatic crystals, and is only slightly bitter. *Hygrine* has frequently been written of as an alkaloid, but its identity as a constituent of coca leaves is denied. It is by no means certain that this denial is well founded, and it is to be regarded as a doubtful substance. *Cocaimidine*, not yet thoroughly studied, is reported by Schaefer as being a distinct alkaloid, probably isomeric with cocaine, less anæsthetic, and yielding crystalline salts. There are strong reasons for believing that, connected with these marked differences in the composition of the two varieties of leaves, the Truxillo approaches more nearly to the physiological action of the native-chewed coca.

History.—The history of coca is most intimately entwined with the religious, social, and even political history of the people of Peru and the adjacent countries, and has even left its permanent impression upon that of their conquerors (see Mortimer's *Peru, The*

History of Coca). This history is of great physiological interest, since coca is unquestionably the agent which has enabled the dwellers of the higher Andes not only to withstand the effects of a high elevation, but to become noted for their physical strength and endurance in spite of them. Deprived of its support, those abilities fail. Foreigners going there have found it possible to gain a similar assistance from its use, and to endure without distress physical trials which are otherwise unendurable. The natives chew the leaves regularly several times during the day, the total daily amount being about ½ ounce, remaining perfectly inactive while the operation is in progress. The leaf is commonly chewed with *llipta*, a mixture the chief ingredient of which is ashes, those from certain plants being preferred. Aside from the effect of flavoring the mass, very much as salt would do, it is not improbable that the alkali of the ash brings about changes in the constituents, rendering them more active or more available to the system. A coca-habit may be said to be unknown among these people, who chew the leaf from youth to old age, without ill effects.

The U. S. P. requires that coca leaves shall contain not less than 0.5 per cent. of ether-soluble alkaloids when assayed by the following process:

Assay of Coca.—Coca, in No. 60 powder, 10 Gm.; chloroform, ether, normal sulphuric acid, ammonia-water, distilled water, tenth-normal sulphuric acid, fiftieth-normal potassium-hydroxide solution, hematoxylin or iodeosin test-solution, each a sufficient quantity. Place the coca in an Erlenmeyer flask, add 50 Cc. of a mixture of chloroform 1 volume and ether 4 volumes, and insert the stopper securely. Allow the flask to stand ten minutes, then add 2 Cc. of ammonia-water mixed with 3 Cc. of distilled water, and shake the flask well, at frequent intervals, during one hour. Then transfer as much as possible of the contents of the flask to a small percolator which has been provided with a pledget of cotton packed firmly in the neck, and insert in a separator containing 6 Cc. of normal sulphuric acid, diluted with 20 Cc. of distilled water. When the liquid has passed through the cotton, pack the coca firmly in the percolator with the aid of a glass rod, and, having rinsed the flask with 10 Cc. of chloroform-ether mixture, transfer the remaining contents of the flask to the percolator by the aid of several small portions (5 Cc.) of the chloroform-ether mixture, and continue the percolation with successive small portions of the same liquid (in all 50 Cc.). Next shake the separator well for one minute, after securely inserting the stopper, and when the liquids have completely separated, draw off the acid liquid into another separator. Add to the chloroform-ether mixture 10 Cc. of the sulphuric-acid mixture, agitate well and again draw off the acid liquid. Repeat this operation once again, drawing off the acid solution as before into the second separator, collect the acid solutions in the second separator, and introduce a small piece of red litmus-paper; then add ammonia-water until the liquid is distinctly alkaline, and shake out successively with 3 portions of 20, 20, and 15 Cc. of ether. Collect the ether solution in a beaker, place it on a water-bath filled with warm water, and allow the ether to evaporate entirely. Dissolve the residue in 3 Cc. of ether, and let this also evaporate completely. To the alkaloidal residue add 4 Cc. of tenth-normal sulphuric acid and 5 drops of hematoxylin or iodeosin test-solution, then titrate the excess of acid with fiftieth-normal potassium hydroxide solution. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide solution used by 5, subtract this number from 4 (the 4 Cc. of tenth-normal sulphuric acid used), and multiply the remainder by 0.03, and this product by 10, to obtain the percentage of ether-soluble alkaloids contained in the coca.—U. S.

The Puckner-Gunn method for assaying coca gives very satisfactory results and is less troublesome than the former. Moisten 5 Gm. of the powdered drug with 3 Cc. of 2 per cent. ammonia water, and at once pack very firmly into a small cylindrical percolator. Shake 100 Cc. of ether with 5 Cc. of 28 per cent. ammonia water in a separator, draw off the watery portion, and percolate the drug slowly with the ammoniated ether directly into a separator containing 20 Cc. of 1 per cent. hydrochloric acid; finally pass a further portion of 20 Cc. of plain ether through the mark in the percolator. When all the ethereal menstruum has passed, the contents of the separator are well shaken, and after perfect separation the acid aqueous liquid is drawn off into another separator. The ethereal liquid is shaken twice more with separate portions of 10 Cc. of 1 per cent. hydrochloric acid, the latter being each time drawn off and added to the acid liquid in separator No. 2. The combined acid liquids are rendered just alkaline with ammonia water and shaken out 3 times, using 20, 15, and 10 Cc., with chloroform, which latter is carefully drawn off and allowed to evaporate on a warm, not boiling, water-bath. The residue, when dry, is treated with 5 Cc. of ether to remove adhering traces of chloroform, again dried, dissolved in 10 Cc. of decinormal acid, and titrated with centinormal alkali, using hæmatoxylin solution as an indicator. Divide the number of Cc. of alkali solution used by 10, subtract the quotient from 10, and multiply the remainder by 0.030 and then by 20, to get the percentage of cocaine present in the sample.

Pharmaceutical Preparations.—Aromatic Wine of Coca, N. F.; Elixir of Coca, N. F.; Elixir of Coca and Guarana, N. F.; Fluidextract of Coca, U. S. P.; Wine of Coca, N. F.

Action and Uses.—The action of coca upon the inhabitants of its native country is markedly different from that of its alkaloid *cocaine* upon those residing in North America and European countries. The Indians of Peru and Bolivia employ an infusion of the leaves as a stomachic, stimulant, and mild diaphoretic. The leaves mixed with ashes or lime are also chewed for the purpose of allaying hunger, appeasing thirst, preventing fatigue, and overcoming mental depression. It has been generally stated that this habit produces utter mental and physical degradation in these persons, but Rusby failed to find any such cases, although for more than a year he was associated with coca-chewers and made diligent inquiry concerning them in general and these results in particular. The moderate use of coca leaves is, therefore, apparently productive of no such untoward effects in these Indians. Taken in moderate amounts coca or cocaine produces a sense of exhilaration.

The application of cocaine to mucous membranes causes first a blanching and then local anæsthesia by its depressing effect on the peripheral nerves of sensation. When given internally, cocaine stimulates the central nervous system, but, unless the dose be poisonous, has little effect upon the sensory nerves. The drug in moderate doses stimulates the cerebrum, increasing the rapidity of thought, and acts as a stimulant to the medulla, increasing the number of respirations and elevating blood-pressure. If the dose be a poisonous one, the drug acts as a depressant, lowering blood-pressure, producing irregular and shallow respirations, and at times causing tonic and clonic convulsions of cerebral origin. Under its administration the heart's action becomes more rapid and forcible, a condition which is probably due either to a direct stimulation of the heart muscle or its accelerator nerves. In moderate amounts it has no effect upon the temperature, but overdoses cause a rise of several degrees by increasing heat-production. Cocaine is principally destroyed in the body, but a portion is eliminated by the kidneys. The urine is usually augmented during its administration, but the nitrogenous elements are slightly decreased.

The chief use of cocaine in medicine is as a local anæsthetic. When introduced into the eye, cocaine produces mydriasis without paralysis of accommodation, and local anæsthesia. It is frequently employed either by injection or local application for the purpose of relieving the pain attending the removal of foreign bodies or hypertrophies from the eye, nose, mouth, pharynx, or larynx. It may be employed in the eye when any operation is to be performed. It may also be used by hypodermic injection for the amputation of fingers or toes, or for the removal of small tumors. When a finger or toe is to be amputated, a rubber band should be placed tightly about the base of the digit to prevent the cocaine which is injected into the part gaining access to the general circulation. After a few minutes, during which time the nerve of the part becomes benumbed, the operation is rapidly performed, and on its conclusion the rubber band is loosened so as to allow slight hemorrhage to take place, thereby washing the parts free from cocaine. The rubber band is now readjusted to control hemorrhage, and the wound closed with proper antiseptic precautions. Cocaine has recently been injected in the subarachnoid space for the purpose of producing spinal anæsthesia, but this procedure may cause alarming symptoms, and there is possibility of infection of the spinal cord.

Coca or cocaine is not largely employed in internal medicine, but may be given as a temporary stimulant during the typhoid state of the low fevers. While its physiological action would lead us to believe that it is an invaluable stimulant in cases of collapse, clinical experience has shown that it is not particularly useful under these circumstances, as it not infrequently produces untoward and unexpected effects which are harmful in their character. Cocaine is said to be a good stimulant and anti-emetic in the treatment of yellow fever, and it enjoys an excellent reputation in the treatment of the vomiting of pregnancy, that following anæsthetization, and that accompanying acute gastric irritation. It has been employed in cases in which great mental or physical strain was to be borne, and in the treatment of the "opium habit," but should be given cautiously lest the patient develop the cocaine-habit. Coca has also been recommended in the treatment of hysteria, melancholia, and allied nervous conditions, but is of little benefit in any of them.

Under the name "infiltration anæsthesia," Schleich, a German surgeon, has introduced the employment of very weak solutions of cocaine mixed with morphine and common salt, for the purpose of benumbing peripheral sensory nerves not only by the action of the cocaine and morphine, but also by the pressure which is exerted upon them by the fluid injection. The advantage of Schleich's fluid is that the danger of cocaine and morphine-poisoning is avoided by reason of the very weak solution employed. Schleich uses the following solutions according to the degree of anæsthesia required:

	No. 1.	No. 2.	No. 3.
Cocaine hydrochloride	gr. iv (0.25 Gm.)	gr. ij (0.10 Gm.)	gr. $\frac{1}{2}$ (0.01 Gm.)
Morphine hydrochloride	gr. ss (0.025 Gm.)	gr. ss (0.025 Gm.)	gr. $\frac{1}{10}$ (0.005 Gm.)
Sodium chloride	gr. iv (0.25 Gm.)	gr. iv (0.25 Gm.)	gr. iv (0.25 Gm.)
Sterilized distilled water	f℥iv (120 Cc.)	f℥iv (120 Cc.)	f℥iv (120 Cc.)

To each of these three solutions 3 minims of a 5 per cent. solution of carbolic acid are added. Solution No. 2 is the one commonly employed.

In some instances when cocaine is applied too freely, it suddenly produces loss of speech, blindness, nausea and vomiting, fainting and unconsciousness, and even epileptiform convulsions. Curiously enough, these accidents most frequently follow the instillation of cocaine into the urethra prior to urethral operations.

The treatment of poisoning by cocaine consists in the use of strong coffee, and, if the circulation fails, the employment of strychnine, ether, or alcohol. While the convulsions are present it is stated that nitroglycerin may be given hypodermically with advantage.

Because of the pleasant effects which cocaine produces when taken hypodermically or by the mouth, the cocaine-habit is not rarely met with, many persons becoming slaves to the use of this drug. Often its abuse is combined with that of morphine. The symptoms of the cocaine-habit consist in a great loss of flesh, circulatory disorders, insane delusions and hallucinations, and sometimes collapse. The nervous breakdown of the patient under the continued use of this remedy is even more rapid than when morphine is abused.

As an anæsthetic for use in the eye, the amount used is from 3 to 5 minims (0.20–0.3 Cc.) of a 1 to a 4 per cent. solution. The same strength solutions may be employed in the nose and throat; but in the rectum and vagina 10 per cent. solutions are preferable. In the urethra it is not safe to use a solution stronger than 1 or 2 per cent., as the drug is sometimes rapidly absorbed.

The internal dose of cocaine is from $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015–0.03 Gm.), and of fluidextract of coca from $\frac{1}{2}$ to 1 fluidrachm (2–4 Cc.).

Allied Products.—No part of the plant other than the leaves is in use, though small quantities of alkaloid occur in the bark of the root and stem and in the fruit. None occurs in the wood. The genus *Erythroxylon* contains some 140 species, bearing 170 names. By far the greater number have not been tested for the presence of alkaloids nor for properties similar to those discussed above. Several, however, are known to share those properties to some extent. Under the names *Te*, *Haya*, etc., the leaves of *E. Popayennensis* Poepp., and some others which are undetermined, are used similarly in various parts of South America. One (Fig. 127, *b*), cultivated to some extent in the West Indies and in Java, but not an article of commerce, in this country at least, appears to be a form or a derivative of *E. Carthaginense* Jacq. This is probably the variety which, produced in Java, is reported to contain *benzoyl-pseudotropeine* ($C_{15}H_{19}NO_2$).

In Ceylon, the dried leaves of *E. lucidum* Moon (*Sethia acuminata* Arn.) are given in 15 grain (1 Gm.) doses, as an anthelmintic, and the fresh juice is also administered for the same purpose.

COCAINA, *U. S., Br.*—Cocaine.

Cocainum, Benzoyl-methyl-ecgonine, Methyl-benzoyl-ecgonine.—Cocaine, Fr.; *Cocain*, G.

Formula, $C_{17}H_{21}NO_4$ or $C_8H_{12}(C_6H_5CO)NO.COOCH_3$. Molecular weight, 300.92.

An alkaloid, $C_{17}H_{21}NO_4$, obtained from the leaves of *Erythroxylum Coca* Lam. and It is also obtained synthetically from ecgonine.

The alkaloid was originally called *erythroxyline* by its discoverer, Gaedeke (1855).

Preparation.—The early process of Niemann (1860) (*Nat. Disp.*, 5th ed., p. 504), and that of Lossen (1865), have been supplanted by more economical methods. In Squibb's process the coarsely ground leaves are exhausted of their alkaloidal content by repercolation with an aqueous 5 per cent. solution of sulphuric acid, and the concentrated extract thus obtained is thoroughly agitated with pure coal oil (kerosene oil) and an

excess of sodium carbonate. The liberated alkaloid is retained by the coal oil quite free from coloring-matter, and recovered by repeatedly agitating the oil with acidulated water, and again precipitating the alkaloid by sodium carbonate in the presence of ether. Upon distillation the ether solution yields cocaine in the form of a yellowish-brown crystalline mass, which may be purified by re-solution in acidulated water, decolorized with animal charcoal, and again precipitated by means of sodium carbonate, and dissolved in ether or hot alcohol, from which it is obtained in the form of crystals. A method was patented by Henriques (*Pharm. Centralh.*, 1895, 92), in which the alkaloid is extracted from the leaves by treatment with a solution of a zinc salt, and this precipitated with a sulphocyanide; or the leaves may be exhausted with a solution of a sulphocyanide and precipitated with a zinc salt, the alkaloid in both instances being precipitated as an insoluble double sulphocyanide of cocaine and zinc. At present much of the cocaine is obtained as crude cocaine in South America by methods similar to Squibb's, and exported to foreign factories for purification. Since Liebermann and Geisel (*Ber.*, 1888, xxi. 3196) have shown that the amorphous alkaloidal by-products can be hydrolyzed into *ecgonine* by boiling with hydrochloric acid and subsequently converted into cocaine, the by-products have become valuable. In Einhorn's process (*Ber.*, 1888, xxi. 3335) the ecgonine is converted into ecgonine hydrochloride, and the solution of the latter in methyl alcohol subjected to a current of dry hydrochloric acid gas, producing the hydrochloride of ecgonine methyl-ester. The latter is heated with an equal weight of benzoyl chloride, and the fused mass poured into water, the solution filtered, and the *cocaine* precipitated from the filtrate by ammonia and recrystallized from alcohol. Cocaine has also been prepared synthetically by Merck, by heating ecgonine, benzoic anhydride, and methyl iodide to 100° C. (212° F.) in sealed tubes for 10 hours.

Properties.—Cocaine crystallizes from alcohol in the form of colorless monoclinic prisms, which are soluble in 600 parts of water, 5 parts of alcohol, and in 3.8 parts of ether at 25° C. (77° F.); very soluble in chloroform and warm alcohol; also soluble at 80° C. (176° F.) in 260 parts of water (U. S.). Insoluble in glycerin, soluble in 10 parts of alcohol (90 per cent.), in 4 parts of ether, in ½ part of chloroform, in 12 parts of olive oil, and 14 parts of oil of turpentine (Br.); soluble in benzene, toluene, carbon disulphide, and carbon tetrachloride; insoluble in lard and vaseline (*Pharm. Jour.*, 1896, p. 28). Cocaine on being kept in solution for some time, or by boiling with acids or alkalies, is hydrolyzed into methyl alcohol, benzoic acid, and ecgonine. The latter has a sweetish taste, and is soluble in water, but insoluble in alcohol. The hydrolysis is illustrated by the equation: $C_{17}H_{21}NO_4$ (cocaine) $+ 2H_2O = C_9H_{15}NO_3$ (ecgonine) $+ C_7H_6O_2$ (benzoic acid) $+ CH_3OH$ (methyl alcohol). Cocaine melts at 98° C. (208.4° F.), U. S.; 96° to 98° C. (204.8–208.4° F.), Br.. Heated to a much higher degree, it volatilizes, with decomposition of the greater portion. It is strongly alkaline in reaction, and may be titrated with acids direct, with litmus as an indicator. Applied to the tongue, it has a bitter taste, and produces a sudden and characteristic numbness. Its solutions are strongly lævorotatory. Dissolved in chloroform, $S_d = 15°$. It is a monacid base, and yields easily crystallizable salts, the most common of which is the hydrochloride.

Tests.—The purity of cocaine is determined best by its melting-point, and, after conversion into the hydrochloride, by the tests given under that salt (which see).

For the action and uses of cocaine, see COCA.

Salts of Cocaine.—Besides the hydrochloride, which is the only salt of cocaine that has received recognition in any of the pharmacopœias, a number of other combinations have been placed upon the market, and are in use to a more or less limited extent, thus: *Cocaine-aluminum sulphate* or *Cocaine alum*, $Al(SO_4)_2C_{17}H_{21}NO_4 + 12H_2O$; *Cocaine benzoate*, $C_{17}H_{21}NO_4.C_7H_6O_2$; *Cocaine borate*, $C_{17}H_{21}NO_4.(H_3BO_3)_2$; *Cocaine cantharidate*, $(C_{17}H_{21}NO_4)_2 + C_{10}H_{12}O_4$; *Cocaine citrate*, $(C_{17}H_{21}NO_4)_3H_3C_6H_5O_7$; *Cocaine hydrobromide*, $C_{17}H_{21}NO_4.HBr$; *Cocaine lactate*, $C_{17}H_{21}NO_4.HC_3H_5O_3$; *Cocaine nitrate*, $C_{17}H_{21}NO_4.HNO_3$; *Cocaine oleate*, $C_{17}H_{21}NO_4.HC_{18}H_{33}O_2$; *Cocaine phenate* or *phenylate*, $C_{17}H_{21}NO_4.C_6H_5(OH)$; *Cocaine salicylate*, $C_{17}H_{21}NO_4.HC_7H_5O_3$; *Cocaine stearate*, $C_{17}H_{21}NO_4.HC_{18}H_{35}O_2$; *Cocaine sulphate*, $(C_{17}H_{21}NO_4).H_2SO_4$.

Of the foregoing salts, the cocaine borate is preferred to the hydrochloride in solutions intended for the eye and for subcutaneous use, on account of their greater stability. Cocaine oleate and stearate are preferred for use in ointments and suppositories; the normal oleate, containing about 52 per cent. of cocaine, is rarely used, a solution of the alkaloid in oleic acid, of either 5, 10, or 25 per cent. strength, being preferred, which can be quickly pre-

pared by warming 5, 10, or 25 grains of cocaine alkaloid with 95, 90, or 75 grains of oleic acid in a dish on a water-bath. Since hydrochloric acid is incompatible with silver salts, cocaine nitrate should be used in place of the hydrochloride in connection with silver nitrate whenever such a combination is desired. Cocaine phenate or cocaine-phenol is obtained by warming 12 parts of crystallized carbolic acid on a water-bath until it melts and adding 38 parts of cocaine alkaloid. It occurs as a yellow viscid mass, insoluble in water but soluble in alcohol, and is recommended especially for use in dentistry.

Allied Products.—CINNAMYLCOCAINE. $C_6NH_{10}CHO(C_9H_7O)CH_2COOCH_3$.—This alkaloid, which occurs in coca leaves, may also be produced synthetically by substituting cinnamyl chloride for benzoyl chloride in the process for the synthetic manufacture of cocaine from ecgonine. It forms lustrous prismatic crystals, melting at 121° C. (249.8° F.). Owing to its ready oxidation by potassium permanganate, the presence of cinnamylcocaine in cocaine may easily be detected.

DEXTRO-COCAINE.—While, as stated above, the cocaine found in coca leaves, and also when artificially made from ecgonine, is lævorotatory, a dextrorotatory variety has also been produced, which differs in many respects from the other. It is obtained by first acting on ecgonine for 2 or 3 days with a 30 per cent. potassium hydroxide solution, whereby dextro-ecgonine is formed, and then proceeding as directed above for the synthetic manufacture of cocaine from ecgonine. Dextro-cocaine melts at 44° C. (111.2° F.). Its hydrochloride, which melts at 205° C. (401° F.), is far less soluble in water than the official cocaine hydrochloride.

HOMOCOCAINE. *Ethyl-benzoyl-cocaine.* $C_{18}H_{23}NO_4$.—This base, also known as coca-ethyline, is a synthetic product obtained by substituting ethyl alcohol for methyl alcohol in the process for making cocaine from ecgonine, mentioned above, and then benzoylating the ecgonine ethyl-ester formed. The crystals melt at 109° C. (228.2° F.). The anæsthetic action of homococaine and its salts is relatively weaker than that of cocaine.

TROPACOCAINE. *Benzoyl-pseudotropeine.* $C_8H_{14}NO(C_7H_5O)$.—This alkaloid, found chiefly in the coca leaves of Java, differs from cocaine markedly in its constitution, and also in its therapeutic effects in possessing slight mydriatic properties. Upon being heated with hydrochloric acid, it is split up into benzoic acid and tropine.

ISATROPYLCOCAINE. $C_{19}H_{23}NO_4$.—An amorphous base found in coca leaves, which yields amorphous salts and is difficultly soluble in ammonia water. Its presence in cocaine is readily detected by the Maclagan ammonia test described under Cocaine Hydrochloride. Isatropyl-cocaine is not oxidized by potassium permanganate, as in the case of cinnamylcocaine. It is very poisonous.

ANESON. *Anesin.*—This name has been applied in the trade to a 2 per cent. aqueous solution of tertiary trichlorbutyl alcohol or acetone-chloroform, $(CH_3)_2 : COH.CCl_3$, which has been recommended as a substitute for cocaine. It cannot be compared, however, in anæsthetic power with a 5 per cent. solution of cocaine hydrochloride, although it is well suited for some minor operations. The solution is said to be non-toxic and has no irritating effect on the eye.

COCAINÆ HYDROCHLORIDUM, *U. S.*, *Br.*—Cocaine Hydrochloride.

Cocaïnum hydrochloricum, P. G.—*Chlorhydrate de cocaine*, Fr.; *Cocainhydrochlorid*, G.

Formula, $C_{17}H_{21}NO_4.HCl$ or $C_8H_{13}(C_6H_5CO)NO.COOCH_3.HCl$. Molecular weight, 337.10.

The hydrochloride of the principal alkaloid obtained from the leaves of *Erythroxylon Coca* and its varieties.

Preparation.—Cocaine hydrochloride may be obtained in several ways: The alkaloid cocaine may be dissolved in alcohol, the solution neutralized with an alcoholic solution of hydrochloric acid gas and then set aside to crystallize, or the salt precipitated by addition of ether. The dry alkaloid may also be dissolved in ether or petroleum ether, and dry hydrochloric acid gas then passed into the solution, when the salt will separate out. Or the alkaloid may be dissolved in just sufficient water with the aid of hydrochloric acid, and the solution then evaporated to dryness in vacuo over sulphuric acid or calcium chloride, the residue being subsequently recrystallized from alcohol.

Properties.—Cocaine hydrochloride crystallizes from alcohol in short, thin, transparent *anhydrous* prisms, and from water in needle-shaped crystals with 2 molecules of water of crystallization. The official salt of the U. S., Br., and P. G. is anhydrous, while that of the French contains 2 molecules or 9.59 per cent. of water. It occurs commercially in transparent, monoclinic prisms or flaky, lustrous leaflets, or as a white crystalline powder, permanent in the air and containing no water of crystallization. It is odorless, has a saline, slightly bitter taste, and produces on the tongue a tingling sensation followed by numbness of several minutes' duration. It is soluble at 25° C.

(77° F.) in 0.4 part of water, 2.6 parts of alcohol, or 18.5 parts of chloroform; at 80° C. (176° F.) in 0.1 part of water, and at 60° C. (140° F.) in 1.4 parts of alcohol (U. S.). Soluble in half its weight of cold water and in 4 times its weight of 90 per cent. alcohol or of glycerin (Br.). It is insoluble in benzene, petroleum benzin, ether, and olive oil. Its aqueous solution is neutral to litmus-paper and is lævogyrate. Cocaine hydrochloride melts at 189.9° C. (373.8° F.), U. S., 180° to 186° C. (356°–366.8° F.), Br., 183° C. (361.4° F.), P. G., 181.5° C. (358.7° F.), Fr. Cod., forming a light brownish-yellow liquid, and when ignited burns without residue. Minute quantities of impurities may reduce the melting-point to 180° C. (356° F.), U. S. "If silver nitrate test-solution be added to the aqueous solution of the salt (1 in 100), a white precipitate is produced, which is insoluble in nitric acid. On adding 5 drops of a 5 per cent. solution of chromic acid to 5 Cc. of a solution of cocaine hydrochloride (1 in 50), a yellow precipitate will be produced, which redissolves on shaking; on now adding 1 Cc. of hydrochloric acid, a permanent orange-colored, crystalline precipitate will be formed. On adding a solution of potassium chromate (1 in 20) to a hydrochloric acid solution of the salt, orange-yellow leaflets of cocaine chromate are precipitated. If mercuric chloride test-solution be added to an aqueous solution of the salt, a white flocculent precipitate is produced. Cocaine hydrochloride is not colored by sulphuric acid, but if a crystal be heated with sulphuric acid, in a test-tube, vapors are produced, from which benzoic acid is deposited on cooling. If 3 drops of palladious chloride test-solution, with 3 Cc. of chlorine-water, be added to 3 drops of an aqueous solution of the salt (1 in 20), a red precipitate is produced. A crystal of the salt dissolved in alcohol yields when stirred with a piece of potassium hydroxide an odor of ethyl benzoate. When 0.01 Gm. of the salt is dissolved in 2 drops of water, the addition of 1 Cc. of a solution of potassium permanganate (1 in 30) produces a violet precipitate, which appears brownish violet when collected on a filter."—U. S. "Cocaine hydrochloride affords a yellow precipitate with solution of auric chloride; a white precipitate with solution of ammonium carbonate, and also with solution of borax. Its aqueous solution yields with picric acid a yellow precipitate, becoming crystalline on standing. Moistened with nitric acid, the mixture evaporated to dryness, and a drop of alcoholic solution of potassium hydroxide added, a characteristic odor is evolved more or less recalling that of peppermint."—Br. Cocaine hydrochloride precipitates Prussian blue from a mixture of ferricyanide and ferric chloride. If a drop of ferric chloride be added to a solution of the salt and the liquid boiled, an intense red color will be developed (Lerch and Scharges).

Tests.—Besides the characteristic reactions mentioned above, cocaine hydrochloride should respond to the following tests for purity: If 0.1 Gm. of the salt be dissolved in 5 Cc. of distilled water, containing 3 drops of diluted sulphuric acid, the addition to this solution of 1 drop of potassium permanganate solution (1 in 100) will produce a violet color, which should not fade in half an hour (limit of cinnamyl-cocaine). If 0.1 Gm. of the salt be dissolved in 85 Cc. of distilled water, in a beaker, and 4 drops of ammonia-water added, and the solution stirred vigorously for fifteen minutes, with the occasional rubbing of the sides of the beaker with a stirring rod, a crystalline precipitate of cocaine should be formed, and the supernatant liquid should be perfectly clear (limit of isatropyl-cocaine). The presence of 0.5 per cent. of isatropyl-cocaine will prevent the formation of nearly all of the precipitate, and will cause the supernatant liquid to be opalescent.—U. S. Dried for 20 minutes at 95.6° to 100° C. (204°–212° F.), the salt should not lose more than 1 per cent. of moisture (Br.). Maclagan's ammonia test given above is extensively used, and is considered sufficient for all commercial lots of cocaine hydrochloride.

Schaeffer's chromic acid test, based upon the relative solubility of cocaine chromate (1 in 500) as compared with that of the chromates of the objectionable alkaloids (1 in 5000), is applied as follows: 0.05 Gm. of cocaine hydrochloride is dissolved in 20 Cc. of distilled water, mixed with 5 Cc. of a 3 per cent. solution of chromic acid (freshly prepared), and then 5 Cc. of 10 per cent. hydrochloric acid added—the temperature of the mixture being kept at 15° C. (59° F.). In the presence of more than traces of the foreign coca alkaloids the solution becomes cloudy at once, or in a few minutes, according to the proportion present.

Action and Uses.—The medicinal properties and therapeutic effects of this salt are fully described under Coca (which see).

COCCUS, *U. S.*, *Br.*—Cochineal.

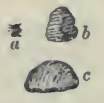
Coccionella.—Cochenille, G,, Fr.; *Cochinilla, Grana*, Sp.; *Cochinilha*, Port.; *Coccinigliа*, It., Swiss.

The dried female insect *Pseudococcus cacti* (L.) Burmeister (Order *Hemiptera*).

Cochineal is official in most pharmacopœias. The Br. P. allows 6 per cent. of ash.

Origin.—The cochineal insect is indigenous to Mexico and Central America, and has been introduced into and is cultivated in some of the West India islands, the Canaries, Algiers, and southern Spain. It feeds on different species of cactus, particularly on *Nopalea cochinillifera* (Mill.) Salm-Dyck (*Opuntia c.* Mill.) and other "prickly pear" cactuses. The male insect is very small, winged, and bears 2 long bristles upon the tail. The female is about twice as large, wingless, and without the bristles. She lives attached continuously to the same point upon the plant, and her eggs, several thousand in number, hatch within her body after death. The body is entirely concealed by a white wax, formed into a fluffy, cotton-like mass. Two methods are employed for killing the insects after they are brushed off, resulting in different forms of the commercial product. If carefully killed by fumes of sulphur or other substances, the wax is retained, though compacted to the body, and we get the so-called "silver-grain" form. If dipping in boiling water is practised, the wax is removed, this relatively increasing the percentage of active constituent by reduction of total weight, and we get the "black-grain" article. Other varieties of commerce depend upon the age of the insects when collected, the older ones being inferior in yield of coloring-matter, and upon a wild or cultivated origin, the *Granilla* ("little grain") or *Grana sylvestra* ("wild grain") being the wild ones, and inferior. In cultivation, a supply of insects is preserved under cover during the rainy season, for purposes of propagation. Three crops are usually secured during the dry season.

FIG. 127.



Coccus cacti: female insect (Nat.): *a*, before, and *b*, after impregnation, dry; *c*, latter after soaking in water.

Description.—About 5 Mm. ($\frac{1}{5}$ In.) long, nearly as broad and half as thick, angularly elliptical in outline, the lower surface flat, a little concave, the upper convex, transversely wrinkled, or ringed after swelling by soaking in water, which causes 3 pairs of legs to become visible; gray- or silvery-purple, or purple-black, and imparting a red coloration to water, alcohol, or ammonia water, slightly to ether, but not to fixed or volatile oils; readily pulverizable to a dark-red powder; odor faint, characteristic; taste bitterish.

No insoluble powder should separate upon macerating in water, and the ash should not exceed 6 per cent.

Adulterants.—Of the entire cochineal, the *Grana sylvestra* is to be regarded as an adulterant or substitute. Although permitted by our definition, it is excluded by the description as to size. An artificial cochineal, very readily identified, is made by coloring the exhausted powder with rosaniline, forming into grains, and dusting with some white powder. Various methods of adulteration by coating with heavy mineral powders of suitable color are in vogue. This is so ingeniously done as to cause the foreign matter to be concealed in the folds. Maceration in water, however, usually frees it. Adulteration of powdered cochineal is less readily detected, and the only certain and practicable method of examination is the determination of the percentage of coloring-matter.

Constituents.—The peculiar wax *coccerin*, $C_{30}H_{60}(C_{31}H_{61}O_3)_2$, which coats the insect, amounts to from 1 to 2 per cent. in the silver variety, 0.5 to 1 per cent. in the black, and 4.2 per cent. in the inferior *granilla*. It is soluble in benzene, but nearly insoluble in ether. The insect yields 1.5 to 2 per cent of myristin, 4 to 6 per cent. of fixed oil, fats, gum, a volatile acid, and *carminic acid* or *carmine-red* ($C_{11}H_{12}O_6.2H_2O$), amounting to 8 or 10 per cent. in the silver coccus. This acid has a bright purplish-red color, unalterable in dry air, and is soluble in water, alcohol, and alkalies, slightly so in ether, and not at all in fixed and volatile oils. It forms colored precipitates with most metallic salts, that from aluminum hydroxide being called *lake*. It was long believed to be a glucoside, but it is now known that the reducing substance separated by prolonged boiling with sulphuric acid, is not a sugar. P. Mayer remarks that carmine is not found in any organ apart from the diffuse fatty body and the yolk.

Carmine may be precipitated from a decoction of cochineal by alum, cream of tartar, or potassium binoxalate. It should be entirely soluble in ammonia water. Fietler

found that the amount of moisture in 5 samples of pure carmine ranged from 13.15 to 20.48 per cent., and averaged 16.36 per cent. The ash ranged from 8.1 to 10.51 per cent., the coloring-matter from 57.4 to 67.2 per cent. Alumina was present to the extent of from 25.95 to 43.18 per cent. Commercial carmine is extremely subject to adulteration of many kinds. The restriction of the ash to 9 per cent. and the absolute exclusion of barium or lead (not tin) are regarded by Fietler as the most useful precautions. It should be soluble in dilute ammonia, leaving but few flakes of insoluble matter.

Pharmaceutical Preparations.—Cochineal Color, N. F.; Cochineal Test-solution, U. S. P.; Solution of Carmine, N. F.; Tincture of Cochineal, Br. P.

Action and Uses.—Cochineal is rarely employed in medicine at the present day. Formerly it was supposed to possess certain anodyne properties, and was used in the treatment of whooping-cough, hiccough, and neuralgia.

It may be given to infants in doses of $\frac{1}{4}$ grain (0.015 Gm.) 3 times daily. The adult dose of the tincture is from 30 to 60 minims (2–4 Cc.); but as much as 4 fluidrachms (16 Cc.) may be employed.

The females of *C. ilicis* Fabricius (*Kermes*, *Chermee*, or *Alkermes*), obtained in the Mediterranean region from trees of *Quercus coccifera* L., are similarly used, and yield a similar coloring-matter. They are several times larger than the official, globular-ovoid, and nearly smooth.

CODEINA, *U. S.*, *Br.*—Codeine.

Codeïnum.—*Codeina*, *Methyl-morphine*, E.; *Codéine*, Fr.; *Kodein*, G.; *Codeina*, It., Sp.

Formula, $C_{18}H_{21}NO_3.H_2O$ or $C_{17}H_{17}NO(OH).OCH_3 + H_2O$. Molecular weight, 314.83.

An alkaloid contained in opium to the extent of 0.1 to 2 per cent. It is prepared from opium, and also artificially from morphine.

Codeine was discovered as a constituent of opium by Robiquet (1832), and prepared artificially from morphine by Grimaux (1881), by heating an alcoholic solution of morphine with sodium hydroxide and methyl iodide.

Preparation.—In preparing morphine by Gregory's process (see Morphina), after precipitating with calcium chloride, the hydrochlorides of morphine and codeine crystallize together, and on redissolving them in water and adding ammonia, morphine alone is precipitated. The ammoniacal filtrate is concentrated, the crystallizing codeine hydrochloride freed from ammonium chloride, then dissolved in hot water, and decomposed by potassium hydroxide, when a portion of the codeine will crystallize on cooling, but the greater part separates as an oily liquid, which gradually solidifies. The mother-liquor yields a further quantity of the same alkaloid, contaminated with morphine. The alkaloid is washed with cold water, then dissolved in ether, the ethereal solution mixed with water, and evaporated to crystallize.

Codeine is prepared synthetically from morphine, according to a recent patent, by adding a solution of 50 Gm. of potassium hydroxide in 800 Gm. of methyl alcohol to a solution of 285 Gm. of morphine and 132 Gm. of nitroso-methyl-urethane in 1000 Gm. of methyl alcohol. On completion of the reaction the methyl alcohol is removed by distillation, and the codeine extracted from the residuum by suitable solvents and crystallized. It is also prepared artificially by the action of methyl iodide or methyl chloride upon an alkaline solution of morphine—process of Dott; as well as by the action of sodium methylsulphate upon an alkaline solution of morphine—process of Knoll.

Properties.—Codeine occurs in the form of white or nearly translucent rhombic prisms or octahedral crystals, which are odorless, have a slightly bitter taste, and a strong alkaline reaction to moist litmus-paper. The crystals are soluble at 25° C. (77° F.) in 88 parts of water, 1.6 parts of alcohol, 12.5 parts of ether, and 0.66 part of chloroform; at 80° C. (176° F.) in 59 parts of water and at 60° C. (140° F.) in 0.92 part of alcohol (U. S.). The British Pharmacopœia gives the solubility at 15.5° C. (60° F.) as 1 in 80 of water or 30 of ether. It is also soluble in 17 parts of boiling water, 10 parts of benzene, 10 parts of oil of anise (morphine, insoluble) (L. Fouquet), and 85 parts of ammonia-water, and freely soluble in amyl alcohol, methyl alcohol, and carbon

disulphide, but insoluble in petroleum benzin and aqueous solution of potassium or sodium hydroxide. Codeine crystallizes anhydrous from dry ether or carbon disulphide, but from aqueous solutions with 1 molecule (5.67 per cent.) of water of crystallization. The latter form is official in the Br. and U. S. P. When heated to 100° C. (212° F.) codeine loses its water of crystallization. It melts, in an insufficient amount of boiling water for complete solution, to an oily liquid, but when heated alone it fuses at 155° C. (311° F.) (152°–153° C.) (305.6°–307.4° F.) (Hager), and on ignition burns without residue. Its aqueous solutions react strongly alkaline, precipitate the salts of copper, lead, iron, and other metals, and liberate ammonia from ammonium salts. It may be titrated direct with acids, using litmus as an indicator. Its solutions are strongly lævorotatory, the degree being much affected by the nature of the solvent, $S_3 = -100.9°$ in chloroform, and —122.9° in alcohol. Codeine does not separate iodine from iodic acid, and is not colored blue by ferric chloride (difference from morphine). Its solution in absolutely pure sulphuric acid remains colorless for several days, but on heating a violet color is developed; in the presence of traces of nitric acid or of iron the cold solution changes to green and blue, and deposits a blue precipitate. Erdmann's reagent, used for this test, consists of 20 Gm. of pure sulphuric acid and 10 drops of a mixture made with 6 drops of nitric acid (specific gravity 1.15) and 100 Gm. of water. Codeine is dissolved by sulphuric acid containing sodium molybdate (Fröhde's reagent) to a liquid having at first a dirty-green color, which after a while becomes pure blue, and gradually fades within a few hours to pale yellow. For the testing of alkaloids, Fröhde's reagent is prepared best by adding 1 Mg. of sodium molybdate to 1 Cc. of pure sulphuric acid. The yellow solution of codeine in nitric acid when heated contains *nitro-codeine*, $C_{18}H_{20}(NO_2)NO_3$. Codeine yields with chlorine water a colorless solution, which changes to red-brown on the addition of ammonia. If codeine is added to a solution of a morphine salt, precipitation of morphine occurs, and if the former alkaloid in powder be added to a solution of ammonium chloride, solution takes place and the odor of ammonia becomes perceptible. Codeine heated with an equal weight of paranitroso-dimethylaniline in alcohol produces *codeine-violet* (P. Cazaneuve, *Compt. rend.*, 113, pp. 747–749). Codeine dissolves with a violet color in concentrated sulphuric acid containing formaldehyde (3 Cc. of sulphuric acid + 3 drops of formaldehyde, Marquis, *Jour. Chem. Soc.*, 1900, p. 121), morphine producing a purple-red to pure blue; in 20 per cent. solution of benzylaldehyde in absolute alcohol followed by sulphuric acid it produces yellow to blood-red streaks (Melzer); in 5 per cent. solution of potassium perruthenate in concentrated sulphuric acid it produces a blue color after warming, morphine giving a green color (Brociner, *Zeitschr. Anal. Chem.*, 37, p. 62); mixed with a few drops of a solution of sodium hypochlorite and a few drops of sulphuric acid, codeine presents a persistent blue coloration (L. Raby); dissolved in concentrated sulphuric acid containing 5 per cent. of ammonium selenite, codeine gives a magnificent green color (Lafon). It forms a condensation-product, *dicodeylmethane*, with formaldehyde.

Codeine forms crystallizable salts with acids, the solutions of which give precipitates with the general alkaloidal reagents.

Tests.—Codeine dissolves without production of color in pure concentrated sulphuric acid; but if about 2 Cc. of this solution are poured into a small porcelain capsule, and 1 drop of highly diluted nitric acid (made by adding 1 drop of nitric acid to 200 Cc. of water) added, a bluish or blue tint will be developed. Another portion of this solution, of about 2 Cc., gently warmed, and mixed with 1 drop of a mixture of 1 volume of ferric chloride test-solution and 19 volumes of water, likewise assumes a bluish or blue tint (difference from morphine). On dissolving a small crystal of potassium ferricyanide in 10 Cc. of water, adding 1 drop of ferric chloride test-solution, and then 1 Cc. of codeine solution (1 in 100), no blue color should be produced at once (absence of morphine). On sprinkling 0.05 Gm. of codeine upon 2 Cc. of nitric acid (specific gravity 1.200), the crystals will turn red, but the acid, even when warmed, will acquire only a yellow color (difference from and absence of morphine).—U. S.

A 2 per cent. solution of codeine in water acidulated with a few drops of hydrochloric acid gives a whitish precipitate with solution of potassium hydroxide, but not with solution of ammonia. A saturated solution of codeine in water acidulated with hydrochloric acid should give no blue color, but only gradually a dull-green, on the addition of test-solution of ferric chloride and a very dilute solution of potassium ferricyanide (absence of morphine and other impurities).—Br. P.

Pharmaceutical Preparation.—Syrup of Codeine, N. F.

Action and Uses.—In its physiological action, codeine closely resembles morphine, with which it is sometimes contaminated. It is possessed of less narcotizing power, however, and does not arrest secretion in the respiratory and intestinal tracts. If given in overdose, it produces gastric disturbance, cerebral congestion, stupor or delirium, contracted pupils, and tremors. In the lower animals it causes tetanus, followed by paralysis of the peripheral motor nerves. Codeine is employed quite largely to relieve nervous cough and other manifestations depending upon an irritable condition of the nervous system. It is an excellent remedy in many cases of diabetes mellitus, but in some cases proves useless. It should, however, be given a trial in the treatment of this condition. It may be employed with success where the cough of tuberculosis or bronchitis is excessive. Because of the fact that codeine constipates but slightly, it may be given to relieve the pain of intestinal colic, enteralgia, and other painful conditions. Being variable in its composition, the beginning dose should not exceed from ½ to 2 grains (0.03–0.12 Gm.). For the relief of cough, this dose is quite sufficient, but in the treatment of diabetes it should be rapidly increased until the glycosuria has diminished. Sometimes as much as 20 or 30 grains (1.3–2 Gm.) are required daily.

Derivative Products and Unofficial Salts of Codeine.—Apocodeine. $C_{18}H_{19}NO_2$ or $CH_3O.C_{17}H_{16}NO$.—This substance was discovered by Matthiessen and Wright (1869), and is obtained by heating codeine hydrochloride with a concentrated solution of zinc chloride for about 15 minutes at a temperature of 180° C. (356° F.). The mass is cooled, dissolved in water, made alkaline with an excess of sodium carbonate solution, and the free base extracted with chloroform or ether. After recovery of the solvent, the residue, consisting of brown amorphous masses, soluble in alcohol but almost insoluble in water, is apocodeine. Recent researches indicate that apocodeine is a mixture of bases. Apocodeine hydrochloride, $C_{18}H_{19}NO_2.HCl$, may be obtained by dissolving apocodeine in sufficient dilute hydrochloric acid to produce a neutral solution, and evaporating the same to dryness. It occurs as a yellowish-gray amorphous powder, readily soluble in water and alcohol, and possessing properties similar to those of apomorphine hydrochloride.

Pseudocodeine. $C_{18}H_{21}NO_3 + H_2O$ or $CH_3O.C_{17}H_{18}NO_2 + H_2O$.—If moderately dilute sulphuric acid be allowed to act on codeine at the temperature of boiling water, pseudocodeine will be produced, which occurs as a white crystalline base, soluble in alcohol and forming crystallizable salts.

Codeinæ Hydrobromidum. *Codeinum hydrobromidum. Codeine hydrobromide*, E.; *Kodeinhydrobromid. Bromwasserstoffsaures Kodein*, G. $C_{18}H_{21}NO_3.HBr + 2H_2O$.—Codeine hydrobromide is prepared by dissolving and neutralizing 10 parts of codeine with 51 parts of warm 5 per cent. hydrobromic acid. The salt crystallizes out on cooling, and may be purified by recrystallization from 70 per cent. alcohol. It occurs as white glistening needle-like crystals. It is readily soluble in water and dilute alcohol.

Codeinæ Hydrochloridum. *Codeinum hydrochloridum. Codeine hydrochloride*, E.; *Kodeinhydrochlorid*, G. $C_{18}H_{21}NO_3.HCl + 2H_2O$.—The salt is readily prepared by neutralizing codeine with hot dilute (12.5 per cent.) hydrochloric acid, the codeine hydrochloride crystallizing on cooling. It occurs as small white crystals, soluble in 26 parts of water, in less than its own weight of boiling water, and loses its water of crystallization slowly on drying at 100° C. (212° F.).

CODEINÆ PHOSPHAS, *U. S.*, *Br.*—Codeine Phosphate.

Codeïnum phosphoricum, P. G.; *Phosphate de codéine*, Fr.; *Kodeinphosphat, Phosphorsaures Kodein*, G.

Formula, $(C_{18}H_{21}NO_3)_3H_3PO_4 + 2H_2O$ or $(PO(OH)_3(C_{18}H_{21}NO_3)_3 + 2H_2O)$. Molecular weight, 430.

Phosphate of the alkaloid *codeine*, obtained from opium or prepared from morphine.

Preparation.—Dissolve 10 parts of codeine in 12.5 parts of phosphoric acid (25 per cent.), leaving the solution slightly acid in reaction, and add sufficient alcohol to precipitate the salt.

Properties.—The water of crystallization is variable, depending upon the conditions of the crystallization. The formula of the Br. P. salt is given as $(C_{18}H_{21}NO_3.H_3PO_4)_2 + 3H_2O$. Codeine phosphate contains about 70 per cent. of codeine, and occurs as fine, white, needle-shaped crystals, or crystalline powder, without odor, and having a bitter taste. It is soluble at 25° C. (77° F.). in 2.25 parts of water, 261 parts of alcohol,

1340 parts of ether, and in 6620 parts of chloroform; at 80° C. (176° F.) in 0.46 part of water, and at 60° C. (140° F.) in 97 parts of alcohol. The Br. P. gives the solubility as 1 in 4 parts of cold water, and the P. G. as 1 in 3.2 parts. At 100° C. (212° F.) it loses all of its water of crystallization; above 200° C. (392° F.) it becomes darker in color, and at 235° C. (455° F.) melts to a brown liquid, which rapidly volatilizes. Its aqueous solution reddens blue litmus-paper. If silver nitrate test-solution be added to an aqueous solution of codeine phosphate, a yellow precipitate is produced, which is soluble in dilute nitric acid; if, after the solution is decanted, ammonia-water be added, the precipitate is dissolved.—U. S.

Tests.—When dried at 100° C. (212° F.) it should not lose more than 8 per cent. of water, nor should it react for chloride or sulphate when its 5 per cent. aqueous solution, acidulated with nitric acid, is tested with test-solution of silver nitrate or barium chloride. If 0.2 Gm. of codeine phosphate be dissolved in 5 Cc. of water and 3 Cc. of potassium hydroxide test-solution, and the solution shaken out successively with 3 portions of chloroform (5 Cc. each), the combined chloroformic solutions evaporated to dryness in a tared dish, should yield not less than 0.13 Gm. of codeine (U. S.). It should dissolve without color in concentrated sulphuric acid. In an aqueous solution of codeine phosphate (1 in 20) silver nitrate causes a yellow, and potassium hydroxide a white precipitate (P. G.). The precipitate caused by potassium hydroxide in the aqueous solution should give the reactions characteristic of codeine. A solution of 1 grain of potassium ferricyanide and 1 drop of ferric chloride in 10 Cc. of water should not be colored blue upon the addition of 1 Cc. of an aqueous (1 per cent.) solution of codeine phosphate (P. G.). It should not be colored blue by ferric chloride test-solution (absence of morphine).—Br. P.

Action and Uses.—This salt is employed for the same purposes and in the same dose as CODEINE (which see).

CODEINÆ SULPHAS, *U. S.*—Codeine Sulphate.

Codeïnum sulfuricum.—Sulfate de codéine, Fr.; *Kodeinsulfat, Schwefelsaures Kodein*, G.

Formula, $(C_{18}H_{21}NO_3)_2.H_2SO_4 + 5H_2O$ or $SO_2.(OH)_2(C_{18}H_{21}NO_3)_2 + 5H_2O$. Molecular weight, 780.65.

The sulphate of an alkaloid obtained from opium or prepared from morphine by methylation. It should be kept in small, well-stoppered, amber-colored vials.—U. S.

Preparation.—Codeine sulphate may be prepared by dissolving the alkaloid codeine in warm water, and adding sufficient sulphuric acid to obtain a neutral liquid, which is concentrated and allowed to crystallize. 100 Gm. of crystallized codeine will require 16.54 Gm. of official (92.5 per cent.) sulphuric acid.

Properties and Tests.—Codeine sulphate occurs in long, glistening, white, needle-shaped crystals, rhombic prisms, or crystalline powder, efflorescing in the air, odorless, and having a bitter taste. It is soluble at 25° C. (77° F.) in 23 parts of water, and 1035 parts of alcohol, but is insoluble in chloroform and ether; at 80° C. (176° F.) it is soluble in 6.25 parts of water and at 60° C. (140° F.) in 340 parts of alcohol. The salt loses its water of crystallization at 100° C. (212° F.); chars, decomposes, and partially volatilizes above 200° C. (392° F.), without melting; the residue melts at about 278° C. (532.4° F.). Its aqueous solution is neutral to litmus-paper. If barium chloride test-solution be added to an aqueous solution of the salt, a white precipitate is obtained, which is insoluble in hydrochloric acid.—U. S. In all other respects it conforms to the reactions and tests mentioned under CODEINE (which see).

Action and Uses.—Codeine sulphate, being more soluble in water, is used in preference to the alkaloid itself. (See CODEINA.)

COLA.—Kola.

Semen (*Nuces*) *Colæ; Kola-nuts, Guru* (*Gooroo*) *nuts, Female cola, Soudan coffee, Bichy* (*Bissy*) *nuts*, E.; *Kola-nuss*, G.; *Noix de Cola* (*de Gourou*) Fr.; *Nuez de Cola*, Sp.

The recent or dried cotyledons of *Cola vera* Schum. or of *Cola acuminata* (Beauv.) Schott (*Sterculia a.* Beauv.; *Bichea solitaria* Stokes: *Lunanea Bichy*, DC.—Fam. *Sterculiaceæ*).

Origin.—From good-sized and handsome trees, natives of tropical Africa, and rather extensively cultivated in some other tropical countries, the second-named especially in the West Indies, where it is quite extensively naturalized. Commercial supplies come from Africa and the West Indies. The West Indian are larger and better-looking, but, according to Dohme's analysis, contain less caffeine. The fruit is a very large, rough, and woody, 3- to 8- (mostly 5-) celled dehiscent capsule, each cell containing from 1 to 3 seeds, the best varieties containing but 1. The seed-coats are thick and rather soft. The seeds are left for several days, when their coats partly decay or soften, and then are removed and the kernels washed. When fresh, the seeds are either white or purplish-red. The native use of the kernels is almost wholly in the fresh state, and usually after they have been caused to germinate, probably because they are then sweeter. Great quantities are now exported in the fresh condition. By careful treatment, packing, and storing, they can be preserved fresh for more than 3 months. For this purpose, they are thoroughly washed in the purest of water, drained, and packed in peculiar cane-baskets holding about a half-bushel. In the basket they are carefully enclosed in the large leaves of another species of Cola. These leaves not only prevent moulding and decay, but repel larval attacks, to which the fresh seeds are very liable. They do not long preserve their bright color, but change to a dull purplish-brown. For drying, their cotyledons (2 in *C. vera*, 3 or 4 in *C. acuminata*) are separated and exposed to the sun. When thoroughly dried, they can be easily and perfectly kept for any desired time.

FIG. 128.

Cola vera: edge of fresh kernel (Nat.).

FIG. 129.

Cola vera: inner face of dry cotyledon (Nat.).

Kola is used by the natives as a muscular stimulant or supporter, very much as coca is used in the Andes, and there is a very large domestic trade in it in Africa. The literature of its native use is now quite extensive.

Description.—The fresh kernels are preserved entire; that is, the cotyledons are not separated. They are 3 to 4 Cm. (about 1 to 1½ In.) long, nearly as broad and two-thirds as thick, irregularly ovoid, often somewhat bluntly angular from mutual pressure, the base truncate, the summit rounded, 1 side (sometimes 2 sides) flattened; the surface is smoothish, or somewhat granular-leathery, the color purple, varying to brownish or brown, a crack often indicating the margins of the cotyledons. They are rather tough-fleshy, and somewhat aromatic, bitter, and astringent.

The dried kernels are usually separated into their cotyledons, which are halves or quarters of the above described bodies, the size a little diminished by drying, which also warps them considerably and usually causes the flat surface to become concave, with sharp edges which are slightly incurved. The color is a deep-brown, the flat side commonly a little lighter, and the surface is granular-wrinkled. They are heavy, hard, and tough, the fractured surface light-brown and minutely granular. There is no odor, and they have merely a slight astringent taste. No other drug can possibly be mistaken for dried kola.

Some confusion, involving commercial complications, has arisen over the question whether the kola having more than 2 cotyledons is of the same species as the other. Schumann appears to have determined differences in the flowers which prove the seed with 2 cotyledons to be from *C. vera*, his newly described species. Both are extensively used, but the latter are preferred and bring a higher price.

Constituents.—Kola seeds contain fat, 0.1 per cent. of volatile oil, from a trace to 4 per cent. of sugar, more than 40 per cent. of starch, 1.7 to 4 per cent. of kolatannin, and 1.5 to 3.6 per cent. of total alkaloids. From $\frac{1}{100}$ to $\frac{1}{40}$ of this alkaloid is *theobromine* ($C_7H_8N_4O_2$), and the rest is *caffeine* ($C_8H_{10}N_4O_2$). The ash amounts to 3 or 4 per cent. Kilmer (1896) describes the *kolanin* of Knebel as a body which under the influence of heat or ferments splits into glucose, caffeine, and a tannin (*kola-red*). One of these ferments, *kolazyn*, he obtained from the fresh seeds. Knox and Prescott, in an exhaustive study (*Proc. Am. Pharm. Assoc.*, 1896, 1897), have shown this caffeine-bearing substance to be neither an oxidation-product nor a glucoside, but *kola-tannate of caffeine*. Their estimations indicate a much greater caffeine content (2.7 to 3.6 per

cent.) than did those of previous investigators, who had not taken cognizance of this combined alkaloid. Caesar and Loretz find the caffeine to be much diminished by roasting the seeds; and Porkin states that the germinated nuts are believed in Congo to be much stronger than those not germinated, yet Knox and Prescott found that, though sterilizing destroys the ferment and checks the formation of kola-red, it does not change the amount of caffeine obtained. Dohme and Engelhardt (1896) found 1.93 per cent. of alkaloid in Jamaica cola, and 2.24 per cent. in the African. Jean (1896) obtained the following percentages from the different sources: Congo, 1.17 to 1.48; Niger, 0.9 to 1.23; Sierra Leone, 2.27 to 2.41; Ivory Coast, 1.86; Soudan, 1.33; and East Indies, 1.63. Heckel and Schlagdenhauffen found the polycotyledonous variety (*C. acuminata*) to yield only half as much alkaloid, and twice as much fat. Topping obtained the same alkaloid yield from both the red and the white seeds. Caffeine kola-tannate represents about half the total alkaloid. It is only slightly soluble in water, but is so much more so in the presence of caffeine or tannin that it is taken up in the aqueous infusion.

Kola-tannin is a cream-colored powder, freely soluble in water, alcohol, and acetone, sparingly soluble in ether, and quite insoluble in chloroform and benzin. It turns green with ferric chloride, precipitates albumin, and belongs to the oak-tannin group, no gallotannic acid being found in kola. Boiled with dilute acids, it forms protocatechuic acid, and a red or dark-brown amorphous substance, insoluble in water, alcohol, chloroform, or ether, and only partly soluble in alkalies, so that it may be a mixture.

("It cannot be assumed that a stable caffeine compound of an acid of such marked chemical individuality as that of kola-tannin can have the same physiological effect as free caffeine, a fact of importance in considering the activity of all caffeine beverages." —Knox and Prescott.)

Valuation of Kola.—The method of Keller (somewhat modified) for the determination of the caffeine content of kola nut is simple and gives good results. Place 6 Gm. of the powdered drug in a flask or bottle and add 84 Cc. of chloroform and 6 Cc. of 10 per cent. ammonia water. Shake for half an hour and let stand for 4 hours. Pour off 70 Cc. of the chloroform solution, filtering if necessary into a tared flask, and rinse the measuring cylinder and filter with a little chloroform. Then distil off the chloroform and purify the residue by dissolving in hot water, allowing the liquid to cool, adding ammonia water and shaking out with 2 or 3 portions of chloroform, which are drawn off into a tared flask, evaporated to dryness and dried to constant weight. Instead of adding ammonia water and shaking out with chloroform, it will generally suffice to evaporate the aqueous solution to dryness. The weight of residue obtained, which latter should be free from color, when multiplied by 20 expresses the percentage of caffeine present. The following plan may also be employed: Mix 10 Gm. of powdered kola nut in a porcelain dish with 5 Gm. of calcined magnesia, and add 60 Cc. of 70 per cent. alcohol. Stir well and evaporate to dryness on a water-bath, stirring with a glass rod to guard against loss. Mix the dry residue with 30 Cc. of alcohol of the same strength as the preceding, and again evaporate to dryness. Transfer the residue to a dry bottle, add 100 Cc. of chloroform, and shake well during 1 hour. Allow the liquid to settle, and filter off 50 Cc. of the chloroform solution into a tared flask, evaporate, and dry the residue to constant weight. The weight of caffeine obtained, multiplied by 20, expresses the percentage. Treatment of the powdered drug with ammonia water, or calcined magnesia and heat, is intended to decompose the caffeine kolatannate (so-called kolanin), and thus insure complete extraction by the chloroform of all the caffeine, free and combined, present.

Pharmaceutical Preparation.—Fluidextract of Kola, which is named in the National Formulary as Fluidextract of Sterculia.

Action and Uses.—Kola may be employed for practically the same purposes as caffeine. The remedy has been recommended in the treatment of cardiac failure and in tropical diarrhœa. It is claimed that the powder when eaten increases one's power of enduring fatigue without food, and it has been employed to some extent for this purpose. It may also be given for headache, neuralgia, and migraine, and is useful in cases of nervous breakdown resulting from overwork. Its physiological effects are closely allied to those of caffeine. The dose in substance is from 20 to 40 grains (1.3–2.6 Gm.), 3 times daily.

Allied Species and Products.—The number of species in this genus is variously estimated at from 14 to 30, the higher number claimed by Schumann, in his monograph. They are all natives of Africa, though some South American plants have been erroneously classed with them. Schumann states that the seeds of *C. lepidota* Schum. with 2 cotyledons, and another species, are used similarly to the official. Flückiger speaks of a *Kola ballaya*, with 6 cotyledons, as containing 1 per cent. of caffeine. None of the several other seeds which have been sold as kola contains caffeine. The most important substitute is the African *Garcinia*

Kola Heckel (*False, Male,* or *Bitter kola;* Fam. *Guttiferæ*), which is a fruit and not a seed, and is bitter and astringent. It is not exported. The seed of *Pentadesma butyracea* Don (*Kanya*), related to the last, closely resembles kola, and is sometimes mixed with it in commerce. It contains no alkaloid, but much fat, which is extracted and used under the name *Kanya butter*. *Heritiera littoralis* Ait., of this family, widely diffused through the tropics of the Old World, is said to yield a smaller seed of a purplish-brown color, free from caffeine or kolanin. A Santa Domingo false kola has been seen in commerce, and identified as *Dimorphandra Mora* Schomb. (*Mora excelsa* Benth.—Fam. *Leguminosæ*). Several other substitutes have been occasionally reported.

COLCHICINA, *U. S.*—Colchicine.

Colchicine, Fr.; *Colchicin*, G.

Formula, $C_{22}H_{25}NO_6$ or $C_{15}H_9.(OCH_3)_3.NHCOCH_3.COOCH_3$. Molecular weight, 396.23.

An alkaloid obtained from colchicum. It should be kept in dark, amber-colored, well-stoppered vials.—U. S.

Colchicine was discovered in 1820 by Pelletier and Caventou, but considered by them identical with veratrine. Although Geiger and Hesse in 1833 recognized the distinctive character of the alkaloid and applied to it its present name, its true chemical nature was not definitely determined until 1888 by Zeisel.

Preparation.—Pure colchicine may be prepared by the following process, which is based upon the fact that it is capable of forming a crystalline compound with chloroform. Colchicum seed are exhausted with hot 90 per cent. alcohol, the alcohol recovered by distillation, the residue treated with water equal in quantity to $\frac{1}{5}$ of the weight of the drug used, and filtered for the removal of resin, wax, and fatty matter. The clear dark-brown filtrate is well shaken with four successive portions of chloroform, which are united and distilled, the residue being again dissolved in water and shaken with chloroform. From the latter solution crude colchicine-chloroform separates upon evaporation of the solvent and is dissolved in alcohol, the solution being again concentrated by distillation. A third treatment with chloroform yields a yellow solution, which is evaporated on a water-bath and the residue treated with luke-warm ether and set aside, when pure colchicine-chloroform, having the composition $C_{22}H_{25}NO_6.2CHCl_3$, will separate in the form of faintly yellowish needle-shaped crystals, which are decomposed in the presence of water when heated to 100° C. (212° F.), the chloroform escaping and leaving pure colchicine in aqueous solution, from which it may be obtained as an amorphous mass by evaporation to dryness or in form of lamellæ by spreading the concentrated solution on plates of glass and drying.

Properties and Tests.—Colchicine occurs as pale-yellow leaflets, or a pale-yellow amorphous powder, turning darker on exposure to light, having an odor suggesting damp hay, and a very bitter taste. It is soluble at 25° C. (77° F.) in 22 parts of water, 155 parts of ether and in 87 parts of benzin; soluble in 26 parts of water at 80° C. (176° F.); very soluble in alcohol and chloroform; insoluble in petroleum benzin. After drying over sulphuric acid it melts if heated to 142.5° C. (288.5° F.) (143°–147° C., Bruehl), and upon incineration leaves no residue. Its aqueous solution is neutral to litmus-paper, lævogyrate, and of a yellow color, which is intensified by mineral acids. Sulphuric acid produces with colchicine a citron-yellow color, which upon addition of a drop of nitric acid changes to greenish blue, then to red, and finally to yellow. On adding an excess of potassium hydroxide, the color is changed to red. Ferric chloride test-solution, on being added to an aqueous solution of colchicine, gives no color, but on heating, a brownish-red color is developed, which changes to brownish black; if ferric chloride test-solution be added to an alcoholic solution of colchicine, a garnet-red color is at once produced. Sulphuric acid, containing a fragment of potassium dichromate, gives a greenish-blue color, changing to orange. If a mixture of 5 drops each of an aqueous solution of colchicine, fuming nitric acid, and ferric chloride test-solution be heated to boiling, a yellow solution will be formed, changing to olive green. When cool, if the liquid be shaken with a little chloroform, the latter will turn ruby red, and the aqueous layer will remain green.—U. S. Nitric acid of 1.40 specific gravity forms a violet-red colored solution with colchicine, which changes to yellow, and after dilution with water and addition of an excess of sodium hydroxide, to red. Colchicine is precipitated from acid solution by cadmium iodide, phosphotungstic acid, phosphomolybdic acid, and Mayer's Solution, but not by picric acid or platinic chloride. It yields, however, well-defined

crystals as a double chloride with gold chloride, if the latter be added in excess to a solution of the alkaloid slightly acidified with hydrochloric acid.

The salts of colchicine are not very stable. The one most used is the salicylate, $C_{22}H_{25}NO_6.HC_7H_5O_3$, made by moistening a mixture of 20 parts of colchicine and 7 parts of salicylic acid with water and subsequently drying the same. It is a yellow amorphous powder, soluble in water and alcohol. The name *colchisal* has been given to a solution of colchicine in methyl salicylate, dispensed in gelatin capsules, each containing 0.00025 Gm. of the alkaloid and 0.2 Gm. of the methyl ester.

Action and Uses.—Colchicine and its salts may be used in those conditions in which colchicum is indicated. As a substitute for colchicum it has not met with the full approval of the medical profession, and it probably does not represent fully the medicinal properties of the seed or root. The dose is from $\frac{1}{160}$ to $\frac{1}{120}$ grain (0.0004–0.0005 Gm.).

COLCHICUM, *U. S.*—Colchicum.

Meadow-saffron, E.; *Herbstzeitlose, Wiesensafran*, G.; *Colchique, Safran Bâtard, Veillotte, Veileuse*, Fr.; *Colchico*, It., Sp.

Official Parts.—1. Colchici Cormus, U. S., Br.—The dried corm of *Colchicum autumnale* L. (Fam. *Liliaceæ*), yielding not less than 0.35 per cent. of colchicine.

2. Colchici Semen, U. S., *Colchici Semina*, Br.; *Semen Colchici*, P. G.—The dried ripe seed of *Colchicum autumnale* L., yielding not less than 0.55 per cent. of colchicine.

Either the seeds or the corm, or both, are official in all pharmacopœias. The British requires that the corm be dried at a temperature not exceeding 65.5° C., the Italian that it contain from 0.08 to 0.2 per cent. of colchicine, and that the seeds contain 0.2 to 0.4 per cent. The Portuguese prohibits the substitution of the seeds of other species of *C.*, and several pharmacopœias exclude seeds of a pale or yellowish color, and those that have been kept more than a year.

Origin.—A rather handsome low herb of pastures and meadows of central and southern Europe. In its late fall-flowering it might be regarded, physiologically, as a precocious spring plant, since its seeds are not ripened until the following summer. In the autumn, the subterranean portion consists of the fully developed corm, bearing at its apex the scar left by the fruit-stem of the preceding summer. A tuft of root-fibers is attached to a lateral projection of the base, above which there is a shallow groove running to the apex of the corm. In the lower part is a conical rudimentary stem with 3 or 4 rudimentary leaves, and bearing upon the apex 1 or more flowers, with the lower part of their long perianth-tubes resting in the groove. The whole is surrounded by a few brown leaves, forming a sheath above. After flowering, the tuber gradually diminishes in size, until by the following summer it is completely absorbed and decayed. In the meantime the upper internode of the short conical axis is gradually developed into a stem rising above ground with the capsules, and at the base is enlarged to an ovoid fleshy corm, as yet without the lateral groove, but showing in the lower axil the bud, which by the following autumn will be developed into a short conical flowering axis, while in the meantime the lateral groove on the fruit-bearing tuber will have been formed. The development and duration of the tuber embrace, accordingly, a period of 2 years, in the first half of which the tuber produces flowers and fruit, and afterward serves for developing and nourishing its successor. The tubers are collected in July and August, before the appearance of the flowers; but Schroff (1856), and afterward Maclagan, concluded from physiological experiments that the proper time for its collection is the period of flowering or immediately afterward.

Description.—The Corm.—About 2.5 Cm. (1 In.) long and two-thirds as broad, ovoid-conical, somewhat laterally compressed, with a large longitudinal groove upon the flatter side, or in reniform transverse or ovate longitudinal slices of the same; externally gray-brown or brownish-gray, finely wrinkled; internally whitish, solid, the dried transverse surfaces presenting a papillose appearance; fracture short, starchy; odorless and of a sweetish and bitter, afterward somewhat acrid taste.

The powder is of a light-gray or slightly brownish-gray color. Its abundant starch-grains are mostly compound or angular, nearly isodiametric and the nearly central hilum strongly stellate.

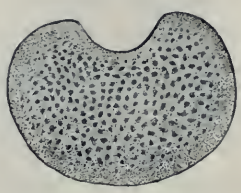
The Seeds.—About 2.5 Mm. ($\frac{1}{10}$ In.) in diameter, globoidal, with a slight point at the hilum; reddish-brown; finely pitted; internally whitish; tough and of bony hardness; odorless and of a bitterish and somewhat acrid taste. They are well distinguished from all similar seeds by their hardness.

Constituents.—Besides resin and fatty matter, colchicum contains as its most important constituent the alkaloid colchicine (treated separately elsewhere), and of which about 0.4 per cent. is found in the root, and from 0.4 to 0.6 per cent. in the seed. Colchiceine, $C_{21}H_{23}NO_6 + \frac{1}{2}H_2O$, which was at one time supposed to exist in colchicum, is

FIG. 130.

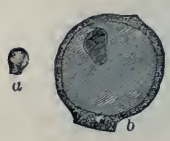
Tuber of colchicum.

FIG. 131.



Colchicum: transverse section.

FIG. 132.



Colchicum seed: *a*, natural size; *b*, section magnified.

produced, according to Zeisel, as a result of hydrolysis by extracting the drug with acid menstrua. Chemically it may be looked upon as acetyl-trimethyl-colchicic acid; but according to Bruehl, it gives no reaction with litmus-paper and seems to form compounds with mineral acids. It is said to be non-toxic and occurs in white crystals, which are inodorous and soluble in hot water, alcohol, and chloroform, but only slightly soluble in cold water. It readily dissolves with yellow color in solutions of the alkalies and their carbonates. Colchiceine ordinarily melts at 140° C. (248° F.), and in the anhydrous condition at 172° C. (341.6° F.). By treatment with mineral acids it is split up into acetic acid, methyl alcohol and apocolchiceine. It is readily converted into colchicine by etherification with methyl alcohol and hydrochloric acid, or by treatment with methyl iodide and sodium hydroxide in methyl alcohol. Colchiceine was first obtained in 1856 by Oberlin.

The Pharmacopœia requires that the corm and seed of colchicum, when assayed by the process officially given, which is practically identical with that given below, shall yield respectively not less than 0.35 per cent., and 0.55 per cent. of colchicine. Another method and perhaps better than the official, for the valuation of colchicum, is that of Gordin and Prescott, published in the *Proc. Am. Pharm. Assoc.*, 1900, page 133.

Assay of Colchicum Corm or Seed.—Colchicum corm (or seed), in No. 60 powder, 10 Gm.; ether, chloroform, alcohol, ammonia-water, distilled water, each a sufficient quantity. Introduce the colchicum corm (or seed) into a 200 Cc. Erlenmeyer flask, and add to it 100 Cc. of a mixture of 77 Cc. of ether, 25 Cc. of chloroform, 8 Cc. of alcohol, and 3 Cc. of ammonia-water, insert the stopper securely, and macerate with frequent shaking for 12 hours (or preferably for 4 hours in a mechanical shaker). Filter a sufficient quantity of the liquid into a measuring cylinder until 50 Cc. (representing 5 Gm. of colchicum corm or seed) have been obtained; then transfer it to a beaker or dish, and evaporate it nearly to dryness by applying a very gentle heat. Dissolve the residue in 10 Cc. of ether, add 5 Cc. of water, stir well, and heat gently until the ether has evaporated. After cooling, filter the aqueous solution into a small separator, retaining the insoluble matter as much as possible in the beaker or dish. Redissolve the residue in a little ether, add 5 Cc. of water, and proceed as before. Wash the container and filter with a little water, and shake the aqueous solution well for a minute with 15 Cc. of chloroform. Draw off the chloroform, after perfect separation, into a tared flask, and again shake out the aqueous liquid with 3 portions of 10 Cc. each of chloroform, collecting these solutions in the tared flask. Evaporate the chloroform completely; dissolve the residue in a little alcohol, evaporate the latter, redissolve the residue in alcohol, evaporate the alcohol as before, and dry the residue at 100° C. (212° F.) until the weight remains constant after cooling. The weight of the residue multiplied by 20 gives the percentage of colchicine in the corm (or seed).—U. S.

Pharmaceutical Preparations.—EXTRACT OF COLCHICUM CORM, U. S. P.; FLUIDEXTRACT OF COLCHICUM SEED, U. S. P.; TINCTURE OF COLCHICUM SEED, U. S. P.; WINE OF COLCHICUM SEED, U. S. P.

Action and Uses.—When colchicum is taken in overdose, it produces violent gastro-enteritis, and if the dose be large, death inevitably results because of the violent inflammation of the gastro-intestinal tract and of the kidneys which ensues. When moderately large doses are taken for several days, heat and discomfort are often felt in the epigastrium, and some laxity of the bowels and even nausea and vomiting may

develop. The drug is one of the most dangerous of poisons, because after it is taken in large doses nothing can be done for the cure of the patient provided it has remained long enough in the stomach to produce its inflammatory effects. Colchicum is not so largely employed in the United States as it is in England, as cases of true gout are not so frequently met with in America as in the British Isles. It is in true gout alone that colchicum finds its chief medicinal value, and practitioners of experience are generally in accord that if it is given in as large dose as the patient will bear, it does more to cut short an attack of acute gout than any other remedy. In the aberrant form of gout with lithæmia it does not possess the same specific influence. In the treatment of gout, the wine of the root is most commonly employed in the dose of from 10 to 30 minims (0.60–2 Cc.), repeated every few hours until evidences of gastric irritation or pain in the bowels develops. The drug has been used in the treatment of acute and chronic rheumatism, but is probably of little value in those affections. The active principle of colchicum has been largely employed in the last few years to substitute the wine of the root. It is given dissolved in oil of gaultheria in capsules, or it may be given in pill-form. It is a powerful poison. Its dose varies from $\frac{1}{150}$ to $\frac{1}{100}$ grain (0.0004–0.0005 Gm.), 3 or 4 times a day.

Other Species.—The genus contains some 30 species, a number of which have been similarly employed. The Oriental *Hermodactyls* are supposssd to have been derived from *C. variegatum* L., *C. speciosum* Stev. (*C. Illyricum* Friw.), and *C. luteum* Baker.

COLLODIUM, *U. S., Br., P. G.*—Collodion.

Collodion, Fr.; *Collodium, Kollodium*, G.; *Collodio*, It.

Preparation.—Pyroxylin, 40 Gm.; ether, 750 Cc.; alcohol, 250 Cc. To the pyroxylin, contained in a bottle, add the ether, and let it stand for 15 minutes; then add the alcohol, and shake the mixture until the pyroxylin is dissolved. Cork the bottle well and set it aside until the liquid has become clear. Then decant it from any sediment which may have formed, and transfer it to bottles which should be securely corked. Keep the collodion in a cool place, remote from lights or fire.—U. S.

Collodion prepared from 295 grains of pyroxylin, 12 fluidounces of ether, and 4 fluidounces of alcohol, will correspond to the official article.

The British Pharmacopœia directs the solution of 1 ounce of pyroxylin in a mixture of 36 fluidounces of ether and 12 fluidounces of 90 per cent. alcohol. The proportions of the German Pharmacopœia are: 1 part of collodion-cotton to 21 parts of ether and 3 parts of alcohol. The pharmacopœias order the solution to be poured off from any sediment which may form.

Properties.—If the pyroxylin—or, more correctly, *colloxylin*—has been properly made, there is no difficulty in preparing collodion by simply agitating it occasionally with the liquid. It forms a neutral, nearly clear or slightly opalescent, either colorless or slightly yellowish, liquid having a syrupy consistence and ethereal odor. On evaporation it forms a colorless, glossy, and contractile film.

Pharmaceutical Uses.—Collodion and flexible collodion may be used as an excellent vehicle for the local application of medicinal substances soluble in ether, such as aconitine, atropine, tannin, salicylic acid, iodine, iodoform, resorcin, pyrogallol, carbolic acid, oleoresin of capsicum, camphor, corrosive sublimate, red mercuric iodide, etc.

Collodions are best dispensed in small round-shouldered vials provided with a cork through which a camel's-hair pencil has been passed and securely fastened; this avoids loss of material and drying of the collodion in the brush—a very annoying occurrence.

Medical Uses.—Collodion is employed as a protection to cuts, wounds, and abrasions. Because it contracts upon drying, it frequently causes considerable pain, and unless required to coapt the edges of a wound, the flexible collodion should be substituted for it. It is painted over small boils and buboes for the purpose of causing their absorption, and is said to be more or less successful in the treatment of acne, herpes zoster, and intertrigo.

COLLODIUM CANTHARIDATUM, *U. S., P. G.*—Cantharidal Collodion.

Collodium vesicans, Br.; *Collodium cantharidale.—Blistering collodion*, E.; *Collodion vésicant (s. cantharidé, cantharidal)*, Fr.; *Blasenziehendes Kollodium, Spānisch-fliegen-Kollodium*, G.

Preparation.—Cantharides, in No. 60 powder, 60 Gm.; flexible collodion, 85 Gm.; chloroform, a sufficient quantity. Pack the cantharides firmly in a cylindrical percolator,

and gradually pour chloroform upon them until the cantharides are exhausted. Recover the chloroform by distillation on a water-bath, and evaporate the residue in a capsule, by means of a water-bath, until it weighs 15 Gm. Dissolve this in the flexible collodion, and let it stand at rest for 48 hours. Finally, pour off the clear portion from any sediment which may have been deposited and transfer it to bottles, which should be securely corked. Cantharidal collodion should be kept in a cool place, remote from lights or fire.—U. S.

If 4 avoirdupois ounces of cantharides be exhausted with chloroform, the resulting tincture evaporated (as directed above) to 1 avoirdupois ounce, and sufficient flexible collodion then added to make the mixture weigh 6½ avoirdupois ounces, the finished product will be about of pharmacopœial strength.

Chloroform is an excellent solvent for cantharidin or the cantharidin compound contained in old Spanish flies. Powdered cantharides being much lighter than chloroform, their percolation with this menstruum presents some difficulty unless pressed down by a layer of washed sand. Owing to the volatility of the chloroform, percolation should be performed with an apparatus such as is used for the percolation of ethereal liquids (see OLEORESINÆ), and the greater part of the menstruum remaining absorbed in the powder may be recovered by judicious percolation with water. The present formula is similar to that of Procter (1852), in which, however, ether was used for exhausting the cantharides; the inflammability of this liquid and its vapor requires additional precautions in distilling the tincture.

Blistering Collodion of the Br. P. (*Collodium vesicans*) is slightly weaker than the above, and does not form a flexible film. It is prepared by dissolving ½ avoirdupois ounce of pyroxylin in 1 Imperial pint (20 fluidounces) of Blistering Liquid, which latter represents 50 Gm. of cantharides in 100 Cc. of finished product, and is made with acetic ether.

The German Pharmacopœia directs this preparation to be made by exhausting coarsely powdered cantharides with a sufficient quantity of ether, evaporating the tincture to a syrupy consistence, and adding sufficient collodion (not flexible) to make the total weight of the finished product equal the weight of the cantharides used.

Properties.—Cantharidal collodion has the same physical properties as flexible collodion, except that it is of a brownish-green color, which becomes yellowish on exposure to light; it is therefore best kept in amber-colored vials. The film left on evaporation has also a greenish color.

Action and Uses.—The medicinal properties of cantharidal collodion have been described under Cantharides (which see). It has an advantage over the cerate in that it can be applied more readily and it is more cleanly. It should be applied with a camel's-hair brush.

COLLODIUM FLEXILE, *U. S.*, *Br.*—Flexible Collodion.

Collodium elasticum, P. G.—*Collodion élastique*, Fr.; *Elastisches Kollodium*, G.

Preparation.—Collodion, 920 Gm.; Canada turpentine, 50 Gm.; castor oil, 30 Gm.; to make 1000 Gm. Mix them and keep the mixture in a well-corked bottle in a cool place, remote from lights or fire.—U. S.

This is nearly identical with the formula of the British Pharmacopœia: the German Pharmacopœia directs the dissolving of 1 part of castor oil and 5 parts of turpentine in 94 parts of collodion.

Flexible collodion may also be made by weighing successively, into a tared bottle, 4 avoirdupois ounces of collodion, 95 grains of Canada turpentine, and 57 grains of castor oil.

Properties.—This preparation has the same appearance as collodion, but on evaporation it forms an elastic and scarcely contractile film.

Medical Uses.—Flexible collodion is used as a protection where an air-tight dressing is needed. It is employed quite largely as a vehicle for iodine, iodoform, caustic and astringent remedies. Its application is said to prevent the pitting of smallpox.

The following medicated varieties of flexible collodion are recognized in the National Formulary:

Compound Salicylated Collodion.—Made by dissolving extract of Indian hemp 2 Gm. in alcohol 10 Gm., mixing this with a solution of salicylic acid 11 Gm. in flexible collodion 50 Gm., and finally adding sufficient flexible collodion to make the total weight 100 Gm.

Croton Oil Collodion.—Made by mixing croton oil 10 Gm. with flexible collodion 90 Gm.

Iodized Collodion.—Made by dissolving iodine 5 Gm. in flexible collodion 95 Gm.

Iodoform Collodion.—Made by dissolving iodoform 5 Gm. in flexible collodion 95 Gm.

COLLODIUM STYPTICUM, *U. S.*—Styptic Collodion.

Collodium hæmostaticum.—Styptic colloid, Xylostyptic ether, E.; *Collodion au tannin, Collodion styptique,* Fr.; *Tannin-Kollodium,* G.

Preparation.—Tannic acid, 20 Gm.; alcohol, 5 Cc.; ether, 25 Cc.; collodion, a sufficient quantity to make 100 Cc. Introduce the tannic acid, alcohol, and ether into a graduated bottle, agitate until the tannic acid is thoroughly incorporated and partially dissolved, then add sufficient collodion to make up the volume to 100 Cc., and shake occasionally until the acid is completely dissolved. Keep the product in cork-stoppered bottles, in a cool place, remote from lights and fire.—U. S.

Styptic collodion of pharmacopœial strength may also be prepared by using 620 grains of tannic acid, 160 minims of alcohol, 13½ fluidrachms of ether, and sufficient collodion to bring the volume up to 6¾ fluidounces.

Owing to the large proportion of tannin ordered in the formula for styptic collodion, it is necessary to use a small quantity of diluent—ether and alcohol—with which the tannin is thoroughly mixed before the final addition of collodion. Flexible collodion is not suitable in this case, as a constringent pellicle is desired. Any impurities from the tannin may be removed by rapidly straining the solution through gauze previously moistened with ether and alcohol.

This preparation was suggested originally by Dr. Benjamin W. Richardson (1867), who added a small quantity of tincture of benzoin. A somewhat similar but much stronger preparation is the one recommended by Pavesi, consisting of tannin 5 parts, carbolic acid 10 parts, benzoic acid 3 parts, and collodion 100 parts.

Medical Uses.—Styptic collodion was introduced as an astringent and local hæmostatic agent, but experience has proved it to be of very little value.

COLOCYNTHIS, *U. S.*—Colocynth.

Colocynthidis Pulpa, Br.; *Fructus Colocynthidis,* P. G.; *Poma colocynthidis.—Bitter apple, gourd,* or *cucumber,* E.; *Koloquinthen,* G.; *Coloquinte,* Fr.; *Colloquintide,* It.; *Coloquintid,* Sp., Port.

The peeled dried fruit of *Citrullus Colocynthis* Schrader (Fam. *Cucurbitaceæ*). Colocynth is gathered when full-grown, but still immature, dried, and deprived of its rind, the seeds to be rejected before using.

Colocynth is official in all pharmacopœias, some of which name the pulp in the title, and specify that ether should extract from it only traces of fixed oil. The Br. P. guards against ground colocynth which contains the seeds, by requiring at least 9 per cent. of ash.

Origin.—A perennial, hispid, tendril-bearing herb with yellow monœcious flowers, resembling the watermelon plant, inhabiting hot, arid, sandy regions of the Mediterranean basin, and introduced thence through southern Asia and eastern Africa. It is gathered just before maturity, dried in the sun, and peeled. Efforts to cultivate it in England have not been successful. In Texas it produced large fruits, but they were deficient in active constituent. The supply of wild colocynth is inexhaustible. From the rinds is prepared a blackish, resinous, bitter and nauseous extract, which is spread upon water-bags to repel camels. Colocynth seeds contain about 17 per cent. of fat, and after very thorough cleaning are sometimes used as food by the natives.

FIG. 133.

Peeled colocynth · longitudinal and transverse sections.

Description.—Globular, from 5 to 10 Cm. (2 to 4 In.) in diameter, the pulp white or whitish, very light, spongy, readily separable longitudinally into 3 carpels, each with numerous flat, ovate, white or light-brown seeds, mostly near the outer and convex surface; odorless and of an intensely bitter taste. No starch is present, and the ash of the pulp should not exceed 12 per cent. nor be less than 9 per cent. The ash of the unripe seeds equals only about 2.5 per cent., that of the ripe seeds about 4.5 per cent.

The preceding is a description of Trieste or Turkish colocynth.

The Spanish article is usually smaller, has a great many black or blackish seeds, with a correspondingly much smaller proportion of pulp, and this is more compact and darker. The pulp should constitute from 30 to 35 per cent. of the total weight. Lots of unpeeled fruit are occasionally seen, as well as a Syrian variety, which is very greatly shrivelled, due to its having been peeled before drying. In purchasing colocynth, the pharmacist should guard against receiving an undue proportion of seeds, which fall out and accumulate to a great extent in the last portions in the box or barrel.

Constituents.—The unimportant constituents of colocynth pulp are pectin, gum, a trace of fixed oil, and calcium and magnesium phosphates. *Colocynthin* ($C_{56}H_{84}O_{23}$), usually amorphous, but crystallizable, is a pale-yellow inflammable powder, soluble in 8 parts of water, more so in alcohol and ammonia water, and almost insoluble in ether and chloroform. By treatment with acids it yields sugar and resinous *colocynthein*. Colocynthin constitutes 2 per cent. of the pulp (Wagner, 1893). *Colocynthitin* occurs in tasteless white microscopic prisms, insoluble in water and cold absolute alcohol, but soluble in ether and boiling alcohol. It is probably a resin. The ash from the pulp amounts to from 9 to 14 per cent., from the seeds, 2 to 4 per cent., and from the whole fruit, only 4 to 5 per cent. The seeds contain practically no colocynthin. In India their fixed oil is extracted for use.

Pharmaceutical Preparations.—Extract of Colocynth, U. S. P.; Compound Extract of Colocynth, U. S. P.; Compound Pills of Colocynth, N. F.; Pills of Colocynth and Hyoscyamus, N. F.; Pills of Colocynth and Podophyllum, N. F.

Action and Uses.—Colocynth belongs to that class of drugs known as hydragogue cathartics, since it produces large watery stools when taken in full medicinal dose. For this reason colocynth has been largely employed by many practitioners for the relief of cardiac and renal dropsy. The contraindication to its employment in these cases is any condition of circulatory or respiratory feebleness, since the active purging may unduly weaken the patient. Overdoses of the drug, as might be supposed, produce violent gastro-enteritis, and death may be caused by the inflammation of the stomach and bowels associated with exhaustion produced by excessive purging and vomiting. Small quantities of colocynth are sometimes added to purgative pills in cases of obstinate constipation to increase their efficacy. Colocynth is rarely employed alone. It is most commonly used in the form of the Compound Extract of Colocynth (which see).

If colocynth is employed as a purgative, to produce large watery stools, it is commonly given in the dose of from 5 to 10 grains (0.30–0.60 Gm.). As a powerful laxative it may be given in the dose of from 2 to 5 grains (0.12–0.30 Gm.). The purgative dose may be repeated at the end of 8 or 12 hours if the first one has not produced satisfactory results.

COMBRETACEÆ.—The Myrobalans Family.

A family of 15 genera and nearly 200 species. The fruits of *Buceras*, P. Br. (*Terminalia*, L.) are considered in connection with Galla. The barks of many of those species also are astringent. *B. fagifolia* (Mart.) (*Terminalia f.* Mart.), of Brazil, yields a drastic resin, and the root of *B. macroptera* (Guill. et Per.) (*Terminalia m.* G. et P.), the *Rebreb* of Senegal, has similar properties.

Several species of *Conocarpus* L., especially *C. erecta* Jacq., the Zaragosa mangrove, have local uses, as has the bark of *Laguncularia racemosa* (L.) Gærtn. (*Conocarpus r.* L.), the *Manca Branca* of the West Indies. The fruit and leaves of *Quisqualis Indica* Lour. are used in India under the names *Rangun kibel*, *Irangun mali*, etc. The seed-kernel tastes like Cacao, but is powerfully anthelmintic. Large doses produce hiccoughing. Its greenish fixed oil is supposed to be the active agent. In China, *Q. Chinensis* (*Sze-kiun-tsze*) is used similarly.

The genus *Combretum* L., containing upward of 125 species of tropical regions, yields a number of very active barks, leaves, and fruits. Several of these are used, and apparently possess some special activity, in the treatment of gall fever and various specific tropical fevers. This is especially true of the leaves of *C. altum* G. et P. and of *C. Raimbaultii* Heck., both known as *Kinkeliba* in Africa. The leaves of *C. racemosum* Beauv., also of Africa, are anthelmintic. An African arrow poison is believed to come from the astringent bark of *C. grandiflorum* Don., and the genus is credited with yielding other arrow poisons. The fruits of *C. decandrum* Roxb. (*Umtandawa*) and *C. erythrophyllum* Sond. (*Umbida*), of South Africa, are strongly poisonous.

COMPOSITÆ.—The Daisy Family.

As here regarded, including as subfamilies several groups regarded by some botanists as distinct families, the *Compositæ* is much the largest of all the families of plants. It comprises more than 800 genera and more than 10,000 known species, a number which is likely to be at length increased by at least a half.

By most botanists the *Compositæ* are placed at the head of the vegetable kingdom, as representing its highest degree of development, although this distinction is contested by the *Leguminosæ*. These plants are distributed over the entire globe. They are mostly herbs, though a great many shrubs and a few trees are included.

Owing to the very peculiar structure of this family of plants, a number of distinct descriptive terms, not applied in other families, have to be employed. The following synopsis of structure and terminology will therefore be found useful. The system and methods of arrangement of the flowers are not less important as family characteristics, and as a basis of classification, than is the floral structure. A number of flowers, usually many (very rarely reduced to one), are massed closely together in a *head*, surrounded and clasped by a number of modified leaves, the *bracts*, together constituting the *involucre*. This involucre may be *double*, sharp differences existing between its outer and inner portions, or the changes may proceed gradually from the outer to the inner bracts. The involucre, or each of its divisions, consists of from one to very many series or cycles of bracts. If of one, they appear in a circle; if of more, the arrangement is more or less spiral. The scales may be quite distinct or a portion or all of them may cohere at the base or for any part or the whole of their length. In all these respects, in its form and relative position or that of its parts, the number of its series, or even of the scales, and the individual characters of the latter, even to minute details, the characters of the involucre, are constant and characteristic. The more or less expanded termination of the stem, enclosed by the involucre, is the *receptacle*, the characteristics of which are not less important than those of the involucre itself. These include its form, in a few cases its structure or consistency, and especially its surface and the appendages upon the latter. It is rarely entirely smooth. It frequently exhibits prominent pits, like the cells of a honeycomb, when it is said to be *foveolate*. The margins of these pits may be unaltered or elevated, entire, notched, or variously fringed. The intervening portions may be naked or more or less densely clothed with scales (paleæ or chaff), hairs, or bristles. When such scales exist, their own characteristics are of the utmost importance. They may be flat, or each variously folded or wrapped about a flower, and they occasionally adhere and even enlarge as prominent portions of the fruit. Their form, apex, margin, appendages, and consistency are wonderfully various. The individual flowers of the head are, of course, relatively very small, in many cases minute, and are commonly spoken of as *florets*. They may be hermaphrodite (either fertile or sterile), monœcious, diœcious, or polygamous. If pistillate, they may be fertile or sterile. Occasionally, those of the same head, possessing similar sexual organs, will be partly fertile and partly sterile. A head in which all the florets agree in these respects is called *homogamous;* one which exhibits differences therein is *heterogamous*. The calyx is always present as to its tube, though this is not apparent, being adherent to the outer surface of the ovary. The limb of the calyx may be present or obsolete. In the original type of the family it was tubular and 5-toothed, but this condition is not now seen, except imperfectly in a few cases. So profound have been the changes of development that it has ceased to be called a calyx, and is known as the *pappus*. When only its last vestiges exist, it is seen as a mere circular rim upon the summit of the ovary. When a little less reduced, this rim is a ring, cup, or tube, its margin from very slightly to strongly lobed or toothed, or with the teeth extended into scales (*paleæ*), slender spines (*awns*), or awns with a paleaceous base, or into bristles (*setæ*) or hairs. These structures may be 5 in number, corresponding to the original sepals, or reduced even to one, and they may be equal and similar or unequal or dissimilar. Similar or different parts may be alternated with the former, or each sepal may have become divided into from 2 to a great number of bristles, these coherent at the base into groups, each representing a sepal or a part of one, all equally so coherent or entirely separate. In many cases, the outer members will be shorter or otherwise different from the inner, thus constituting a double pappus. The individual paleæ, awns, setæ, or hairs are as greatly varied as any individual organ of any other flower. Awns are frequently hooked at the end, or barbed. Setæ or hairs are commonly toothed along the margins (*serrate*), and these teeth may be extended into branch-setæ or -hairs (the *plumose* bristle). They may be tapering, acute, or upwardly thickened; or the plumose condition may be present at the tip only (the *pennicillate* or *tufted* bristle). The original typical corolla of the family was tubular and 5-toothed, like the calyx, and a great majority of the species still retain this condition for at least a part of their flowers. Variations in such tubular corollas are, of course, as common and important as when they occur in other families. A more profound modification is the development of the *ligulate* or strap-shaped corolla. This may have been developed in all cases from the same direction, or two different

lines may have been followed in two branches of the family. One known method has been the development of the 2-lipped (*bilabiate*) condition, in which 1 lip, the outer or lower, was, and in many cases has remained, 3-lobed, the upper or inner 2-lobed or 2-toothed. This upper lip is that which has suffered the greatest change. It has been reduced until in some genera we find only a long thread-shaped filament, or a small tooth or ligule, of it remaining, and in a great many cases it has disappeared altogether. In such cases, we have at the base a more or less short tubular portion, passing above by an oblique orifice into a more or less elongated flat or strap-shaped, normally 3-toothed body, the ligulate corolla. The fact that this ligulate corolla exhibits in some cases a 5-toothed summit seems to indicate that in such cases the condition has been attained by a simple fissuring of the inner or upper side of the tube and the flattening out of the split portion. The relative occurrence and position of ligulate or bilabiate and of the ordinary tubular florets is of fundamental importance in the classification of this family. In the great subfamily *Cichoriaceæ*, all the florets of the head are ligulate. In the remainder of the family all or a part are tubular, together forming the *disk*. When, in the latter class (the *Discoideæ*, such heads being called *discoid*), ligulate or bilabiate flowers occur, they form one or more marginal circles, such as the white portion of a common daisy, and constitute the *rays*, the head being then called *radiate*, otherwise *eradiate*. Under cultivation, the disk-flowers often become replaced by the gradual invasion of the rays, until all or most are radiate, the *double* condition of the dahlia, chrysanthemum, aster, etc. When disk and rays are colored similarly, the head is *homochromous;* when differently, *heterochromous*. The stamens are 5 in number, their filaments separate and adnate to the corolla, at least to the base, the anthers, with rare exceptions, other than in the *Ambrosiaceæ*, where they are separate, cohere by their edges into a ring or, being elongated, into a tube. The anther-bases are frequently elongated into short or sometimes very long appendages, which may be either stiff or flaccid, and interesting and sometimes beautiful appendages are often borne upon the summit. The style is single, usually 2-toothed or cleft at the summit, the branches wonderfully varied in many ways, naked or appendaged at the tips and furnishing the most valuable characters for classification. The fruit is an akene—that of each floret usually separating individually, though occasionally they are enclosed together within a persistent involucre. These akenes exhibit an infinity of variation as to size, form, surface, and appendages, furnishing yet other valuable classification-characters. The seed is exalbuminous.

The chemical characteristics of the *Compositæ* are of great interest. Starch is practically wanting, being replaced by the peculiar related substance Inulin (which see), which occurs commonly only in this and in the closely related family *Campanulaceæ*. One of the most constant characters is the storage in the embryo of large amounts of fixed oils, a number of which (see *Helianthus*, etc.) are important articles of commerce. Others are likely to be introduced. Glucose is a common constituent, though rarely occurring in large amounts, and glucosides occur frequently. These glucosides are usually bitter, and are to a large extent responsible for the medicinal properties, which are in other cases to be credited to amaroids. The occurrence of alkaloids is a rare exception, and it is only recently that their presence in the family has become known with certainty. It appears, likely, however, that several of them are highly active and may become of importance in materia medica. Perhaps not second in importance to the bitter principles are the volatile oils, which constitute the most constant and abundant class of constituents of the vegetative parts. These impart to a large number of the drugs their most important activities, some of them being very powerful. Almost equally important with the volatile oils are the resins, which are not only abundant, but varied in their physical, chemical, and physiological characters, many of them powerfully active. Finally, reference may be made to the tannins, which are common and fairly abundant, and in a few instances impart the characteristic properties to the drugs. Although little studied, the tannins of this family appear to present quite a high degree of variation in their chemical properties.

The economic importance of the family is not so great as its extent would lead us to expect. It is highly ornamental, many of the members, like the asters, chrysanthemums, dahlias, sunflowers, coreopses, etc., being among the most highly prized of cultivated flowers. Comparatively few edible products are yielded, and none of these can be said to take first rank among food-plants. The best known of them are the salsify or oyster plant, the burdock root, as used in Japan, and the Jerusalem and globe artichokes. The common thistles and many others are decidedly nutritious and possess local uses as foods in various regions. In all these cases the inulin is the most important nutrient. The seeds of many species are more or less consumed as fatty products, either by the human race or by domestic animals.

In considering the drugs of the *Compositæ*, our classification is in accord with the more important active constituents, corresponding, in a general way, with their medicinal uses.

(See also LAPPA, TARAXACUM, PYRETHRUM, INULA, EUPATORIUM, TANACETUM, ABSINTHIUM, ERIGERON, SANTONINUM, ARNICA, CALENDULA, etc.)

DRUGS YIELDING FIXED OILS.

The several fixed oils, the sources of which are here described, will be found discussed in the general article on OLEA PINGUIA.

HELIANTHUS (*Sunflower, Sonnenblume*, G. ; *Helianthe, Grand Soleil*, Fr. ; *Elianto*, Sp.) is *Helianthus annus* L., a tall and coarse herb, native of tropical America and well known in cultivation in a large number of varieties. Its akenes are obovate-oblong, somewhat quadrangular, flattened, vary in color between whitish and black or are striped, and crowned with a very deciduous pappus of 2 chaffy scales. They contain from 16 to 28 per cent. of a fixed oil, on account of which they are considerably used as food for domestic animals and to some extent by human beings. They are also occasionally employed, like flaxseed, in poultices and indefinitely as a medicine. The expressed oil is an important article of commerce, being used as a cheap substitute for olive and other oils. The herbage is occasionally used for poultices and internally as a diuretic.

SILYBUM OIL is very similar, and is obtained from *Mariana Mariana* (L.) Hill (*Carduus M.* L.; *Silybum M.* Gærtn.), the *Milk-, Lady's-*, or *Virgin-Mary's-thistle, Steckkoerner, Frauendistel, Chardon Marie*. The fruit, on account of this oil and a bitter constituent, has similar uses to that of helianthus. The plant is a native of southern Europe, and is cultivated to a considerable extent. The akenes are 4 to 5 Mm. ($\frac{1}{6}$ to $\frac{1}{5}$ In.) long, not curved, flattened, smooth, glossy, light-brown with black or blackish striæ, oblique at the apex, and crowned by a yellowish margin, from the center of which the base of the style projects; inodorous; taste mucilaginous, oily, and somewhat bitter.

NIGER-SEED OIL is similar, and is obtained from *Guizotia Abyssinica* Cass. (*G. oleifera* DC. ; *Verbesina sativa* Roxb.), native of western Africa and considerably cultivated in the tropics of the Old World.

MADIA OIL is expressed from the akenes of *Madia sativa* Molina, an annual herb of Chile and cultivated in a number of countries. These akenes are brownish-gray, 4-angled and 4-ribbed, and destitute of pappus.

DRUGS USED WHOLLY OR CHIEFLY FOR THEIR VOLATILE OILS.

LEUCANTHEMUM or CHRYSANTHEMUM, the common *White, Ox-eye, Bull, Dog, Field, Moon* or *Maudlin daisy, Horse-gowan, Goldens* or *Great Marguerite*, is the flowering herb, or the flower-heads separated, of *Chrysanthemum Leucanthemum* L. (*Leucanthemum vulgare* Lam.). The plant is a native of Europe and Asia, and was introduced for ornament into America, where it spread vigorously as a pasture-weed. It is too well known to require description. The herbage is pleasantly aromatic and slightly bitter, and contains about $\frac{1}{6}$ of 1 per cent. of a greenish volatile oil. Perrier found this to combine the odors of mint and chamomile, to have a specific gravity of 0.932 at 15° C. (59° F.), a refraction index of 1.4931 at 18° C. (64.4° F.), to boil at 160° C. (320° F.), soluble in 10 parts of 70 per cent. alcohol, solidifying in a mixture of ether and solid carbon dioxide, and of an acid reaction. The drug has been used as a diuretic, antispasmodic, and mucous membrane tonic; large doses said to be emetic. Several cultivated species of Chrysanthemum of China, two of which have been identified as *C. Sinense* Lab. and *C. Indicum* L., are there largely employed medicinally, and are important articles of trade under the names *Hang-chu* or *Kan-chu*.

BIDENS L.—Several North American species of this genus (the *Beggar-lice* or *-ticks*) are used for their aromatic-stimulant properties, depending apparently upon their volatile oils. The most important is *B. bipinnata* L., the *Spanish needles* or *S. Beggar-lice*, a common and pernicious weed, especially of the warmer districts. It has a slender, quadrangular, branched stem about 3 to 10 Dm. (1 to 3 Ft.) high, opposite, triangular-ovate, bipinnate leaves, the segments cordate at the base and acute, the small heads on long, slender, erect peduncles, with a double involucre, the outer loose, 3 or 4 short, yellow, dark-veined rays and slenderly quadrangular, occasionally triangular, akenes bearing a retrosely barbed slender and sharp awn at each angle. It is aromatic, but not agreeably so, and yields an acrid after-taste. Its stimulant and antispasmodic properties have been utilized in the treatment of hay-fever. Except that it contains a certain amount of volatile oil, its constituents are not known. *B. tripartita* L. is the European *Swamp beggar-ticks, Water-hemp, Wasserhanf*, or *Chanvre aquatique*, and is employed somewhat similarly. Spanish needles is said to be stimulant, expectorant, and diaphoretic. A hot infusion of the drug has been popularly employed in the treatment of amenorrhœa, and has also been recommended as a remedy in asthma and in bronchial and laryngeal affections.

GNAPHALIUM.—One of the most interesting groups of plants of this family, from a medicinal point of view, are the *Gnaphalinæ*, including a number of species of *Gnaphalium* L., *Antennaria* Gaertn., and *Anaphalis* DC., all common and abundant in the eastern and some other parts of North America, and some similar species of other countries. All these plants are more or less white-woolly, and all give off in drying a peculiar and characteristic

odor, reminding one somewhat of that of elm bark, dried medick flowers, and tussilago herb. The peculiar hydrocarbon or group of hydrocarbons to which these odors are due have never been subjected to proper investigation. Since numerous plants possessing them are used for the same or very similar purposes by peoples remotely located and isolated from one another, the probabilities are strong that such uses are well founded and might be developed in important ways. Their special application is as soothing expectorants, but, because of the presence in them of glucosides or other bitter principles, they possess also more or less marked stomachic properties. The following drugs of this group require special attention: *Gnaphalium obtusifolium* L. (*G. polycephalum* Mx.), the *Sweet, Field, Old-field,* or *White balsam, Life-everlasting, Chafe-* or *Chaff-weed*) is a very abundant plant in dry, open, or shrubby fields throughout eastern and central North America, blooming in late summer and fall. The entire plant is white-woolly; the stems 3 to 8 Dm. (1 to nearly 3 Ft.) high, more or less branched above; leaves lanceolate, the uppermost narrow, sessile, narrowed at the base, at least the smaller ones acute, green on the upper surface, mostly 5 to 7 Cm. (2 to 3 In.) long, entire or somewhat wavy on the margin; heads numerous, crowded, erect, about 6 Mm. (¼ In.) long; involucre more or less bell-shaped, white or light-brown, the scales obtuse, thin, and papery; receptacle flat or slightly convex, pitted, naked; florets all tubular, the outer very slender, pistillate, the central broader and perfect; akenes oblong, glabrous; pappus of rather few capillary bristles. *Gnaphalium polycephalum*, as well as the other species of *Gnaphalium*, has been employed to some extent in medicine, but is probably of little value. A poultice made from the leaves and flowers has been recommended as an application to unhealthy ulcers, and an infusion [½ ounce (16 Gm.) of the plant to 1 pint (480 Cc.) of boiling water] has been employed in doses of a wineglassful in the treatment of chronic bronchitis, chronic diarrhœa, and in hemorrhagic affections. *G. sylvaticum* L., though growing in North America, is more abundant in Europe, where it is variously known as *Wood cudweed, Golden motherwort,* or *Owl's crown.* It is distinguished from the last by the arrangement of its heads in spikes, or spike-like panicles, and by its linear leaves. *G. uliginosum* L., of the same regions, the *Low, Mouse ear,* or *Marsh cudweed, Small life-everlasting,* or *Dysentery weed,* is a low, widely spreading plant, with much smaller leaves, the heads only about two-thirds as large and the involucral scales dark-brown. Quite as largely employed is *Anaphalis margaritaceæ* (L.) B. et H. (*Gnaphalium m.* L.; *Antennaria m.* Hook.), the *Pearly* or *Large-flowered everlasting, Everwhite, Indian posy, Poverty weed,* etc., which grows throughout the northern hemisphere. The plant has a similar habit to that of *Gnaphalium obtusifolium*, but grows chiefly in clumps and is stouter, denser, and more leafy. It is distinguished from the related genera by the pappus bristles, which are not thickened above. Its leaves are longer and relatively narrower, its heads broader than long, the scales at length roughly spreading. Several species of *Antennaria* are employed. Like *Anaphalus*, this genus is dicœcious or polygamous and the bristles of the pappus are thickened upward. The species most commonly employed are *A. plantaginifolia* (L.) Richards (*Gnaphalium p.* L.), the *Ladies'* or *Indian tobacco, Pincushion plant, White plantain, Spring* or *Early cudweed* or *Life-everlasting*, exceedingly common throughout eastern North America, and one of the earliest-blooming of spring plants, in dry meadows, where it grows in patches, spreading by runners. The pistillate stems range from 15 to 30 Cm. (6 to 12 In.) high, the leaves an inch or more long, mostly obovate, 3-ribbed, greenish above, silky underneath, those of the stem lance-oblong. The heads are closely clustered, white or occasionally a little pinkish, 8 to 12 Mm. (⅓ to ½ In.) long, and about as broad when fully mature. The staminate plant is only about half as tall, and all its parts are smaller. *A. dioica* (L.) Gærtn. (*Gnaphalium d.* L.), having a somewhat broader range, known by the same names, also called *Cat's-ear, -foot,* or *-paws, Katzenpfoetchen, Pied de chat,* is even more largely employed, the flower-heads being an article of commerce under the name *Flores Gnaphalii* or *Flores pedis cati.* The very similar plant of North America which has gone under this name is *A. aprica* Greene.

A number of species of *Helichrysum* Vaill., especially *H. arenarium* (L.) Moench (*Gnaphalium a.* L.), the *Strohblume, Katzenpfoetchen,* or *Immortelle,* yielding the *Flores Stoechados,* and *H. Stoechas* (L.) DC. (Galen's *amaranthon*), are used as stimulants, antispasmodics, and diuretics, because of their large content of volatile oil, and also to some extent as anthelmintics.

Various species of the genus *Pluchea* Cass., especially *P. camphorata* (L.) DC. (*Erigeron c.* L.), the *Camphor-plant, Spicy* or *Salt marsh fleabane,* and *P. odorata* Cass., are noted as containing a very fragrant sort of camphor, on account of which they have been domestically employed for their stimulant or antispasmodic effects. *Blumea balsamifera* DC. (*Pluchea b.* Cass.) is very similar. The plucheas are common salt-marsh plants along our Atlantic and Gulf States. They exhale a pleasant camphoraceous odor when bruised, whence the name of the common species. In Brazil, *P. Quitoc* DC. is commonly employed as an antispasmodic and carminative. In India, *P. lanceolata* Oliv. is similarly used under the name *Ra-sana* or *Koura-sana.*

In the higher Andes grows a large mullein-like plant, *Culcitium canescens* H. B. K., closely related to Arnica, but apparently belonging, as to constituents, to the group under

consideration, and most highly esteemed by the Aymara and Quichua Indians in the treatment of pectoral complaints.

AGERATUM CONYZOIDES L., cultivated for ornament and native of tropical America, where it is the commonest of weeds, bordering the roadsides for miles together, apparently contains considerable volatile oil, and is a diuretic and a reputed emmenagogue. *Actinomeris helianthoides* Nutt. appears to act very similarly. It is quite distinctly diuretic, which property has led to its being commonly known and medicinally employed, under the names *Gravel-weed* and *Diabetes-weed*, in the treatment of chronic cystitis.

RUDBECKIA.—Members of the genus *Rudbeckia* L., best known by the common names *Yellow daisy* or *Black-eyed Susan* (*R. hirta* L.), have contributed a number of little-used drugs, the most important being *R. laciniata* L. (*Thimble-weed*, *Tall cone-flower*, or *Cone sunflower*), a very tall species of the United States. Its constituents are unknown. There is some evidence to indicate its fatally poisonous effects upon sheep, though it is not impossible that *Helenium* has in these cases been mistaken for it. It has been considerably used by the eclectics as a stimulating diuretic, in the form of the decoction, very freely administered. The herbage of *Sphæranthus Indicus* L. (*Mundi*, *Murmuria*, etc.), of India, contains a cherry-colored volatile oil, and is used as a deobstruent and aphrodisiac, and in other ways as a stimulant.

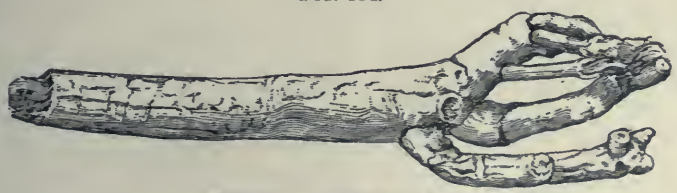
LYGODESMIA JUNCEA Don, the *Prairie pink* of the Rocky Mountain region, is one of a number of related plants which have been employed as galactagogues, probably on the basis of mere ignorant assumption, in view of their milky juices. The juice of this, like those of the related dandelion, lettuce, etc., is bitter. The plant has been suspected of poisoning stock, though direct evidence is wanting.

SOLIDAGO (*Golden rod*).—A number of species of this large genus have been employed in medicine, *S. odora* Ait., the *Sweet* or *Fragrant golden rod* or *Blue Mountain tea*, having at times held a rather important place in materia medica. Its stem is slender, almost perfectly smooth, 0.5 to 1 M. (1½ to 3 Ft.) high, nearly simple. The sessile alternate leave are linear-lanceolate, 5 to 10 Cm. (2 to 4 In.) long, acute, the margins entire but roughish, the midrib prominent, the venation not so. Held against the light, they are pellucid-punctate. The stems terminate in a secund panicle of bright-yellow flowers. The heads are rather small for the genus. The odor is pleasant, somewhat resembling that of anise, the taste aromatic and somewhat astringent. The leaves contain nearly 1 per cent. of a peculiar volatile oil, which has been commercially distilled. There is also a small amount of tannin. The drug is used as a mild carminative and antispasmodic, and to some extent as an intestinal astringent. It has also been employed in combination with ambrosia in the immunization treatment of hay fever, the beginning dose being 2 minims (0.10 Cc.) of the fluid extract, and gradually increased to 20 minims (1.3 Cc.). This plan of treatment is, however, without scientific basis. In some sections of the United States the leaves are considerably used as a substitute for tea. A number of other species of *Solidago* are medicinally employed, their properties apparently depending in variable proportions upon their content of tannin and volatile oil. *S. Virgaurea* L., the *Aaron's rod* of Europe, *Wound-wort*, *Goldruthe*, *Heidnisch-wundkraut*, *Verge d'or*, *Vara de oro*, is quite largely employed as a diuretic and vulnerary.

DRUGS EMPLOYED CHIEFLY FOR THEIR RESINS OR OLEORESINS.

ECHINACEA.—A great deal of attention has been directed during recent years to the two plants *Brauneria purpurea* (L.) Britton (*Rudbeckia p.* L.; *Echinacea p.* Moench, the *Purple cone-flower*, *Red sunflower*, *Black Samson* or *Nigger-head*) and *B. pallida* (Nutt.) Britton (*Rudbeckia p.* Nutt.; *Echinacea angustifolia* DC.), the *Pale purple cone-flower*, and considerable of a commercial demand for them has grown up. Both are plants of the central

FIG. 134.



Echinacea angustifolia (⅔ Nat.).

and southern United States. The first-named is supposed to be employed, but both are probably collected. The drug occurs chiefly in pieces about 7 to 15 Cm. (3 to 6 In.) long, of much longer roots, 6 to 25 Mm. (¼ to 1 In.) thick at the crown, which divides into several erect, rather slender branches; cylindrical and only slightly tapering; of a rather dark gray-brown, from very slightly to strongly longitudinally short-wrinkled, and bearing occasional capillary rootlets; fracture short and weak; consistency rather soft and resinous; transverse section exhibiting a rather thin gray-brown bark, a blackish-gray cortex, and irregular, bright-

yellow or greenish-yellow wood-wedges, the parenchyma thickly charged with resin-cells; odor rather faint but peculiar; taste moderately aromatic, with a suggestion of decay or mustiness, afterward acrid and sialagogue. It contains a minute amount of an alkaloid and 1 per cent. or less of an acrid resinous substance, nearly colorless and possessing the peculiar taste of the drug. This resin is apparently the active principle. *Echinacea* is stated to possess diaphoretic, sialagogue, and alterative properties. Its administration has been recommended in syphilitic and strumous conditions, and it is said to be especially useful in treating chronic ulcers which have not been benefited by the iodides or other alteratives. The freshly scraped root has been employed by the Sioux Indians as a remedy for hydrophobia, snake-poisoning, and septic conditions. The dose of the powdered drug is from 15 to 30 grains (1–2 Gm.).

Polymnia.—The root of *Polymnia Uvedalia* L., the *Bear's foot*, *Yellow-* or *Large-flowering leaf-cup*, closely related to Inula, is very largely employed in the United States. Although its investigation and the development of its use represent the worst fallacies of the homœopathic and eclectic schools, there is sufficient evidence of its being a useful alterative and deobstruent. Although commonly used as an external application, its stimulating effects are apparently slight, except through internal administration. Polymnia is a coarse perennial herb of rich woodlands in the eastern United States, 3 to 6 feet high, the very stout branched stem rough-hairy, the large triangular 3-lobed opposite leaves growing upon short dilated petioles, the lobes acute, the inferior surfaces hispid or scabrous. The upper pairs are sessile and so placed as to form a sort of cup. The inflorescence is corymbose, the heads about 6 Cm. (2 or 3 In.) broad, the involucre cup-shaped, double, the outer scales ciliate. The rays are bright-yellow. The drug is sometimes a foot in length and a half inch in diameter at the upper part, where several vertical branches are frequently given off. Other branches are frequently produced, and the main root commonly terminates in several branches. It is brown and heavily wrinkled externally, white or often greenish internally, and of a soft texture. Its odor is heavy and disagreeable, its taste resinous. Its constituents are volatile oil, soft resin divisible into two portions, the one dark-brown and hard, the other pale-yellow and balsam-like. The latter is apparently the most important constituent. There is also a large amount of glucose, a small amount of tannin, and a body which is apparently a glucoside. Polymnia has been recommended as a tonic, stimulant, laxative, and anodyne. When given internally, it is supposed to increase nutrition and to aid in the elimination of waste products. Internally, the drug has been used in the treatment of chronic rheumatism, scrofula, and various glandular enlargements. An ointment containing 2 drachms of the fluid extract in 1 ounce of fresh lard has been applied over the spleen when that viscus is enlarged from malarial infection. Its application in mastitis, lumbago, and enlargement of the liver is also alleged to have been successful. The dose of the fluid extract is 3 minims (0.20 Cc.), every 3 or 4 hours, gradually increased.

Silphium is the rhizome of *Silphium perfoliatum* L., the *Indian cup*, *Indian cup plant*, or *Ragged cup*, and is used almost precisely like polymnia. In habit the plants are very similar, but silphium is distinguished by its square stem. The large leaves are opposite, broadly ovate, coarsely toothed, and connate by their broadly winged petioles, or the upper sessile ones by their broad bases. The flower-clusters are 3-branched, the involucres squarrose, the akenes winged. The rhizome is horizontal, elongated, crooked, cylindraceous, markedly pitted and rough with small roots, its transverse section exhibiting large resin-cells. Its important constituent is one or more acrid resins. Two other species are similarly used, and are notable on account of the natural exudation from their stem and herbage of a peculiar turpentine-like substance. That of *S. laciniatum* L. (*S. gummiferum* Ell.), of the southern United States, the *Rosin weed*, *Compass plant*, or *Pilot weed*, so called because its large lower leaves are directed north and south, has been analyzed and found to contain 20 per cent. of volatile oil and 37 per cent. of resin. *S. terebinthinaceum* Jacq., of the same region, is also known as *Rosin plant*, and as *Prairie dock* or *Turpentine sunflower*.

Balsamorhiza.—Considerable attention has been directed to *Balsamorhiza terebinthinacea* Nutt., of the Rocky Mountain region, where the Indians are said to employ it as a medicine. It has been reported as aiding in reformation from the tobacco-habit. Sayre describes the root, the portion used, as much contorted, 1 to 6 inches long, the large short crown dividing into numerous hairy branches, of a nearly black color, an open spongy texture, yellowish-white within, and very abundantly supplied with yellow resin-glands. The odor is strongly terebinthinate, the taste pungently aromatic and somewhat acrid. It is highly combustible. It was found to contain about 0.5 per cent. of volatile oil, 5 per cent. of fat, and 9 per cent. of resin. No careful attention has been given to its medicinal properties. So abundant is the oleoresin in the bark of the root that it exudes upon the slightest wounding, or even, it is said, spontaneously. The roots of some species of this genus are said to be eaten by the Indians.

Liatris.—Under this name, the rhizomes of several species of the American genus *Lacinaria*, Hill, have been employed as diuretics. *L. scariosa* (L.) Hill (*Serrutula s.* L.; *Liatris s.* Willd.) grows throughout the eastern and central United States, and is known as the large *Button snake-root*, *Blue blazing star*, or *Gay feather*. The rhizome of this species par-

ticularly is largely employed by the eclectics in female diseases. *L. spicata* (L.) Kuntze has not quite so wide a range, and is known by the same name, also as *Backache root*, *Rough root*, or *Prairie pine*. *L. squarrosa* (L.) Hill is the *Scaly blazing star* or *Colic root*. It occurs chiefly in the central United States. These drugs are aromatic, somewhat terebinthinate, bitter and more or less acrid. The second-named species only has been chemically examined. The only important constituents were about 0.1 per cent. of volatile oil, nearly 5 per cent. of resin, and about 2 per cent. of a caoutchouc-like body.

SPILANTHES OLERACEA L., the *Para cress*, native of tropical America, and cultivated and escaped in most tropical countries, is a pungent plant, used as a cress. Medicinally, it is employed as a stomachic and antiscorbutic. Its properties are probably due to a soft pungent resin, and perhaps in part to the crystallizing substance *spilanthin*, which is soluble in alcohol but not in water. It is a popular application for toothache, in tropical America. This drug has been official in the Austrian Pharmacopœia. Somewhat similar and similarly employed, though more bitter, is *S. Acmella* L. (*Acmella Mauritiana* Rich.).

GYMNOSPERMA MULTIFLORA DC. is known as *Tatalancho* in Mexico, where it is much used as a vulnerary and for its local analgesic effects. It contains volatile oil and resin.

DRUGS USED CHIEFLY FOR THEIR BITTER PRINCIPLES.

CARDUUS.—Various species of thistle have been more or less employed in medicine, and the *Blessed thistle*, *Cnicus Benedictus* L. (*Centaurea b.* L. ; *Carduus b.* Steud. ; *Carbenia b.* Adans. ; *Calcitrapa lanuginosa* Lam.), is still quite an important article of commerce. It is a European plant, sparingly introduced to the United States, and is variously known as *Blessed*, *Cursed*, *Holy*, *Spotted*, or *Bitter thistle* or *cardus*, *Spinnendistel*, *Chardon benit*, or *Cardo santo*. The stem is 30 to 60 Cm. (12 to 24 In.) high, stout and coarse, angular, branching, usually of a reddish color ; leaves alternate, oblong to lance-ovate, sinuately pinnatifid and dentate, the teeth terminating in soft spines. The lower are sometimes a foot in length and borne on angular winged petioles, the upper smaller and sessile or the uppermost decurrent ; heads solitary at the ends of the branches, ovoid, about 30 Mm. (1¼ In.) long, the involucral scales terminating in yellowish spines ; akenes well marked by their double pappus, the outer of 10 short teeth, the inner of 10 long, alternating with 10 short bristles. The drug is grayish-green, has a peculiar, mild, and not unpleasant odor, and a saline and very bitter taste. The bitter principle has been isolated under the name of *cnicin*, is prepared like salicin, occurs in colorless needles, freely soluble in alcohol, slightly in cold water and ether, dissolving in strong hydrochloric acid with a green, and in sulphuric acid with a red, color. Blessed thistle possesses the properties of a simple bitter. It is also said to be an hepatic and urinary stimulant. It may be employed in atonic dyspepsia, especially if hepatic torpor exists, and, like other bitters, it has been successful in the treatment of mild malarial infections. Overdoses of its active principle *cnicin* sometimes produce nausea, vomiting, intestinal pain, and diarrhœa. The dose of the infusion (1 ounce to 1 pint) is from 1 to 2 fluidounces (30–60 Cc.) ; of the powdered drug, from ½ to 1 drachm (2–4 Gm.) ; of cnicin, from 5 to 8 grains (0.30–0.50 Gm.) ; the latter amount, however, may produce nausea. *Carduus arvensis* (L.) Robs. (*Serratula a.* L. ; *Cnicus a.* Hoffm. ; *Cirsium a.* Scop.) is the common *Canada thistle*, also called *Corn*, *Boar*, *Hard*, *Prickly*, *Creeping*, or *Sharp thistle*, *Dashel*, or *Dodger*, among the worst of American weeds. This contains a glucoside and, it is said, an alkaloid.

C. LANCEOLATUM L., the common *Bull*, *Bur*, or *Scotch thistle*, has probably a similar composition, and is similarly employed as a diuretic and tonic.

Several species of *Centaurea*, especially *C. calcitrapa* L., the *Star thistle*, and *C. Cyanus* L., the common cultivated *Corn flower* or *Bluebottle*, both native of Europe, are credited with properties similar to those of the blessed thistle, and are similarly employed.

HELENIUM.—Various species of the genus *Helenium* L. are known as *Sneeze-weed*, in allusion to the effects of inhaling the volatile substance given off by the crushed flower-heads. They possess active physiological properties and appear well worthy of thorough investigation. *H. autumnale* L., the *Swamp* or *False sunflower* or *Yellow-star*, common along river-banks throughout most of North America, except the far north and far west, has been quite largely employed as a drug and is a common article of commerce. It is a stout perennial, the stem somewhat quadrangular, winged by the decurrent leaves, which are alternate, 5 to 12 Cm. (2 to 5 In.) long, lanceolate, narrowed at the base, acuminate and acute, and acutely serrate. The long-peduncled flower-heads are well characterized by their drooping, bright-yellow rays and subspherical disk, which is sometimes nearly an inch broad. The drug is nearly odorless, but very bitter. The important constituent appears to be a bitter glucoside soluble in alcohol and boiling water. The amounts of volatile oil and tannin are very small. The plant has been known as a cattle poison. It is used as an errhine. Other species have similar properties, and *H. tenuifolium* Nutt., the *Fine-leaved sneeze-weed* of the southern United States, is a severe poison, the effects being strongly narcotic. A Mexican species possesses even greater activity.

XANTHIUM STRUMARIUM (*Cocklebur*, E. ; *Lampourde, Petit glouteron*, Fr. ; *Spitzklette, Knopfklette*, G.) is a coarse-looking weed, common in waste places throughout North America, Europe, and northern Asia. The leaves are alternate, long-petiolate, triangular heart-shaped, and rough-hairy. The sterile flowers are in short terminal spikes. The fertile flowers are numerous, in axillary clusters, and produce flat, oblong akenes, without pappus and enclosed in the enlarged involucre, which is oval or oblong in shape, nearly 25 Mm. (1 In.) long, and densely beset with hooked prickles. Zander (1881) obtained from 100 parts of the fruit 5.2 ash, 38.6 fat, 36.6 albuminoids, 1.3 xanthostrumarin and organic acids, besides sugar, resin, etc. *Xanthostrumarin* seems to be a glucoside, is yellow, amorphous, soluble in water, alcohol, ether, benzol, and chloroform, and yields precipitates with group reagents for alkaloids and with ferric chloride, lead acetate, and salts of other metals, but not with tannin or gelatin. M. V. Cheatham (1884) obtained only 14.5 per cent. of fixed oil, and a principle which was precipitated by tannin.

X. spinosum L., *Spiny clotbur*, is indigenous to southern Europe, but has become somewhat naturalized in waste places of the United States and most civilized countries. It has shortly petiolate, lanceolate, or ovate-lanceolate leaves, which are either cut-toothed or the upper ones entire, and have at the base sharp, 3-forked, yellowish, stipulate spines, nearly 25 Mm. (1 In.) long. The fertile axillary burs are crowned with an inconspicuous beak. The alkaloid, the presence of which was announced by Guichard (1877), is regarded by Yvon as a bitter resin, soluble in both alcohol and ether. A number of American species are very similar and probably share in the above properties. *Xanthium spinosum* is said to be a diuretic, diaphoretic, and sialagogue. It has been credited with the cure of intermittent fever, and was formerly thought to be of value as a prophylactic against hydrophobia. The dose of the dried leaves is 10 grains (0.60 Gm.), 3 times daily, for a period of several weeks.

BACCHARUS.—This American genus, of some 300 species, mostly tropical, yields a number of drugs, noted either for their intense bitterness or for their aromatic properties, many yielding oleoresinous exudations. *B. genistiloides* Pers., of tropical America, and some species so closely related as to be almost indistinguishable from it, belong to the bitter division and are quite extensively used under the name *Carquega amargosa*. They are also said to be largely exported for use in proprietary bitters. One of these is an important anthelmintic in the Andean region. *B. cordifolia* DC., of Brazil, is similarly bitter, and is said to be a seriously fatal sheep and cattle poison. *B. glutinosa* Pers. (*B. Alamani* DC. ; *Molina viscosa* R. et P.) is largely used in Mexico and in the Andes in the treatment of catarrh. Other species of the genus are used as vulneraries. *B. halamifolia* L., the *Groundsel bush, Cotton-seed*, or *Ploughman's spikenard*, of the Atlantic coast region, is used as an aromatic bitter, while *B. Pilularis* DC., the *Kidney root* of the Californian coast, is used as a diuretic.

NABALUS.—Most species of the North American genus *Nabalus* Cass. (*Prenanthes* Vaill.) are bitter, and a number of them have been used as bitter tonics. *N. albus* (L.) Hook. (*Prenanthes a.* L. ; *Harpalyce a.* Don) is still largely employed by the eclectics, and is a commercial drug under the name *Lion's foot, Rattlesnake root, White lettuce*, or *Cancer weed*. *N. serpentarius* (Pursh.) Hook. (*Prenanthes s.* Pursh. ; *N. Fraseri* DC.) has been regarded as a variety of the last, but is probably distinct. It is similarly used under the same names, and especially under that of *Gall-of-the-earth*. It grows from a tuberous turnip-shaped root, occasionally as much as 2 or 3 inches in diameter. The stem is 3 to 10 Dm. (1 to 3 or 4 Ft.) high, usually smooth, green, and irregularly angled ; leaves exceedingly variable, being ovate and hastate, cordate at the base, acute or obtuse, varying from nearly entire to more or less dentate, pinnatifid, or even palmately divided, the upper ones becoming narrow and entire ; inflorescence a broad panicle, the widely spreading branches upturned at the ends ; pendulous heads bristly, 5 to 6 Mm. ($\frac{1}{5}$ to $\frac{1}{4}$ In.) wide and a little more than twice as long ; involucral scales about 8 ; flowers ligulate, yellowish-white, 5-toothed ; receptacle flat and naked ; akenes oblong or linear, about 10-ribbed ; the pappus of copious, somewhat stiff bristles, varying from white to tawny and rather longer than the involucre. The herb is intensely bitter, but its constituents have not been studied. The first-named species is very similar, but is usually nearly twice as tall, more slender, the stem glaucous and usually purple, the leaves thinner. *M. altissimus* (L). Hook. (*Prenanthes a.* L.), the *Tall lion's-foot*, etc., is similarly employed. All these plants are common and abundant in the rich woodlands of eastern North America. Nabalus has been reported as a cure for rattlesnake-bites. It has also been given in the treatment of dysentery. The fresh milky juice may be employed internally, and a poultice made from the leaves applied externally and frequently changed.

PEREZIA.—The members of the genus *Perezia* Lag., of the southwestern United States and southward in tropical America, contain an abundance of one or more bitter principles to which, probably, are due their distinctly laxative properties. The rhizome of *P. adnata* Gray (*Trixis Pipitzahoac* Schaffn. ; *Dumerelia Alamani* DC.) is an important Mexican drug, under the name of *Pipitzahoac*. It is described by Th. Greenish (1884) as 8 to 10 Cm. (3 to 4 In.) long, 2 Mm. ($\frac{1}{12}$ In.) thick, longitudinally wrinkled, brown, bitter, and rather persistently pungent ; it has a thick central pith, surrounded by about 8 short fibrovascular

bundles, on the outside of which, in the thickish bark, are contained a number of cells forming a circle and containing a yellow crystalline substance; stone-cells of a somewhat stellate appearance are scattered in the parenchyma. The yellow principle, *pipitzahoic acid*, $C_{15}H_{10}O_3$, was examined by C. M. Weld (1855); it crystallizes in golden-colored glossy scales or plates; hence it has been called *vegetable gold;* it is nearly insoluble in cold water, dissolves readily in alcohol and ether, melts near 100° C. (212° F.), sublimes when heated with care, and acquires an intense purple color with alkalies and alkaline earths. The same compound was obtained by Charles Mohr (1884) from the roots of *Perezia Wrightii* and *P. nana* Gray, of southwestern Texas—from the latter in smaller quantity; it separates from the decoction in needles. The acid acts as a drastic purgative in doses of 4 to 8 grains (0.25–0.50 Gm.), and imparts a greenish color to urine.

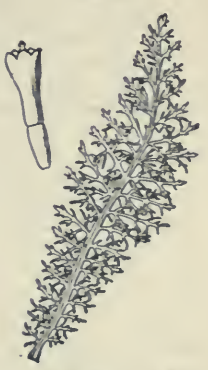
NEUROLÆNA LOBATA R. Br. (*L'herbe à pique*), of tropical America, is used in the West Indies as a quinine substitute and in the treatment of dysentery. It contains about 1 per cent. of an extremely bitter alkaloid.

DRUGS USED FOR THEIR BITTER AND AROMATIC PROPERTIES.

PARTHENIUM (*Feverfew* or *Featherfew*, *Wild chamomile*, *Bertram*, *Mutterkraut*, *Matricaire*) is *Chrysanthemum Parthenium* (L.) Pers. (*Matricaria P.* L.; *Pyrethrum P.* Smith; *Tanacetum P.* Schultze), a chamomile-like plant of Europe, the double-flowered form much cultivated in gardens. The stem is about 60 Cm. (2 Ft.) high, furrowed, and has alternate, petiolate, ovate, twice pinnately cleft leaves, with obovate or oblong, mostly toothed lobes, each tooth terminating in a white point. The flower-heads are in small cymes at the ends of the branches, have an involucre composed of linear scales in 2 rows, a naked hemispherical receptacle, white ligulate obovate and 3-toothed ray-florets, and tubular yellow disk-florets. The herb (*Herba matricariæ*) has a peculiar odor resembling that of chamomile, but less agreeable, and a bitter, somewhat acrid taste. It contains a powerful volatile oil, its stearopten having the composition of camphor, fusing at 170° C. (338° F.) and lævogyre. There are also considerable tannin and an unknown extremely bitter substance. The drug is a valuable carminative, stomachic, and antispasmodic, its properties and uses closely resembling those of chamomile. The genus *Parthenium* L. is quite distinct, but yields several species which are similarly employed. *P. Hysterophorus* L. (*Wild feverfew*, *Wild wormwood*, *Indian mugwort*, or *Whitehead*), of the southern United States and tropical America, is the most important. Its composition has been considerably studied, but the results are indefinite. Its amaroid has been reported as glucosidal and again as alkaloidal, but it is probably neither. Large doses have an antipyretic effect. *P. integrifolium* L. (*P. amplectens* Raf.), the *Cutting almond*, *Nephritic plant*, *American feverfew*, and one of the plants known as *Prairie dock*, of the southern and central United States, appears to have a very similar composition and properties, and is used as a diuretic and antiperiodic. These plants differ from true feverfew in their size, being usually from 5 to 15 Dm. (about 2 to 5 Ft.) high, and widely branched, by their large leaves, the larger frequently 3 Dm. (1 Ft.) long, or in the first species even twice that size. In that species they are bipinnatifid; in the second crenate-dentate, the lower petioled, the upper sessile. The heads are much smaller than in feverfew, the rays only about 5, instead of numerous as in feverfew, and the drugs are more bitter and less aromatic.

ACHILLEA, *Yarrow*, *Milfoil*, *Schafgarbe*, *Schafrippe*, *Millefeuille*, *Herbe aux charpentiers* (*Herba*, or *Summitates Millefolii* of the Austrian Pharmacopœia), is the flowering herb of *A. Millefolium* L., a common roadside weed of Europe and Asia, as well as of North America, where it has been introduced, and is one of the most ancient of drugs. Although its present employment is slight in comparison with that of the past, it is still frequently seen in commerce. It is a perennial herb, rarely exceeding 60 Cm. (2 Ft.) in height, the stem rather stout, branching only at the top, furrowed and hairy; radical leaves petioled, 10 to 25 Cm. (4 to 10 In.) long, and about one-third as broad, the stem-leaves nearly sessile, about half as large and rather narrower, alternate, soft-hairy, deeply and finely 2 or 3 times pinnatifid, the lobes linear-spatulate, crowded, 3 to 5 cleft, finely mucronate and beset underneath with small oil-glands; inflorescence a white, or occasionally pink, dense, flat-top corymb; involucre oblong, 4 or 5 Mm. ($\frac{1}{6}$ to $\frac{1}{5}$ In.) long, the scales imbricate and keeled; receptacle flat and chaffy; rays 4 or 5, pistillate, fertile, the disk-flowers few, perfect, the tube yellowish, the limb whitish; akenes oblong, flattened, without pappus. The drug somewhat resembles chamomile in odor, and is bitter and somewhat astringent. The herbage yields about 0.1 per cent. of a blue or dark-green butyraceous volatile oil. The bitter principle, *achilleine* ($C_{20}H_{38}N_2O_{15}$), is an alkaloid and is present in small amount, and exists also in *A. moschata* Jacq. The latter species (*Ptarmica m.* DC.) is considerably employed in Europe

FIG. 135.



Achillæa leaf (½ Nat.); floret (× 4½).

under the name *Ivæ*, or *Genippi*, for the same purposes. The leaf-lobes of this species are linear and entire, and the drug is much more strongly aromatic and bitter. Its volatile oil has been called *ivaol*. Besides the alkaloid named above, it contains two others, *achilletine* ($C_{11}H_{17}NO_4$) and *moschatine* ($C_{21}H_{27}NO_7$). *Ivain* ($C_{24}H_{42}O_5$) is a soft yellow substance, soluble in alcohol but not in water. Achillea possesses tonic, stimulant, and astringent properties. Formerly it was employed to a limited extent as an emmenagogue, and was believed to be useful in the various atonic conditions common to the organs of reproduction. The drug has been recommended in chronic, depraved conditions of the mucous membrane of the entire gastro-intestinal tract, but is rarely employed. It is usually prescribed in hot infusion, made with 1 ounce (30 Gm.) of the drug and 1 pint (480 Cc.) of boiling water, in doses of from 4 to 6 fluidounces (120–180 Cc.). The volatile oil may be employed in the dose of 30 minims (2 Cc.). *A. ptarmica* L. (*Sneeze-weed, Bertramgarbe, Herbe à éterneur*) is similarly used.

Ambrosia, or *Rag-weed*, as commonly understood, is the flowering herb of *A. artemisifolia* L., the common *Rag-weed, Hog-weed, Tassel-weed, Bastard* or *Roman wormwood*, or *Wild*

Fig. 136.

A, *Ambrosia artemisifolia;* B, *A. trifida;* C, pollen-grains of A (A and B, ½ Nat.; C, much magnified).

tansy, probably the most abundant weed of eastern North America, growing along roadsides, choking out cultivated plants, and abounding especially in grain-fields after the harvest. The range of the plant is a matter of great importance. Many persons who suffer from hay-fever annually seek those localities where it does not grow, and where "hay-fever colonies" are sometimes established. The plant is a more or less hairy annual with a widely branching stem, sometimes reaching a height of 2 Mm. (6 Ft.) and almost as great a breadth. Its thin leaves, opposite below and alternate above, are more or less petioled, 5 to 15 Cm. (2 to 6 In.) long, and almost equally broad, triangular-ovate, finely once- or twice-pinnatifid, the lobes oblong to lanceolate. The sterile flowers, of a yellowish-green color, terminate the branches in long, slenderly cylindrical racemes, the heads being very small. The pistillate heads are clustered, chiefly at or near the base of the staminate racemes. Occasionally the plant is dicœcious. The fertile heads are obovoid or turbinate, and usually bear 4 to 6 short spines upon the summit. The plant is rather disagreeably aromatic and intensely bitter. Its bitter and aromatic constituents are but little known. It is said that the volatile oil does not amount to more than 0.1 per cent., and that there is nearly 3 per cent. of combined resin,

chlorophyll, and bitter glucoside. Because of its astringency, ambrosia has been employed as a local hæmostatic agent. Like other simple bitters, it has been given in atonic dyspepsia and in mild malarial affections, but it possesses no marked advantages over other bitters more commonly used in these conditions. The eclectics state that it possesses stimulant properties, and claim that it may be given with success during the typhoid state of the acute infectious fevers. The pollen of this plant is said to be the principal exciting cause of *hay asthma*, and in many cases this statement is probably correct. It is, however, denied by some writers. Its inhalation probably irritates an already hypersensitive nasal mucosa, but, according to Dr. D. Braden Kyle, it is not known whether the irritation results from "mechanical impact, continual presence, or by the impregnation of the nasal secretion with some intrinsic substance irritant to the hypersensitive membrane." Recently this drug has been recommended in conjunction with golden rod (see SOLIDAGO) in the immunization treatment of hay-fever, but this plan of treatment is not based on scientific or accurate reasoning. The beginning dose is stated to be 2 minims (0.10 Cc.), 4 times daily, of a mixture of equal parts of the fluid extracts of Ambrosia and Solidago, which is to be increased 2 minims at each succeeding dose until 20 minims (1.30 Cc.) are taken. An infusion of the tops may be made with 4 drachms (16 Gm.) in 1 pint (480 Cc.) of water, and given in doses of 1 wineglassful, as required.

A. trifida L., the *Great, Giant, Riverside,* or *Salt marsh rag-weed, Horse-cane, Buffalo-weed,* or *Wild hemp,* is a half larger and much stouter in proportion. Its color is a light or yellowish-green, instead of the dark gray-green of the former. It is rough-hairy. Its large leaves are deeply 3-lobed, the lobes lance-oblong or lance-ovate and coarsely serrate. Its bitter properties are similar to those of the preceding.

The flower-heads of *Mutisia viciæfolia* Cav. (*Scale flower, Chinchircoma*) are considerably employed in the Bolivian Andes as an expectorant in phthisis and other chronic disorders. They contain small amounts of bitter extractive and volatile oil.

DRUGS USED FOR THEIR BITTER AND ASTRINGENT PROPERTIES.

SENECIO (*Squaw-weed, Life-root, Ragwort, Female regulator, False valerian*) is the root and herb of *S. aureus* L., and is a favorite drug among the eclectics and homœopaths, and quite an important article of commerce. It was also a much-used aboriginal medicine under the names *Mequot, Nunqua* or *Nutqua,* and *Unkum.* It is a common weed of eastern North America, blooming in early spring, and quite a number of forms are variously regarded by different botanists as varieties of this or as distinct species. Doubtless all of them have been promiscuously employed. The plant is a perennial herb, nearly smooth, the rather slender fluted stems 3 to 7 Dm. (1 to 2 Ft.) or more high, simple, excepting the inflorescence. It bears a tuft of semiprostrate root-leaves, some of which reach a length of 15 Cm. (6 In.), are ovate to reniform, obtuse, crenate or dentate, and borne on long petioles. The stem-leaves are successively smaller and narrower, usually more or less incisely pinnatifid, sessile and clasping. The few heads are borne in a loose corymb on slender peduncles, are 16 to 20 Mm. (⅔ to nearly 1 In.) broad and about half as long. The involucral scales are in a single series or with a few short loose ones at the base. The rays are 8 to 12, golden-yellow, widely spreading, or at length slightly reflexed, and the disk is brownish-yellow. The receptacle is flat or nearly so, and naked. The rays are pistillate and fertile, the yellow or brownish disk-flowers perfect, the akenes oblong, smooth, 5- to 10-ribbed, the pappus of copious fine white bristles. The rhizome is short and oblique, and somewhat resembles that of arnica. The drug is bitter, astringent, and slightly acrid, but little odorous. Its constituents are unknown. *Senecio aureus* has been employed as a vulnerary by the American Indians. The eclectics claim that it possesses emmenagogue and diuretic properties, and that it not only stimulates in atonic conditions, but also regulates the menstrual function when irregular or too profuse. A decoction or infusion made from the whole plant (℥j to Oj) may be given in doses of 1 wineglassful, and repeated as needed. *Senecin* of the eclectics is obtained by precipitating an alcoholic tincture of the drug with water and collecting the precipitate.

S. vulgaris L., the European *Groundsel* or *Bird seed, Kreuzkraut, Jacobs-kraut,* or *Senecon,* is somewhat similarly used. The plant is interesting as containing a very small amount of 2 alkaloids, *senecionine* ($C_{18}H_{26}NO_6$), which crystallizes in rhomboidal tablets and is soluble in alcohol, and *senecine,* which crystallizes in needles and is soluble in ether, which the other is not. *S. Jacobæa* L. is another common European species, known under a great variety of common names, especially *Tansy ragwort, St. James-wort, Ban-weed,* or *Felon-weed,* and *Stinking Alexander,* and credited with properties similar to those of *S. aureus.* Good evidence has been adduced to show that it acts well in many cases of functional amenorrhœa. *S. Cineraria* DC. (*Cineraria maritima* L.), the common *Dusty miller* of cultivation, has attracted considerable attention from time to time because of its reputed activity in causing the absorption of soft capsular cataract, the fresh juice being instilled into the eye.

GUACO.—The leaves of *Willughbœa,* Neck. (*Mikania,* Willd.), of one or more species, more

especially *W. amara* (W.) Kuntze (*Mikania a.* W.; *M. Guaco* H. et B.), are among the numerous drugs used in tropical America under the name *Guaco*. They are markedly bitter and astringent, as well as aromatic, and although ignorantly employed in cancerous complaints, as an antidote to snake-bites, etc., they undoubtedly possess important tonic and alterative properties. The leaves range from 5 to 12 Cm. (2 to 5 In.) long and fully two-thirds as broad, are ovate and slenderly petioled, abruptly short-acuminate, rough above, soft-hairy underneath, and rather thick. A volatile oil, a bitter principle, and tannin have been found in this drug. The genus is a vast one in tropical America, and it is probable that most of the species have similar constituents and properties. One, *W. scandens* (L.) Kze. (*Eupatorium s.* L., *Mikania s.* W.), is common in eastern North America, in moist localities, twining over shrubbery, and known as *Climbing boneset* or *Climbing hemp-weed*. It has been considerably employed in indefinite ways, as an alterative, and has undoubted value as a stimulating intestinal astringent.

ERICHTITES.—Several species of *Erechtites*, Raf., especially *E. hieracifolia* (L.) Raf. (*Senecio h.* L.), one of the *Fire-weeds*, also called *Pilewort*, contain much tannin and had many uses as astringents among the aborigines and early settlers. It also contains a volatile oil somewhat resembling the oil of erigeron, but not soluble like that in an equal volume of alcohol. This herb, which has quite an extensive sale, particularly among the eclectics, is described as follows: Stem 30 to 150 Cm. (1 to 5 Ft.) or more high, stout but fleshy and weak, fluted, roughish, branching above, the branches erect, making a somewhat contracted-paniculate inflorescence; leaves alternate, of exceedingly variable size, from lance-ovate to linear, shortly petioled, irregularly and sharply toothed or sometimes subpinnatifid, thin, the upper becoming sessile and at length clasping; heads cylindrical, bristly-hairy at the base, the lower scales of the involucre short and spreading, the upper long and linear, strictly erect or even contracted at the summit. The florets are very slender, the akenes slenderly oblong and surmounted by a copious, exceedingly fine and silky, white or sometimes violet pappus.

HIERACIUM, L.—Several species of this large genus, the *Hawk-weeds*, somewhat distantly related to lettuce and dandelion, have been employed medicinally, both in Europe and America. That most generally employed is *H. venosum* L., the *Veiny-leaved hawk-weed*, *Striped bloodwort*, or *Rattlesnake-weed*. It is common in dry woodlands throughout eastern North America. It produces a rosette of nearly prostrate radical leaves, 7 to 15 Cm. (3 to 7 In.) long, and about half as broad, oblanceolate, narrowed to the sessile base, hairy, and with prominent, broad, red-purple veins. The stem is 50 to 60 Cm. (a foot or two) high, slender, bearing several small leaves, which are reduced upward to narrow bracts, and a loose and scant branched corymb of pretty deep-yellow flower-heads, consisting entirely of ligulate florets. The drug is bitter and astringent, but scarcely odorous. Its constituents have not been studied, but appear to include tannin and an amaroid. It, like the other species, has been indefinitely employed as a tonic and mild astringent. The claims that it is antidotal to the bite of the rattlesnake are doubtless fanciful, as in the case of hundreds, if not thousands, of other plants concerning which the same claim is made.

ECLIPTA.—The herbage of several species of *Eclipta* L. is used for the sake of its tannin, and more especially for its volatile oil, as an intestinal astringent and antispasmodic, and even for the cure of toothache. *E. prostrata* L., of the East Indies, introduced to tropical America, is known as *Bhangra*, *Maka*, *Garaga*, and by various other names. Besides the above uses, it is eaten as a vegetable, as is *E. spicata* Spr.

VERNONIA.—The very large genus *Vernonia* supplies a number of species, in widely separated countries, which find important domestic uses as aromatic bitters and tonics. The common American species, *V. fasciculata* Mx., or *Iron-weed*, is chiefly used in the United States, particularly by the eclectics. *V. anthelmintica* W., of the East Indies, is there quite highly esteemed as an anthelmintic.

ADENOCAULON BICOLOR Hook. (*A. adhœrescens* Maxim.) is used in Japan as an application in rhus-poisoning, the leaves being warmed and applied to the affected surface. It appears at least probable that in this case the benefit occurs mechanically, from the deposit of an adhesive protecting layer upon the skin.

CONDURANGO CORTEX, *It.*—Condurango.

Cortex Condurango, P. G.; *Condurangorinde*, G.

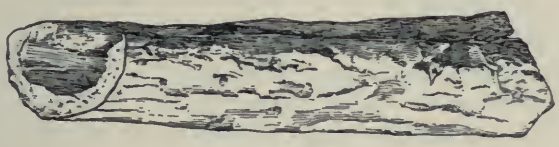
The dried bark of *Marsdenia Condurango* Nichols (non Reichb.—*Gonolobus C.* Triana.—Fam. *Asclepiadaceæ*).

Origin.—From a half-climbing or prostrate shrub of Ecuador, where it enjoys quite a repute for the cure of cancer, due apparently to the ignorant and general application of that name to various non-malignant diseases.

Description.—In quills or quilled pieces, about 10 Cm. (4 In.) or less long, and rarely exceeding 2 Cm. ($\frac{4}{5}$ In.) in diameter, the bark 2 to 6 Mm. ($\frac{1}{12}$ to $\frac{1}{4}$ In.) thick; externally brown-gray, roughened with low, broad, somewhat scale-like warts, and often wrinkled;

internally grayish- or pale brownish-white, striate; fracture short, granular or slightly fibrous in the inner layer, exhibiting under the lens a thin brown cork, a whitish or yellowish-white starchy layer, which is traversed by wavy bast-wedges and dotted with numerous brownish or

FIG. 137.



Condurango (Nat.).

yellow stone-cells; nearly odorless, taste bitter and somewhat aromatic and acrid. A clear 20 per cent. infusion prepared with cold water, becomes turbid on heating and clear on being cooled.

Constituents.—The bark (*Zimmermann*, 1891) yields 0.5 per cent. of starch, fermentable sugar, wax, light-colored resin, 0.75 per cent. of a very light deliquescent crystalline acid, 12.6 per cent. of tannin, and *condurangin*, a bitter glucoside (?). From commercial condurangin, Carra (1892) obtained a yellow substance ($C_{18}H_{28}O_7$) soluble in water and insoluble in ether, and a whitish body ($C_{20}H_{32}O_6$) insoluble in water and soluble in ether and benzin. He also found in the bark a new glucoside ($C_{40}H_{74}O_6$), which is insoluble in ether, sparingly soluble in cold alcohol, and very slightly soluble in water. These substances have been still farther investigated, Hager (*Handbook*, 1900) determining them as *a*- and *b*-condurangin. *a*-Condurangin melts at 60° to 61° C. (140° to 141.8° F.), is insoluble in water but soluble in benzene, and strikes a green color with Froehde's reagent (concentrated sulphuric acid and molybdic acid). *b*-Condurangin melts at 134° C. (273.2° F.), is insoluble in water, and gives no reaction with Froehde's reagent. Besides these, *conduransterin* ($C_{30}H_{50}O_2$), a cholesterin relative, cinnamic acid, and a minute quantity of alkaloid (Flückiger) with strychnine-like action, have been isolated.

Pharmaceutical Preparations.—FLUIDEXTRACT OF CONDURANGO, P. G.; WINE OF CONDURANGO, P. G.

Action and Uses.—Condurango has been employed in South America for many years as an alterative in the treatment of syphilis. It was introduced into medicine in 1871 as a reputed cure for gastric carcinoma, but as a specific for this condition is a complete failure. Like the other aromatic bitters, it may be employed as a stomachic, and it lessens the gastric catarrh and alleviates the nausea and vomiting which usually accompany carcinoma of the stomach. It also exercises a certain sedative effect upon the gastric mucous membrane, and may be given to relieve the pain incident to gastric ailments. Condurangin causes irritability of the stomach, nausea, and vomiting, with impairment or loss of appetite, and in large amounts produces incoördination of the muscles and convulsions, which may be followed by paralysis.

Condurango is given in the dose of 1 fluidrachm (4 Cc.) of the fluidextract, or 4 fluidrachms (16 Cc.) of the wine.

An infusion made with 1 part of the drug and 8 parts of boiling water may be given in doses of 1 tablespoonful.

Other Condurangos.—Dr. Joseph G. Ayers, U. S. N. (1871), ascertained that there are at least 10 different shrubby vines designated as condurango, said to mean *Eagle-vine;* of the majority of these, he was unable to collect the flowers and fruit. The origin of the following, however, has been determined:

GONOBOLUS TETRAGONUS DC. yields *Condurango de paloma*, from Malacatos. It is of a dark-gray or brown color, and on the dry stem is slightly wrinkled longitudinally.

ECHITES HIRSUTA R. et P. (Fam. *Apocynaceæ*) yields *Condurango de paloma*, from Zaruma. The bark has a soft, pale-yellow or white corky layer, which is a line or more thick.

ECHITES ACUMINATA R. et P. yields *Condurango de plátano*. The bark is thin and pale-gray on the outside.

GUAYAQUIL and MEXICAN CONDURANGOS are not from this source.

Other Marsdenias.—The genus contains about 70 species, distributed through all warm countries. The milk-juice of *M. erecta* (L.) R. Br. (*Cynanchum e.* L.), the *Chanik-el-Kilab* of Syria, is carminative and narcotic. The fruit of *M. Roylei* Wight, of India, is used as an alterative and antiblennorrhagic. The leaves of *M. tinctoria* R. Br. and *M. parviflora* DC., of the East Indies, yield a blue, indigo-like dyestuff.

CONFECTIONES.—Confections.

Electuaries, E.; *Conserves, Électuaires, Saccharolés mous*, Fr.; *Conserven, Latwergen*, G.

These preparations are now but little employed medicinally, compared with the extensive use made of them during the last century. A distinction was then, and in some countries is still, made between *conserves* and *electuaries*, which in the British and U. S. Pharmacopœias are now comprised under the title of Confections.

Conserves were made by covering fresh drugs with a layer of sugar; afterward by beating fresh vegetable substances with sufficient sugar until the whole was converted into a uniform soft mass. As indicated by the name, the primary object in view was to preserve the medicinal virtues of the plants thus treated, and incidentally their administration was rendered more agreeable.

Electuaries differ from conserves mainly in being mixtures of powders with pulps, syrups, or honey, and are made by triturating the ingredients together in a mortar. The powders should be very fine; when extracts are to be added, they are previously liquefied by trituration with a little water or other suitable menstruum, and gum-resins, if not pulverizable, are best converted into an emulsion to insure their uniform distribution. Soluble as well as insoluble salts may be given in this form, but of the latter kind only the lighter ones should be used, since heavy insoluble salts are apt to gradually subside in the soft mixture. Of other insoluble substances, volatile oils should first be rubbed with a portion of the sugar or an absorbent powder, and fixed oils be suspended in mucilage before they are incorporated.

If intended to be kept on hand, electuaries are made of such a consistence that they are rather soft, but at the same time sufficiently firm to prevent separation of the ingredients. For immediate use they are made somewhat softer, so that the mixture, when taken upon a spatula, will gradually drop off; they are then in a condition to be swallowed without mastication, and if partial separation should have occurred on standing, a uniform mixture is readily obtained by stirring.

If the main excipients of electuaries are pulps and honey, they will for a long time insure a proper consistence and prevent the preparation from becoming hard and dry. With sugar as the principal constituent, as in the case of conserves, the gradual evaporation of water will often cause the mass to become hard and the sugar to crystallize; the electuary should then be worked over, if necessary, with the addition of a little water or glycerin, but the substitution of common for refined sugar should not be resorted to.

CONFECTIO PIPERIS, *Br.*—Confection of Pepper.

Electuarium piperis.—Électuaire (Confection) de poivre, Fr.; *Pfefferlatwerge*, G.

Preparation.—Take of black pepper, in fine powder, 2 ounces; caraway fruit, in fine powder, 3 ounces; clarified honey, 15 ounces. Rub them well together in a mortar.—Br.

Action and Uses.—This preparation was introduced as a substitute for Ward's paste, and was employed as a remedy for anal fissure, hemorrhoids, and rectal ulcers. At present it is rarely used. The dose is from ½ to 1 drachm (2–4 Gm.) several times daily.

CONFECTIO ROSÆ, *U. S.*—Confection of Rose.

Confectio rosæ gallicæ, Br.; *Conserva rosarum.—Conserve de rose rouge*, Fr.; *Rosenconserve*, G.

Preparation.—Red rose, in No. 60 powder, 80 Gm.; sugar, in fine powder, 640 Gm.; clarified honey, 120 Gm.; stronger rose water, 160 Cc. Rub the red rose with the rose water heated to 65° C. (149° F.), then gradually add the sugar and honey, and beat the whole together until thoroughly mixed.—U. S.

Confection of rose may also be prepared of pharmacopœial strength by using—of red rose, in No. 60 powder, ½ avoirdupois ounce; sugar, 4 avoirdupois ounces; clarified honey, ¾ avoirdupois ounce; and stronger rose water, 1 fluidounce.

The British Pharmacopœia directs 1 pound of fresh red rose petals to be beaten in a stone mortar with 3 pounds of sugar.

The formula of the French Codex is similar to the first one, but omits the honey.

With a good quality of powdered red rose petals an excellent confection is obtained.

Pharmaceutical Uses.—It is used as an excipient in the official pills of aloes and iron, and is occasionally serviceable for the same purpose in extemporaneous pill-masses.

Action and Uses.—Confection of rose is used as an excipient in the preparation of pill-masses. Aside from the slight astringency due to the tannic acid in the rose, it is devoid of medicinal properties. It is never employed as a therapeutic agent.

CONFECTIO SENNÆ, *U. S., Br.*—Confection of Senna.

Electuarium e senna, P. G.; *Electuarium sennæ compositum, Electuarium lenitivum.—Lenitive electuary*, E.; *Electuaire de séné composé, Electuaire lénitif*, Fr.; *Sennalatwerge*, G.; *Elettuario lenitivo*, It.

Preparation.—Senna, in No. 60 powder, 100 Gm.; cassia fistula, bruised, 160 Gm.; tamarind, 100 Gm.; prune, sliced, 70 Gm.; fig, bruised, 120 Gm.; sugar, in fine powder, 555 Gm.; oil of coriander, 5 Gm.; water, a sufficient quantity to make 1000 Gm. Place the cassia fistula, tamarind, prune, and fig in a closed vessel with 500 Cc. of water and digest for 3 hours by means of a water-bath. Separate the coarser portions with the hand, and rub the pulpy mass, first through a coarse hair-sieve, and then through a muslin cloth. Mix the residue with 150 Cc. of water, and, having digested the mixture for a short time treat it as before, and add the product to the pulpy mass first obtained. Then, by means of a water-bath, dissolve the sugar in the pulpy liquid, and evaporate the whole, in a tared vessel, until it weighs 895 Gm. Lastly, add the senna and the oil of coriander, and incorporate them thoroughly with the other ingredients while they are yet warm.—U. S.

The separation of the coarser portions with the hands is objectionable, and by no means necessary, for if the digestion be carried on on a boiling water-bath for 3 hours, with occasional stirring by means of a thick glass rod or a porcelain spatula, the pulpy mixture can easily be passed through a hair-sieve with the aid of a horn spatula.

It will be found advisable, instead of adding the oil directly with the senna to the pulp, to triturate it thoroughly first with about 50 Gm. of sugar, which should be reserved for that purpose out of the original quantity.

To make 10 avoirdupois ounces of confection of senna, the following quantities should be used: Senna, in No. 60 powder, 1 ounce; cassia fistula, bruised, 1 ounce and 263 grains; tamarind, 1 ounce; prune, sliced, 306 grains; fig, bruised, 1 ounce and 88 grains; sugar, 5½ ounces; oil of coriander, 23 minims; water a sufficient quantity. For the first treatment with water 5 fluidounces may be used, and for the second treatment 1¾ fluidounces. Before adding the senna and oil of coriander the pulpy mass should be evaporated to 9 avoirdupois ounces.

Take of senna, in fine powder, 7 ounces; coriander fruit, in fine powder, 3 ounces; figs, 12 ounces; tamarind, 9 ounces; cassia pulp, 9 ounces; prunes, 6 ounces; extract of licorice, 1 ounce; refined sugar, 30 ounces; distilled water, a sufficiency. Boil the figs and prunes gently with 24 ounces of distilled water in a covered vessel for 4 hours; then, having added more distilled water to make up the quantity to its original volume, mix the tamarind and cassia pulp, digest for 2 hours, and rub the softened pulp of the fruits through a hair-sieve, rejecting the seeds and other hard parts. To the pulped product add the sugar and extract of licorice, and dissolve them with gentle heat; while the mixture is still warm add to it gradually the mixed senna and coriander powders, and mix the whole thoroughly, making the weight of the resulting confection 75 ounces either by evaporation or by addition of more distilled water.—Br.

Mix powdered senna, 1 part; simple syrup, 4 parts; purified tamarind pulp, 5 parts, and warm by means of a steam-bath. It is greenish-brown.—P. G.

The last formula is the simplest, and yields a less pleasant but equally effectual preparation. That of the French Codex is of more complex composition.

Action and Uses.—This remedy is an agreeable laxative, and may be employed in habitual constipation and in persons suffering from hemorrhoids. The dose is from 1 to 2 drachms (4–8 Gm.), as required. (See EXTRACTUM SENNÆ FLUIDUM.)

CONFECTIO SULPHURIS, *Br.*—Confection of Sulphur.

Electuarium sulphuris.—Electuaire de soufre, Fr.; *Schwefellatwerge*, G.

Preparation.—Take of sublimed sulphur, 4 ounces; acid potassium tartrate, in powder, 1 ounce; tragacanth, in powder, 18 grains; syrup, 2 fluidounces; tincture of orange, ½ fluidounce; glycerin, 1½ fluidounces. Mix.—Br.

Action and Uses.—Confection of sulphur is a mild laxative, producing large semi-solid stools, and for this reason is well adapted for use as a laxative in cases suffering from hemorrhoids and anal fissure. The dose is from 1 to 2 drachms (4–8 Gm.).

CONIUM, *U. S.*—Conium.

Conii Fructus, Br.; *Fructus ("Semen") Conii; Poison hemlock, Hemlock fruit ("seed"), Poison or Spotted hemlock or parsley, St. Bennett's herb, Spotted cowbane*, E.; *Schierling, Gefleckter Schierling*, G.; *Grand ciguë, Ciguë officinale*, Fr.; *Cicuta Maggiore*, It.; *Cicuta mayor*, Sp.; *Sementes de Cicuta*, Port.

The full-grown, but unripe, fruit of *Conium maculatum* L. (Fam. *Umbelliferæ*), carefully dried and preserved, and yielding, when assayed by the U. S. P. process, not less than 0.5 per cent. of coniine. After being kept for more than two years conium is unfit for use.

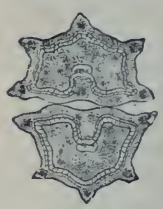
Conium is official in all pharmacopœias. The names "*Cicuta major* Lam." used by the Sp. P., and "*Cicuta maculata* Lam." used by the Port. P., are not synonyms in the true sense, but confusions of the ancient name, which was Cicuta, with Conium, which latter is authoritative under the rules of botanical nomenclature. In several pharmacopœias, notably the British, the herb or leaves are also official, the Br. P. requiring that the herb be collected when the fruit is beginning to form.

Origin.—The hemlock plant is a tall, erect-branched, white-flowered biennial (Fig. 138), native of the temperate regions of Europe and Asia, and extensively naturalized in

FIG. 138.

Conium (⅓ Nat.).

FIG. 139.



Conium; transverse section (× 8).

FIG. 140.

Conium fruit (× 6).

similar regions of both the north- and south-temperate zones. Both wild and cultivated plants contribute to the commercial drug, and it is not certain which, if either, is superior.

Its use, both as a medicine and a poison, is of great antiquity, it being the poison hemlock which furnished the death-draught of Socrates. The herb has been determined (see *Constituents*) as richest when in full bloom; the fruit, at the time specified in our definition.

Description.—Greenish-gray-brown, and about 3 Mm. ($\frac{1}{8}$ In.) long; consisting of 2 (usually separated) carpels, each about 1.5 Mm. ($\frac{1}{16}$ In.) broad, ovoid, somewhat curved, the inner and flattened side marked by a deep longitudinal groove, or by a line overlying such a groove, the outer, convex side bearing 5 pale-yellow, thin, sharp, somewhat crenate ribs, the intervening surfaces wrinkled, but otherwise smooth; pericarp without oil-tubes; odor slight, mousey, disagreeable, greatly increased by soaking in water, especially if a little potassium or sodium hydroxide be added; taste slight, at length somewhat acrid.

Although there are many umbelliferous fruits (see UMBELLIFERÆ) which bear some superficial resemblance to conium, there is none which possesses the combination of characters found in our description. The drug is scarcely subject to adulteration, though substitution sometimes occurs through carelessness (see also ANISUM).

THE HERB (*Conii Folia*, Br.; *Herba Conii*, P. G.).—The characters of the herb are best indicated by the accompanying cut. The color of the leaves, *including their tips*, is a pale and dull or gray-green, and the entire plant is quite smooth. It has the peculiar odor-character described under the fruit. No other herb having its general appearance, with involucres to both umbels and umbellules, shares these characters. Anthriscus and Æthusa (*Fool's parsley, Small hemlock*, E.; *Hundspetersilie, Gartenschierling*, G.; *Ethuse, Petite cigue, Ache des chiens*, Fr.) have been confused, but the former is hairy, while the latter has somewhat shining leaves and its primary umbels are without involucres.

Constituents.—Both the nature and the amount of the active constituents of conium, especially of the herb, are still subject to contradictory statements. Considering first the fruit, we find that its important active constituents are *coniine*, or "conine" (cynapine?) ($C_8H_{17}N$), separately considered below, and *conhydrine* or *oxyconiine* ($C_8H_{17}NO$), which occurs in iridescent scales, has a slight odor of coniine, is soluble in alcohol, ether, and chloroform, and slightly in water, melts at 118° to 122° C. (244.4°–251.6° F.) and boils at 220° to 225° C. (428°–437° F.). A sample of fruits selected individually is said to have yielded more than 3 per cent. of coniine, but owing to the impossibility of securing all of them, in bulk, in exactly that stage of development, the commercial drug yields but from 0.5 to 1.5 per cent., and is extremely irregular, according to the proportion of fruits which are in just the proper condition. Three other alkaloids, present in small amount, are as follows: *pseudoconhydrine*, isomer of conhydrine, in needle-like crystals, soluble in water as well as in alcohol, ether, and chloroform, melting at 98° C. (208.4° F.) and boiling at 230° to 233° C. (446°–451.4° F.); *methylconiine* ($C_9H_{19}N$), and *ethyl-piperidine* ($C_7H_{15}N$). In addition, the fruit contains a fixed oil, a minute portion of non-poisonous volatile oil having the odor of cumin, and probably malic acid (coniic acid) combined with the alkaloids.

Statements concerning the constituents of the herb are most widely at variance. Farr and Wright reported that, when in full flower, the stem contains 0.064 per cent., the leaves 0.187 per cent., and the flowers and flower-stalks 0.236 per cent. of total alkaloid, but other analysts have reported much less. The root is said to contain 0.018 to 0.047 per cent., but the variation would perhaps be much greater if assayed at all the different stages of development.

The Pharmacopœia requires that conium, when assayed by the process given below, shall yield not less than 0.5 per cent. of coniine;

Assay of Conium.—Conium, in No. 60 powder, 10 Gm.; ether, alcohol, ammonia-water, normal sulphuric acid, sodium carbonate test-solution, distilled water, hydrochloric acid (5 per cent. solution), of each, a sufficient quantity. Place the conium in a 200-Cc. Erlenmeyer flask, add 100 Cc. of a mixture of ether 98 parts, alcohol 8 parts, and ammonia-water 3 parts, all by volume, insert the stopper securely, and shake the flask at intervals during 4 hours. After the powder has settled, decant 50 Cc. of the clear liquid into a beaker and add sufficient normal sulphuric acid to produce a distinctly acid reaction. Evaporate the ether at a gentle heat by the aid of a water-bath; then add 15 Cc. of alcohol, and set the beaker aside in a cool place for 2 hours to allow the ammonium sulphate to deposit. Filter the liquid; wash the residue and filter with a little alcohol, and add the washings to the filtrate; neutralize any excessive amount of acid with sodium carbonate test-soluion,

being careful to retain a slight acidity. Concentrate the liquid to 3 Cc. by the aid of a gentle heat on a water-bath, add 3 Cc. of distilled water and 2 drops of normal sulphuric acid. Add 15 Cc. of ether to remove traces of fatty matter, pour off the ether solution and repeat the washing with 15 Cc. of ether. Then transfer the acid liquid to a separator, introduce a small piece of red litmus-paper, and add sufficient sodium-carbonate test-solution to render the liquid slightly alkaline; then shake out with successive portions of 15, 15, and 10 Cc. of ether. To the combined ether solutions, in a tared beaker, add, drop by drop, sufficient hydrochloric acid (5 per cent. solution) to insure an excess of acid, and then evaporate the ether by a gentle heat on a water-bath. Remove the excess of hydrochloric acid by adding to the residue 3 Cc. of alcohol, and heating gently to evaporate the liquid, repeat this operation once, and dry the residue at a temperature not exceeding 60° C. (140° F.) until the weight, after cooling in a desiccator remains constant. The weight of the residue multiplied by 0.777, and this product by 20, gives the percentage of coniine contained in the conium.—U. S.

Coniine.—*Coniine*, E.; *Koniin*, G. $C_8H_{17}N$.—This, the most important constituent of conium, was discovered by Giesecke in 1827, but its true nature as an alkaloid was not determined until 1831 by Geiger. It occurs in all parts of the plant, but chiefly in the immature fruit, in combination with malic acid. Coniine may be obtained by adding potassium or sodium hydroxide to the crushed fruit and subjecting the mixture to distillation on a steam-bath. The resulting distillate is neutralized with hydrochloric or sulphuric acid, evaporated to dryness, and the alkaloidal salt extracted by means of ether or alcohol, which removes ammonia. By adding potassium hydroxide to the alkaloidal salt the base is liberated, and can be extracted with ether, to be finally purified by distillation in a current of hydrogen.

Pure coniine occurs as a colorless, almost odorless liquid, having a specific gravity of 0.8438 at 19° C. (66.2° F.), and boiling at 165.8° C. (330.44° F.). In the cold it congeals to a crystalline mass, which melts at —2° C. (28.4° F.). Coniine is soluble in 90 parts of water, the saturated solution becoming turbid on warming. On the other hand, coniine is capable of taking up 25 per cent. of water. It has an alkaline reaction, and is readily oxidized upon exposure to air, assuming a brownish color.

Commercial coniine is usually contaminated with conicein, as much as 70 per cent. having been found by Wolffenstein, from which it may be freed by treating the hydrochloride with acetone, in which coniine hydrochloride is sparingly soluble, whereas the conicein salt is readily soluble. It is a yellowish liquid having a rather disagreeable odor.

Concentrated sulphuric acid colors coniine blood-red, the color gradually changing to green. Potassium-cadmium iodide causes an amorphous precipitate in solution of coniine, which distinguishes the latter from nicotine, yielding a crystalline precipitate. Dilute solutions of nicotine are precipitated by aqueous solutions of platinic chloride, while those of coniine are not.

Chemically, coniine may be looked upon as hexahydropropylpyridine, $C_5H_9.NH.C_3H_7$. Its constitution was established by Hoffmann in 1881, and its synthetic production accomplished by Ladenburg in 1886.

The salts of coniine are readily soluble in water, moderately so in alcohol and mixtures of alcohol and ether, and insoluble in ether. Aqueous solutions of the salts cannot be concentrated in air without decomposition. The most important salt of coniine is the hydrochloride, $C_8H_{17}N.HCl$, which may be obtained from an aqueous solution in large rhombic crystals, permanent in air and melting at 220° C. (428° F.).

Pharmaceutical Preparations.—Fluidextract of Conium, U. S. P.; Tincture of Conium, Br. P.

Action and Uses.—All the preparations made from the fruit, the juice from the leaves, and the alkaloid obtained from both fruit and leaves, have identical physiological actions, and may be employed interchangeably. When taken in full dose, conium produces muscular relaxation followed by loss of power. When the amount ingested is sufficiently large, it produces vertigo, staggering, disordered vision, and circulatory depression. Poisonous amounts, in addition to the above symptoms, cause dilatation of the pupils, ptosis, partial aphonia, and complete muscular paralysis. Conium exerts its dominant influence upon the motor nerves, which are greatly depressed. Full doses slightly depress the sensory nerves and the spinal cord, but the cerebrum is not affected, as consciousness

is retained almost until death occurs when lethal doses are given. Respiration is depressed because of the paralyzing action of the drug upon the motor nerves supplying the respiratory muscles. Its dominant action upon the circulation is that of a depressant; blood-pressure is at first decreased, but later it is increased, because of the asphyxia resulting from respiratory failure. The treatment of conium-poisoning consists in the early removal of the drug by the stomach-tube, and the administration of respiratory and nervous stimulants, such as strychnine. Cardiac stimulants should be given when needed, and artificial respiration may be resorted to.

The drug has been recommended as an antispasmodic, anaphrodisiac, diuretic, and anodyne. Formerly it was employed in many conditions, but at present its field of usefulness has become greatly limited. It was thought to be of value in the treatment of epilepsy, tetanus, chorea, laryngismus stridulus, and other spasmodic conditions. It has been recommended in mania, melancholia, glandular enlargements, engorgement of the liver, and cardiac palpitation, but is rarely employed for any of these conditions. A lotion containing 1 to 4 minims (0.05–0.25 Cc.) of the alkaloid in 1 ounce (30 Cc.) of water or very dilute alcohol, has been tried in scrofulous ophthalmia with asserted success. A plaster containing hemlock, especially when combined with belladonna, is sometimes beneficial in the treatment of intercostal neuralgia; and an ointment containing 10 per cent. of the extract sometimes does good in anal fissure and hemorrhoids. The drug when spread over the surface of a poultice relieves the pain of cancers and ulcers, and should be tried in these conditions. It is of value in spasm due to irritation of a nerve-trunk, and coniine when injected hypodermically frequently affords relief.

The fluidextract is probably the best preparation to employ. Because of the unreliability of the drug, it should always be given in small doses at first, and increased until its effects are produced. The dose of the fluidextract is from 2 to 6 minims (0.10–0.40 Cc.). The dose of the powdered leaves is from 2 to 6 grains (0.12–0.40 Gm.); of the extract, from ½ to 1 grain (0.03–0.06 Gm.). Coniine hydrochloride is given in doses of from ⅛ to 1 grain (0.008–0.06 Gm.), but the latter amount should be given cautiously.

Allied Plants (see also UMBELLIFERÆ).—The genus *Conium* contains one other species, native of Africa, the properties of which have not been investigated. The closely related genus *Cicuta* L. should be here considered. Authors are not agreed as to the number of its several species, some of them being classed as varieties. The two of importance are the *C. virosa* L. (*Cicutaria aquatica* Lam.), of northern Europe and Asia (the European *Wild* or *Water hemlock* or *cowbane*, *Wild* or *Spotted parsley* or *parsnip*, *Brook-tongue*, *Death-in*, *Wasser-Schierling*, *Giftwütherich*, *Cigue vireuse*, *Cicuta virulenta*), and the *C. maculata* L. (*C. virosa maculata* Coulter et Rose), the American *Wild* or *Water hemlock* or *cowbane*, *Beaver* or *Muskrat poison*, *Children's death*, etc. Both species are used to some extent in medicine, and both are responsible yearly for cases of fatal poisoning, chiefly of children. The stem, which has a not unpleasant odor, is mistaken for angelica, and the highly attractive fleshy roots for Jerusalem artichokes or other edible tubers. The latter species, which especially interests us, is one of our commonest swamp-weeds, growing abundantly along streams, ponds, ditches, and wet meadows throughout the eastern and central portions of the United States. It has a thick, hollow, glaucous-purple, somewhat spotted stem, which sometimes reaches a height of 5 feet and branches strongly, the ascending branches terminating in large umbels of white flowers. Its character and appearance are best learned from Fig. 141. Coniine and *cicutine* have been reported. The important active constituent appears to be *cicutoxin*, an amorphous, tenacious, non-drying, resinous substance, occurring in bright-yellow drops, soluble in alcohol, ether, chloroform, alkalies, and hot water. It is said not to be present in the fruit, where it is replaced by the volatile alkaloid *cicutine* (which may be identical with coniine), but is present in the resinous cortical zone of the rhizome to the extent of 3.5 per cent., and almost certainly in the stem and herbage. The fruit contains about 1 per cent. of a volatile oil, said to be practically identical with that of cumin. Several other species are poisonous to stock, and doubtless contain the same constituents.

In some parts of Europe, especially England, *Œnanthe crocata* L., the *Water dropwort* or *Dead tongue*, also called *Water hemlock*, plays a similar rôle to that of the cicuta in America. Holmes reports it as the most poisonous and dangerous of all native English plants. The symptoms of poisoning are very similar to those caused by cicuta, and the active constituent is very likely identical. The plant produces a fascicle of fleshy thickened roots very much like those of cicuta, although somewhat more slender and more tapering, and contains a similar yellow, resinous, acrid juice. The leaf and fruit characters are indicated in Fig. 142, *a*, *b*, *c*.

Fig. 141.

Cicuta maculata (½ Nat.).

Fig. 142.

Œnanthe crocata: *a*, segment of lower leaf; *b*, of upper; *c*, fruit (*a* and *b*, ½ Nat.; *c*, enlarged). (After Holmes.)

Several species of the genus *Sium* L. are also known as *Water parsnip*, and are poisonous. They appear to contain a constituent very similar, if not identical, with that of cicuta.

CONVALLARIA, *U. S.*—Convallaria.

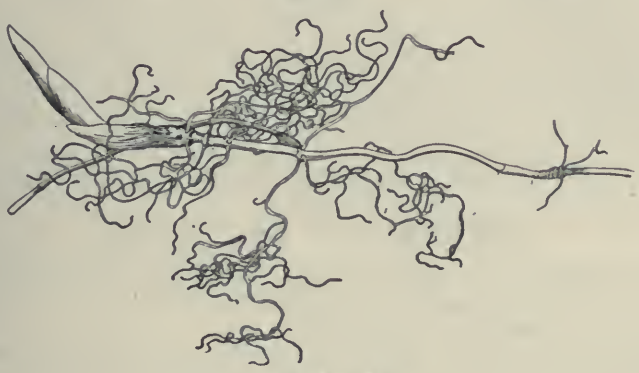
Lilium convallium.—*Lily of the valley*, E.; *Maiblumen*, G.; *Muguet*, Fr.; *Mughetto*, It.; *Liris de los valles*, Sp.

The dried rhizome and roots of *Convallaria majalis* L. (*C. latifolia* Lam.—Fam. *Liliaceæ*).—U. S.

Convallaria is official in several other pharmacopœias in the form of the entire plant or of the flowers only.

Origin.—This well-known garden-flower is a native of Europe and northern Asia. The plant which is native of our southern Alleghenies, is not recognized as distinct, though it seems difficult to believe that it can be the same. The latter is collected to some extent, but its contribution to commerce is unimportant. Lily of the valley should not be confounded with Solomon's seal, which was once known as *Convallaria multiflora.*

FIG. 143.



Convallaria (¾ Nat.).

Description.—Rhizome of horizontal growth and somewhat branched; length indefinite, the internodes mostly about 5 Cm. (2 In.) long, 1 to 3 Mm. ($\frac{1}{25}$ to $\frac{1}{8}$ In.) thick, cylindrical, whitish or pale-brown, bearing few circular scars, and at each joint a circle of 8 or 10 long, thin, wavy, branched, brown roots; fracture somewhat gummy and fibrous, white; odor peculiar, pleasant; gummy on chewing, the taste sweetish and bitterish, then somewhat acrid. No other drug is to be mistaken for it.

Constituents.—The rhizome yields 0.6 per cent. of the bitter-sweet, white, somewhat crystalline glucoside *convallamarin* ($C_{23}H_{44}O_{12}$). It is soluble in water and alcohol, insoluble in ether and chloroform, is precipitated by tannin, and with dilute acids splits up into glucose and *convallamaretin.* Convallarin ($C_{34}H_{62}O_{11}$) is an acrid glucoside crystallizing in rectangular prisms, soluble in alcohol, insoluble in ether, and sparingly soluble in water, but foaming with it like saponin. On boiling with dilute acids it forms sugar and *convallaretin.* The odorous principle of the flowers forms volatile crystals which are fragrant in dilute solution. The rhizome is reported to contain about three times as much active constituent as the stems and flowers.

Pharmaceutical Preparations.—FLUIDEXTRACT OF CONVALLARIA FLOWERS, N. F.; FLUIDEXTRACT OF CONVALLARIA, U. S. P.

Action and Uses.—Convallaria has been employed as a substitute for digitalis. While it is less powerful than digitalis, in certain cases it seems much more efficient than the latter remedy. It was first used in medicine in the treatment of dropsy, as its administration augments the flow of the urine. When given in full dose, it sometimes produces nausea and vomiting, and by increasing the peristaltic action of the intestines causes some laxity of the bowels. When given in proper amount, it strengthens the contraction of the heart muscle, reduces the number of heart-beats, increases blood-pressure, stimulates the respiratory function, and frequently increases the appetite and aids digestion. Poisonous amounts act as a depressant, disturbing respiration and paralyzing the heart, sometimes in diastole, at others in systole. The emetic properties of the drug are probably due either to its acrid resin or to its glucoside, convallarin. Convallamarin is the active principle which produces the favorable changes in the circulation Convallaria may be employed in cardiac dropsy and in all of those conditions in which digitalis is beneficial (see DIGITALIS); but it is probably most useful in cases of arhythmia and cardiac hurry. The dose of the fluidextract is from 4 to 8 minims (0.25–0.50 Cc.), 3 times daily. A tincture may be given in doses of from 5 to 20 minims (0.3–1.30 Cc.), and an aqueous extract of the whole plant has been given in doses of from 15 to 20 grains (1–1.30 Gm.) daily. The dose of convallamarin is $\frac{1}{2}$ grain (0.03 Gm.), 3 times daily.

Allied Drugs.—The rhizomes of various species of *Polygonatum* Adans., of the same family, are largely used under the name *Solomon's seal*. *P. multiflorum* (L.) All. (*Convallaria m.* L.) and *P. officinale* (L.) All. (*Convallaria o.* L.; *C. Polygonatum* L.; *P. vulgare* Desf.) yield the European Solomon's seal (*Ladies' seal, David's harp, Ladder to heaven* (*Scala Cœli*), *Whitewort, Weisswurzel, Salomon-Siegel, Fraxinelle, Sceau de Salomon, Genouillet*). *P. biflorum* (Walt.) Ell. (*Convallaria b.* Walt.) and *P. commutatum* (R. et S.) Dietr. (*Convallaria c.* R. et S.; *P. gigantenum* Dietr.) yield the American variety. *Vagnera racemosa* (L.) Morong (*Convallaria r.* L.; *Smilacina r.* Desf.) yields the American *False Solomon's seal*. All these rhizomes, nearly bare of roots, have the following general characters: They occur of irregular length, up to about a foot, are more or less crooked, occasionally branched, 1 Cm. (about ½ In.) or less in thickness, more or less flattened from above, irregularly transversely wrinkled or ridged, yellow or yellowish-white, smoothish and usually somewhat shining, and bearing very large, shallow-stem-scars on the upper surface, these either depressed or slightly elevated. The fracture is short, somewhat waxy, yellowish. There is little odor, and the taste is gummy or mucilaginous, sweetish and bitter, afterward somewhat acrid. The constituents are very similar to those of convallaria, convallarin being the important one.

COPAIBA, *U. S., Br.*—Copaiba.

Balsamum copaïvæ, P. G.—*B. Copaiferarum.*—*Balsam copaiva, Balsam capivi*, E.; *Copaivabalsam*, G.; *Oleo-resine (Baume) de copahu*, Fr., It.; *Balsamo di copaive*, It., Sp.; *Terebinthinia Copahiba, Oleo de Copaiba*, Port.

The oleoresin of one or more South American species of *Copaiba* Mill. (*Capaifera* L.—Fam. *Leguminosæ*).

Copaiba is official in all pharmacopœias.

Origin.—The genus *Copaiba* Mill. comprises some 12 species of tropical America, besides about 4 African species. The former yield our commercial supplies. They are handsome trees, with pinnate leaves and panicles of bean-like flowers. Some of them are very large, and their timber is highly prized for its great strength, hardness, toughness, and durability. It is largely used for the keels of river-boats and for wheels, as well as for cabinet-work. The cotyledons of some species become very hard, like vegetable ivory, and are used like that substance in the manufacture of small objects (for an account of coumarin-yielding seeds, see DIPTERYX). Not all of the species have been examined as to their production of copaiba, but it is likely that most of them produce it. The following are known to yield commercial supplies: In Brazil, *C. Langsdorffii* (Desf.) Kuntze, *C. confertiflora* (Benth.) Kuntze, *C. coriacea* (Mart.) Kuntze, *C. oblongifolia* (Mart.) Kuntze; in and northwest of the Orinoco Valley *C. officinalis* Jacq.; in the Amazonian region, *C. Guianensis* (Desf.) Kuntze, and *C. multijuga* (Hayne) Kuntze. These products differ considerably in their appearance, composition, and value, giving us different geographical varieties or grades, but it is not definitely known from which species all of these grades are respectively derived. The liquid, often incorrectly termed "balsam," collects in cavities of the trunk as a pathogenic product, doubtless as an antiseptic protective provision by the plant. It exists abundantly, however, in schizogenous ducts in the secondary wood. The cavities are of all sizes, often extending through a great part of the length of the trunk and containing many gallons. The pressure exerted by these columns of liquid sometimes bursts the trunks. Collection is made by boring or cutting through the heart of the tree, when the copaiba often spurts out with great violence, requiring special provisions for avoiding loss. It is said that trees which will not yield copaiba at once may do so after a time if the cavity thus made is plugged up.

Adulteration.—The variable conditions of commercial copaiba, depending on its origin from different species, renders the detection of adulteration by no means an easy task. This well-known fact has greatly encouraged fraudulent operations, which are, in fact, so common that adulterated copaiba has long been the rule rather than the exception. One of the commonest methods of fraud is the abstraction of a part of the volatile oil. This treatment increases the relative amount of resin and, like the addition of foreign resins, is provided for in the official tests. The presence of other volatile oils and turpentines usually becomes quite evident by the different odors on slowly heating a little of the copaiba.

The ordinary adulterants of copaiba are fixed oils, paraffin, and gurjun balsam, the detection of which is provided for in the following official description and tests:

Properties and Tests.—A pale-yellow to brownish-yellow, more or less transparent

and viscid liquid, sometimes fluorescent; having a peculiar, aromatic odor and a persistent, bitter, and acrid taste.

Specific gravity, 0.950 to 0.995 at 25° C. (77° F.).

Insoluble in water, soluble, or showing at most a slight opalescence, in absolute alcohol, carbon disulphide, petroleum benzin, and in fixed and volatile oils, completely soluble in chloroform and ether.

When heated on a water-bath, it should evolve no odor of turpentine, and after 48 hours should leave a resinous mass weighing not less than 50 per cent. of its original weight.

1 Gm. of copaiba, when dissolved in 50 Cc. of alcohol, should require not less than 2.3 Cc., and not more than 2.8 Cc. of half-normal alcoholic potassium hydroxide for neutralization, using 1 Cc. of the phenolphthalein test-solution as indicator (presence of a normal proportion of acid resin).

When 4 drops of nitric acid (specific gravity 1.40) and 1 Cc. of glacial acetic acid are mixed in a test-tube, and 4 drops of copaiba are carefully poured on top of the liquid, no reddish zone should appear, nor should the fluid assume a red or purple color after being shaken (absence of gurjun balsam).

If 5 Cc. of copaiba be shaken with 15 Cc. of alcohol, and heated to boiling for 1 minute, no drops of oil should separate after cooling and standing for an hour (absence of paraffin oils).

If 20 drops of copaiba be boiled with 1 Cc. of an alcoholic potassium-hydroxide solution (1 in 10) for 2 minutes and cooled, and then twice its volume of ether be added to the liquid, no gelatinization should occur (absence of fixed oils).

If 1 Gm. of copaiba be shaken with 10 Cc. of ammonia-water in a stoppered vial, and allowed to stand for 24 hours, the liquid will become turbid, but it should not gelatinize, nor should a firm mass be formed (limit of resin).—U. S.

Constituents.—The acrid and bitter taste of copaiba is due to the resin and a bitter principle. The amount of oil (see Oleum Copaibæ) varies from 30 to 60 per cent., or even above 80 per cent., and on driving it off by evaporation a hard brittle mixture of acid resins is left. Copaiba, on long standing, will deposit prismatic soft crystals of copaivic acid ($C_{20}H_{32}O_2$), which are soluble in alcohol, ether, and fixed and volatile oils. The Para variety has a similar deposit of oxycopaivic acid ($C_{20}H_{28}O_3$), and the Maracaibo variety deposits metacopaivic acid ($C_{22}H_{34}O_4$). On keeping, copaiba gradually becomes thicker, through conversion of the volatile oil into a soft resinous body.

Varieties.—The different kinds of copaiba are commercially named from the places of export, but even as obtained from the same places they are not always identical in every particular. *Para copaiba* is the most limpid and the lightest-colored kind, and frequently contains from 65 to 85 per cent. of volatile oil. *Maranham copaiba* is a little denser, has about the consistence of olive oil, differs somewhat in odor from the preceding, and contains from 40 to 50 per cent. of volatile oil. *Rio Janeiro copaiba* resembles the last. These Brazilian copaibas yield, with one-third to one-half their weight of ammonia, compounds which form perfectly clear solutions in the volatile oils contained in them; but in the presence of a fixed oil clear solutions are not obtained. *Surinam copaiba*, chiefly from *C. Guianensis*, is also one of the thinner and lighter yellow sorts, containing, in a sample examined by Pool, 78 per cent. of oil. This variety is freely soluble in ether and chloroform, and in 4 to 5 parts of absolute alcohol, with an equal portion of which it forms a turbid mixture. It gives a violet color with a solution of 1 part of bromine in 20 of chloroform. *Maracaibo copaiva* is the thickest variety, usually of a dark-yellow color and not quite transparent. It contains less volatile oil, and does not always yield a clear mixture with a little ammonia water; but it solidifies readily with magnesia, and is well adapted for making the official Massa Copaibæ. According to the German Pharmacopœia, thick copaivas are to be preferred.

Pharmaceutical Preparations.—Compound Copaiba Mixture, N. F.; Chapman's Mixture, N. F.; Lafayette Mixture, N. F.

Action and Uses.—Copaiba is a mild stimulant, laxative, and diuretic. When taken in moderate amount, it produces a sensation of warmth throughout the gastro-intestinal tract and acts as a stimulant upon the pulmonary and genito-urinary mucous membranes. It is eliminated by the kidneys, giving the urine a peculiar odor; by the pulmonary mucosa, imparting a characteristic smell to the breath; and by the skin, sometimes causing an eruption like measles or one closely resembling that seen in secondary

syphilis. Overdoses produce nausea, vomiting, purging, and hæmaturia, and if the urine be examined with nitric acid after the ingestion of this drug, a precipitate is formed which may be mistaken for albumin.

Copaiba is regarded as a stimulant to mucous membranes, especially of the genito-urinary tract, and is usually employed in subacute and chronic conditions. The drug is contraindicated in acute sthenic inflammations, but may be employed with asserted success during the stage of depression which invariably follows them. It is one of the best drugs we possess in the treatment of specific urethritis of a subacute or chronic type, and may be employed in chronic cystitis resulting from gonorrhœa. It has also met with favor in the treatment of subacute and chronic bronchitis, and has been recommended in leucorrhœa, vaginal gonorrhœa, subacute and chronic pyelitis, chronic dysentery, diarrhœa, and hemorrhoids. In dropsy resulting from slow renal changes and in that accompanying cirrhosis of the liver it may be of benefit. Copaiba has been locally applied to ulcers, chilblains, cracked nipples, anal and other fissures, with fairly good success, but at present it is rarely employed for these conditions.

The dose of copaiba is from 15 minims to 1 fluidrachm (1–4 Cc.), 3 times daily; or it may be given in smaller amounts more frequently repeated. It is usually administered in gelatin capsules, but may be given in the form of an emulsion made with yolk of eggs or with acacia. Equal parts of liquor potassæ and copaiba make a perfect solution which may be diluted and flavored as desired. The volatile oil is employed in doses of from 5 to 15 minims (0.3–1 Cc.), and the resin in doses of from 5 to 20 grains (0.30–1.3 Gm.).

Copal varnish has been applied locally to abort felons; but at present it is rarely employed.

Gurjun balsam has been given as a substitute for copaiba in the various conditions in which the latter remedy has proved efficacious.

Allied Products.—An *African copaiba* has occasionally appeared which shows some resemblance to the genuine article. It varies greatly in appearance and properties, so that no characteristic description of it is possible. A specimen examined by Umney, containing 39 per cent. of oil, had a specific gravity of 0.9185 at 16° C. (60.8° F.). It dissolved in its own weight of petroleum ether, in 3 parts of ether, and in 7 of glacial acetic acid, but not completely in 50 parts of absolute alcohol. The blue oil fractionated from its oil in a perfectly dry state, agreed with that from Maracaibo copaiba. African copaiva is reported as being less unpleasant to take than the ordinary kind, and to be active, though less so than the other. Peckolt states that the pods of *C. nitida* Mart., which has black seeds, contain nearly 20 per cent. of a soft resin having the odor of copaiba, and are successfully used by Brazilian herbalists in the treatment of gonorrhœa.

Hardwickia pinnata Roxb. (Fam. *Leguminosæ*) is a large East Indian tree, yielding from incisions a thick, dark-brown oleoresin, which in thin layers is greenish or wine-red, transparent but not fluorescent, and resembles copaiba in both odor and taste. Broughton (1872) obtained from it between 25 and 40 per cent. of volatile oil having the composition $C_{10}H_{16}$, the remainder consisting of several resins, but copaivic acid was not obtained.

Dipterocarpus alatus Roxb., *D. turbinatus* Gærtn. (*D. lævis* Ham.), *D. incanus*, Roxb. (*D. costatus* Gærtn.), and several other species of the same genus (Fam. *Dipterocarpaceæ*) which are indigenous to various parts of India, the East Indian and the Philippine Islands, yield *gurjun balsam* or *wood-oil*, obtained by cutting large holes into the lower part of the stem and charring the wood, after which the oleoresin flows abundantly. It is a viscid liquid, varying in color from greenish-gray to brownish, opaque in reflected light, but transparent and of a dark-brownish or reddish tint when viewed in transmitted light; its odor is similar to but weaker than that of copaiba, and its taste is more bitter and somewhat aromatic, but not acrid. It is freely soluble in chloroform, carbon disulphide, and volatile oils, but only partly soluble in alcohol, fusel oil, ether, and petroleum benzin. When strongly agitated with water, gradually added until 5 parts have been used, gurjun balsam furnishes a very thick emulsion, which does not become clear on warming, but on the addition of the same bulk of water the balsam separates, and the clear watery liquid has a bitter taste and an acid reaction (Flückiger). When heated in a stoppered vial to near 130° C. (266° F.) it has the curious property of becoming gelatinous, the fluidity not being restored on cooling. The amount of volatile oil present in gurjun balsam varies considerably: Werner (1862) obtained 16 per cent., Flückiger 45.5 per cent., and from one specimen even 72 per cent.; it is strongly lævogyre, and has the composition $C_{15}H_{24}$, the density 0.9044 to 0.918 at 15° C. (59° F.), and the boiling-point at 255° C. (491° F.). The resin left after distillation of the volatile oil yields to caustic potassa *gurjunic acid*, $C_{22}H_{34}O_4$, which may be obtained pure by adding to the potassa solution an excess of ammonium chloride, filtering, and decomposing with hydrochloric acid. Gurjunic acid dissolves readily

in ether and strong alcohol, slowly in benzene, and with difficulty in carbon disulphide; it melts at 220° C. (418° F.), and congeals again at 180° C. (356° F.). A crystalline neutral resin of gurjun balsam, which had been sold as copaivic acid, was found by Flückiger (1878) to have the composition $C_{28}H_{46}O_2$, to melt at 126° C. (258.8° F.), and to dissolve in sulphuric acid with an orange color.

Lagam Balsam, *Minjak-lagam*, comes from an unknown tree in Sumatra, and closely resembles gurjun balsam. Examined by Haussner (1883), it was dingy-green in reflected and yellowish-transparent in transmitted light, had a bitterish and lastingly acrid taste, and was completely soluble in alcohol, ether, benzene, chloroform, and carbon disulphide; it yields about 33 per cent. of lævogyre volatile oil of the composition $C_{20}H_{32}$, and boils at about 250° C. (482° F.). The acid resin is uncrystallizable, and has the composition $C_7H_{14}O_3$; the neutral resin, fused with potassa, yields phenols and formic, acetic, butyric, and aromatic acids.

CORIANDRUM, *U. S.*—Coriander.

Coriandri fructus, Br.—*Coriander-fruit* ("*seed*"), E.; *Koriander*, G.; *Coriandre*, Fr.; *Cilantro*, *Culantro*, Sp.; *Coentro*, Port.; *Semina Coriandri*, Dan.

The dried ripe fruit of *Coriandrum sativum* L. (Fam. *Umbelliferæ*).

Fig. 144.

Coriandrum: fruit and longitudinal section, magnified 3 diameters; transverse section, magnified 8 diameters.

Origin.—A smooth, branching annual, native of Asia, very widely and extensively cultivated for its fruit, and naturalized in many temperate and warm-temperate regions. It has decompound leaves and compound naked umbels of white or rose-colored flowers. It emits an offensive odor of bedbugs, whence its name. This statement is especially true of the young plant, and pertains also to the young fruit. In that condition the fruit yields a very small amount of volatile oil, which also partakes of this odor. Russia produces the bulk of the crop. The earliest is from Morocco, being marketed in London in July and August, a month or two ahead of the Russian.

Description.—Of 2 united carpels; globular, 4 to 5 Mm. ($\frac{1}{6}$ to $\frac{1}{5}$ In.) in diameter, pale brownish-yellow, bearing 5 short calyx-teeth and a short stylopodium; each carpel bears 5 indistinct wavy ribs and 4 more prominent filiform ones, their interspaces nearly smooth; pericarp with 2 oil-tubes upon the inner, more or less concave side; odor and taste aromatic, mild, and pleasant.

Indian coriander constitutes a distinct commercial variety, recognized by its ovoid form.

Constituents.—Trommsdorff obtained from coriander nearly 0.5 per cent. of volatile oil (see Oleum Coriandri), and 13 per cent. of fatty matter, besides a small amount of mucilage, malic acid, and traces of tannin.

Action and Uses.—Coriander is a mild stimulant and aromatic. It is rarely employed in medicine alone, but is combined with other remedies either to aid in their absorption or to render them more agreeable to the taste. The drug is used by the laity as a condiment, and is believed to aid in the digestion of pastry. The dose is from 20 grains to 1 drachm (1.3–4 Gm.).

CORNUS.—Cornus.

Dogwood, Flowering, American, Virginia, or Florida dogwood bark, New England, American, or False boxwood, Flowering or White cornel, E.; *Grossblütige Kornel, Hornbaum*, G.; *Cornouiller a grandes fleurs*, F.

The dried bark of the root of *Cornus florida* L. (Fam. *Cornaceæ*).

Origin.—A small and beautiful tree of the eastern United States, valued for its ornamental properties and for its hard and fine-grained wood, used to substitute boxwood, as well as for its medicinal properties. The showy inflorescence, commonly mistaken for the flower, with its 4 large white or purplish (in one variety rose-colored) bracts, here figured, has similar properties to those of the bark, and is much used in country practice, steeped in gin or other spirit. The red drupaceous fruits are also used.

Description.—In short quilled pieces or irregular curved chip-like fragments, rarely exceeding 5 Cm. (2 In.) in any direction and 1 to 4 Mm. ($\frac{1}{25}$ to $\frac{1}{8}$ In.) thick; externally of a dirty-brown color, thinly and lightly fissured, sometimes thinly scaly, usually with a few short, transverse ridges, or, if the corky layer has been removed, reddish and without fissures or ridges; inner surface red-purple, with very numerous short, broad striæ, and somewhat

harsh to the touch; fracture short, light purple in the inner layer, otherwise whitish, with yellow striæ of stone-cells; nearly odorless, astringent, and bitter.

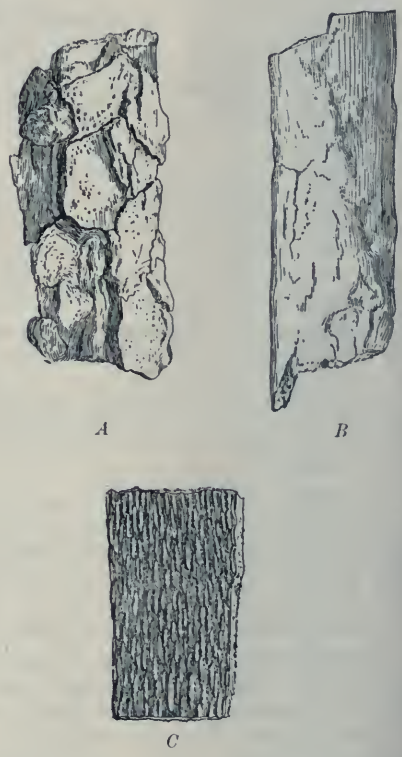
The stem-bark, which is frequently substituted, is in quills or quilled strips, reaches a greater thickness, is externally dark gray or blackish, deeply fissured and very scaly (or if very young smoothish, with some warts and oblong white spots), reddish brown if the corky layer has been removed; internally very finely short striate and harsh to the touch; fracture as in the root-bark, but the inner purple layer relatively thinner and distinctly white-radiate; taste more bitter.

The powder is of a reddish-brown color, and exhibits pitted stone-cells of very variable form, rarely exceeding 50 mikrons in breadth, bast-fibers mostly about half as thick and abundant calcium oxalate crystals, some single and large, others smaller and forming rosettes.

FIG. 145.

Dogwood: twig and inflorescence (½ Nat.).

FIG. 146.



Cornus: *A*, stem-bark; *B*, root-bark; *C*, inner surface of root-bark (*A* and *B*, Nat.; *C*, × 4).

Constituents.—The bark contains a bitter principle, *cornin* or *cornic acid*, crystallizing in silky needles, and soluble in water, alcohol, and ether. The other constituents are a tasteless resinous body, soluble in ether and hot alcohol, and insoluble in water; a bland, odorless, orange-colored fixed oil; gallic acid; and 3 per cent. of tannin. The "cornin" of the eclectics is a resinous extract.

Pharmaceutical Preparation.—FLUIDEXTRACT OF CORNUS, N. F.

Action and Uses.—Dogwood is a mild astringent, aromatic bitter, and stomachic. Formerly it was considered an antiperiodic, and was given in doses of from ½ to 1 ounce (16–30 Gm.) of the powdered drug between the paroxysms, in the treatment of mild malarial affections; but this use of it is now practically abandoned. As a simple bitter, it may be given in doses of from 15 minims to 1 fluidrachm (1–4 Cc.) of the fluidextract at meal-time. The other species of dogwood are bitter, astringent, and in large doses emetic.

Other Species.—The genus contains some 25 species of the north-temperate zone, a few extending into tropical mountains. All have a similar taste to the above, and probably share in its properties, and the following have been more or less extensively used like it:

C. CIRCINATA L. Herit, the *Round-leaved dogwood* or *Cornel*, of the same region as the official, is a slender shrub, forming copses. Its flowers lack the involucre of *C. florida* and the

fruit is light blue. The bark occurs in small, short quills or irregular small pieces, is only about 1 or 2 Mm. ($\frac{1}{25}$ or $\frac{1}{12}$ In.) thick, externally greenish, and with scattered light brown warts when young, brownish gray with the lighter-colored warts confluent in irregular lines or ridges when older. The inner surface is cinnamon brown and very finely striate. The fracture is short and even, the inner layer pale-reddish. Fluid extract of Cornus Circinata is official in the N. F.

C. Amomum Mill. (*C. sericea* L.), the *Swamp* or *Silky cornel*, *Red osier*, or *Kinnikinnick*, has a somewhat more extensive range than either of the others, and grows similarly in low places, especially along streams and on the borders of swamps. It is rather smaller than the last, and its stems are bright-red and the fruits bluish-white. The bark occurs in pieces much like those of the last, but are of a red-purple color and either quite smooth or less warty than that.

The bark of *C. stolonifera* Mx. is known by the same common names as the *C. Amomum*, closely resembles it, and is similarly used.

C. mascula L., of Europe, the *Cornelian cherry*, *Kornelkirsche*, *Dürlitze*, *Herlitze*, or *Corniola* (It.), and the *C. Canadensis* L., of North America, the *Low* or *Dwarf cornel*, *Bunchberry*, *Bunch-plum*, or *Crackerberry*, only a few inches high, but with inflorescences much resembling those of *C. florida*, yield fruits which are eaten to some extent.

Cornaceæ (*the Cornel or Dogwood Family*).—This small family (genera 15, species about 100) of shrubs and trees, growing in temperate regions, including high tropical mountains, is characterized by the possession of bitter constituents, properties, and uses, similar to those of cornus, on account of which several of them have become recognized as meritorious drugs. *Garrya*, the leaves and to some extent the bark, of *G. Fremontii* Torr., the *California fever-bush*, or *Skunk-bush*, an opposite-leaved evergreen shrub or small tree, with quadrangular branches, of the Pacific coast and Rocky Mountain region, is there extensively and successfully employed as a bitter tonic and mild antiperiodic. These leaves are shortly petioled, 2.5 to 8 Cm. (1 to 3 In.) long, and about as broad, oblong to ovate, narrowed at each end, and commonly mucronate, entire. They have a slight odor and are very bitter. The bitter constituent is said to be an alkaloid, *garryine*. The fluid extract is administered in doses of from 15 to 30 minims (1 to 2 Cc.). The bark, root, and leaves of *Alangium Lamarckii* Thw. (*Dhera*, *Akola*, or *Ankul*, *Alangi*, etc.), a small tree of India, contains the alkaloid *alangine*. This drug is a powerful bitter tonic, and is somewhat antiperiodic; emetico-cathartic in large doses, as is also the bark of *A. acuminatum* W. et A.

The wood of the root of several species of *Nyssa* L., of the southern United States, especially *N. aquatica* L. (*N. uniflora* Wang.), the large or *Swamp tupelo*, *Cotton*, *Black*, or *Sour gum*, of the Gulf States, has been considerably used as a substitute for sponges or laminaria in the making of uterine tents.

COTO.—Coto Bark.

The bark of an unknown tree (Fam. *Lauraceæ*) of northern Bolivia.

Origin.—The tree is a good-sized one, apparently of very local distribution along the lower portion of the La Paz River. A specimen seen by the writer in 1886 consisted of a lance-oblong leaf, nearly a foot long, and a large acorn-like fruit, similar to those of Nectandra and related genera.

Description.—In curved pieces of indefinite length (longitudinal sections of quills), and mostly 4 to 6 Cm. (about $1\frac{1}{2}$ to $2\frac{1}{2}$ In.) broad, the bark 0.5 to 1.5 Cm. (about $\frac{1}{4}$ to $\frac{1}{2}$ In.) thick, hard and heavy, of a deep-brown on both surfaces; outer surface smoothish, with a few very slight transverse fissures, occasionally transverse ridges, and a slight, thin scaliness, apparently having suffered the removal of most of the corky layer; inner surface very coarsely striate, but compact; fracture rather weak in view of the thickness, the outer half earthy, with an inner irregular and interrupted dark-red resinous band, the inner half coarsely long-splintery, of dark resin-tissue mixed with light-brown or yellowish bast-fibers and stone-cells; odor strongly and peculiarly aromatic; taste aromatic, at first merely pungent, then quickly peppery-biting.

In the powder, the large lemon-yellow stone-cells and thickened medullary-ray cells are characteristic; also the coarsely granular oil-globules in the parenchyma-cells (Schneider).

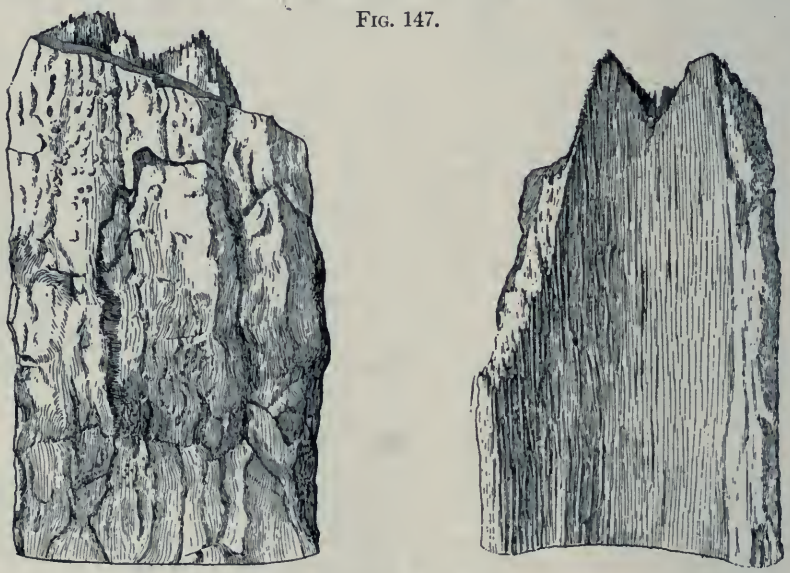
Constituents.—*Coto bark* yields a pale-yellow, aromatic, volatile oil of peppery taste, a volatile alkaloid, probably *propylamine*, *cotoin*, *phenyl-coumalin*, resin, starch, and *piperonylic acid* ($C_8H_6O_4$). *Cotoin* ($C_{14}H_{12}O_4$) crystallizes in light yellowish-white acrid and sternutatory prisms and plates, nearly insoluble in cold water, and soluble in boiling water, alcohol, ether, and chloroform. "Dicotoin" is a mixture (Hesse).

Substitutes.—The original and genuine coto bark has been greatly discredited by a number of inferior substitutes. It is now almost unobtainable, being replaced by Para-coto bark, itself of great and similar value, though distinctly inferior to coto.

Para-coto bark, its origin unknown, but evidently closely related to coto, also comes from Bolivia, but is more widely distributed and abundant than coto. Its appearance is closely similar, though it is usually thicker, and is covered, at least partly, by a silvery-gray soft periderm. Schneider finds the only histological distinction from coto to be the absence of the coarse oil-globules referred to above. Its taste offers the best mark of distinction, in that, while pungent, it lacks the secondary peppery-biting taste of coto, and has a distinct flavor which has been compared with that of nutmeg. It contains (Ciamician, Silber and Hesse, 1895) piperonylic acid, hydrocotoin ($C_{15}H_{14}O_4$), paracotoin ($C_{12}H_8O_4$), protocotoin ($C_{16}H_{14}O_6$), methyl-hydrocotoin ($C_{16}H_{16}O_4$), and methyl-protocotoin ($C_{17}H_{16}O_6$). Former analyses gave paracotoin ($C_{19}H_{12}O_6$), leucotin ($C_{34}H_{32}O_{10}$), oxyleucotin ($C_{34}H_{32}O_{12}$), hydrocotoin ($C_{15}H_{14}O_4$), and dibenzoyl-hydrocotoin ($C_{32}H_{32}O_8$).

Cotoin may be obtained by extracting coto bark with ether, recovering the bulk of solvent by distillation, and precipitating the resinous matter present in the residue by addition of ligroin or benzin. The clear liquid is decanted and allowed to evaporate spontaneously. The crude cotoin thus obtained may be crystallized from its solution in hot water or from alcohol or chloroform. It occurs in the form of pale-yellow needle-shaped crystals, which melt at 130° C. (266° F.) and are sparingly soluble in cold water, but readily soluble in alcohol, ether, chloroform, benzene, carbon disulphide, and acetone.

FIG. 147.



Para-coto bark (Nat.).

It is insoluble in benzin. Cotoin reduces silver nitrate solutions in the cold and Fehling's Solution when heated. If strong nitric acid be added to a solution of cotoin in glacial acetic acid, a blood-red color is produced.

Paracotoin may be extracted in a similar manner, and occurs in the form of pale-yellow glistening laminæ, which melt at 155° C. (311° F.). It resembles cotoin in behavior to different solvents, but is insoluble in benzene. Commercial paracotoin is usually contaminated with oxyleucotin, to which is due the yellow color changing to green when strong nitric acid is added to a solution of paracotoin in glacial acetic acid.

Pharmaceutical Preparations.—FLUIDEXTRACT OF COTO, N. F.; TINCTURE OF COTO, N. F.

Action and Uses.—In moderate amounts, coto bark acts as a tonic and stomachic. Overdoses produce gastro-intestinal irritation with severe pain and vomiting. The powder when locally applied is said to act as a mild counterirritant.

It is stated by those who have used it most, that coto may be successfully employed in the treatment of diarrhœa, particularly that following enteric fever, or that accompanying tubercular ulceration of the intestine. It has been reported to be efficacious in the treatment of cholera infantum, and has been proposed as a remedy for Asiatic cholera. Its chief, if not its sole, medicinal virtue consists in its checking diarrhœa of the atonic sort and without regard to its origin, but it is probable that it is harmful in

acute inflammatory conditions. Cotoin has been employed in the above conditions in the dose of ¾ grain (0.04 Gm.) subcutaneously.

Coto bark is not conveniently given in powder on account of its persistently acrid taste, but the proper dose is stated to be from 3 to 5 grains (0.20–0.30 Gm.), given 3 or 4 times a day. Cotoin has been given in doses of from 1 to 3 grains (0.05–0.20 Gm.), 3 times a day.

The tincture, made with 1 part of the bark and 8 parts of alcohol, and given in the dose of 2 fluidrachms (8 Cc.), sufficiently diluted, has been found the most convenient preparation. The fluidextract may be given in the dose of from 5 to 20 minims (0.3–1.3 Cc.).

Para-coto bark may be employed for the same purposes as coto bark. It is stated that paracotoin has been successfully used in the treatment of Asiatic cholera when administered subcutaneously in doses of 3 grains (0.20 Gm.).

Schuchardt has announced a coto bark from a species of *Drimys*, but its only relation to coto is in its name. It is bitter and mucilaginous, as well as aromatic, and evidently to be classed with the magnolia group.

CRASSULACEÆ.—The Cress Family.

Genera 13, species more than 400, fleshy and succulent plants of wide distribution, growing especially upon and among rocks. A few have been used as salads and potherbs. Because of their striking appearance, growing commonly with a dense rosette of thick, fleshy, radical leaves, they are naturally objects of conjecture and superstition. The belief is very common among the European peasantry that the growth of certain of them upon the roof-top protects against lightning-stroke, and marvellous stories of such protection are extant. Their mucilaginous properties adapt them for use as poultices, and many are so employed. These plants usually contain large amounts of malic acid. Many are active physiological agents, representing quite a wide range of activity. The commonest property and use are diuretic, the action being apparently wholly or chiefly local.

Sedum, or *Stonecarp*, is the herb *Sedum acre* L., of northern Asia and Europe, sparingly naturalized in the United States. It is designated as *Mossy* or *Biting stonecrop*, *Wall-* or *Poor-man's pepper*, *Pepper-crop*, *Wall-moss*, E.; *Mauerpfeffer*, *Steinkraut*, *Katzentraublein*, G.; *Poivre des murailles*, *Joubarbe acre*, Fr.; *Siempriviva menor*, Sp.; medicinally, as *Herba Sedi minoris* or *Herba illecebræ vermicularis*. It grows in patches, spreading by offsets, the erect stems being extremely short, and bearing spirally crowded leaves 3 to 6 Mm. (⅛ to ¼ In.) long, ovate, fleshy-thickened and convex on the lower surface, very smooth, punctate. The inflorescence is upon a short scape, branched above, the flowers nearly sessile on the upper sides of the somewhat recurved branches, the sepals, yellow petals and pistils each 5, the stamens 10. The drug is inodorous, mucilaginous, and acrid. It is said to contain rutin (see RUTA) and an amorphous non-volatile alkaloid, soluble in alcohol but not in water, as are its salts, to which the disagreeable and acrid taste is due. The biting taste is probably referable in part to a small amount of resin. This drug, applied externally, acts as a rubefacient and may even cause blistering. Internally, it is administered as a very active local and diffusive stimulant, diuretic, antiscorbutic, and generally as an alterative, and is in overdose a strong emetico-cathartic. It has distinct aphrodisiac properties. It is claimed to have been used with success for solution of the diphtheritic membrane, though no proteolytic enzyme has been reported. Similar properties appear to pertain to *S. Telephium* L. (*S. vulgare* Link, *S. purpureum* Haw.), the *Garden orpine*, *Live-for-ever*, *Bagleaf*, *Frog's bladder*, *Witch's Moneybags*, *Fetthenne*, *Grassette*, *Joubarbe des vignes;* medicinally employed under the names *Herba telephii*, *fabariæ*, or *crassulæ majoris*. It is native of the same regions as the last, and is naturalized as a troublesome weed in some parts of the United States. Belonging to the same medicinal group are *S. album* L., *S. sexangulare* L., and *S. boloniense* Lois., and doubtless very many other of the 150 species of this interesting genus; also *Sempervivum tectorum* L., the *European house-leek*, *Bullock's eye*, *Fone*, *Hen-and-chickens*, *Thunder-plant* (*Donnerkraut*), *Hauslauch*, *Dachlauch*, *Grande joubarbe*, *Siempreviva major;* medicinally known as *Herba siempreviva* or *sedi majoris;* *S. arboreum* L. and *S. montanum* L., the last named being a strong purgative. *Crassula portulacea* Lam., of the Cape of Good Hope, is, on the other hand, employed as an antidiarrhœal remedy. *Kalanchœ laciniata* DC. is applied to the temples for headache, in India, and is also a much-used vulnerary under the names *Parna-vija*, *Hemsager*, *Ghaipat*, and *Malakulti*. A number of the (nearly 100) species of *Cotyledon* L. are employed like *Kalanchœ* as vulneraries, *C. serrata* L. being in commerce in China under the name *Tau-shang-yoh*. *Bryophyllum calycinum* Salisb. (*Kalanchœ p.* Pers.; *Cotyledon pinnata* Lam.; *C. rhizophylla* Roxb.), widely distributed through tropical countries and marketed in India under the names *Airwan* or *Mairwan* and *Ghaimari*, is largely employed as a diuretic, as is also *Cotyledon lusitanicus* Lam. (*Umbilicus erectus* DC.).

Penthorum, the *Virginia* or *Ditch stonecrop*, is a very common herb of ditches and other moist localities throughout eastern North America, and is an important drug among the eclectics. Description: Smooth; stem about 3 Dm. (1 Ft.) long, usually simple except above; leaves very short-petiolate, scattered, 5 to 7 Cm. (2 to 3 In.) long and one-third as

wide or less, lanceolate, acuminate and acute, sharply serrate, smooth and thin; flowers small, greenish, along the upper sides of several slender branches of the terminal cyme, short-pedicelled, 5-merous like the sedum above described. It is almost odorless and has only a slightly astringent taste. No constituent other than tannin has been isolated from it. Its use is purely empirical, chiefly in catarrhal conditions, and its value is highly problematical.

CREOSOTUM, *U. S.*, *Br.*—Creosote.

Kreosotum, P. G.—*Créosote*, Fr.; *Kreosot*, *Buchenholztheerkreosot*, G.; *Creosoto*, It.

A mixture of phenols and phenol derivatives, chiefly guaiacol and creosol, obtained during the distillation of wood-tar, preferably of that derived from the beech, *Fagus sylvatica* L. or *Fagus ferruginea* Ait.—U. S.

A mixture of guaiacol, creosol, and other phenols, obtained in the distillation of wood-tar.—Br.

Preparation.—Wood-tar is distilled until about one-half is passed over and dense vapors of paraffin, etc., make their appearance. The distillate separates into a heavy and a light oily layer, with an intervening aqueous stratum of an acid reaction. The light oil contains *eupion*. The heavy oil is treated with a concentrated solution of sodium carbonate, and the separated oily liquid is distilled, that portion of the distillate only being collected which is heavier than water. This distillate is treated with potassium hydroxide solution, specific gravity 1.12, whereby the creosote is dissolved and *eupion* separated. The potassium hydroxide solution is now supersaturated with sulphuric acid, and the precipitated creosote well washed with water and rectified, the product distilling at 200°–220° C. (392°–428° F.) being collected. The treatment with potassium hydroxide and sulphuric acid is repeated until the potassium creosote solution does not turn brown on being heated in the air.

To obtain creosote from crude pyroligneous acid, the oily constituents are first separated by saturating the crude acid with sodium sulphate at about 70° C. (158° F.), and while warm skimming off the supernatant layer. The cold thick oil is distilled, treated with sodium carbonate, and further purified as above.

Creosote is a mixture of phenoloid compounds, principally of the series of acid methylic ethers of catechol and its homologues, and varies in composition according to the method of its preparation and the wood from which it is prepared. According to Voelckel, it is the product of the incrusting layers of the cells rather than of the cellulose. It was prepared first by Reichenbach (1830), and in 1867 Gorup-Besanez recognized the principal constituents of beechwood-tar creosote as *guaiacol*, $C_7H_8O_2$ or $C_6H_4.OCH_3OH$, and *creosol*, $C_8H_{10}O_2$ or $C_6H_3.CH_3.OCH_3.OH$; both are oily liquids having the general properties of creosote, the former boiling at 200° C. (392° F.), the latter at 219° C. (426.2° F.). Heated with hydriodic acid, both yield methyl iodide, and in addition thereto *pyrocatechin*, $C_6H_4(OH)_2$, is produced by the former, and by the latter a non-crystallizing body isomeric with orchin, $C_7H_8O_2$. Tiemann and Mendelssohn (1876) proved also the presence of *xylenol* or *phlorol*, $C_6H_{10}O$, which previously had been supposed to exist in it and in impure carbolic acid. They dissolved the portion obtained by fractional distillation near 220° C. (428° F.) in ether, and added concentrated potassium hydroxide solution, whereby its compound with creosol was separated, while the phlorol remained in the mother-liquor. Reimer observed (1876) that guaiacol, treated with chloroform and sodium hydroxide, and afterward with an acid, is converted into *vanillin*, the aldehyde of *vanillic acid*, which latter was obtained from creosol by converting it first into acetyl-creosol and oxidizing this with potassium permanganate (Tiemann and Mendelssohn, 1877). Besides the three principles named, others are likely to be present in creosote from different sources, such as *methyl-creosol*, $C_9H_{12}O_2$ (boiling-point 215° C. = 419° F.), and *methyl-guaiacol*, $C_8H_{10}O_2$ (boiling-point 205° C. = 401° F.). The cresols and phenols boiling below 200° C. (392° F.) should be absent.

Attention must be called to the fact that the pharmacopœial creosote is the product of the dry distillation of *wood*, and that it should not be confounded with the substance occasionally offered as "coal-tar creosote," prepared from coal, as the latter is of a different composition and poisonous, and should never be used in medicine or pharmacy. Beechwood creosote is richer in guaiacol than that obtained from the wood of the oak. Behal and Choay (*Rep. de Pharm.*) found the distillates obtained at 200°–210° C. (392°–410° F.) from beechwood creosote and that from oak to contain respectively 39 and 55 per cent. of monovalent phenols, 26.4 and 14 per cent. of guaiacol, and 32 and 31 per cent. of creosol and its homologues.

Properties.—Creosote is a colorless to yellowish (not pinkish), highly refractive, oily liquid having a penetrating, smoky, aromatic odor, a pungent, burning taste, and a neutral, only faintly acid, reaction to litmus-paper. Its specific gravity should not be below 1.072 at 25° C. (77° F.), U. S.; at 15° C. (59° F.), 1.080, P. G.; 1.079, Br. It is soluble in about 140 parts of water at 25° C. (77° F.), but without forming a perfectly clear solution. With 120 parts of hot water it forms a clear liquid, which becomes turbid on cooling and separates oily droplets. The filtrate from these oily globules yields a reddish-brown precipitate with bromine test-solution (distinction from phenol and so-called coal-tar creosote, both of which yield white precipitates). It is soluble in all proportions in absolute alcohol, ether, chloroform, benzin, carbon disulphide, acetic acid, fixed and volatile oils. It dissolves a considerable proportion of iodine, phosphorus, and sulphur. It begins to boil at about 200° C. (392° F.), and most of it distils over between 200° and 220° C. (392°–428° F.), U. S., P. G., Br. When cooled to —20° C. (—4° F.), it becomes gelatinous, but does not solidify (difference from phenol), It is inflammable, burning with a luminous, smoky flame. It takes up 50 per cent. of glycerin or 15 per cent. of ammonia, specific gravity 6.940. When agitated with an equal bulk of ammonia water it separates unchanged on standing, but it dissolves in potassium or sodium hydroxide solution, the liquid becoming discolored when exposed to air, and giving off creosote when heated to boiling. Heated with ammonia-water to 60° C. (140° F.), then spread over a porcelain surface and subjected to the action of bromine vapors, a brown to green color is developed (phenol produces a blue color). It causes precipitates with solutions of gum and albumen, but not with gelatin, and does not render collodion gelatinous (difference from phenol). It is an antiseptic and preservative; it is owing to the presence of creosote in the smoke of burning wood that smoked meats have their keeping qualities prolonged. Creosote reacts violently with strong nitric acid. Sulphuric acid dissolves creosote with a red color, gradually changing to purple violet. With concentrated hydrochloric acid it produces a deep-red color which in contact with air changes to brown or black.

Tests.—1 Gm. should dissolve clear in 120 parts of hot water, and the solution turn turbid or milky on cooling to 15° C. (59° F.) (excess of phenols would increase the solubility). The specific gravity should not be below 1.075. One or two drops placed upon blue litmus-paper should not redden it even after moistening it with water. On mixing equal volumes of creosote and collodion in a dry test-tube, no permanent coagulum should form. If 1 volume of creosote be mixed with 1 volume of glycerin, a nearly clear mixture will result, from which the creosote will be separated by the addition of one-fourth volume of water. On adding to 10 Cc. of a saturated aqueous solution of creosote 1 drop of ferric chloride test-solution, the liqutd will acquire a violet-blue tint which rapidly changes to greenish and brown, with formation, usually, of a brown precipitate. (The three preceding tests show difference from phenol and so-called coal-tar creosote, and limit of the former.) On mixing 2 Cc. of creosote with 10 Cc. of normal solution of sodium hydroxide, a clear, pale-yellowish liquid results, which becomes turbid when diluted with water, but clears up after 50 Cc. have been added (absence of neutral oils). If 1 Cc. of creosote be mixed with a 20 per cent. solution of potassium hydroxide in absolute alcohol, a solid crystalline mass will form upon cooling. If 1 Cc. of creosote is shaken with 2 Cc. of petroleum benzin and 2 Cc. of freshly prepared barium hydroxide test-solution, upon separating, the benzin should not be blue or muddy, and the aqueous layer should not have a red tint (absence of cœrulignol and some other high-boiling constituents of wood-tar).—U. S. If creosote be shaken with 5 times its bulk of ammonia water (10 per cent.), its volume should not be diminished materially (distinction from phenol).—Br.

Excess of water may be determined by heating 10 Cc. of the creosote with 2 Gm. of crystallized calcium chloride until the salt melts, mixing the liquids and cooling thereafter. In presence of water the calcium chloride does not again solidify.

Frŏhde's reagent, prepared by dissolving 1 part of molybdic acid in 1000 parts of sulphuric acid, has been found by E. W. Davy (1878) to be a reliable test for detecting an admixture of carbolic acid in creosote, the former producing with the reagent a yellowish or brownish tint, passing into maroon or reddish-brown, and finally into beautiful purple; the latter causes a brown or reddish-brown color, which becomes fainter, and finally light yellowish-brown. The test is applied by adding 1 or 2 drops of the aqueous solution of the substance to 3 or 4 drops of the reagent; warming the mixture gently will hasten the production of the final coloration. If the creosote contains but a small

quantity of carbolic acid, 10 drops of it are dissolved in ½ ounce of water and the solution distilled. The first portion of the distillate will give the creosote reaction, and the last portion that of carbolic acid.

The amount of guaiacol may be approximately determined as follows: 5 Cc. of the creosote are mixed with 50 Cc. of alcoholic potash (1 part of potassium hydroxide in 5 parts of absolute alcohol). The mixture solidifies in from 10 to 30 or 40 minutes according to the amount of guaiacol present. The crystalline mass is pressed between filter-paper, decomposed by warming with 5 Cc. of 10 per cent. sulphuric acid, water added until the mixture of creosol and guaiacol sinks, the aqueous solution poured off, and 4 Cc. of ammonia added. Guaiacol gives a hard crystalline mass, while creosol gives only semifluid scales after some time which are soluble in petroleum spirit, while the guaiacol compound is insoluble (Merklen).

Pharmaceutical Preparation.—Creosote Water, U. S. P.

Action and Uses.—Creosote is employed in medicine for several purposes. The most important of these is as a remedy in pulmonary tuberculosis. In this disease it has been thought to act as a curative agent, but as a matter of fact its influence over the tubercular process is very limited, and it does good chiefly by acting as a stimulating expectorant and by relieving the associated bronchitis. Usually, large doses are required to control the cough, and these are apt to irritate the stomach. Creosote has been given by the rectum in cases of tubercular peritonitis, but this practice is rarely resorted to.

As creosote acts as an antiseptic, it has been used as a remedy in fermentative dyspepsia and diarrhœa, with good results in some cases. Owing to its anæsthetic properties, it may be used in obstinate vomiting due to irritability of the stomach.

The dose varies from 1 to 20 minims (0.05–1.30 Cc.), according to the needs of the case; it may be given in capsule, in wine, in milk, and in other vehicles.

When poisonous doses of creosote are taken, the patient suffers from all the symptoms of carbolic acid poisoning (see Carbolic Acid), and the treatment is identical with that instituted for poisoning by that drug, the chief antidote being any soluble sulphate, such as sulphate of magnesium. (See also Guaiacol.)

COMPOUNDS OF CREOSOTE.

Creosoti Carbonas. *Creosote carbonate, Creosotal,* E.; *Kreosotkarbonat,* G.—Creosote carbonate is prepared by conducting a current of carbon oxychloride into a solution of creosote in sodium hydroxide solution. The oil which separates is washed with a dilute aqueous solution of sodium hydroxide and finally with water. It is a thick, yellowish, oily liquid, quite odorless and tasteless, insoluble in water, soluble in ethyl, methyl, and amyl alcohol, chloroform, and benzene. Boiled with potassium hydroxide solution the odor of creosote is evolved. Creosote carbonate contains the equivalent of 90 parts of beechwood creosote. This is a useful substitute for creosote, being less irritating. Some practitioners assert that it is most valuable in croupous pneumonia. Its dose is from 5 to 10 grains (0.30–0.60 Gm.).

Creosoti Oleas. *Creosote oleate,* E.; *Oelsaures Kreosot, Oleokreosot,* G.—A light-yellowish oily liquid, quite odorless, insoluble in water, difficultly soluble in 90 per cent. alcohol, readily soluble in absolute alcohol, ether, chloroform, benzene, and fixed and volatile oils.

Creosoti Phosphas. *Creosote phosphate. Phosote.*—This is prepared by allowing creosote and phosphoric anhydride to act upon each other in presence of sodium. A thick, syrupy mass results, which is washed with water and subjected to fractional distillation, and the fraction distilling between 190° and 203° C. (374°–397.4° F.) collected separately, dissolved in alcohol, and precipitated by addition of water. Creosote phosphate is a thick, oily liquid having an astringent, bitter taste. It is insoluble in water, glycerin, and fixed oils, but soluble in alcohol or ether. It contains 25 per cent. of phosphoric acid and 75 per cent. of creosote, into which constituents the ester is easily decomposed by treatment with solutions of alkali hydroxides.

Creosoti Tannas. *Creosal. Tannosal.*—Creosal is a tannic acid ester of creosote. It is a brown amorphous hygroscopic powder, having the odor of creosote, and is readily soluble in water, alcohol, and glycerin. It contains 60 per cent. of creosote and 40 per cent. of tannic acid.

Creosoti Valerianas. *Creosote valerianate. Eosot. Baldriansaures Kreosot,* G.—15 parts of creosote, 20 parts of valerianic acid, and 7 parts of phosphorus oxychloride are heated together until hydrochloric acid ceases to distil. The resulting ester is washed with 3 per cent. sodium hydroxide solution, dissolved in benzene, and recovered on evaporation of the latter. Creosote valerianate is a light-yellowish oily liquid, having an odor suggestive of creosote and valerianic acid, boiling at about 240° C. (464° F.), and is insoluble in water, but soluble in alcohol, ether, and fixed and volatile oils.

Phosphotal. *Phosphatal.*—Trade name for the esters of creosote with phosphorous acid.

CRESOL, *U. S.*—Cresol.

Cresolum, Cresolum purum.—Cresylic acid, Methylphenol, Tricresol, Oxytoluene, E.; *Cresol,* Fr.; *Kresol, Trikresol, Enterol,* G.

Formula, C_7H_7OH or $C_6H_4(CH_3)OH$. Molecular weight, 107.25.

A mixture of the three isomeric cresols obtained from coal-tar, freed from phenol, hydrocarbon, oils, and water. It should be preserved in amber-colored bottles protected from light.—U. S.

Preparation.—Cresol is prepared commercially from the "phenol" distillates of coal-tar obtained between 140° and 220° C. (284°–428° F.). The phenols are dissolved in sodium hydroxide solution, and by careful dilution with water and the addition of a limited amount of hydrochloric or sulphuric acid most of the hydrocarbons (benzene, naphthalene, toluene, etc.) and tarry matter are separated. To the clarified filtrate a further limited amount of hydrochloric acid (insufficient to liberate the carbolic acid) is added, and the precipitated cresols separated from the carbolic acid, which remains in solution. The product is "crude carbolic acid," although not identical with the article sold under that name in this country, and for further purification is redissolved in sodium hydroxide solution, subjected to fractional precipitation with hydrochloric acid as above, and the precipitated acids finally fractionated by distillation between 180° and 200° C. (356°–392° F.), the product constituting crude *cresol* (*Cresolum crudum—Rohes Kresol,* P. G.). By further purification and subsequent distillation between 190° and 205° C. (383° and 401° F.) the official article may be obtained.

Properties and Tests.—Official cresol occurs as a colorless or straw-colored refractive liquid, having a phenol-like odor and turning yellowish brown on prolonged exposure to light. Its specific gravity is 1.032 at 25° C. (77° F.). It is soluble in 60 parts of water at 25° C. (77° F.); miscible in all proportions with petroleum benzin, benzene, alcohol, ether, and glycerin. Also miscible with alkali hydroxide solutions. Cresol boils at from 195° to 205° C. (383°–401° F.). If 1 Cc. of cresol be mixed with 1 Cc. of an aqueous solution of sodium hydroxide (1 in 10), it should dissolve with no appreciable liquid residue (absence of or limit of hydrocarbon oils). If 1 Cc. of cresol be mixed with 1 Cc. of glycerin, a clear solution should be produced, from which, on the addition of 1 Cc. of water, the cresol should completely separate (absence of and distinction from phenol).—U. S

Cresol is composed principally of the 3 isomers *ortho-*, *meta-*, and *paracresol*, represented by the formula C_7H_8O or $C_6H_4CH_3OH$, and to which the names cresylic acids, cresylic hydrates, methyl-hydroxybenzene have also been applied. *Metacresol* is a liquid which boils at 201° C. (393.8° F.), but does not solidify even at —80° C. (—112° F.), and is convertible into meta-hydroxybenzoic acid by fusion with potassium hydroxide. *Orthocresol* and *paracresol* form colorless prisms with phenol-like odor, and dissolve sparingly in water; both give a blue color with ferric chloride. Orthocresol melts at 31° C. (87.8° F.), boils at 185° C. (365° F.), and by prolonged heating with potassa is converted into salicylic acid. Paracresol melts at 36° C. (96.8° F.), boils at 198° C. (388.4° F.), and by heating with potassa is converted into paraoxybenzoic acid. The 3 cresols are variously affected by the oxidizing ferment of mushrooms, orthocresol being oxidized with the formation of a greenish-brown liquid and a dull-green precipitate, soluble in ether; paracresol forming a red liquid which afterward turns green, the coloring-matter being insoluble in ether; metacresol yields a rose-white precipitate soluble in alcohol (Bourquelot).

The crude cresol of the P. G. is a clear liquid of yellowish to yellowish-brown color, and having an empyreumatic odor. It has a neutral reaction, is heavier than water, and is imperfectly soluble in water, but soluble in alcohol and ether. 10 Cc. of crude cresol shaken in a 200 Cc. cylinder with 50 Cc. of sodium hydroxide test-solution and 50 Cc. of water, should not separate more than a few flakes after standing some time; after adding 30 Cc. of hydrochloric acid and 10 Gm. of sodium chloride and thoroughly shaking the mixture, an oily layer measuring 8.5 to 9 Cc. should separate, 0.5 Cc. of the separated cresols shaken with 300 Cc. of water and 0.5 Cc. of ferric chloride solution should produce a blue-violet coloration.

The cresols possess strong disinfectant, antiseptic, and germicidal properties, the metacresol being the most powerful, while at the same time they are far less poisonous than

carbolic acid. In combination with sodium as sodium cresylate, C_7H_7ONa, which renders the cresols soluble in water, or by sulphonation with sulphuric acid, various combinations have been commercially introduced, as solveol, solutol, sapocresol, lysol, saprol, creolin, etc.

Action and Uses.—Cresol is an antiseptic whose uses are similar to PHENOL (which see). It is an ingredient of several proprietary antiseptic preparations.

PREPARATIONS OF CRESOL.

Creolinum. *Creolin*, E.; *Creoline*, Fr.; *Kreolin*, G.—Creolins are disinfectant and antiseptic soluble preparations of cresols (quite free from carbolic acid), rendered soluble by means of soap or by sulphonation with sulphuric acid. The former class is represented commercially by Pearson's (British) and the latter by Artman's (German) creolin. The methods for their preparation are trade secrets. Creolins of the Pearson type are reddish-brown to reddish-black syrupy liquids having a tarry odor, vary in specific gravity from 1.040 to 1.078, and form clear solutions with alcohol, ether, chloroform, benzene, benzin, etc. Published analyses by Weyl, Fischer, Beckurts, and Otto indicate the presence in the British creolin of about 60 per cent. of hydrocarbons boiling between 190° and 350° C. (384°–662° F.), 10 to 22 per cent. of phenols boiling between 200° and 300° C. (392°–572° F.), about 0.8 per cent. of pyridine bases, etc.; while a more recent analysis by Pfrenger gives the composition of Pearson's creolin as: phenols, 12.67; hydrocarbons, 44.94; organic bases, 2.76; sodium, 1.45; rosin, 32.45, etc.; and analyses of certain German-creolins show the latter to contain from 17 to 21 per cent. of rosin soap and about 56 per cent. of "30 per cent." carbolic acid. In both preparations the phenols are combined with an alkali (sodium or potassium), and the hydrocarbons are held in solution by the compounds thus formed. *Disinfectol*, *Izal*, *Entcrokresol*, and *Sapokarbol* belong to the same class. Artman's creolin contains less phenols, but a much larger percentage (85 per cent.) of hydrocarbons, and differs from the above class in being but little soluble in ether, and in depositing when refrigerated for some time hard white crystals of naphthalene, which are sublimable and melt at 79°–80° C. (174.2°–176° F.), boiling at 216°–218° C. (420.8°–424.4° F.). The sulphonated cresols are capable of holding free cresols in solution and form milky emulsions with water. Recent researches have shown sodium salicylate to be a good solvent of cresols. When added to water in the proportion of 2 per cent. creolin is a useful antiseptic in the lying-in state, being employed as a wash for the hands, and in those cases which require vaginal irrigation. It does not make a good solution in which to place instruments prior to operation, as it forms an opaque mixture with water, and so prevents them from being seen at the bottom of the pan in which they are placed.

Cresalol. *Cresol salicylate. Cresol salol.* $C_6H_4(OH)COOC_6H_4CH_3$. or $C_6H_4CH_3.C_7H_5O_3$.—When a mixture of sodium salicylate and sodium cresylate in molecular proportions is heated with phosphorus oxychloride, cresol salicylate or cresalol is obtained. Three isomers of this compound are possible, depending upon the use of sodium ortho-, meta-, or paracresylate. It is a crystalline powder, soluble in alcohol and ether, but insoluble in water. In its action and uses it resembles salol, which see. Dose, 5 to 30 grains (0.3–2 Gm.).

Cresin.—A brown clear liquid, soluble in water and alcohol, and obtained by dissolving 25 parts of cresol in 75 parts of solution of sodium cresoxylacetate. Used as a disinfectant.

Cresol Iodide. *Iodocresol. Traumatol.* C_7H_7OI.—Prepared by the action of a solution of iodine in potassium iodide upon an emulsion of cresol in water. A reddish-violet odorless amorphous powder containing about 55 per cent. of iodine, soluble in alcohol, oils, and alkaline solutions, difficultly soluble in ether, insoluble in water.

Cresol Triiodide. *Metacresol triiodide. Losophane, Trijodmetakresol*, G. $C_6HI_3(CH_3)OH$.—Prepared by the action of a solution of iodine in potassium iodide upon the sodium salt of o-oxy-p-toluic acid. A colorless to slightly yellowish crystalline powder, melting at 121.5° C. (251° F.), insoluble in water, difficultly soluble in alcohol, readily soluble in ether, chloroform, benzene, hot oils, and in dilute aqueous solution of sodium hydroxide. Concentrated solutions of alkali hydroxide decompose it. It contains 78.39 per cent. of iodine.

Liquefied Orthocresol.—This preparation is recognized in the Austrian Pharmacopœia as *Cresolum liquefactum*. It is a colorless oily liquid having an odor suggestive of carbolic acid and cresol, and prepared by fusing 100 parts of orthocresol and incorporating therewith 10 parts of distilled water.

Liquor Cresoli Saponatus, P. G. *Solution of cresol soap*, E.; *Kresolseifenlösung*, G. *Liquor disinfectans.*—This is prepared by dissolving 1 part of crude cresol in 1 part of a potassium soap, with constant stirring and the application of heat until a homogeneous fluid is obtained. A yellowish-brown to brown oily, saponaceous liquid, having the odor of cresol, a specific gravity of 1.055, forming a clear solution with distilled water, and miscible with alcohol, chloroform, glycerin, and benzin. It is 3–5 times more powerful as a bactericide than carbolic acid, and much less poisonous. Similar preparations are marketed under the trade names *Sapocresol*, *Crelium*, *Phenolin*, *Lysol*, and *Kresapol*, and are all used as antiseptics.

Potassium Orthodinitrocresylate. *Antinonnin.* "*Saffransurrogat,*" G. $C_6H_2.(NO_2)_2.CH_3.OK$.—A yellow coloring-matter obtained by diazotizing a nitric acid solution of nitro-o-toluidin with sodium nitrite and converting the diazotoluene nitrate formed into *dinitrocresol* by gradually dropping it into boiling nitric acid. The dinitrocresol is neutralized with potassium carbonate. The dry salt is explosive, to overcome which the potassium dinitrocresylate (50 parts) is mixed with soap and glycerin, forming a reddish-brown paste. The latter dissolved in 300 to 1000 parts of water is a good insecticide spray for plants.

Solutol.—A brown transparent oily liquid of strong alkaline reaction, miscible with water, and containing about 60 per cent. of cresols, of which about one-fourth is free cresol and three-fourths in combination with sodium.

Solveol.—A brown transparent oily neutral solution of cresol in which the cresol is held in solution through the agency of the sodium salts of salicylic, cresylic, or benzoic acid. Soluble in alcohol, and miscible with water.

Tricresolamine. *Ethylenediamine-tricresol, Kresamin.*—A clear colorless aqueous solution containing 2 per cent. of tricresol and 2 per cent. of ethylenediamine.

CRETA PRÆPARATA, *U. S., Br.*—Prepared Chalk.

Creta lævigata.—Craie préparée, Craie lavée, Fr.; *Präparirte Kreide, Schlämmkreide,* G.; *Creta preparada,* Sp.

Formula, $CaCO_3$. Molecular weight, 99.35.

Native calcium carbonate, freed from most impurities by elutriation, existing either as a powder or moulded into conical drops.

Neither the U. S. nor the Br. Pharmacopœia now gives a process for the preparation.

Origin.—Chalk is a mineral found in many parts of the world, and very abundantly on the coasts of the English Channel. It consists mainly of the microscopic shells of *Foraminifera,* and, chemically, is calcium carbonate, generally containing a little silica, aluminum, iron, magnesium, and organic matter. It is usually soft and earthy, but occasionally compact and rather hard, often of a yellowish-white or even red color, due to ferric oxide; as met with in commerce it is nearly white. Its specific gravity is about 2.5. It is much used for making marks which are readily effaced. Freed from the hard, silicious portions by pulverization and diffusion in water, it constitutes *whiting,* and if prepared from very white and soft chalk it is known as *Spanish* or *Paris white* (*Blanc d'Espagne, Blanc de Paris,* Fr.). The latter, mixed with coloring-matters and moulded into pencils, forms the main ingredient in *pastil* colors. Being very rapidly and almost completely dissolved by hydrochloric acid, chalk is not adapted for generating a continuous stream of carbon dioxide. To be suitable for medicinal purposes it requires to be purified or *prepared.*

Preparation.—Prepared chalk is obtained by elutriation, which consists in suspending native chalk in cold water, allowing the coarser particles to subside, decanting the milky liquid on suitable straining cloths, and collecting the residue while still moist, and forming the same into small nodules by dropping the soft mass from a funnel-shaped vessel on to porous tiles or other suitable drying trays. The dry powder coheres loosely in the form of small cones. The heavy portion first separated may be triturated with water and again treated as above.

Properties and Tests.—Prepared chalk is in conical nodules, forming a white, amorphous, insipid powder, and, being nearly pure calcium carbonate, has all the physical properties of that compound (see page 336), except that the color is usually of a less bright tint, and that, viewed under the microscope, the particles do not present a crystalline appearance. The chemical behavior is likewise the same, except that on dissolving prepared chalk in diluted hydrochloric, nitric, or acetic acid a trifling insoluble residue is usually left, and that the rapid and copious effervescence of carbon dioxide gas produces a more permanent foam. When heated to redness, prepared chalk loses carbon dioxide and is converted into lime. The solution in diluted acetic acid yields, with ammonium oxalate test-solution, a white precipitate insoluble in acetic, but soluble in hydrochloric acid.

Substitutes.—*Powdered gypsum,* calcium sulphate, has been during the past 30 years repeatedly sold in place of prepared chalk. It is of a whiter color, does not effervesce with acids, and yields with a large quantity of distilled water a neutral solution giving white precipitates with barium chloride and ammonium oxalate, the latter being soluble in diluted hydrochloric acid.

Pharmaceutical Preparations.—Aromatic Chalk Powder, N. F.; Aromatic Chalk Powder with Opium, N. F.; Compound Chalk Powder, U. S. P.; Chalk Mixture, U. S. P.; Troches of Chalk, U. S. P.

Action and Uses.—Prepared chalk is a mild, non-irritating astringent and an excellent antacid. It may be employed internally in the treatment of gastric acidity and in the various forms of diarrhœa. It is especially adapted to the treatment of diarrhœa resulting from intestinal fermentation with the formation of acid stools. In this condition, however, it should be preceded by a purge. It is also to be remembered as an antidote to poisoning by oxalic acid. As a dusting-powder it may be applied with benefit in the treatment of superficial ulcers, burns, scalds, and abrasions. Prepared chalk is preferable to precipitated calcium carbonate, as it is more impalpable and more absorbent. It is stated that the products prepared from coral, fishbone, and crabs' eyes are more acceptable to the stomach. This may be due to the fact that small quantities of calcium phosphate are present. The internal dose is from 10 to 40 grains (0.60–2.6 Gm.), best administered with mucilage or syrup (see Mistura Cretæ).

Allied Drugs.—1. Corallium.—*Coral*, E., Sp.; *Corail*, Fr.; *Koralle*, G.—*Oculina virginea* Lamarck, and *Corallium rubrum* Lamarck (*s. Isis nobilis* Pallas). Class *Polypiphera*. Corals are polypipherous animals inhabiting the sea, and consisting of a skeleton and a fleshy portion. Those which were formerly, and are still occasionally, employed in medicine have a calcareous skeleton which branches considerably, assuming the form of a tree or shrub, on the branches of which the individual animals are located in tube-like apertures. Of the numerous species which have been distinguished, the skeletons of only two have been used. The first one mentioned above has a milk-white color, the second is of a dull-red. Besides a small quantity of organic matter, coral consists almost exclusively of calcium carbonate, with a little magnesium carbonate. The color of red coral is due to about 4.25 per cent. of ferric oxide.

2. Lapides (*s.* Oculi *s.* Calculi *s.* Lapilli) cancrorum.—*Crabs' eyes, Crabs' stones*, E.; *Yeux (Pierres) d'écrevisses*, Fr.; *Krebsaugen, Krebssteine*, G.; *Ojos de cangrejos*, Sp.—They are concretions contained in the stomach of the crawfish, *Astacus fluviatilis* Fabricius, class *Crustacea*, and are obtained in Russia by allowing the animals to putrefy and washing the mass with water. They contain about 63 per cent. of calcium carbonate and 17 per cent. of calcium phosphate, the remainder being various animal matters with small quantities of other salts. Factitious crabs' stones, which are sometimes met with, are completely dissolved or disintegrated by hydrochloric acid.

3. Os Sepiæ.—*Cuttlefish-bone*, E.; *Os de sèche*, Fr.; *Sepie, Weisses Fischbein*, G.; *Hulsas de Xibia*, Sp.—It comes chiefly from the Mediterranean, from *Sepia officinalis* L., class *Cephalopoda*, and is the calcareous bone contained in the mantle of the animal. It is of a white color, and consists of 80 to 85 per cent. of calcium carbonate, with traces of phosphates, 12 to 16 per cent. of animal matter, and about 4 per cent. of moisture.

4. Testa præparata, U. S. 1870; *Conchæ præparatæ*, P. G. 1872.—*Prepared oyster-shell*, E.; *Magistère de coquilles (d'écailles) d'hûitres*, Fr.; *Präparirte Austerschalen*, G.—From the shell of *Ostrea edulis* L., class *Acephala* (*Conchifera*), ord. *Lamellibranchia*, Fam. *Ostracea*. The principal constituent of oyster-shells is calcium carbonate, which varies in the different layers between 88 and 98 per cent., the pearly inner layer containing the largest quantity. The organic matter present in oyster-shells may vary between 0.5 and 4.5 per cent. The remaining inorganic constituents are small amounts of calcium phosphate and sulphate, magnesium, silica, oxide of iron, and alumina.

CROCUS, *Br., P. G.*—Saffron.

Stigmata Croci, Stigmata Croco, Spanish Saffron; Safran, Fr., G.; *Zafferano*, It.; *Azafran*, Sp.; *Acafrao*, Port.

The dried stigmas of *Crocus sativa* L. (*C. officinalis* Martyn.—Fam. *Iridaceæ*).

Crocus is official in all pharmacopœias. Several of them require that the test-coloration be produced within an hour. There is considerable variation among them as to the allowable loss in drying, which amounts to from 12 to 14 per cent., as well as in the amount of ash, from 7 to 8.5 per cent., the higher percentage from the "thoroughly dried drug." Some caution against the styles, while one expressly admits them, and there are various provisions against the common adulterants.

Origin.—A low bulbiferous plant with grass-like leaves and pale-purple flowers, a native of southwestern Asia and adjacent Europe, very extensively cultivated in Asia and throughout southern Europe, and considerably naturalized in the latter region. In India, the bulbs have been eaten in times of famine. It is more extensively used among the ignorant Orientals than in Europe and America, and those people produce their own

supplies. Our product comes chiefly from Spain and France. Crocus has been successfully grown in the United States, but the high cost of labor forbids profit. The stigmas of nearly 4000 flowers are required to yield 1 ounce of dry saffron, and it is estimated that about 33 to 36 pounds can be produced to the acre.

Attempts have been made to develop races of the plant possessing duplicated stigmas, or with stigmatic appendages to the stamens and petals. It appears doubtful whether the latter would possess the constituents of normal stigmas, though the former probably would.

FIG. 148.

Crocus sativus L.: *a*, stigma, upper part (× 4); *b*, style with stigmas; *c*, papillose margin of stigma (× 120).

Description.—Separate, or 3 attached to a very short portion of their style, each 2 to 3 Cm. (about 1 In.) long, flattish-filiform below, dilated and funnel-form tubular above, with the margin irregularly notched; orange-brown, the style-portion yellow; texture somewhat cartilaginous, unctuous to the touch, strongly and peculiarly aromatic and bitterish.

If genuine and pure saffron be thrown upon the surface of warm water, it will very quickly expand to display the characteristic form of the stigmas. No inorganic matter should separate, either settling to the bottom or dissolving out in the water, nor should any oil separate and float upon the surface. When pressed between filtering-paper, it should not leave an oily stain. When chewed, it tinges the saliva deep orange-yellow.

On agitating 1 part of saffron with 100,000 parts of water (the Ph. It. says 1,500,000 parts) the liquid will acquire a distinct yellow color. No color is imparted to benzin agitated with saffron (absence of picric acid and some other coal-tar colors).

On drying saffron at 100° C. (212° F.), it should not lose more than 14 per cent. of its weight (absence of added water). When thus dried and ignited with free access of air, 100 parts of dry saffron should not leave more than 7.5 parts of ash (absence of foreign inorganic substances).

Under the microscope, the surface of the stigmas is seen covered with finger-shaped papillæ, commonly with large globular pollen-grains attached, and both these elements are characteristic of the powder. Numerous parenchymatic cells nearly filled with the peculiar orange-red coloring-matter can also be seen.

Austrian saffron is regarded as the best, French or Gatinais as second, Spanish as usually inferior, because of the larger portion of the style which is picked with the stigmas. Saffron is sometimes pressed into cakes—usually open to suspicion—and loose saffron is often called *Hay-saffron* in distinction from it.

Constituents.—The constituents are 7.5 to 10 per cent. of odorous volatile oil ($C_{10}H_{14}O$), gum, wax, fat, 65 per cent. of peculiar extractive, a colorless bitter principle, *picro-crocin* or *saffron-bitter* ($C_{38}H_{66}O_{17}$), of glucosidal nature, and *crocin* ($C_{44}H_{70}O_{28}$), a yellow glucoside which decomposes into the sugar *crocose* and *crocetin* ($C_{34}H_{46}O_9$), a red powder. *Polychroit* is a mixture of volatile oil, sugar, and crocin. Crocin occurs as a red powder, soluble in alcohol and diluted alkalies, scarcely in water, and not in ether. Warm concentrated potassa solution evolves from it vapors of a pungent odor; concentrated sulphuric acid produces a deep-blue color, changing to violet and brown; nitric acid colors it green, then yellow and brown. Hilger and Schiller find that upon distillation with water scarcely any volatile oil is obtainable; that in a current of carbon dioxide a little more is yielded; and that an abundance is obtained after treatment with sulphuric acid. They therefore conclude that the volatile oil is derived from the splitting up of the coloring-matter molecule (crocetin?), which they regard as identical with carotin.

Adulterations.—The occasional admixture in true saffron of considerable portions of the yellow style has been noticed above. The appearance of inferior saffron is sometimes improved by oil or by glycerin; it then leaves a greasy stain on being slightly pressed between paper. Partially exhausted (mixed with good) saffron is recognized by the lighter and more uniform color of the stigmas. The tubular florets of *Carthamus* are easily distinguished by their 5-toothed corolla and the projecting anthers with style. The styles of crocus, suitably dyed, have appeared in commerce as *feminelle*, a name also given to the dyed ligulate florets of *Calendula officinalis* L.; the latter are strap-shaped, with a 3-toothed margin, and are easily distinguished from true saffron after soaking in water, or in dilute ammonia, should the coloring-matter of the dye be insoluble

in water. The stigmas of other species of crocus are lighter colored and more deeply notched. The cut petals of the pomegranate, and the stamens of crocus and perhaps other flowers, are by the same means easily recognized from their different shape. About 1860, and again since 1870, Spanish (Alicante) saffron has often appeared adulterated with chalk, gypsum, or heavy spar, the powders having been rendered glutinous by honey and mixed with the saffron; they then become yellowish and of the appearance of pollen. Powdered emery is said to be used in the same manner. The amount of such adulteration is sometimes 20 per cent., and may be estimated by incineration. Such adulterations are detected without difficulty by throwing a pinch upon water, when the mineral matter will subside, and may be identified by appropriate tests.

By thoroughly soaking in a solution of a barium salt and then in a soluble sulphate, crystalline barium sulphate is precipitated within the cell-walls. Potassium ferrotartrate is known to be so used, and F. Daels reports that by slowly impregnating the saffron with a concentrated aqueous solution of it and drying at a low temperature 14 per cent. can be added to its weight. It increases the ash very greatly.

An article known to Indian trade as *lacka* is made by mixing with the stigmas a product obtained from the remainder of the flower, by alternate beatings, specific gravity separation in water, drying, again beating, and so on. Saffron consisting of the stigmas only is there called *Shahi*, while the styles are known as *Mongla*.

In India a false saffron is made by thoroughly washing onion-roots, cutting into small pieces, and coloring with matter extracted from the buds of the *Nyctanthes arbortristis* L., or *Sad-tree* (Fam. *Oleaceæ*). Although this practice pertains to India, the product is very likely that referred to by Cesare Ghecete, as yielding a spurious saffron found in Spain.

Action and Uses.—Saffron has practically been abandoned by practitioners, but is occasionally employed in flatulent dyspepsia. It was formerly highly recommended as an anodyne, antispasmodic, and emmenagogue, and employed in the treatment of asthma, spasmodic cough, and dysmenorrhœa. In the form of an ointment it has been recommended as a palliative for hemorrhoids, and a collyrium of crocus may be tried in subacute and chronic inflammations of the conjunctiva. An infusion of the drug is frequently employed by the laity to promote exanthematous eruptions.

The dose of saffron is from 5 to 30 grains (0.30–2 Gm.). An infusion may be made with 2 drachms (8 Gm.) of saffron to 1 pint (480 Cc.) of boiling water, of which 4 fluidounces (120 Cc.) may be given at intervals of half an hour or an hour.

Allied Drugs.—The flowers of *Tritonia aurea* Pappe (*Crocosma a.* Pl.), of central and southern Africa, yield a coloring-matter very similar to that of saffron, and have been proposed as a substitute. This coloring-matter is more soluble in dilute alcohol and in alkaline solutions than in water. The partly dry, aqueous extract gives with sulphuric acid a blue coloration passing into violet, as does that of saffron (Heim).

An orange-yellow powder consisting of dinitro-naphtol and tropæolin, odorized with a little saffron, has been produced in France under the name of *Algerian saffron*.

GARDENIA GRANDIFLORA Lour., G. FLORIDA L., and G. RADICANS Thunb. (Fam. *Rubiaceæ*).—These shrubs are indigenous to eastern and southern Asia, and produce obconical 4- or 6-sided somewhat winged berries, which attain a length of 4 Cm. (1⅝ In), and contain numerous flat and finely pitted seeds imbedded in a red pulp. The coloring-matter of the latter, according to Rochleder and L. Mayer (1858), is identical with that of crocus. The fruits are regarded as possessing demulcent and refrigerant properties, and are largely used in the East for dyeing yellow.

CRUCIFERÆ.—The Mustard Family.

Genera more than 200, species about 1500, chiefly herbs, of the temperate or subtropical regions of both hemispheres. Except as regards the fruit-structure, the family is a most natural one in all respects. The well-known food-plants, cabbage, cauliflower, turnip, colza, kale, etc., are among the most important of cultivation. The specific distinctiveness or identity of some of these plants is subject to great difference of opinion. *Brassica oleracea* L., native of Europe, yields the ordinary *Cabbage* (*Sea-cabbage* or *Sea-kale* in the wild state), and the *Cauliflower*, *Borecole*, *Brussels sprouts*, and *Kohl rabi*, are now generally accepted as being mere cultivated varieties of it. *B. campestris* L., also of Europe, also yields a variety of cabbage, but is better known as *Colza*, *Naves*, *Navette*, or *Nape*. It appears probable that

the turnip comes from a distinct species, *B. Napus* L., although the view is not wanting that this, too, is merely a variety of the last-named species. The *Radish, Raphanus sativus* L., native of Asia, is perhaps to be regarded rather as a condiment or relish than as a food proper.

The seeds of a number of the above-named species yield important fixed oils, similar to that of mustard (see *Oils of Rape* and *Cŏlza*, under OLEA PINGUIA).

The medicinal constituents and properties of the *Cruciferæ* are almost perfectly typified in the mustards (see SINAPIS), as representing the more powerful substances, and in the *Horseradish* and *Scurvy-grass* (see ARMORACIÆ RADIX), as representing the milder drugs. A similar class of compounds permeate the family, imparting pungent and biting properties in greater or less degree, and causing a large number of species to be employed internally as stomachics, carminatives, laxatives, diuretics, antiscorbutics, antispasmodics, and general stimulants, or externally as counterirritants, vulneraries, and mild antiseptics. Some are so active as to be, like mustard, poisonous if improperly employed. Of these, a number have been found to contain active alkaloids or other bitter constituents.

Beyond these general statements, little is called for except an enumeration of those species which have been commonly employed as drugs.

Capsella.—Next to mustard, horseradish, and scurvy-grass, this is the most important drug of the family. It is the fresh or dried herb of *Bursa Bursa-pastoris* (L.) Britton (*Thlaspi B.* L.; *Capsella B.* Medic.), the *Shepherd's-* or *Lady's-purse, Witches' pouches, Mother's-heart, Blind-weed, Casse-weed*, E.; *Hirtentaeschlein, Saeckelkraut, Gaensekresse*, G.; *Bourse á pasteur, Mollette*, Fr.; medicinally known as *Herba Capsellæ* or *Herba Bursæ Capsellæ*, a low annual of Europe, established as one of the commonest garden-weeds of the United States. The stem is slender, smooth except at the lower part, 3 to 6 Dm. (1 to 2 Ft.) long, usually sparingly branched; leaves chiefly radical, 5 to 15 Cm. (2 to 6 In.) long, oblanceolate, almost invariably more or less pinnatifid, the few stem-leaves much smaller, lanceolate, the base clasping and auricled; flowers racemed along the entire length of the slender branches, white, very small, followed by a peculiar, strongly flattened pod of about 5 to 8 Mm. ($\frac{1}{5}$ to $\frac{1}{3}$ In.) long and broad, triangular, notched at the summit, 2-celled, the partition crossing the narrower diameter, the seeds 10 to 12 in each cell. The odor is peculiar, rather disagreeable, not pungent; the taste aromatic and biting. It contains a peculiar volatile oil, closely similar to, if not identical with that of mustard, and a resin to which part of the biting taste is probably due. The drug has important uses among the eclectics as a diuretic, emmenagogue, and antirheumatic, and is an excellent application to unhealthy sores.

The following species are very similar in their nature to *Capsella*, and are more or less used as "cresses" and as antiscorbutics:

Roripa Nasturtium (L.) Rusby (*Sisymbrium N.* L.; *Nasturtium officinale* R. Br.), native of Europe and Asia, widely cultivated and naturalized, is the true *Watercress* or *Brown cress, Brunnenkresse, Cresson de fontaine*, or *Derro*. *R. palustris* (L.) Bessey (*Sisymbrium amphibium palustre* L.; *Nasturtium p* DC.; *N. terrestre* R. Br.), having the same range, is the *Yellow* or *Marsh watercress*.

The *Lepidiums* grow with, and are very similar to *Capsella*, but are distinguished from it by the possession of oval or rounded, though similarly small and flattened pods, a solitary seed in each of the 2 cells. That which has been most used is *L. sativum* L., the *Garden-cress* or *Pepper grass, Sauce-alone* or *Poor man's pepper, Gartenkresse, Cresson Alenois*, or *Cresson des jardins*. *L. Virginicum* L. and *L. apetalum* W. (*L. intermedium* Gray) are very similar common weeds of America, and are known as *Wild pepper grass*, the latter called *Lentijilla* in Mexico. *L. Iberis* L., of Europe, is also commonly known as *Pepper grass, Pfefferkraut, Iberiskresse*, or *Passerage iberide*. It has an ovate and acute pod, while that of *L. sativum* is oval and notched. *L. latifolium* L., the *Broad-leaved pepperwort*, is distinguished by its much broader and less toothed or pinnatifid leaves.

Cardamine pratensis L., the *Herba Nasturtii pratensis, Cuckoo flower, Wiesenkresse, Kukuks-kraut, Cresson des pres*, of Europe and Asia, rare in the United States; *C. amara* L., the *Bitter cress*, and *C. hirsuta* L., the *Small* or *Hairy bitter cress*, are also employed. *C. amara* combines distinct bitter with the ordinary pungent properties of the group.

Barbarea vulgaris R. Br., the *Yellow scurvy-grass, Winter-cress* (*Winterkresse* G.), *Herbe de Sainte-Barbe*, and the *B. præcox* R. Br., are considerably cultivated as land or garden cresses, and, especially the former, are very largely naturalized weeds in the United States. *Senebiera didyma* Pers. is the *Wart-cress* or *Swine-cress; Arabis lyrata* L., the *Rock* or *Wall cress*.

Sisymbrium officinale (L.) Scop. (*Erysimum o.* L.) is the *Bank-cress, Hedge mustard* or *Scrambling rocket, Wilder senf, Hederich, Velar, Tortelle, Herbe aux Chantres*, and is a very common and homely yellow-flowered weed of roadsides and waste places. The seeds are very similar in composition and properties to mustard. *Alliaria Alliaria* (L.) Britton (*Erysimum A.* L.; *Sisymbrium A.* Scop.; *Alliaria officinalis* And.) occurs only sparingly in America, and is the *Garlic-* or *Poor man's mustard, Hedge-garlic, Leek-cress, English treacle*, or *Poor man's*

treacle, Knoblauchkraut or *Alliare commune.* The herb, and especially the seeds, have, in addition to mustard-like properties, a distinctly alliaceous odor and taste.

Thlaspi arvense L. and *T. campestris* L., of Europe and Asia, are known and used under the names *Penny-cress, Mithridate mustard, Bauernsenf, Feldkresse,* and *Thlaspi champetre,* their seeds combining the odors and tastes of mustard and garlic, as in hedge mustard.

Two species of *Iberis—I. umbellata* L. (*I. coronaria* Don.) and *I. amara* L.—contain glucosides which depress the heart and more or less paralyze the nervous system. Their seeds also contain a markedly poisonous glucoside, soluble in water and precipitated by sodium sulphate. They have been used since ancient times as antirheumatics and antispasmodics. The common *English wallflower* also contains two alkaloids, *cheiranthine,* which acts as a heart poison, and *cheiranine,* which paralyzes the nervous system.

Various species of *Dentaria* (*Pepper root* or *Toothwort, Zahnwurz, Dentaire*), some of Europe and Asia, some of America, have peppery-tasting roots.

The herb of *Anastatica hierochuntica* L., the *Rose of Jericho,* and one of the plants to which the name *Resurrection plant* has been applied, is found in the Levant. Although possessing slight stimulant properties, its use is chiefly fanciful.

A kind of indigo is yielded by two species of *Isatis.*

Tropæolum (Fam. *Balsaminaceæ*).—This beautiful and interesting genus of tropical American plants contains many species which are permeated by pungent constituents similar to those of the *Cruciferæ,* on account of which the unripe fruits are pickled and used as a delicious relish, similar to horseradish and capers. These fruits, as well as the leaves, are valued also as antiscorbutics. The most common species so used is *T. majus* L., the *Garden nasturtium* or *Kapucinerkresse. T. pentaphyllum* Lam. is known in Chile, where it is largely so used, as *Chagas da Miuda. T. tuberosum* R. et P., of the Andean region, yields a starchy and edible tuber.

CUBEBA, *U. S.*—Cubeb.

Cubebæ, P. G.; *Cubebæ Fructus,* Br.; *Fructus* (*s. Baccæ*) *cubebæ, Piper caudatum, Tailed pepper, Cubebs,* E.; *Cubèbe, Poivre à queue,* Fr.; *Kubeben,* G.; *Pepe cubebe,* It.; *Cubebas,* Sp.; *Pimente Cubebe,* Port.

The dried unripe, but fully grown fruit of *Piper Cubeba* L. f. (*Cubeba officinalis* Raf.—Fam. *Piperaceæ*).

Origin.—A dicœcious, woody climber, native and cultivated in the East India islands, closely related to the black pepper, and bearing its fruit in loose spikes 1 or 2 inches

Fig. 149.

Cubeb (after Planchon and Collin) (× 3½).

Fig. 150.

Cubebs upon the stalk (Nat.).

long. Attempts have been made to cultivate it in various other tropical regions, but have not proved successful. The so-called "stem" of the cubeb is in reality the base, or *thecaphore,* of the fruit, which develops during its growth. The stem, which is required to be sifted out and rejected, is the rachis of the spike. The fruits are collected while still of a green color, and are dried with great care.

Description.—From 1 to 1.3 Cm. (⅔ to ½ In.) long, blackish-gray, internally whitish; upper portion globoidal, 4 to 5 Mm. (⅛ to ⅕ In.) in diameter, reticulately wrinkled, consisting of a thin crustaceous endocarp enclosed by a thin sarcocarp and containing one basally attached seed; lower stem-like portion about 6 to 8 Mm. (¼ to ⅓ In.) long, cylindraceous, continuous with the globoidal portion; fruit brittle, strongly and peculiarly aromatic, and of a somewhat bitter and pungent taste.

Upon treating the crushed or powdered fruit with sulphuric acid, a crimson coloration results.

The ash should be under 8 per cent., and is usually less than 7 per cent.

Structurally, cubeb possesses the following tissues, from without inward: (1) epidermis, of a single layer of cubical cells; (2) a subepidermal layer, usually of a single row of thick-

walled stone-cells; (3) the mesocarp of many layers of thin-walled cells containing starch and crystals of cubebin, and with some larger cells filled with oil, their walls suberized and with fibrovascular bundles in the basal portion; (4) the endocarp or stone, consisting of 1 or 2 irregular layers of very large stone-cells, their long axis mostly radial; (5) the seed, which more or less completely fills the cavity according to the degree of ripeness. In a good cubeb it should about three-fourths fill it.

The light-brown powder displays all the above elements, besides free starch-grains, oil-globules, and crystals. The starch-grains are very small, rarely exceeding 5 mikrons in diameter, simple or compound, and much resembling those of black pepper. The crystals are in stellate masses and are very fine and feathery.

Constituents.—Cubeb yields 5 to 15 per cent. of volatile oil (see OLEUM CUBEBÆ), 1 to 3.5 per cent. of cubebic acid, 2.5 to 3.5 per cent. of indifferent resin, 1 per cent. of fatty oil, 8 per cent. of gum, and 0.4 to 3 per cent. of cubebin. *Cubebic acid* ($C_{13}H_{14}O_5$ or $C_{25}H_{30}O_7.H_2O$) is an amorphous yellowish mass, soluble in alcohol, ether, chloroform, and alkalies. The resin is amorphous, slightly soluble in ether and chloroform, and freely so in caustic alkalies and alcohol. *Cubebin* ($C_{10}H_{10}O_3$) occurs in odorless bitter needles or scales, freely soluble in boiling alcohol and chloroform. It forms most of the deposit from official oleoresin of cubeb, and is inert medicinally.

Adulteration and Substitution of cubeb have been practised upon a very extensive scale, and by the use of a great variety of articles. Supplying small and immature fruits, sifted out from the larger ones, is properly to be regarded as an act of substitution. This powder is lacking in the structural elements of the seed and exhibits a scarcity of the cubebin crystals. The use of the stalks (rachis) has probably been resorted to upon a more extensive scale than that of all other forms of adulteration combined. This powder is distinguished by its large amount of fibrovascular tissue. It yields 7 to 10 per cent. of ash, its admixture thus increasing the ash percentage of cubebs.

The evidences of specific adulteration with spurious fruits, in the entire condition, may be summarized as follows: The possession of a stem which is a true pedicel, or ripened flower-stem, rather than a thecaphore or narrowed fruit-base (*Rhamnus* fruits); a stem which is very short—less than one-half the length of the body—or wanting (black pepper and *Litsea citrata* (Nees) Blume,—*Tethrantus c.* Nees, this latter false cubeb having been long erroneously referred to *Daphnidium Cubeba* Nees, and being distinguished by its strong odor of lemon, due to its volatile oil containing 30 per cent. of citral, and containing the alkaloid *lauro-tetanin*); a stem which is very long—regularly twice or more the length of the body and much thickened at the free end (*Piper mollissimum* Blume); a similar long and thick and strongly curved stem (*Piper crassipes* Korth.); a body distinctly branched or mucronate at the top (*Piper caninum* Blume and *P. sylvestre* Lam.), or very large—7 Mm. or more in diameter (*P. crassipes* and *P. mollissimum*), or very heavily wrinkled (young cubeb or *P. mollissimum*, the latter when crushed with sulphuric acid giving a brownish coloration). The fruit of *P. ribesioides* Wall. also gives the last-mentioned color-reaction, and has rhombic crystals in its epidermal cells. *P. Clusii* (*Cubeba C.* Miq.; *Piper Afzelii* Lindl.), the *Ashantee* or *African pepper* or *cubeb*, has the taste of black pepper, and its tincture gives a carmine-red color with sulphuric acid; *P. crassipes* is bitter and gives a yellow color with sulphuric acid. *Padang cubeb*, its origin unknown, has the long stone-cells of the endocarp elongated tangentially instead of radially, as they mostly are in the genuine. In the Japanese *Carbamo berries* the stone-cells are few and small.

Pharmaceutical Preparations.—FLUIDEXTRACT OF CUBEB, U. S. P.; OLEORESIN OF CUBEB, U. S. P.; TINCTURE OF CUBEB, U. S. P.

Action and Uses.—Cubebs are stimulant, carminative, and stomachic. Given in moderation they excite a sense of warmth in the gastro-intestinal tract, augment the secretion of urine, to which they impart a peculiar odor, and stimulate the bronchial mucous membrane. Large amounts act as a circulatory stimulant, and may occasion headache, vertigo, nausea, and purging. Cubebs may be successfully employed in the treatment of gonorrhœal urethritis in both the male and female, but it should not be given in the very early stages. It has been given also in prostatic abscess, chronic inflammations of the vesical neck accompanied by tenesmus, chronic cystitis, nocturnal incontinence of urine, and in chronic bronchitis. In susceptible individuals its administration sometimes produces an exanthematous eruption. The powdered drug may be

given in doses of from 1 to 3 drachms (4–12 Gm.), several times daily. The volatile oil may be given in doses of 10 minims (0.6 Cc.), either in capsule or emulsion; or the oleoresin may be substituted, and given in capsules (see OLEORESINA CUBEBÆ) in doses of from 10 to 30 minims (0.6–2 Cc.).

CUCURBITACEÆ.—The Gourd or Cucumber Family.

The properties of this peculiar family of nearly 100 genera and about 500 species of tendril-bearing, prostrate or climbing vines, are well illustrated in our accounts of BRYONIA, COLOCYNTH, and ELATERIUM. The family is permeated by constituents similar to those of the drugs named, and the properties agree accordingly. The fruits and the fleshy roots of many species are richly nutritious, and very commonly grow under conditions calling for special protection against their consumption by hungry animals, such protection being well secured by the presence of the intensely bitter, promptly purgative, and more or less poisonous principles referred to above. Scarcely any other family of plants is so uniform in its physiological actions, so that a discussion of the properties of the several drugs becomes rather one of the degree than of the kind of activity. Laxative or purgative properties usually reside in most of the plant-parts. With the purgation, and similarly produced, there is more or less diuresis; but distinct diuretic properties are usually present in the seeds, and to some extent in the pulp of such fruits as the melons; this quite aside from such effects produced by their large percentage of water. The seeds of many, like Pepo (which see), are active anthelmintics. So important are the edible fruits of this family that the following enumeration of the more important ones may not be out of place:

Cucurbita Pepo L., the common *Pumpkin*, presenting a number of varieties ranked by some botanists as species; *Cucurbita maxima* Duchesne, of tropical Asia, the *Winter* or *Turban squash*, *Vegetable marrow* or *pompion* of England; *C. moschata* Duchesne, the *Crook-neck squash*; *Citrullus Citrullus* (L.) Karst. (*Cucurbita C.* L.; *Cucumis C.* Ser.; *Anguria C.* Blakw.; *Citrullus vulgaris* Schrad.; *C. fistulosa* Stock.), the *Watermelon*, native of Asia; *Cucumis Melo* L., the *Melon* or *Muskmelon*, native of Central Asia. The botanical relationship of the several strongly marked varieties of melon is a subject on which there is great difference of opinion, the following being regarded as species by some authorities, by others merely as varieties of *C. Melo*: *C. Cantalupensis* Haberl., of Armenia, the *Cantaloupe melon*; *C. deliciosus* Roth. (*C. maculatus* W.), the *Melonecto del olor* of tropical America; *C. Dudaim* L., the *Apple melon* of Persia; *C. utilissimus* Roxb., the *Kankum* of Bengal; *C. Chate* L., the *Egyptian melon*; *C. flexuosus* L., the *Serpent melon*. At least half a dozen other members of this genus yield edible fruits. *Cucumis sativus* L., the *Cucumber*, *Gherkin*, *Gurke*, *Concombre*, is a native of Asia; *Lagenaria Lagenaria* (L.) Lyons (*Cucumis L.* (L.); *Cucurbita Siceraria* Moll.; *Lagenaria vulgaris* Ser.), the *East Indian calabash*; *Sechium edule* Sw. (*Chayota e.* Jacq.), the *Choco* or *Chayote* of tropical America; *Apodanthera pedisecta* (L.) Arn. (*Momordica p.* L.; *Anguria p.* Nees et Mart.); *Zanonia Indica* L., the *Chirpota*, *Dirghapatra*, or *Kuntali*, of the East Indies; *Acanthosicyos horrida* Welw., of Africa; *Coccinia Indica* W. et A. (*Momordica monadelpha* Roxb.; *M. Pavel* Dennst.; *Cucumis P.* Kost.; *Bryonia cordifolia* L.; *B. grandis* L.), the *Kunduri*, *Telakucha*, *Gholi*, *Vimba*, etc., of India.

A complete account of the hundred or more species which are used medicinally is impracticable, but the following are so commonly employed in their respective homes that, if not already so, they are at any time liable to find a place in our materia medica.

Purgatives. *Melon-root.*—The root of the common melon is purgative and, in large doses (7 to 10 grains, 0.5–0.7 Gm.), is said to be a certain emetic, the active and bitter principle (glucoside?) having been called *Melon-emetin*.

Tayuya.—The root of *Trianosperma ficifolia* Cogn., said to contain the alkaloids *trianospermine* and *trianospermatine*, as well as the amaroid *tayuyin*, and being one of the several Brazilian drugs used under the name *tayuya*, and that of *T. dermaphylla*, are much used purgatives in South America. *Cayaponia Martiana* DC., besides being called tayuya, is known as *Abohna* or *Abohrinha do mato*, a much used drug for a great variety of disorders. The root of *Cayaponia globosa*, the *Silva Manso* of Brazil, is said to owe its activity to the alkaloid *cayaponine*, $\frac{1}{10}$ grain of which is said to purge without griping.

The large, hard, fleshy roots of several species of *Micrampelis* Raf., of the Rocky Mountain and Pacific Coast region, especially *M. fabacea* (Naud.) Greene (*Echinocystis f.* Naud.; *Megarhiza Californica* Torr.), are somewhat employed. The species named have yielded the bitter glucoside *megarhizin* and the resin *Megarhizitin* (Heamy), and the saponin-like substance *megarhin* (Young). A similar root of the great Central Plains, *Cucurbita fœtidissima* H. B. K., the *Wild colocynth* or *Wild pumpkin*, *Buffalo gourd*, or *Man-in-the-ground*, is also somewhat used. The rhizome of *Microsechium Helleri* Cogn., the Mexican *Chichicamole* or *Quilamole*, has a composition very similar to that of megarhiza. It is an emetico-cathartic poison, producing great depression of the nerve-centers. The root of *Corallocarpus epigœus* B. et H.

(*Bryonia e.* Rottb.), the *Karos-nai*, *Chilihinda*, or *Addas-gadda*, of India, is there used as a substitute for bryonia. The root of *Wilbrandtia scabra* Mart., of Brazil, and those of many species of *Melothria*, are similarly employed.

Cucumis Fruits.—The fruits of *Cucumis trigonis* Roxb. (*Karit*,—*C. pseudo-colocynthis* Royle), *C. Hardwickii* Royle (the *Hill-colocynth* of India), and *C. prophetarum* L., of Arabia, the last named containing the bitter substance *prophetin*, which occurs also in elaterium, are largely employed as purgatives. A less bitter variety of karit is said to be eaten after the removal of its bitter principle by maceration in water. *C. myriocarpus* Naud., of South Africa, is used in the form of the fruit-pulp, 20 grains having been found to produce nausea and purgation after several hours. Larger quantities produce vomiting, with some blood and considerable salivation. Its active principle has been called *myriocarpin*.

Luffa Fruits.—*Luffa operculata* Cogn. is largely used as a cathartic in Brazil. Peckolt states that for dropsy a fruit is boiled for some time, the pulp strained and beaten to a froth, and a tablespoonful given every half hour until vomiting or purging occurs. It is also made into a rude tincture by standing the sliced fruit, in rum, in the sun for some days. The fruit of *L. echinata* Roxb., of India, is similarly employed. It contains a bitter principle almost, if not quite, identical with colocynthitin. The fruit of *Luffa acutangula* (L.) Roxb. (*Cucumis a.* L.) the *Karvi-turai* of India, is active as a cathartic, and its leaves and fresh juice are applied as a vulnerary. After the removal of their pulp by maceration, the fibrous frames of the fruits of various species of Luffa, especially of *L. Luffa* (L.) Lyons (*Momordica L.* (L.); *L. Ægyptiaca* Mill.; *Turia sativa* Forsk.; *Poppya Fabiana* Koch), constitute the well-known *Dish-rag gourd*, *Gourd towel*, or *Vegetable sponge*.

The emetico-cathartic and anthelmintic properties of *Fevillea cordifolia* L. (*F. scandens* L.; *F. punctata* Poir.), the *Nhandiroba*, *Noix de serpent* or *Boite à savonette*, of tropical America, appear to reside in its essential oil.

Anthelmintics.—The root and seeds of *Melothria scrobiculata* DC. (*Bryonia s.* Hochst.), the *Taffafala* of Abyssinia; the seeds of *Sicydium monosperma* DC. (*Fevillea m.* Vell.), the *Castante do Jabota* of Brazil; of *Ampelosicyos scandens* Thou., and *Talfairia pedata* Hook. (*Joliffa Africana* DC.), both of Zanzibar, and of *T. occidentalis* Hook., of West Africa; the leaves and fresh juice of *Momordica Charantia* L., the *Karela*, *Kurla*, or *Papari* of India, and everywhere introduced into tropical America; the fruit of *M. anthelmintica* Schum., of Malabar; the oil of the seed of *M. Balsamina* L. (*Ku-kwa*); the seed of *Cucurbita Melopepo* L., called in China *Nun-kwa* and *King-kwa;* the fruit of *Trichosanthes Anguina* L. (*Cucumis A.* L.), of China, and other species of *Trichosanthus*, the seed of *T. pubera* L. (*T. palmata* Roxb.; *T. laciniosa* Wight.; *T. cordata* Roxb.), being very poisonous.

Other Uses.—The seeds of *Crua* or *Melao do Babelo* (*Sicana odorifera* Naud.), of tropical America, are used as a powerful stimulating emmenagogue; those of *Momordica Charantia* L. are credited with aphrodisiac properties. The root of *Trichosanthes trifoliata* (L.) Bl. (*Momordica t.* L.) is used as a soap-root. The fruit of *Momordica Balsamina* L. (by many regarded as identical with *M. Charantia* L.), the common *Balsam-apple* of cultivation, are often preserved in alcohol, and the pulp then applied as a vulnerary.

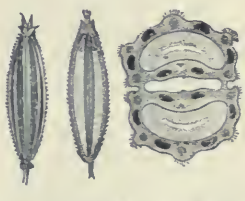
CUMINUM.—Cumin.

Fructus cumini (*cymini*).—*Kreutzkümmel*, *Mutterkümmel*, *Römischer* (*langer*, *scharfer*, *Hafer*, *Kram*, *Pfeffer*) *Kümmel*, G.; *Cumin*, Fr.; *Comino*, Sp.

The dried ripe fruit of *Cuminum Cyminum* L. (Fam. *Umbelliferæ*).

Origin.—A white-flowered annual, about a foot in height, native of northern Africa, and cultivated for its fruit, chiefly in the Mediterranean region. The best cumin comes from Malta and Morocco, and arrives in London during late August and September.

FIG. 151.



Cumin: fruit and longitudinal section, ×3; transverse section, ×8.

Description.—Of 2 carpels, united or separate, each about 6 Mm. (¼ In.) long, nearly a third as broad, and nearly as thick as broad, oblong, nearly straight, narrowed toward both ends and slightly pointed at the summit; gray-brown, or yellowish-brown; bearing 5 strong and coarse ribs alternating with 4 less elevated ones, all rough-hairy, or the 5 primary ones smoothish; oil-tubes 6; odor and taste strongly aromatic, peculiar, though somewhat resembling caraway.

It is very prone to the attacks of insects, which leave only the shell.

Constituents.—With about 8 per cent. each of fat and gum, and 13 per cent. of resin (Bley), cumin contains 3 or 4 per cent. of volatile oil (see OLEUM CUMINI).

Action and Uses.—Cumin fruit is a stimulating aromatic stomachic, and may be employed like the other umbelliferous fruits in the treatment of certain gastric and intestinal conditions when associated with nausea and flatulence.

The dose of the powdered drug is from ½ to 1 drachm (2–4 Gm.). The volatile oil is most commonly administered (see OLEUM CUMINI).

CUPRI SULPHAS, *U. S., Br.*—Copper Sulphate.

Cuprum sulfuricum, P. G.; *Cuprum vitriolatum.*—*Cupric sulphate, Blue vitriol, Bluestone*, E.; *Vitriol bleu, Sulfate de cuivre*, Fr.; *Kupfervitriol, Blauer Vitriol, Schwefelsaures Kupfer (Kupferoxyd)*, G.; *Solfato di rame*, It.; *Solfato de cobre*, Sp.

Formula, $CuSO_4.5H_2O$. Molecular weight, 247.85.

It should contain not less than 99.5 per cent. of pure copper sulphate.—U. S.

Preparation.—Blue vitriol is obtained on a large scale from the native (*copper pyrites*) or artificially prepared sulphide by converting it through oxidation into the sulphate; for this purpose the sulphide is obtained by heating sheet copper to redness and throwing sulphur upon it. The water accumulating in copper-mines contains the sulphate in solution, formed by oxidation of the native sulphide. The iron contained in this is removed either by digesting with copper oxide or carbonate, or by evaporating to dryness and heating until the iron salt is decomposed. The same salt is formed also in the preparation of sulphurous acid from copper and hot oil of vitriol, and in the extraction or purification of silver by precipitating this metal from its sulphuric acid solution by means of copper; also by dissolving in weak sulphuric acid (chamber acid) the black scales obtained in coppersmithing.

Purification.—Copper sulphate cannot by recrystallization be separated from the sulphates of the allied and of the alkali metals, owing to the formation of double salts. The so-called *double vitriol* (*vitriol de Salzbourg*, Fr.; *Doppelvitriol*, G.) contains 70 to 80 per cent. of ferrous sulphate, and the *vitriol mixte de Chypre* contains zinc sulphate; these were formerly, but now are rarely, employed in the arts. If iron alone is present, it may be conveniently removed by oxidizing with nitric acid and digesting the solution with barium carbonate; ferric hydroxide and barium sulphate will be precipitated with the excess of the carbonate, and the filtrate will yield pure crystals. If contaminated with other metals, its purification will be difficult, and it is more convenient to prepare the salt directly by heating 3 parts of copper with 10 parts of sulphuric acid, or with 5 parts of sulphuric acid, 50 of water, and 4 or 5 of nitric acid.

Properties.—Copper sulphate crystallizes in transparent azure-blue, oblique, triclinic, short prisms, which are without odor, and have a disagreeable styptic metallic taste, the specific gravity 2.274, and an acid reaction. On trituration they yield a whitish-blue powder, and on exposure to a dry atmosphere they effloresce superficially. When carefully and continuously heated to 30° C. (86° F.), the salt loses 2 of its 5 molecules of water (14.43 per cent.), and is converted into a pale-blue amorphous powder. Two molecules more of water are lost at 100° C. (212° F.), while the fifth is retained until 200° C. (392° F.) is reached, when a white anhydrous powder remains (63.9 per cent.). At a still higher temperature sulphur dioxide and oxygen are given off, and a residue of black cupric oxide is left.—U. S. 1 part of the crystallized salt dissolves in about 2.2 parts of water, 400 parts of alcohol, and 3.5 parts of glycerin at 25° C. (77° F.), U. S., in 3.5 parts of cold water (Br., P. G.), and in 0.5 part of boiling water, U. S. (1 part, P. G.); very soluble in glycerin, Br. The solution has a pale-blue color, which is changed to green on the addition of a soluble chloride. Commercial blue vitriol (*Cuprum sulfuricum crudum*, P. G.) is sometimes quite impure, but there is no difficulty in finding in our market very good and pure copper sulphate.

Tests.—The aqueous solution (1 in 20) has an acid reaction on litmus-paper, leaves a red stain of metallic copper upon bright iron, gives a deep reddish-brown precipitate with potassium ferrocyanide solution, and a white one of barium sulphate, insoluble in acids, with barium chloride solution. If ammonia water be added to the solution drop by drop, a pale-blue precipitate of cupric hydroxide is formed, which redissolves in an excess of ammonia water, forming a deep azure-blue solution, leaving no trace of residue undissolved (absence of iron, aluminum, etc.). If the aqueous solution (1 in 20) be heated to boiling with an excess of sodium hydroxide test-solution until all the copper has been converted into black cupric oxide, it will yield a filtrate which, after acidula-

tion with acetic acid, should not be colored or rendered turbid by an equal volume of hydrogen sulphide test-solution after being corked at 35° C. (95° F.) for at least half an hour, either before or after making alkaline with ammonia-water (absence of arsenic, lead, zinc, etc.). If hydrogen sulphide gas be passed through 10 Cc. of the solution slightly acidulated with hydrochloric acid, until all of the copper is precipitated as sulphide, one-half of the colorless filtrate should, on evaporation, leave not more than a trace of fixed residue, nor should the other half become colored or turbid by addition of ammonia-water (limit of iron, aluminum, alkaline earths, etc.).—U. S.

Action and Uses.—In minute doses copper sulphate acts as an astringent and tonic, and in full doses causes nausea and vomiting by its irritant action upon the gastric mucous membrane. When locally applied, its action is that of a mild escharotic, and advantage of this fact has been taken in the treatment of venereal ulcers and exuberant granulations. Solutions containing from 2 to 4 grains (0.12–0.25 Gm.) to the ounce (30 Cc.) are stimulating, and not infrequently are used to promote the cicatrization of ill-conditioned sores and phagedenic chancroids.

Pencils made by fusing together 1 part of potassa-alum and 2 parts of copper sulphate, and moulding, are usually employed as a caustic, because the pure salt is efflorescent. It was formerly employed to some extent as an emetic in doses of 5 grains (0.30 Gm.), but as it is quite poisonous it is now rarely given. Should emesis not result from the first dose, a second one should not be given. Small doses were formerly employed in the treatment of chorea, epilepsy, chronic diarrhœa, and dysentery, but its internal administration has practically been abandoned. The dose is from $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015–0.03 Gm.), in solution.

Overdoses of copper sulphate produce violent gastro-enteritis followed by collapse. The symptoms usually appear about one hour after the ingestion of the poison, and consist at first of nausea and vomiting, the vomitus consisting of bluish liquid and tenacious mucus. At first the stools consist of the ordinary contents of the bowel, but later contain blood and mucus. Clonic convulsions and profuse ptyalism are occasionally noted, and if the patient survive longer than 24 hours marked jaundice appears. Post-mortem examination usually reveals fatty degeneration of the liver and kidneys. The treatment of the poisoning consists in the administration of yellow prussiate of potassium, eggs, and demulcent drinks; and if the patient is not vomiting, emetics may be given or the stomach-tube employed. Opium may be given to allay pain, strychnine and other stimulants to combat shock, and external heat may be employed to maintain the normal bodily temperature.

Cuprum Aluminatum, P. G.—*Lapis divinus. Aluminated copper,* E.; *Kupferalaun,* G.—It is prepared by powdering 16 parts each of pure cupric sulphate, potassium nitrate, and alum, fusing the mixture in a porcelain capsule at a moderate heat, adding a previously prepared mixture of finely powdered camphor and alum, each 1 part, stirring well, and immediately pouring upon a porcelain slab or plate to cool and harden, when it is broken into pieces and preserved in well-stoppered bottles. The *pierre divine* or *pierre ophthalmique* of the French Codex contains a trifle less of camphor. In dispensing the *aluminated copper,* it should be well triturated in a mortar with a few drops of water before the remaining ingredients are added, to facilitate solution of the camphor. A collyrium, *Collyre de pierre divine* (Fr. Cod.), is made by dissolving 4 parts of aluminated copper in 1000 parts of water, and filtering.

Cuprum Ammoniatum, *Cuprum sulfuricum ammoniatum.—Ammoniated copper, Ammoniosulphate of copper,* E.; *Sulfate de cuivre ammoniacal, Cuivre ammoniacal,* Fr.; *Schwefelsaures Kupferoxyd-Ammoniak* (*Kupfer-Ammonium, Cuprammonium*), G. Formula of crystals, $Cu(NH_3)_4SO_4.H_2O$.—Obtained pure and crystallized by dissolving copper sulphate 1 part in ammonia water 3 parts, filtering, and pouring upon the solution 6 parts of alcohol; in proportion as the latter abstracts the water from the solution prismatic crystals will be deposited. The salt will be at once separated as a crystalline powder on mixing the alcohol with the aqueous solution. Ammoniosulphate of copper has a deep azure-blue color and an ammoniacal odor; exposed to the air, it loses ammonia and gradually changes to light blue. It dissolves in $1\frac{1}{2}$ parts of cold water; the solution has an alkaline reaction and metallic taste, and on the addition of more water becomes turbid and produces a sediment. With a solution of arsenous acid a green precipitate

(Scheele's green) is produced. When this salt is heated to 150° C. (302° F.) ammonia and water are given off, and an apple-green powder remains having the composition $Cu(NH_3)_2SO_4$, being a cupro-diammonium sulphate, while the medicinal salt is a cupro-tetrammonium sulphate; this contains 27.10 per cent. of ammonia and 32.38 of oxide of copper.

Action and Uses.—Ammoniated copper is rarely employed in medicine at the present time. It was formerly given as an antispasmodic in the treatment of epilepsy, hysteria, chorea, and other nervous affections. The beginning dose is ¼ grain (0.015 Gm.), which may be gradually increased to 3 grains (0.20 Gm.), 2 or 3 times daily, immediately after eating. The symptoms of poisoning by this drug are practically those produced by CUPRI SULPHAS (which see).

A collyrium containing ammoniated copper may be used in the treatment of purulent ophthalmia and other forms of conjunctivitis.

CUPRUM.—Copper.

Cuivre, Fr.; *Kupfer*, G.; *Rame*, It.; *Cobre*, Sp.

Symbol, Cu. Usually bivalent, but also univalent. Atomic weight, 63.18.

Occurrence.—Copper, which has been known from the earliest times, is often found in the metallic state as native copper, notably near Lake Superior; occasionally it is met with in the oxidized state as black and red copper ore or as a carbonate in malachite, and frequently as sulphide in copper pyrites, copper glance, copper ore, etc. It is a natural constituent in minute quantities of some mineral springs and of many vegetable and animal organisms. The smelting process is rather complicated for many ores, and depends mainly upon the oxidation of the sulphurets by roasting and the reduction of the metal by means of charcoal or by fusing a mixture of oxide and sulphide of copper. Arsenic and antimony, which are often present, are expelled by the repeated roastings, together with the sulphur, and the iron is made to enter the slag.

Properties.—Copper is a very sonorous, malleable, and ductile metal, of a reddish color, having the specific gravity 8.92, or when hammered 8.95. It melts at a bright-red heat, first becoming brittle, and expands in volume on congealing. It is inferior to iron in tenacity or strength and in hardness, but superior to it as a conductor of electricity and heat, and in resisting the chemical action of moist air. The most important of the numerous alloys of copper are *brass*, containing about 28 to 36 per cent. of zinc; *bronze*, containing 8 to 12 per cent. of tin, and sometimes a little zinc and lead; *bell-metal*, containing 20 to 25 per cent. of tin; and *German silver*, composed of 8 parts of copper, 3½ of zinc, and 3 or 4 of nickel.

Copper is insoluble in all non-oxidizing acids in the cold and as long as oxygen of the air is excluded. In the presence of oxygen the copper is gradually changed to oxide, which dissolves in the acid. Hence it is not safe to let foods with acid juices, that have been boiled in bright copper vessels, cool and stand in such vessels, as they become contaminated with copper. Copper is acted on by hot strong sulphuric acid and readily by nitric acid, with formation of sulphur dioxide and nitric oxide, respectively. Ammonia also dissolves copper in presence of air. Iron, zinc, lead, tin, cadmium, bismuth, nickel, in the metallic state, and phosphorus precipitate copper from its solutions, but copper precipitates silver and mercury from solutions of their salts.

Copper forms two series of salts—*cuprous* and *cupric*, the former of which are of little importance. The anhydrous cupric salts are usually white, the hydrated green or blue; the soluble ones have an acid reaction, and their solutions are decomposed by iron, zinc, and the earth metals, with the precipitation of copper. Potassium hydroxide precipitates voluminous blue hydroxide, $Cu(OH)_2$, which when boiled turns black with formation of some oxide, $Cu(OH)_2 + CuO$. Potassium carbonate precipitates green oxycarbonate of copper, the precipitate turning black on boiling. Ammonia water and ammonium carbonate occasion bluish-green precipitates which dissolve in an excess, forming deep azure-blue solutions. Potassium ferrocyanide yields a brown-red precipitate, which is insoluble in dilute acids. Hydrogen sulphide separates from acid solutions brown-black copper sulphide. Potassium iodide produces a grayish-white precipitate of cuprous iodide, one-half of the iodine being at the same time liberated.

Commercial copper is now rendered chemically pure by electrolysis. Plates of copper

are suspended from the positive pole of an electric circuit in a bath of copper sulphate; the copper is slowly dissolved and deposited on the negative pole, which consists of a thin sheet of pure copper. The impurities of silver, gold, tellurium, etc., remain in the bath as "slimes," and the silver and gold obtained from these are sufficient to cover the expenses of the operation.

Action and Uses.—Metallic copper is never employed in medicine. It is stated that workers in this metal sometimes suffer from chronic copper-poisoning. The symptoms of this condition are by no means uniform, as constipation or serous diarrhœa may be present. The individual becomes anæmic and emaciated, the teeth are usually lost early in life, and a blue line may be found on the gums. Vertigo and indigestion are also early symptoms. Minute quantities of copper have been found in the blood and feces, but it is by no means certain that it is normally present in the blood.

Copper Pigments.—Bremen Blue or Bremen Green is cupric hydroxide, prepared by precipitating a copper salt with an alkali and drying the precipitate below 40° C. (104° F.). Used as a water-color, it remains blue; but if used as an oil-color it becomes green from the formation of a copper soap. Basic cupric carbonate is sometimes sold under the same name.

Brunswick Green is either copper oxycarbonate or oxychloride.

Mountain Green, or Mineral Green, is powdered green malachite or artificially prepared copper oxycarbonate.

Scheele's Green.—Copper sulphate is precipitated by a solution of arsenous acid in sodium carbonate; its composition is $CuHAsO_3$. Scheele's green is largely used as a poison for insects (see Paris green).

Schweinfurt Green, or Paris Green, is copper acetoarsenite prepared by boiling the mixed hot solutions of cupric acetate and arsenous acid. Its composition is $Cu(C_2H_3O_2)_2.3Cu(AsO_2)_2$. It is a beautiful but very poisonous pigment, and its use has been restricted by law. It is manufactured in large quantity in this country for use on potato and other fields against Colorado beetle (*Doryphora decemlineata*). It may be distinguished from Scheele's green by giving a repulsive odor of cacodyl when heated in a glass tube.

The symptoms and treatment of poisoning by these preparations are identical with arsenical poisoning (which see).

Most of these pigments are also sold under other names than those given above. As met with in commerce, they are frequently mixed with alumina or calcium and barium compounds, and thus constitute lower grades. Mixtures of chrome-yellow and Prussian blue are likewise sold under several of the above names.

OTHER COMPOUNDS OF COPPER.

Cupri Acetas. *Cuprum aceticum, Ærugo crystallisata s. destillata. Copper acetate, Copper verditer, Crystallized verdigris*, E.; *Acétate de cuivre, Verdet crystallisé*, Fr.; *Kupferacetat, Gereinigter (krystallisirter, destillirter) Grünspan*, G. $Cu(C_2H_3O_2)_2.H_2O$.—The salt may be prepared by dissolving verdigris (basic copper acetate) in wood vinegar or acetic acid, and evaporating the clear solution to crystallization; or solutions of 2 parts of copper sulphate and 3 parts of lead acetate are mixed, the liquid decanted from the insoluble lead sulphate, acidulated with a little acetic acid, and evaporated to crystallization. The salt forms deep blue-green rhombic prisms which effloresce superficially in air and have a disagreeable metallic taste. It is soluble in 15 parts of cold water, 5 parts of boiling water, and about 16 parts of hot alcohol. The solutions have a blue-green color, and change to a deep-blue color with excess of ammonia water. The crystals become anhydrous at 100° C. (212° F.). Sulphuric and other strong acids liberate acetic acid from the salt. The tests for impurities are the same as given under copper sulphate. Copper acetate is irritant and astringent. In the form of a lotion it has been employed in the treatment of conjunctivitis, aphthous stomatitis, gonorrhœa, and leucorrhœa. Internally it was formerly recommended as a remedy for scrofulosis, intermittent fever, and epilepsy, but its employment is no longer in vogue. The lotion should contain from $\frac{1}{10}$ to 1 per cent. of the drug, and the internal dose is stated to be from $\frac{1}{5}$ to 1 grain (0.013–0.05 Gm.).

Cupri Arsenis. *Copper arsenite*, E.; *Arsenigsaures Kupferoxyd*, G. $CuHAsO_3$.—Prepared as stated above (see Scheele's Green). This is used as a tonic for debilitated mucous membranes and in anæmia. It is also used in the dose of $\frac{1}{100}$ to $\frac{1}{50}$ grain (0.0005–0.001 Gm.) in cases of summer diarrhœa.

Cupri Iodidum. *Cuprous iodide*, E.; *Kupferjodür*, G. Cu_2I_2.—Obtained by adding solution of potassium iodide to a solution of copper and iron sulphates; is a white powder, insoluble in water and dilute acids, soluble in ammonia water and solution of potassium iodide. It contains 66.7 per cent. of iodine.

Cupri Nitras. *Copper nitrate*, E.; *Kupfernitrat*, G. $Cu(NO_3)_2.3H_2O$.—Obtained by dissolving copper or its oxide in 25 per cent. nitric acid, and evaporating to crystallization.

The salt is blue, hygroscopic, and easily soluble in water or alcohol. Under 21° C. (69.8° F.) the crystals formed contain 6 molecules of water. This salt does not differ materially in its physiological action from cupri sulphas, and is employed for the same conditions and in the same dose.

Cupri Oleas. *Copper oleate*, E.; *Oelsaures Kupfer*, G. $(C_{18}H_{33}O_2)_2Cu$.—Formed by precipitating a solution of castile soap with solution of copper sulphate. Greenish-blue, granular powder, soluble in ether. Used as ointment, 1 to 2 : 10 of the vehicle, as antiseptic in indolent boils and extensive granulations.

Cupri Oxidum. *Cuprum oxydatum.—Cupric oxide*, E.; *Oxyde de cuivre, Safran de Vénus*, Fr.; *Kupferoxyd*, G. CuO. Molecular weight, 78.98.—Obtained by precipitating copper carbonate by mixing hot solutions of copper sulphate and sodium carbonate, washing, drying, and heating the precipitate to red heat. It is a soft, black, amorphous, heavy powder, which dissolves in dilute nitric acid without effervescence (absence of carbonate); this blue solution may be tested for iron and other metals by ammonia and hydrogen sulphide in the same manner as copper sulphate. By precipitating a solution of copper sulphate with an excess of potassium or sodium hydroxide and boiling, a brownish-black powder is obtained having the composition $Cu(OH)_2 + CuO$ (molecular weight, 255.38); by red heat it is converted into anhydrous oxide, CuO. Copper oxide is also formed when copper is heated in air or oxygen. The blue solution of cupric hydroxide in concentrated ammonia water is a solvent for cellulose, and is known as Schweizer's Reagent.

Cuprous oxide, a lower oxide of copper, of the composition Cu_2O, is of interest because of its formation in the test for dextrose (glucose) by Fehling's Solution (which see). It is a red powder, unchangeable in air when dry, insoluble in water, soluble in ammonia water, forming a colorless solution which turns blue in contact with air. With hydrochloric acid it forms cuprous chloride.

Cupri Subacetas. *Ærugo, Viride aëris. Verdigris, Copper subacetate*, E.; *Acétate basique de cuivre, Vert-de-gris, Verdet gris*, Fr.; *Grünspan, Spangrün, Basischessigsaures Kupfer (Kupferoxyd)*, G Formula of pure verdigris, $Cu_2O(C_2H_3O_2)_2$.—Verdigris was already known to Theophrastus about 300 B. C., when it was prepared from copper and various refuse-products obtained in making wine. In the wine districts of Southern Europe, and particularly in the neighborhood of Montpellier, verdigris is prepared by the aid of the marc of the wine-press. These grape-husks are allowed to undergo the acetic fermentation, and are then stratified in earthern vessels with sheets of copper, which if new, have been previously superficially corroded by a solution of copper acetate. After having been thus kept at a temperature of 8° or 10° C. (46° or 50° F.) for 3 or 4 weeks, the plates are removed, placed upright to dry, and for the following 6 or 8 weeks are occasionally dipped into water and exposed, until the neutral acetate at first formed has been converted into a thick layer of verdigris, which is scraped off. The sheets are then replaced in the grape-husks, and the process repeated until the copper has been completely corroded. The scrapings are formed with water into cakes of convenient size and dried. The French article is blue, and has the composition, $Cu(C_2H_3O_2)_2.Cu(OH)_2 5H_2O$. Verdigris of inferior quality is said to be made in the cider districts of England in a similar manner from pommage or apple-marc, and in some places it is obtained by exposing the copper to the vapors of vinegar or pyroligneous acid or by treating impure cupric oxide with the latter. The English, German, or Swedish variety is green, and consists principally of $[Cu(C_2H_2O_2)_2]_2 + Cu(OH)_2 + 5H_2O$. Verdigris is met with in commerce in heavy and hard bluish-green masses containing a considerable number of small crystals and breaking with an earthy somewhat crystalline fracture. It varies in composition, but always consists mainly of hydrated oxyacetate of copper, and contains between 45 and 50 per cent. of cupric oxide. It is decomposed by, and but partially soluble in, water, insoluble in alcohol, but completely soluble (the impurities excepted) in ammonia and dilute sulphuric, acetic, and hydrochloric acids. Acids should produce but little effervescence, showing the absence of carbonate. The presence of chalk as an impurity is determined by the copious effervescence when dissolving a sample in warm acetic acid, and by the precipitate occurring in the solution on the addition of ammonium oxalate. The green coat formed on copper when not kept clean, and often called verdigris, is basic copper carbonate, and not true verdigris. Copper subacetate is occasionally used as a stimulant application to sluggish ulcers and as a caustic to condylomata and warts.

Cupri Sulphocarbolas. *Copper sulphocarbolate*, E.; *Paraphenolsulfosaures Kupfer*, G. $(C_6H_4(OH)SO_3)_2Cu.5H_2O$.—Obtained by interaction between copper sulphate and barium phenolsulphonate. Green prisms or needles, soluble in water and alcohol. Used externally as an antiseptic like the zinc salt, 1 : 100–200 of water. In gonorrhœa and blennorrhœa, 0.5–1 : 200 of water.

CURARE, *Fr. Cod.*

Urari, Wourari, Wourali, Woorara.

A vegetable extract, prepared from various plants, by the Indians of South America, for the poisoning of arrows.

Origin.—The use of arrow poisons is ancient and common among savages, the vegetable or animal substances employed depending upon the resources of the region and the knowledge and intelligence of the tribe. The use of such a poison under a specific name would naturally indicate a specific origin and a certain degree of uniformity in its preparation and composition. At the same time, such uniformity is not absolute. Different branches of the same tribe, or associated tribes, might be expected to employ the same name, while introducing more or less variation, in the way of improvements, into the article. Such is clearly the case with the substance under consideration. The important ingredient is certainly *Strychnos bark.* The generic identity of the strychnos plants having been recognized, the tribes of different regions have evidently employed the one or more species obtainable in their respective localities; the following have been reported: *S. Castelnœi* Wedd.; *S. toxifera* Schombk.; *S. pedunculata* Benth. (*S. Schomburghkiana* Klotsch); *S. cogens* Benth. (*Aurimara*), the last 3 in British Guiana, according to Schomburghk; *S. Gubleri* Planch.; *S. Crevauxiana* Baill., the last 2 about the source of the Rio Negro; *S. Yapurensis* Planch., on the Yapuri River, and *S. Rouhamon* Benth. (*Rouhamon Guianensis* Aubl.). With these poisonous articles are associated others, the activity of some of them being doubtful. It seems probable that substances inert, or relatively so, are introduced to impart consistency, to mislead or to maintain secrecy, or from superstitious considerations. The following additional ingredients have been named: *Cocculus toxiferus* Wedd. (?), *Eko* or *Pani du Maharao; Didelphys crancrivora* (?) (*Œne* or *Mucura-ea-ha*); an *aroid* called *Taja;* several species of *Artanthe* (?); the wood of a *Xanthoxylum* (*Manuca*); the wood or bark of *Serjania nodosa* Redlk. (*Paullinia Curura* L.), the last doubtless containing saponin; the fleshy root of a *Cissus* (*Muranna*). Extraction and concoction are performed by ingenious methods, although combined with more or less of superstition and mysticism.

Properties.—Curare is a blackish-brown extract, brittle or hygroscopic, of a very bitter taste, and almost completely soluble in dilute alcohol. Cold water dissolves about 75 per cent.; this portion, containing the poisonous alkaloids, is insoluble in ether and very sparingly soluble in absolute alcohol.

Constituents.—The variable origin of *curare* results inevitably in the variable composition which has been recorded for it. It appears, however, that the closely related species of strychnos employed agree in the possession of the 2 following alkaloids, although their relative and absolute percentages vary: *Curarine* (according to Boehm, $C_{19}H_{21}NO_4$; according to Sachs and others, $C_{18}H_{35}N$) is amorphous and yellow, yielding a greenish fluorescent aqueous solution, freely soluble in alcohol and water, less so in chloroform and amyl alcohol, insoluble in ether, carbon disulphide, and benzol; with nitric acid deep-red, with concentrated sulphuric acid carmine-red, and becoming violet on the addition of potassium dichromate; it is precipitated yellow by potassium ferricyanide and white by the ferrocyanide, sulphocyanate, and iodate, and by sodium phosphate and arsenate. *Curine* ($C_{18}H_{19}NO_3$), non-poisonous, is crystalline, precipitated by metaphosphoric acid, and yields, on treatment with methyl iodide, an alkaloid having the effects of curare. With these alkaloids there is considerable brown resin, fat, gum, clay, and red coloring-matter.

Action and Uses.—When curare is applied to the unbroken skin, no absorption takes place; but if the integument be broken, it is rapidly taken into the circulation and exerts its peculiar effects. If given by the stomach, the drug is eliminated by the kidneys almost as rapidly as it is absorbed, and unless the dose be quite large it produces no very marked effect. When given hypodermically its action is rapid and powerful. Like other members of the strychnos family, if injected into the vessels of the cord it acts as a powerful stimulant and produces exaggerated reflexes followed by tremors and convulsions. If employed hypodermically in other parts of the body, however, no such symptoms follow, as the dominant action of this drug is that of a paralyzant to the motor nerve-plates which end in the striated muscles (the heart excepted), causing more or less complete paralysis. The drug has no effect on the motor nerve-trunks or upon the muscles themselves, but it does depress the termination of nerves around ganglion-cells and causes

paralysis of the sympathetic ganglia. Curare exerts but little effect upon the heart, and the circulation remains intact long after respiration has ceased. Large quantities depress the vagus, increasing the rapidity of the heart's action, and lower blood-pressure by depressing the sympathetic ganglia supplying the peripheral bloodvessels. After the administration of curare the respirations become short, irregular, and jerky in character, and asphyxia finally results from paralysis of the respiratory muscles, because of the depression of the terminals of the motor nerves supplying them. The blood becomes venous in character, the secretions—for example, the perspiration and saliva—are sometimes augmented, and the rhythmic movements of the spleen and peristaltic action of the intestines are increased. Because of the motor paralysis produced, metabolism is interfered with and tissue-waste is greatly decreased. Less oxygen is absorbed and less carbon dioxide is excreted. Curare sometimes augments the flow of the urine, and glycogen and lactic acid are occasionally found in this secretion after its administration.

Curare is of very little importance in practical medicine. It has been employed in the treatment of epilepsy, tetanus, hydrophobia, strychnine-poisoning and other convulsive seizures, and while it will undoubtedly control the spasm it exerts no curative effect whatever.

The beginning dose of curarè is $\frac{1}{10}$ grain (0.005 Gm.), given hypodermically in a watery solution. This may be gradually increased to as much as $\frac{1}{3}$ grain (0.02 Gm.), but the latter amount should be given guardedly. The dose of curarine is stated to be $\frac{1}{100}$ grain (0.0005 Gm.). Curarine resembles digitalis in its action, and has no effect upon the motor nerves.

Other Arrow Poisons (for historical account, see Stockman, *Pharm. Jour. and Trans.*, 7, 1898, 548, 562, and 585).—Owing to the secrecy maintained by the makers of these substances, information concerning their composition is meager and often contradictory, yet their investigation has contributed much to our knowledge of poisonous plants, which knowledge constitutes the chief feature of interest in the following synopsis: It is somewhat remarkable that the genus *Strychnos* should have constituted almost the only resource of the American savages, while in the old world the *Apocynaceæ*, equally abundant and active in American tropics, should have taken first place. Strychnos has, however, especially in Asia, also held an important place in the art. The *Blay-hitam* arrow poison of the Malays has been shown to be from a Strychnos bark, though the species is unknown.

Poisons chiefly or wholly from Acocanthera.—As is so frequently, almost generally, true of useful plants, and especially of important medicinal plants, there is little that is definite or useful concerning *Acocanthera* G. Don. to be found in botanical works, and we must turn to pharmacological sources for our information. Schumann, in monographing the genera of *Apocynaceæ* for *Pflanzenfamilien*, has ignored all the important and valuable literature of pharmacy relating to these plants, and merely said "3 species, ... the *A. deflersii* Schwienf. and *A. Ouabaia* Cathal. not well enough known to me." The genus will probably be found to number a half dozen or more species, and it has been remarked that the poisonous ones are to be recognized by their bitter taste. It appears certain that at least 3 species, none of them among those recognized by Schumann, are used in African arrow poisons, the important one being *A. Schimperi* (A. DC.) B. et H. (*Carissa S.* A. DC.).

Wa Nyika (Wanika), Wakamba, and Wa Gyriama Poisons.—Fraser appears to have positively identified the last mentioned species as the source of the active constituent of this group of arrow poisons, as well as that from Arnaud's unidentified species of *Acocanthera*, and has shown it to be the same as that derived from the seed of a strophanthus which has been called *S. glaber*. This constituent has been called *ouabain*, and the present source of this commercial substance is said to be the above-mentioned seed, which yields it in much larger amount than does the *Acocanthera*. Fraser points out that since the term *ouabain* has been applied to two other bodies (from other species of *A.*), it is desirable to give to this the name *acocantherin*, and to identify it by its known source and by the following characters. He gives it the formula $C_{30}H_{46}O_{12}H_{26}$, the same as ascertained by Arnaud. A statement was at one time accepted that this substance was identical with strophanthin, but it is now known that this is not the case. Fraser describes it as crystallizing from water in colorless and transparent quadrangular plates, from alcohol in tufts or rosettes of fine needle-shaped crystals; soluble in distilled water at 13° to 15° C. (55.4° to 59° F.) to the extent of 0.93 per cent. and in alcohol (specific gravity 0.92) to the extent of 2.4 per cent., much more soluble in both at higher temperatures; insoluble in ether and chloroform. The saturated aqueous solution is tasteless and neutral. It is red, becoming green with concentrated sulphuric acid. The melting-point is 186° C. (366.8° F.). It reacts as a glucoside with dilute sulphuric acid. He finds that small and carefully regulated doses can produce a great slowing of the heart, even when the vagi are divided or when atropine has been administered. Such doses also

produce a great increase in both of the movements of the heart, with practically no effect upon blood-pressure. Large doses produce a great rise of blood-pressure, apparently dependent upon the vasomotor effect or upon the peripheral ganglia. This is different from the method in which digitalis acts. Acocantherin, however, acts powerfully upon striped muscle. Another specimen of Wanika poison, also traced to an *Acocanthera*, yielded a glucoside to which Dobbin assigned the formula $C_{30}H_{52}O_{14}$, this being one of the ouabains.

Ouabaio, Wabei, or Wabajo Poison.—A root, supposed to yield this poison, was described by Holmes as that of *A. Schimperi*, probably yielding Fraser's acocantherin, as follows: Occurring in pieces of irregular length and 18 to 40 Mm. ($\frac{3}{4}$ to $1\frac{1}{2}$ In.) in diameter, of a grayish-brown color, longitudinally and occasionally transversely fissured, the outer surface soft and spongy. On transverse section the outer layer of the bark is marked by a network of darker lines, the outer meshes showing white laticiferous ducts and dark bundles of sclerenchymatous cells, the inner layer rather similar but denser and closely adherent to the wood, which is yellowish-white, tough, minutely porous, and well marked with narrow medullary rays. The bark is more bitter than the wood. Ouabaio poison is thus very closely related to, if not identical with, the preceding group.

Ipoh or Hippo Poison.—Of this, used by the natives of Perak, there are several varieties, and it does not appear that the botanical origin of any one of them is known precisely. The varieties called *Aker* and *Aker-lampong* have been located in the genus *Strychnos*, but the species, even if described, have not been identified with sufficient certainty. The much weaker action of the second variety renders it probable that its source is not the same as that of the first. Stockman found that death resulted from an action on the heart, similar to that of digitalis, the motor nerves remaining excitable to electric stimulation for some time after death. The origin of the variety known as *Prural* is apparently entirely unknown. The idea has been promulgated that it is from a Rubiaceous plant, *Coptosapella flavescens* North, related to cinchona, but it seems highly probable that there was some error in connecting the specimen with the poison. This poison produces stiffness or death of the muscular tissue with which it comes into contact, together with local extravasation. In this it acts like the saponin group of glucosides.

Wakamba (Vakamba), Massai, and Wa Nyamiwesi Poisons.—Von Brieger isolated from Wakamba poison a body which was called *wakambin*, to which he assigned the formula $C_{29}H_{46}O_{19}$. It crystallizes in needles insoluble in ether, acetic acid, chloroform or benzene, and soluble with difficulty in cold, more soluble in hot alcohol or water, the solution lævogyre, not reducing Fehling's Solution. By long heating with mineral acids, a yellow amorphous body separates, readily soluble in alcohol and not poisonous. The portion remaining in the solution reduces Fehling's Solution. It dissolves in concentrated sulphuric acid with a reddish-brown color and green fluorescence, and gives no alkaloidal reaction. It is of extraordinary toxicity, 0.05 Mgm. being fatal to guinea-pigs of 300 Gm. weight in 50 minutes; 0.3 Mgm. per kilo being fatal to dogs. It affects the muscles sooner, but is less tetanic than Ipoh poison. It appears identical with the constituent of Wagogo poison. Schellman regarded the latter as the product of two Euphorbiaceous trees, but this appears improbable.

The Echuja poison of southwestern Africa has been referred to *Adenium Boehmianum* (Fam. *Apocynaceæ*). It contains the glucoside *echujin*. Boehm gives the following as the relative toxic doses per kilo of body-weight in the dog: echujin, $\frac{1}{140}$ grain; strophanthin, $\frac{1}{280}$ grain; ouabain, $\frac{1}{480}$ grain.

Taita, Teita, or Swahili arrow poison is of the same class and quite certainly derived from species of *Acocanthera*, as is also the Merju variety. MacPherson has found in the practical treatment of soldiers poisoned by Acocanthera arrow poisons that strychnine is a useful antidote.

Other Vegetable Arrow Poisons.—The glucoside *antiarin*, from *Antiaris toxicaria*, has been considered elsewhere. It is used as an arrow poison in different parts of the East Indies. Some of the South African natives employed the leaves of *Buphane disticha* Herb. (*Hæmanthus toxicarius* L.—Fam. *Amaryllidaceæ*), and several *Euphorbias*, together with an *Acocanthera*. In India, the tuber of *Aconitum ferox* Wall., *Rhaphidophora decursiva* Schott. (*Pothos d.* Roxb.—Fam. *Araceæ*), and *Lunaria amara* Blanco (*Rabeleisia Philippinensis* Pl.—Fam. *Rutaceæ*), are used. (See also Abrus.)

In Asia a poison called *Likir* is obtained from *Amorphophallus Prainii* Hook. (Fam. *Araceæ*). The Japanese natives (*Ainos*) are said to make use of an extract of aconite and tobacco. The natives of New Hebrides are said to secure damp earth containing the bacillus of lockjaw, with which their arrows are smeared. The use of cadaveric poisons is practised in a number of parts of Africa. The Cayapas Indians, of Ecuador, are said to use a *Solanum*.

Arrow Poisons of Animal Origin.—The Kalahari bushmen of southwestern Africa apply the entrails of a caterpillar called *Nga*. It is said that if this is drawn over a small sore, it causes the most excruciating agony, the subject dying slowly in the most violent delirium. Some Africans employ the larvæ of the beetle *Diamphidia simplex*. The bug is squeezed gradually between the forefinger and thumb until a colorless fluid exudes, which is

smeared over the head of the arrow. The action of this poison appears similar to that of snake-venom, and it appears to be a toxalbumin.

The arrow poison of the Choco Indians of the United States of Colombia is said to be obtained from a small frog of the genus *Phylobates*, and to be obtained as a yellow acrid juice which exudes from the skin of the animal when it is held over a fire. The fact that the effect of the Choco poison is identical with that of curare, and the natural improbabilities found in the above statement, militate against its acceptance.

The arrow poison used by some natives of Central Africa is said to be prepared from the bodies of red ants.

CURCUMA.—Turmeric.

Rhizoma curcumæ.—*Curcuma*, Fr., Sp.; *Souchet des Indes*, Fr.; *Kurkuma, Gelbwurz, Gelber Ingwer, Gelbsuchtwurzel*, G.

The rhizome of *Curcuma longa* L. (*C. rotunda* L.; *Amomum Curcuma* Jacq.—Fam. *Marantaceæ*).

Origin.—A perennial, reed-like plant of India, very largely cultivated in tropical countries, chiefly for the use of its rhizome as a condiment, and known only in cultivation. It is one of the most important constituents of curries, and is largely used as an adulterant of mustard and as a substitute for it in many of its uses. In the course of its preparation, it is subjected to a scalding or parboiling process, which partly hydrates its starch and converts the interior from a mealy to a pasty, or when dry a resinous, consistency and appearance. Round curcuma consists of the main rhizome; long curcuma, or fingers, of the branches.

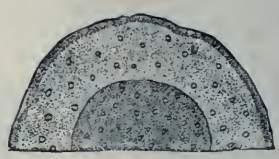
FIG. 152.

Round curcuma.

FIG. 153.

Long curcuma.

FIG. 154.



Curcuma: transverse section (×3).

Description.—From 2.5 to 5 Cm. (1 to 2 In.) in length, the "round" form oval or ovoid, flattened, about half as broad as long, and about half as thick as broad, the "long" nearly terete, somewhat narrowed toward one end, straight or curved, about one-fourth as thick as long; externally bright-yellow to grayish-yellow, with a soft, friable, mealy or dusty outer surface, or gray and smoothish, annulate with leaf-scars and usually marked with small root-scars; fracture short and smooth, with a waxy, resinous luster, gamboge-yellow to brownish-yellow, or varying to dark-red brown or nearly black, the center darker, the vascular bundles scattered throughout, most numerous near the nucleus-sheath; odor aromatic, peculiar; taste warm, aromatic, slightly bitter.

The powder is bright-yellow, and contains starch-grains ranging from 10 to 45 (mostly 15 to 30) mikrons in length, mostly ovoid, the rings conspicuous, but the hilum usually not so. They frequently cohere in masses having more or less the form of the cells from which they came.

Madras curcuma is most highly esteemed. It is bright-yellow, light-orange within, and is frequently cut to facilitate drying. *Bengal curcuma* is mostly of the round form, slender, of a deep reddish or reddish-gray, and dark within. *Java curcuma* is very similar to Bengal, but more gray without and still darker within. *Chinese curcuma* consists of many central rhizomes, with well-developed branches.

C. viridiflora Roxb., and probably other species also, yield rhizomes which are used as curcumas. From one of these is probably derived the *Cochin curcuma*, which consists mostly of sections of a large tuber, often marked with large stem-scars.

Constituents.—Curcuma contains about 1 per cent. of volatile oil, 11 per cent. of viscid oil, 0.3 per cent. of curcumin, a minute quantity of an alkaloid with crystalline salts, starch, gum, resin, and acid potassium oxalate. Curcumin ($C_{14}H_{14}O_4$) is a yellow crystalline powder of slight vanilla odor, tasteless, scarcely soluble in water, and very soluble in alcohol, ether, chloroform, and the oils. It forms a red-brown solution with alkalies. Weak oxidizing agents change it to vanillin. The carmine-colored potassium compound is insoluble in strong alcohol and ether; the zinc compound is soluble in water; the insoluble lead and silver compounds are easily altered. By boiling an alcoholic solution of curcumin with boric acid and decomposing the compound with hot water, Schomberger (1866) obtained yellow *pseudocurcumin*, which is not reddened by boric acid, and is soluble in alkalies with a greenish-gray color. Boiling as before, but in the presence of sulphuric acid, *rosocyanin* is formed, which is crystalline, insoluble in water, benzene, and ether, and soluble with a beautiful red color in alcohol. Alkalies color it blue; the solution, on boiling, turns blood-red, then yellow, and now contains pseudocurcumin.

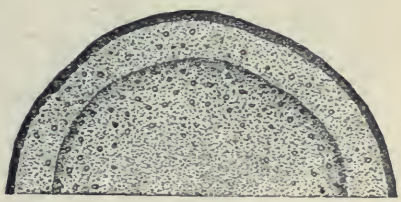
The viscid oil is partly turmerol ($C_{19}H_{28}O$), pale-yellow, aromatic, dextrogyre, of a density of 0.016 at 17° C. (62.6° F.), and boiling at 280° to 290° C. (536° to 554° F.) with partial decomposition.

Action and Uses.—Turmeric possesses slight stimulant properties, but is not used in medicine in this country. At one time it was employed in Europe in the treatment of jaundice, but its efficacy is questionable. The drug is largely used in India as a condiment, and it occasionally answers a similar purpose in America. Solutions of turmeric are occasionally employed to impart color to pharmaceutical preparations and to prepare turmeric paper. Turmeric paper is made by moistening white bibulous paper in a neutral tincture or decoction of the drug. The tincture is prepared by percolating 1 ounce (30 Gm.) of turmeric with sufficient dilute alcohol to obtain 6 ounces (180 Cc.).

Other Curcumas.—The genus *Curcuma* contains about 30 species, all of the old-world tropics. From several of them, especially *C. angustifolia* Roxb., a kind of arrow-root starch is obtained. The most important product, next to curcuma, is the following:

Zedoaria (*Zedoary, Rhizoma Zedoariæ*, P. A., P. G.; *Zittwerwurzel, Langer Zittwer, Giftheil, Zarnabac*, G.; *Zedoaire longue*, Fr.) is the rhizome of *C. Zedoaria* Rosc. (*C. Zerumbet* Roxb.; *Amomum Z.* Kurz.), the so-called *Round zedoary*, coming from *C. aromatica* Salisb. Both are East Indian plants, of similar habit to the curcuma plant, the former extensively cultivated. The rhizome, or, more properly, tuber, is terete and somewhat thicker than curcuma, and, to facilitate drying, is sliced, mostly transversely. It occurs in nearly circular (occasionally oval) disks, from 1 to 4 Cm. ($\frac{1}{2}$ to $1\frac{1}{2}$ In.) broad, and 4 to 10 Mm. ($\frac{1}{6}$ to $\frac{2}{5}$ In.) thick, the thickness almost uniform at margin and center. The edges are grayish-brown and wrinkled, the cut surfaces white or grayish-white and smoothish, with a darkish endodermal circle near the margin.

Fig. 155.



Zedoary: transverse section of one-half of rhizome.

Vascular bundles and resin-cells may be seen throughout, but the former are especially abundant toward the center. The fracture is short and more or less mealy, the aromatic odor and taste peculiar, resembling ginger, and, slightly, camphor. The starch-grains also resemble those of ginger. Round zedoary is yellow internally and appears in yellow disks.

Zedoary contains starch, gum, bitter extractive, a soft pungent resin, and a volatile oil.

CUSPARIA.—Angustura; Angustura Bark.

Carony bark; Cusparicæ cortex; Cortex Angusturæ.—Angustura Rinde, G.; *Angusture vraie*, Fr.

The bark of *Cusparia Angustura* (Rich.) Lyons (*Bonplandia A.* Rich.; *B. trifoliata* W.; *Galipea Cusparia* St. Hil.; *G. febrifuga* Baill.; *Cusparia f.* Humb.; *Galipea officinalis* Hancock.—Fam. *Rutaceæ*), a small tree of the Orinoco basin. It derives its name from the exporting locality, the "Angustura" (*Narrows*) of the Orinoco River.

Description.—In flat, curved or quilled pieces, several inches in length and 1.5–3 Mm. ($\frac{1}{16}$ to $\frac{1}{8}$ In.) thick; outer surface light yellowish to slightly orange gray, with an uneven or finely warty-scurfy and friable cork, sometimes light-gray and rather hard, or reddish-brown and smoothish when the corky layer is removed; inner surface varying from light yellowish-brown to (when long kept) reddish or dark-brown, frequently marked with transverse wavy lines, or showing blistered or partly detached portions of the thin innermost layer; fracture sharp, smooth, somewhat granular, more or less laminated, reddish-brown and resinous, except in the pale-brown corky layer, showing numerous white, glistening striæ of crystals of calcium oxalate, and minute dark-colored oil-cells; odor agreeably aromatic; taste aromatic and very bitter. The lack of sclerenchymatous tissue is regarded as distinguishing Angustura from all of its adulterants.

Fig. 156.

Angustura (Nat.).

Substitution has been extensively practised, chiefly with the bark of *Esenbeckia febrifuga* Juss. (*Evodia f.* Mart.), the Brazilian angustura, which is mostly wanting in the corky layer, has a fibrous fracture, exhibiting much sclerenchymatic tissue, lacks the white striæ, and is without aroma, although bitter. A poisonous, brucine-yielding strychnos bark was at one time accidentally substituted.

Constituents.—Angustura contains a white bitter principle, *angusturin* or *cusparin;* 1.5 per cent. of volatile oil, consisting of galipol, galipene, cadinene, and pinene; 3.8 per cent. of resin, part of which is hard and bitter and the rest soft; and 4 alkaloids: *cusparine* ($C_{20}H_{19}NO_3$), 1.5 per cent., crystallizes in needles and tetrahedrons, and forms bitter white salts sparingly soluble in water; *cusparidine* ($C_{19}H_{17}NO_3$) occurs in white needles, and yields white bitter salts; *galipine* ($C_{20}H_{21}NO_3$) is in white needles and yields yellow crystalline salts; *galipidine* ($C_{19}H_{19}NO_3$) occurs in white laminæ, and forms bitter pale-yellow salts. Some amorphous alkaloids and a glucoside await investigation. There is no tannin present, although the infusion yields a red-brown precipitate with ferric chloride and some other metallic salts.

Fig. 157.

Angustura bark: transverse section, magnified 10 diameters.

The barks of *Cusparia odoratissima* (Lindl.) Engl. (*Galipea o.* Lindl.) and *G. dichotoma* Fr. All., both of Brazil, are used like Angustura.

Action and Uses.—Angustura may be classed among the simple bitters, and may be employed in the various conditions in which they have been recommended. It may be used in atonic dyspepsia and in anorexia following convalescence from acute febrile conditions. In mild cases of intermittent fever it is supposed to possess value, but is rarely employed at the present time. Angustura has also been used with varying degrees of success in the treatment of tropical dysentery.

Angustura may be given in powder in the dose of from 10 to 30 grains (0.60–2 Gm.). An infusion (made with 50 Gm. of drug to 1000 Cc. of water) may be given in doses of from ½ to 1 fluidounce (16–30 Cc.).

CUSSO, *U. S., Br.*—Kousso; Red Cusso.

Brayera, U. S., 1880; *Flores Koso*, P. G.; *Kusso*, E.; *Kousso*, Fr.; *Koso, Kusso, Cusso*, G.; *Cosso*, It.

The dried panicles of the pistillate flowers of *Hagenia abyssinica* (Bruce) Gmelin (*Bankesia A.* Bruce; *Brayera anthelmintica* Kunth.—Fam. *Rosaceæ*). The large stems should be rejected before using.

Origin.—A handsome good-sized tree of the high and rather arid regions of Abyssinia, cultivated to some extent both for its medicinal product and its ornamental properties. Its flowers are unisexual, though more or less polygamous. Little seems to be known as to the best time for collection, though we are informed that it is collected after fertilization. Following the history of Cannabis and some other flowers having active constituents of the same general nature, we might believe that the drug would be more active before pollination. After partial drying, several of the panicles described below are compressed into a roll and tied tightly with the stem of a *Cyperus*.

Description.—Mass red-brown, hairy and minutely glandular, consisting of panicles varying from 25 to 40 Cm. (10 to 16 In.) long, a sheathing bract at the base of each branch, and 2 rounded bracts near the base of each flower; calyx having a cup-shaped, hairy tube, and bearing on its back a circle, resembling an outer calyx, of 5 thickish and rigid, spreading, obovate, purple-veined bracts, which are larger than the 5 thinnish, usually shrivelled and incurved, oval calyx-lobes; petals 5, delicate, whitish, oblong, much shorter than the sepals, caducous, hence often wanting in the drug; stamens aborted; pistils 2, the 1-ovuled ovoid ovaries concealed in the calyx-tube, shorter than the styles, which are exserted; stigmas broad, hairy; odor slight, agreeable; taste bitter, acrid, and nauseous.

Loose flowers, usually largely staminate, should be rejected.

Under the microscope, the surface is seen to bear short glandular-headed hairs of several distinct types, besides long, slenderly tapering 1-celled hairs with dilated hollow bases, and both of these elements are conspicuous and characteristic in the powder. The ash should not exceed 5 per cent.

FIG. 158.

Hagenia abyssinica Gmelin: *A*, lowest branch of panicle (⅔ Nat.); *B*, staminate flower; *C*, section of pistillate flower (×4).

It is believed that much of the disrepute of this very valuable remedy is due to the impure quality of the drug, resulting chiefly from the presence of the male flowers. In the entire condition these are easily distinguished, the mass having a pale greenish-brown color, the official being thus distinguished as *Red cusso*. An examination of the structure is easy and the result positive. In the powdered condition, detection is by no means easy. The presence of pollen-grains is not sufficient, since more or less of them are affixed to the stigma and other parts of the pistillate flowers. Their great abundance in the powder of the staminate flowers is fairly characteristic. The calyx-tissue of the male flowers is of a greenish-yellow, and this can be detected in the powder. The disre-

pute of the drug is also largely due to the general practice of powdering the inert stems with the flowers. English authorities claim much better results from the finely powdered drug suspended in some thick liquid, as syrup, than from any extracted preparation.

Constituents.—Cusso yields a small quantity of tannin, volatile oil, crystallizable acid, bitter resin, *protokosine*, an inactive crystalline body, and 3 per cent. of *kosin*. This substance ($C_{31}H_{38}O_{10}$), also called brayerin, kwosein, and koussin, is a yellowish-white, indistinctly crystalline body of bitter and acrid taste, sparingly soluble in water, and freely so in alcohol, ether, and alkalies. The amorphous kosin of commerce is more active than the pure principle, probably on account of the resin it contains. Kondakor and Schatz (1900) distinguish an amorphous glucoside (?) *coussin* ($C_{26}H_{41}O_5$), and crystalline *cosine* ($C_{22}H_{32}O_7$), which, with dilute sulphuric acid, yields isobutyric acid and an unidentified body.

Action and Uses.—Cusso is exclusively employed as a tænicide. It has been used in Abyssinia for many years, but it is stated that the drug is very severe in its action, producing nausea and vomiting, and at times failure to purge. The worm is expelled in segments, and, as is the case with all similar drugs, the head is not always discharged. By some the drug has been used with excellent results, the claim being that it produces little nausea, and later feculent followed by liquid stools, the worm, including the head, being expelled dead. The active principle, kousin, in an impure state has been employed in Germany with varying success. The impure product is apparently more effective than when highly purified. This has led to the belief by some that the green resin present is probably the active principle.

In this country the remedy is probably best given in the form of the fluid extract, made from the fresh flowers, in the dose of ½ fluidounce (16 Cc.), to an adult, and one-half this amount to a child under 12 years of age. The dose of kousin is from 20 to 40 grains (1.3–2.6 Gm.), best administered in divided doses. If the drug fail to purge in 4 hours, it should be followed by a cathartic.

CYDONIUM.—Cydonium.

Semen cydoniæ.—*Quince-seed*, E.; *Quittensamen, Quittenkerne*, G.; *Semences (Pépins) de coing*, Fr.: *Membrillo*, Sp.

The seed of *Cydonia Cydonia* (L.) Lyons (*Pyrus C.* L.; *C. vulgaris* Pers.—Fam. *Rosaceæ*).

Origin.—The well-known quince is a native of western Asia. Each of the 5 cells of the fruit contains about 12 closely packed seeds, found enveloped in a mass of semi-transparent mucilage.

Description.—From 6 to 10 Mm. (¼ to ⅖ In.) long, and a third as broad, ovoid and angularly compressed, the raphe along the sharper edge, the hilum at the narrow end, a slight beak at the other; testa brown, gummy in the epithelium, and having a mass of gum upon the surface.

Fig. 159.

Quince-seed and section.

One part of the seeds with forty parts of water, should yield a thick, jelly-like mass.

Constituents.—"Cydonin," the gum of the epithelium ($C_{12}H_{20}O_{10}$), constitutes about 20 per cent. of the weight of the dry seeds. The cotyledons yield fixed oil.

The pulp of the fruit contains 3 to 3.5 per cent. of malic acid.

Pharmaceutical Preparation.—Mucilage of Cydonium, N. F.

Action and Uses.—Cydonium is rarely employed in medicine, but, like other substances containing a bland mucilage, may be used as a demulcent and protective. Its mucilage is almost free from adhesive properties. The U. S. P. (1880) gave the following formula for its preparation: cydonium, 2 parts (36 grains); distilled water, 100 parts (4 fluidounces); macerate the cydonium for half an hour in a covered vessel, with the distilled water, frequently agitating. Then drain the liquid through muslin without pressure. This preparation should be freshly made for immediate use.

CYPRIPEDIUM, *U. S.*—Cypripedium.

Rhizoma cypripedii.—*Yellow ladies' slipper root, Yellow moccasin-flower, Yellow Indian shoe, Venus' shoe, American valerian, Male nervine, Yellow Noah's ark,* E.; *Gelbfrauenschuhwurzel,* G.; *Racine de cypripède jaune, Valeriáne americáine,* Fr.

The dried rhizome and roots of *Cypripedium hirsutum* Mill. (*C. pubescens* Swartz) or of *C. pārriflorum* Salisb. (Fam. *Orchidaceæ*).

Origin.—Perennial, hairy herbs, a foot or two high, of boggy or low woodlands of the northern and middle United States, and northward. The flowers are bright-yellow and showy, the corolla-lip forming a large, inflated, bag-like body. The hairs are irritant and capable of producing a cutaneous eruption upon many persons.

Description.—Orange-brown to dark-brown; rhizome of horizontal growth, curved, 5 to 10 Cm. (2 to 4 In.) long and 3 to 6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ In.) thick, the upper surface beset with numerous saucer-shaped or cup-shaped scars which may be slightly elevated or depressed, below covered with numerous unbranched, wavy, coarse roots, which are frequently matted so as nearly to conceal the rhizome; brittle, the fracture short, white; odor heavy, peculiar, or somewhat like valerian; taste sweetish, bitter and aromatic, slightly acrid.

Hydrastis (which see) is frequently found admixed.

Constituents.—These are not very definitely known. Blair (1866) found a minute amount of volatile oil, a volatile acid, 2 resins, tannin, and starch, and these results were confirmed in 1887 by Beshore, who states that the tannic principle is distinct from both tannic and gallic acids.

FIG. 160.

Cypripedium pubescens: portion of rhizome and roots (Nat.).

Pharmaceutical Preparation.—FLUIDEXTRACT OF CYPRIPEDIUM, U. S. P.

Action and Uses.—Cypripedium has been employed for about the same purposes as valerian. It is an antispasmodic, and is supposed to possess a slight stimulant effect upon the nervous system. It has been given with asserted success in hysteria, hypochondriasis, and chorea. It is also stated that it may be employed with benefit in the treatment of epilepsy.

The dose is stated to be 15 grains (1 Gm.), 3 times a day. An oleoresin obtained by precipitating the tincture is employed in doses of from $\frac{1}{2}$ to 3 grains (0.03–0.2 Gm.).

Other Species.—*Cypripedium,* L., comprises about 20 species, of the north-temperate zone, nearly half of them possessing properties similar to those of the official. The leaves of *C. guttatum* Swz., of northern Asia, are used for epilepsy.

D.

DAMIANA.—Damiana.

The leaves of *Turnera diffusa aphrodisiaca* (Ward) Urban (*T. aphrodisiaca* Ward; *T. microphylla* Desv.—Fam. *Turneraceæ*), a small yellow-flowered shrub growing from southwestern Texas through Mexico, especially the western and west-central portions, to northern South America, and in some parts of the West Indies.

Fig. 161.

Damiana (Nat.).

Description.—Owing to the exceeding variability of the plant, and even of the leaves upon the same plant, this drug calls for a very elastic description.

From 1.5 to 3 Cm. ($\frac{3}{5}$ to $1\frac{1}{5}$ In.) long and 3 to 6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ In.) broad, without a true petiole, oblanceolate to obovate, acute or obtuse at the summit and short-cuneate at the base, serrate-dentate, pale-green, with ascending veins, thick or thin, from nearly smooth with whitish hairs on the veins underneath (this mostly in the older and thicker leaves) to tomentose or flocculent underneath or upon both surfaces; pleasantly fragrant, and of an aromatic and bitterish taste. The slender, reddish stems, 5-merous flowers, with 3-nerved sepals and obovate yellow petals, and globoidal, 1-celled and many-seeded capsules, are often present.

Constituents.—Damiana yields 0.5 per cent. of an amber-colored volatile oil with a heavy, aromatic odor and a warm, camphoraceous, bitter taste, light-brown amorphous bitter *damianin*, which is soluble in ether and chloroform, 6.4 per cent. of hard resin, 3.5 per cent. of tannin, soft resin, sugar, and gum.

Pharmaceutical Preparations.—Elixir of Damiana, N. F.; Fluidextract of Damiana, N. F.

Action and Uses.—Damiana possesses the properties of a stimulant tonic, and in large quantities is laxative. As an aphrodisiac it is probably valueless, and it has no power to restore either the size or function of an atrophied testicle. It has been largely employed in sexual impotence, but as it is usually combined with phosphorus and nux vomica it is quite probable that the benefit obtained is due to the latter remedies. The dose of the fluid extract is 30 minims (2 Cc.).

Substitutes and Allied Plants.—Several other plants have been sold for Damiana, notably the leaves of *Isocoma veneta* (H. B. K.) Greene (*Baccheris v.* H. B. K.; *Bigelovia v.* Gray; *Linosyris Mexicana* Schlecht; *Aplopappus discoidea* DC.—Fam. *Compositæ*), which are nearly 5 Cm. (2 In.) long, oblanceolate, the lower half narrowly cuneate, the upper half with about 3 pairs of very sharp teeth, the apex terminating in a similar tooth, thick, light-green, roughish with resin-like granules and occasional black dots, balsamic in odor and taste.

There are more than 50 species of *Turnera*, all, with one exception, plants of tropical or subtropical America, the leaves of many of them being aromatic. *T. apiifera* Mart., of South America, and *T. ulmifolia* L., and *T. angustifolia* Curt., of the West Indies, are used as carminatives, tonics, and, especially the last named, for their mucilaginous properties.

Peckolt states that in Brazil the freshly expressed juice of *Langsdorffii hypogæa* Mart. (Fam. *Balanophoraceæ*), the *Rosa de Caboclo*, or *Indian rose plant*, is used as an aphrodisiac.

DECOCTA, *U. S.*, *P. G.*—Decoctions.

Decoctions, E.; *Décoctions, Tisanes par décoctions*, Fr.; *Abkochungen*, G.; *Decotti*, It.

When the active principles of vegetable drugs are exhausted by boiling with water, decoctions are obtained. Such preparations are obviously not adapted to drugs the activity of which depends upon principles of a resinous nature which are insoluble in water, nor to such as contain volatile oils or other volatile substances which would be dissipated with the vapor of water, and should be restricted to those drugs the active

constituents of which cannot be extracted by water below 100° C. (212° F.). Formerly, decoctions were usually made by using a large quantity of water and boiling it down to one-half, or even to a less amount. No obvious advantage was gained by this method, and in many instances it proved to be decidedly disadvantageous, owing to the alteration and darkening of the extractive matters, and in some cases to changing the nature of the active principles. The pharmacopœias have very properly, in nearly all cases, reduced the time of boiling to 10 or 15 minutes, the general directions given by the present U. S. P. being as follows: An ordinary decoction, the strength of which is not directed by the physician nor specified by the pharmacopœia, shall be prepared by the following formula: Take of the substance coarsely comminuted, 50 Gm.; water, a sufficient quantity to make 1000 Cc. Put the substance into a suitable vessel provided with a cover, pour upon it 1000 Cc. of cold water, cover it well, and boil for 15 minutes; then let it cool to about 40° C. (104° F.), strain the liquid, and pass through the strainer sufficient cold water to make the product measure 1000 Cc. This represents about 23 grains of drug in each fluidounce.

Caution.—The strength of decoctions of energetic or powerful substances should be specially prescribed by the physician.

By following the directions of the P. G., to keep the mixture of drug and cold water for half an hour in a bath of steam arising from boiling water, the time is practically reduced still more; but the physician is required to state the quantity of such drugs for which a maximum dose is given by the pharmacopœia; other drugs may be used in the proportion of 1 part for 10 parts of decoction.

The use of cold water to begin with, insures the complete exhaustion from the drug of all its soluble principles by the gradually heated water, the albuminous principles being subsequently coagulated as the heat is increased to near the boiling-point. If, on the other hand, the drug be at once immersed in boiling water, the albumin contained in cells would be coagulated, and thus seriously interfere with the extraction of the other principles. In preparing compound decoctions, all the drugs may be added to the cold water, with the exception of those which, like senna, are injured by long-continued heat or which contain aromatic or other volatile principles. Such should be added when the decoction is ready to be removed from the fire or steam-bath, and allowed to digest until it is sufficiently cooled for straining. The material should in all cases be cut or bruised, the degree of fineness depending upon the nature of its tissue. Woody drugs may be reduced to a moderately fine powder; leaves, however, and other drugs consisting mainly of loose parenchyma, are better used in the form of a moderately coarse or very coarse powder.

Unless the liquid is to be considerably boiled down, decoctions are best prepared in a vessel provided with a cover, which may be loosely put on until the boiling is completed, when the vessel should be well closed, particularly if additions have been made at the close of boiling. Porcelain is undoubtedly the best material for vessels used for preparing decoctions, since it is not acted upon by the various vegetable principles; for similar reasons, glass flasks will answer a useful purpose in making small quantities of these preparations. As a rule, it is best to avoid metallic vessels, except when made of block-tin and used in connection with a steam-bath. As many drugs contain tannin, vessels made of iron are not adapted for preparing their decoctions, and the usually imperfect covering of galvanized (or zinc) or tinned sheet-iron renders vessels lined with such material but little better suited for this purpose, and still inferior to properly enamelled iron vessels.

As a rule, decoctions should be allowed to cool to below 50° C. (122° F.) before they are strained; principles which are soluble only in hot water are then mostly precipitated, and removed without, in most cases, weakening the medicinal effects of the preparations. But even with this precaution the strained liquid may become unsightly in appearance through the further deposition, on cooling, of apotheme or matter soluble only in hot water. In such cases the pharmacist should be guided by the directions of the pharmacopœia or by the intentions of the physician, and not sacrifice effect to elegance. With some exceptions, decoctions which were formerly made at the house of the patient have gradually fallen into disuse through the introduction of fluid extracts and similar permanent preparations, by which the medicinal properties may be preserved unaltered for months, or even years, while decoctions cannot be depended upon for more than one or, at the utmost, a few days.

DECOCTUM ALOES COMPOSITUM, *Br.*—Compound Decoction of Aloes.

Tisane (Décoction) d'aloès composée, Fr.; *Zusammengestztes Aloedecoct*, G.

Preparation.—Take of extract of Barbadoes aloes, ½ ounce; myrrh, saffron, potassium carbonate, of each, ¼ ounce; extract of licorice, 2 ounces; compound tincture of cardamoms, 15 fluidounces; distilled water, a sufficiency for 50 fluidounces. Reduce the extract of aloes and myrrh to coarse powder, and put them, together with the potassium carbonate and extract of licorice, into a suitable covered vessel with a pint of distilled water; boil gently for 5 minutes, then add the saffron. Let the vessel with its contents cool, then add the tincture of cardamoms, and, covering, the vessel closely, allow the ingredients to macerate for 2 hours; finally, strain through flannel, pouring as much distilled water over the contents of the strainer as will make the strained product measure 50 fluidounces.—Br.

The preparation of the National Formulary is practically identical with the above, and is made in exactly the same manner, the quantities prescribed being as follows: Extract of aloes, 10 Gm.; myrrh and saffron, of each, 7.5 Gm.; potassium carbonate, 5 Gm.; extract of glycyrrhiza, 35 Gm.; compound tincture of cardamom, 250 Cc.; water, a sufficient quantity to make 1000 Cc.

The alkali carbonate is added for the purpose of aiding the solution of the resinous principles of aloes and myrrh; the tincture of cardamom, saffron, and licorice act as correctives, the latter serving more especially for partially masking the nauseous taste of the aloes. The air should be excluded from the preparation as far as possible.

Uses.—This decoction is antacid, tonic, and purgative. It has been employed when purgation is indicated in atonic amenorrhœa, and is useful in the treatment of acid dyspepsia and habitual constipation. The dose is from ½ to 2 fluidounces (16–60 Cc.).

DECOCTUM GRANATI RADICIS, *Br.*—Decoction of Pomegranate Root.

Decoctum corticis radicis granati. Tisane (Décoction) d'écorce de la racine de grenadier, Fr.; *Granat-Wurzel-Rinden Abkochung*, G.

Preparation.—Take of pomegranate root bark, in No. 10 powder, 4 ounces; distilled water, 24 fluidounces. Boil for 10 minutes and strain, making the strained product up to a pint (Imperial) by pouring distilled water over the contents of the strainer.—Br.

Uses.—The action and uses of decoction of pomegranate root will be found under GRANATI RADIX.

DECOCTUM HÆMATOXYLI, *Br.*—Decoction of Logwood.

Tisane (Décoction) de bois de Campêche, Fr.; *Blauholz-Abkochung*, G.

Preparation.—Take of logwood, in chips, 1 ounce; cinnamon bark, in coarse powder, 70 grains; distilled water, 24 fluidounces. Boil the logwood in the water for 10 minutes in a covered vessel, adding the cinnamon toward the end. Strain the decoction, and pour sufficient distilled water over the contents of the strainer to make the strained product measure a pint (Imperial).—Br.

A long-continued boiling of logwood in chips would probably improve the result of this formula. Porcelain or porcelain-lined vessels only should be used.

Uses.—This preparation may be used for those conditions in which hematoxylon is indicated (see HÆMATOXYLUM). Its bulky dose, from 1 to 2 ounces (30–60 Cc.), renders the decoction less desirable than other preparations of the drug.

DECOCTUM SARSAPARILLÆ COMPOSITUM, *P. G.*—Compound Decoction of Sarsaparilla.

Tisane (Apozème) sudorifique, Décoction de salsepareille composée, Fr.; *Zusammengesetztes Sarsaparilla-Decoct, Sarsaparill-Abkochung*, G.

Preparation.—The P. G. directs that 20 parts of sarsaparilla, cut moderately fine, shall be digested with 520 parts of water at a temperature of 35° to 40° C. (95°–104° F.)

for 24 hours; 1 part each of sugar and alum are then added, and the mixture exposed to the heat of a boiling water-bath for 3 hours, after which 1 part each of bruised anise and bruised fennel, 5 parts of senna, cut moderately fine, and 2 parts of licorice-root, crushed, are added, and the heat continued for 15 minutes longer. After settling, the liquid is decanted and the weight brought up to 500 parts by addition of water.

The U. S. P. no longer recognizes the compound decoction of sarsaparilla. The preparation of 1890 was made by boiling 100 Gm. of sarsaparilla, cut and bruised, and 20 Gm. of rasped guaiacum wood, for ½ hour in a suitable vessel with 1000 Cc. of water, and then adding 20 Gm. of sassafras in No. 20 powder, 20 Gm. of bruised licorice-root, and 10 Gm. of bruised mezereum. After covering the vessel, the contents were allowed to macerate for 2 hours, the mixture strained, and sufficient cold water added through the strainer to make the product measure 1000 Cc.

The second formula was constructed upon that of the French Codex, which directs boiling 3 parts of sarsaparilla and 6 parts of guaiacum wood with 200 parts of water, then adding 1 part of sassafras and 2 parts of licorice root, and macerating for 2 hours. It will be observed that this last is much the weaker preparation, and that mezereon bark is not used in it. The first two are simplified formulæ for the *Lisbon diet-drink*, or *Decoctum lusitanicum*, which was formerly much employed. The latter may also be said of *Zittmann's decoction*, of which a *stronger* and a *milder* one are used together. *Decoctum Zittmanni fortius:* Take of sarsaparilla root, cut, 100 parts; digest in water 2600 parts for 24 hours, and add, enclosed in a linen bag, powdered sugar and alum, each 6 parts, calomel, 4 parts, and cinnabar, 1 part; then heat in a covered vessel placed in a steam-bath for 3 hours, stirring frequently, and near the end of the boiling add anise and fennel, bruised, each 4 parts, senna, cut, 24 parts, and licorice root, cut, 12 parts. Express, strain, set aside for some time, and decant to obtain 2500 parts of clear liquid. 2500 Gm. of this are to be divided into 8 parts. *Decoctum Zittmanni mitius:* Take the residue left from the preceding and 50 parts of sarsaparilla, heat with water 2600 parts for 3 hours in a covered vessel placed in a steam-bath, stirring frequently, and when near the end of boiling add lemon-peel, Chinese cinnamon, cardamom, and licorice root, each cut and bruised, 3 parts. Express and operate as before to obtain 2500 parts.—P. G. 1872.

Uses.—The activity of this remedy depends chiefly upon the mezereum and sarsaparilla. It is employed in the treatment of syphilis, scrofulosis, and chronic rheumatism, and is given in doses of from 3 to 6 fluidounces (90–180 Cc.), 3 times daily.

DEXTRINUM.—Dextrin.

Dextrine, Fr. Cod.; *Dextrin, Stärkegummi*, G.

Dextrin is a member of the group of carbohydrates to which cellulose, starch, inulin, and lichenin belong, and has the same empirical formula as these bodies, namely, $(C_6H_{10}O_5)x$. The name dextrin is applied to any or all of the intermediate substances produced during the transformation of starch into glucose, a prefix being added to indicate the degree of conversion; thus, *amylo*dextrin, the first product after change of the starch into amylogen or soluble starch, which causes a purple color-reaction with iodine; *erythro*dextrin, which gives a red color with iodine; *achroo*dextrin, which is not affected by iodine at all, the brownish-red color of iodine remaining. When diastase, or extract of malt, is used as the converting agent, maltodextrin is produced, which is identical with achroodextrin.

While dextrin was observed by Vauquelin as early as 1811, it was more thoroughly studied by Persoz and Payen in 1833. It is assumed to occur in nature associated with glucose and cane-sugar, but its presence in plants and the blood of animals has as yet not been positively demonstrated.

Dextrin may be obtained from starch by the action of dry heat, by dilute acids and heat, by boiling water, and by action of ferments. By prolonged action of these agents starch is easily converted into dextrose or maltose. Being thus partly digested starch, it is used in the manufacture of infants' foods, the ferments ptyalin, amylopsin, and diastase quickly changing dextrin into sugar. The increased digestibility of toast and crust of bread is due to the presence of dextrin.

Crude dextrin is prepared either by the dry heat or acid method. The first consists in heating grain or potato starch, usually the latter, to a temperature of 230°–260° C. (446°–500° F.) in suitable apparatus provided with mechanical stirrers. According to the care observed, the product consists of a white or yellowish powder of faint flour-like odor and insipid taste. It is more or less soluble in cold water, the solubility depending upon the proportion of unconverted starch present. The acid method consists in mixing 1000 parts of potato starch with a mixture of 2 parts of 58 per cent. nitric acid and 300 parts of water, and drying the resulting mass at a temperature of 110°–120° C. (230°–248° F.) until a starch reaction is no longer obtained with iodine. Dextrin thus made resembles the preceding variety, but is usually lighter in color and has a slight acid reaction.

Purified dextrin, suitable for use in pharmaceutical preparations, may be made by mixing dextrin made by the acid method with 3 times its weight of water and adding about 2 per cent. of precipitated calcium carbonate. After thorough agitation, the mixture is allowed to rest for some time, and is then strained through a woollen strainer. The filtrate is concentrated to about two-thirds its volume and poured into twice its volume of 90 per cent. alcohol, whereby the dextrin, freed from acid, glucose, and other impurities, is precipitated. The latter is washed with 70 per cent. alcohol and finally dried on porcelain plates. The German Pharmacopœia of 1872 directed dextrin for pharmaceutical purposes to be made by acting on potato starch with a cold weak solution of oxalic acid for several days, until iodine causes only a wine-red color when added. The acid liquid is then neutralized by means of calcium carbonate, filtered, and the filtrate evaporated to dryness at a low temperature. The residue yields a yellowish odorless non-hygroscopic powder. If carefully prepared, purified dextrin contains only very small quantities of glucose, from which it can be wholly freed by repeated solution in water and precipitation with alcohol.

Commercial dextrin is an uncrystallizable solid occurring both in powder-form and as white or yellowish masses somewhat resembling gum arabic in appearance. It has a slightly sweetish taste, and is also known as *British gum*, and is used on postage stamps and envelopes.

In pharmacy dextrin has been used in powder-form as a diluent and in the form of a mucilage as an emulsifying agent. White dextrin almost invariably requires heat for solution in water on account of the unconverted starch present, but the yellow variety dissolves readily in twice its weight of cold water, forming a mucilaginous liquid after standing a few hours. Boiling water should not be used for making a solution of the yellow dextrin, so as to avoid the formation of glucose.

Dextrin is insoluble in alcohol and ether. Like glucose, it is capable of reducing Fehling's Solution (alkaline cupric tartrate), but may be distinguished from the same by using Barfoed's Solution (cupric acetate, 1 part; distilled water, 93 parts; glacial acetic acid, 1 part), which is reduced by glucose but not by dextrin. Its solution is precipitated by lime water, but not by neutral or basic lead acetate.

Pharmaceutical Preparation.—Mucilage of Dextrin, N. F.

Action and Uses.—Dextrin is rarely employed in internal medicine. The mucilage of dextrin may be given as a demulcent, but is almost entirely used in the arts as an adhesive agent.

DIASTASUM.—Diastase.

An unorganized ferment, or enzyme, occurring in plants, especially in seeds during germination, and possessing the function of converting their starch into sugars.

Diastase is known only by its effects, since the substance itself has never been isolated. Its physical and chemical nature are therefore unknown. Commercial diastase is a concentrated extract containing the diastase, whatever this may be, in an impure condition, and possessing the diastasic property.

Origin.—It is assumed that diastase exists wherever, in the plant-body, starch has to be converted into assimilable forms for the use of the plant, and it is possibly the same agent which converts related compounds. As to whether the diastase is the same

in all cases, or whether there is a class of diastases, cannot at present be stated. For commercial purposes, ordinary diastase is obtained from malt, *Taka-diastase* from certain species of fungi. The diastase is produced during germination from some other body present in the seed, and its amount, or its activity, rises up to a certain point, then declines, and a great deal of care and experience is required to stop the germinating process at the point of greatest activity. At this point, the commercial article can be obtained to the extent of about 0.2 per cent. It is dissolved out of crushed malt by maceration in cold water, filtering the infusion, and pouring the filtrate into twice its volume of 95 per cent. alcohol. The precipitated diastase is collected on a filter and dried at a temperature not exceeding 50° C. (122° F.). Repeated precipitations tend to purify it, but more or less sugar, albumin, and unknown impurities are always present.

Description.—After drying and grinding, diastase is a nearly white, odorless, and tasteless powder, neutral if fresh, acid if old, insoluble in alcohol, soluble in water, and not precipitated by lime, lead acetate, or baryta. The action of diastase, like that of other ferments, is destroyed by high temperatures. It is also destroyed in a freely acid medium. *Taka-diastase* is obtained from the roots of certain species of *Aspergillus* grown upon sterilized bran. It is one of the substances used in Japan in the production of beer.

Solutions of sodium chloride and calcium chloride in moderately concentrated form are without effect on diastase, but concentrated solutions inhibit its action. Fehling's Solution is not affected by pure diastase. If a small quantity of an aqueous solution of diastase be added to a freshly prepared tincture of guaiac previously mixed with a few drops of hydrogen peroxide solution, an intensely blue color will be immediately produced, in which respect diastase differs from pepsin, invertin, and the ferments present in rennet and saliva.

Diastase is recognized in the French Pharmacopœia, which demands that it shall be capable of converting at least 50 times its weight of potato starch into sugar. According to some authorities (Schmidt, Lintner), diastase of prime quality is capable of converting from 2000 to 100,000 times its weight of starch. Aqueous solutions of diastase are unstable and soon lose their power of conversion.

The following test may be applied to ascertain the value of diastase: 0.1 Gm. of diastase is added to 100 Gm. of starch-paste, prepared from 6 Gm. of potato starch, and the mixture heated on a water-bath for 6 hours at a temperature of 50° C. (122° F.), with occasional stirring. At the end of this time a clear colorless solution should result, capable of reducing 5 times its volume of Fehling's Solution, each Cc. of which represents 0.005 Gm. of glucose. For method of testing the diastasic value of malt extracts, see EXTRACTUM MALTI.

Action and Uses.—Diastase is said by Contaret to be identical with ptyalin, the digestive ferment found in the saliva of various animals. It is employed in medicine for the purpose of converting starch into dextrin and sugar in cases of indigestion of the starchy foods. It is also employed in the treatment of atonic dyspepsia.

Taka-diastase is by far the best preparation to employ, and is given in the dose of from 2 to 5 grains (0.12–0.30 Gm.), either in tablet, capsule, or solution, with or immediately after meals.

DIGITALIS, *U. S.*—Digitalis.

Digitalis folia, Br.; *Folia digitalis*, P. G.—*Foxglove* (*from "Folksglove," meaning "Elves'- glove"*) *leaves, Purple foxglove, Fairy-cap, -fingers, -thimbles*, or *-bells, Ladies' glove, Flop-dock, Cottagers, Throatwort*, E.; *Feuilles de digitale pourprée* (*de grande digitale*), Fr.; *Fingerhutkraut*, G.; *Digitale*, It.; *Dedalera*, Sp.; *Dadaleira, Abeloura, Herva Dedal*, Port.

The dried leaves of *Digitalis purpurea* L. (*D. tomentosa* Link et Hoffm.—Fam. *Scrophulariaceæ*), collected from plants of the second year's growth at the commencement of flowering.

Digitalis is official in all pharmacopœias. Most require that it be used within a year after being collected. Many require that it be collected from wild plants; others, that it be taken when the plant is in bloom. The British requires that the plant be just commencing to bloom.

Origin.—The foxglove plant is a biennial or perennial herb, native of western and central Europe, and cultivated very widely as a garden flower and rather extensively for

medicinal purposes. It is said to have become thoroughly naturalized in Australia and in Oregon, producing in the latter State plants attaining 12 feet in height, 6 feet elsewhere being regarded as unusually large. It prefers sandy and partially shaded slopes. During the first year it develops a rather large, fleshy root, and a rosette of radical leaves, but no stem, the latter, with its flowers and fruit, developing during the second season. The stem is mostly simple, the upper half forming a rather dense, often 1-sided raceme of large, pendulous, irregularly bell-shaped flowers, the corolla purple, dark-spotted on the inside. The stem is leafy, the leaves becoming smaller upward, and finally reduced to mere floral bracts.

Since it is impossible to obtain the full physiological effects of digitalis from the use of any of its constituents, a fully satisfactory chemical assay is impossible. Although the percentage of digitoxin is usually taken as the standard, a great deal must be conceded to clinical trial, the results of which do not always agree with the digitoxin test. There is, therefore, more or less of an element of uncertainty in all conclusions, but those set forth below are probably not far from correct.

Geographical Sources.—Reported experiments to determine the relative value of leaves from different localities should be received with great caution, since the conditions of collection and preservation may not have been equivalent. Benyschek has made very extensive comparisons (as to digitoxin yield) of leaves from nearly all sources, collected and preserved under the same conditions, and finds little difference among them. It is almost universally believed that leaves from wild plants are more active than those from cultivated ones, and the digitoxin yield seems to indicate a slight advantage in this respect, but the belief cannot be regarded as fully confirmed.

Collection and Preparation.—It is generally conceded that leaves of the first year's growth are more or less wanting in activity, and digitoxin assay fully confirms this view. It is generally believed that the leaves should be collected when the plant is in flower or just beginning to flower. This idea has largely grown out of the desire to avoid all possibility of mistake as to the plant, a care which is almost entirely unnecessary. Cæsar and Loretz have found the percentage of digitoxin greatest before flowering, and Benyschek has found it to be inversely proportional to the amount of water in the herbage, which would partially agree with the conclusions of the first-named authors. The same authors found the same percentage of digitoxin in the flowers, with their calyx, as in the leaves, but both the flowers and seeds have a different composition from the leaves, and neither should be included. The admixture of the stems is, of course, wholly unwarranted. The leaves should be dried as soon as possible after collection, and great care should be bestowed upon this work. Drying should be rapid, yet without exposure to the sun or to undue heat, and, of course, protected from all extraneous moisture. Doubtless nothing can be better than the old Dutch method of hanging the plants by the roots in a current of warm air. Benyschek found a great increase in the yield of digitoxin from leaves dried upon the stem, over those which were separated before drying.

Preservation.—There is a general opinion that, no matter how carefully kept, digitalis is nearly or quite worthless after a year from the time of its collection, but the idea appears to have no foundation. Deterioration is due to exposure to moisture and light; and if these be excluded, its properties, or at least its yield of digitoxin, can be long preserved intact. Cæsar and Loretz found that properly pressed into bales, and the latter carefully preserved, there was but a very slight change after a year. Moderately pressed into small cakes and carefully preserved, digitalis keeps very well, and the same is true of the powdered leaves if kept in an air-tight and dark container. Benyschek found digitalis unaltered after two and a half years when kept in hermetically sealed, dark-brown or black bottles. He recommended as the best method, keeping them in tins, over lime—the old Dutch method.

Description.—Abruptly contracted into a usually long, stout, winged petiole; blade 10 to 30 Cm. (4 to 12 In.) long and 5 to 15 Cm. (2 to 6 In.) broad, ovate to oval, obtuse or acutish, crenate or erose-dentate, thin, dull, and rather pale-green or grayish underneath; upper surface wrinkled, sparsely hairy, the venation inconspicuous; lower surface densely and finely hairy, the venation conspicuously reticulated, the midrib and principal veins broad and flat, usually purplish, the latter decurrent into the midrib and the lower continued into the wings of the petiole; odor slight, peculiar; taste very bitter, nauseous.

There is no satisfactory method of distinguishing the leaves of the first from those of the second year's growth, in a description, though experience will usually enable one

to recognize them. Wild-grown leaves are apt to be thinner, grayer or paler, more hairy and more inclined to an acute apex. The powder ranges from a pale to a bright-green, and is distinguished from all adulterants by the hairs and the absence of calcium oxalate crystals. The hairs are mostly 3- to 5-celled, and invariably simple, except that they may end in 2 glandular cells. Some are glandular, but most are not. In some the cells are connected by a very slender or filamentous section. Many of the hairs are very much bent or curly. The heads of the glandular hairs are mostly depressed globular, and of a yellowish or light-brown color. The epidermal cells which are accompanied by stomata are very small and have irregular, jagged outlines.

Considerable has been written concerning the adulteration of digitalis, but as a matter of fact it is rarely seen adulterated, and none of the adulterants resemble it sufficiently to lead to a mistake in the light of our description. The leaves of *D. ambigua* Murr. (*D. ochroleuca* Jacq.) are nearly smooth. Those of mullein are yellowish-white and densely long-tomentose and entire; those of Symphytum are entire and scabrous, as are those of *Conyza squarrosa* Gengi (*Inula s.* Bernh.).

FIG. 162.

Digitalis purpurea L.

Constituents.—Because of the difficulty of separating the components without change, and because much of the study has been upon the active principles of the seeds, which by some are claimed to differ from those of the leaves, the chemistry of digitalis is still unsettled. According to Kiliani (1898), the principles of the seeds are *a-digitoxin, digitalin,* and *digitonin;* those of the leaves (less well known) are *b-digitoxin, digitophyllin,* much *digitalein,* and probably *digitalin.* According to Keller, *digitoxin, digitalin,* and *digitonin,* the last named representing purified *digitalein,* are met with both in the seeds and leaves. *Nativelle's digitalin* has been shown to consist almost wholly of *digitoxin,* accompanied by inert crystalline *digitin.* The commercial German *digitalinum purum* is a mixture, containing probably 50 per cent. of *digitonin* and about 5 or 6 per cent. of true *digitalin.* The *digitalinum verum* of Kiliani, or true digitalin, is a glucoside, capable of splitting up into *digitaligenin* ($C_{22}H_{30}O_3$), *digitalose* ($C_7H_{14}O_5$), and *dextrose* ($C_6H_{12}O_6$). *Digitoxin* is a glucoside crystallizing in pearly scales or white needles, which on boiling with dilute acid in alcoholic solution yields *digitoxigenin* ($C_{22}H_{32}O_4$) and *digitoxose* ($C_6H_{12}O_4$), a sugar. According to Kiliani, the *digitoxin* of the seeds ($C_{34}H_{54}O_{11}$) differs from that of the leaves ($C_{28}H_{46}O_{10}$), and he suggests the names *a-digitoxin* and *b-digitoxin* respectively for the two varieties. *Digitophyllin* ($C_{32}H_{52}O_{10}$) is probably *methyl-digitoxin. Digitalein,* supposed by Schmiedeberg, who obtained it as an amorphous yellowish-white powder, to be an individual principle, is not yet chemically well characterized. Investigations concerning it are still in progress. Keller considers it to be *digitonin* with traces of *digitoxin* and *digitalin.* Its yield is said to be about 1 per cent. By some *digitonin* and *digitin* are considered identical.

The following commercial varieties of the active principles of digitalis are of interest:

Digitalin.—Both French and German digitalin occur on the market. The French Pharmacopœia recognizes an amorphous and a crystalline variety, designated respectively as *digitaline amorphe* and *digitaline cristallisée*, which differ materially from each other. The former is also known as *digitaline chloroformique* or *digitaline-Homolle*, and the latter as *digitaline-Nativelle*. Neither variety represents a pure principle, although, as stated above, French crystalline digitalin consists almost wholly of digitoxin. The French Pharmacopœia directs that the amorphous digitalin is always to be dispensed in prescriptions when the physician fails to specify any particular variety. Amorphous French digitalin is a white (slightly yellowish) powder, having a faint characteristic odor and bitter taste. It is soluble in alcohol and chloroform, but difficultly soluble in water and ether. In contact with hydrochloric acid a green color is produced. Crystallized French digitalin occurs as needle-shaped crystals, of very bitter taste, almost insoluble in water, ether, and absolute alcohol, but readily soluble in 90 per cent. alcohol and chloroform. Its solutions in concentrated hydrochloric and phosphoric acids gradually develop a beautiful emerald-green color.

Two pharmaceutical preparations of digitalin are directed in the French Pharmacopœia (Supplement, 1895): *Granules de digitaline*, each granule containing $\frac{1}{10}$ milligramme of crystalline digitalin, 40 milligrammes of milk-sugar, and 10 milligrammes of acacia, the mass being made with honey; *Poudre de digitaline cristallisée au centieme*, a powder composed of 1 part of crystallized digitalin, 2.5 parts of carmine, and 96.5 parts of milk-sugar.

German digitalin is known on the market as *digitalinum purum pulveratum*. As already stated, it consists chiefly of digitonin, containing but a small proportion of true digitalin, and occurs as a yellowish-white amorphous powder, soluble in water and alcohol, but insoluble in ether and chloroform. Being of variable composition, its medicinal value is questionable. It is, however, the source of true digitalin, the *digitalinum verum* of German manufacture, which was first obtained by Schmiedeberg, and has since been more thoroughly studied by Kiliani.

Digitalinum verum. True Digitalin. $C_{35}H_{56}O_{14}$.—This glucoside occurs as a white amorphous powder or colorless characteristic granules. It melts at 217° C. (422.6° F.), is sparingly soluble in water (1000 parts), more soluble in 50 per cent. alcohol, and readily soluble in alcohol and a mixture of chloroform and alcohol. In chloroform and in ether it is almost insoluble. Its solubility in water is very materially increased by the presence of digitonin. Concentrated hydrochloric acid, as well as sulphuric acid, forms yellow-colored solutions with the glucoside, the color of the sulphuric acid solution changing to rose-red and then to violet-red upon addition of potassium bromide. Sulphuric acid containing a trace of ferric sulphate causes a bluish-red color when mixed with true digitalin, which remains permanent for some days. If digitalin be treated with Keller's reagent (see Digitoxin), a bright carmine-red zone is obtained. According to Kiliani, a few grains of true digitalin added to 2 Cc. of 10 per cent. potassium hydroxide solution should not assume a yellow color within 1 minute. The presence of even small quantities of digitonin may be detected by mixing digitalin with sufficient water to form a thin paste and then adding, while shaking, one-fifth as much amyl alcohol as water was used, and setting the mixture aside in a closed flask for 24 hours, when the appearance of wart-like crystals will indicate digitonin.

True digitalin is obtained from the commercial German digitalin by dissolving the latter in 4 parts of 95 per cent. alcohol with the aid of a gentle heat, adding 5 parts of ether (specific gravity 0.720) and setting the mixture aside for 24 hours in a tightly closed vessel to prevent evaporation. The ether-alcohol solution is decanted, evaporated at a low temperature to 1.6 times its content of soluble matter (previously determined in a separate portion), the residue mixed with 1½ times its weight of water, set aside for 24 hours, and the resulting deposit of crude digitalin collected, washed with 10 per cent. alcohol and then with water, and dried on porous tiles or in a vacuum apparatus. It is then purified by solution in 95 per cent. alcohol, treated with animal charcoal, and the solution filtered and slowly evaporated.

Digitoxin. $C_{34}H_{54}O_{11}$.—This valuable glucoside is insoluble in water, almost insoluble in ether, far more soluble in hot than in cold alcohol, but readily soluble in chloroform. It occurs as a white odorless crystalline powder, having a bitter taste, or in form of small

needle-shaped crystals. If crystallized from a solution in methyl alcohol and chloroform, it is anhydrous, but if crystallized from alcohol it contains 5 molecules of water. The former melts at 240° C. (464° F.), the latter at 145° C. (293° F.). Its solution is precipitated only in part by tannin. Concentrated hydrochloric acid forms a deep-green colored solution with digitoxin. Keller gives the following reaction as characteristic for this glucoside: If 0.001 Gm. of digitoxin be dissolved in 5 Cc. of glacial acetic acid, a drop of dilute ferric chloride solution then added, and an equal volume of concentrated sulphuric acid carefully introduced by means of a pipette so that the acid liquids do not mix, a brownish-green zone will appear at the line of contact, rapidly changing to bluish-green and finally to indigo-blue. The upper layer of the sulphuric acid assumes a brownish-red color and the acetic acid is gradually colored green.

Digitoxin has been found in digitalis leaves to the extent of 0.15 to 0.30 per cent., the seeds yielding much less. It is said to be most abundant in the leaves during August, hot dry weather increasing and persistent rain decreasing the yield.

Digitonin. $C_{54}H_{92}O_{28}$ (Kiliani).—This principle, although not possessing any specific medicinal value as far as known at present, is of interest because its association with true digitalin renders the latter more soluble in water, and hence seems to play an important part in aqueous preparations of digitalis. It was found at one time on the market under the name *digitalinum crystallisatum*, and may be extracted from commercial German digitalin by treatment with 4 parts of 85 per cent. alcohol, from which solution it readily crystallizes out. Digitonin is difficultly soluble in water, but more readily in the presence of digitalin, the solutions frothing considerably when shaken. It is readily soluble in 50 per cent. alcohol, amyl alcohol, and a mixture of alcohol and chloroform. It is sparingly soluble in chloroform and insoluble in ether, benzene, and petroleum-ether. When heated with diluted acids, digitonin is split up into digitogenin, galactose, and dextrose. It dissolves without color in hydrochloric acid, but if boiled for some time with the strong acid or with moderately dilute sulphuric acid a fine garnet-red color is observed. It is said by Kiliani to be the cause of gelatinization of fluid preparations of digitalis.

Besides the active principles, digitalis contains volatile oil, 5 per cent. of fixed oil, starch, sugar, gum, inosit, pectin (most in petioles and first-year leaves), red coloring-matter, yellow coloring-matter allied to chrysophan (Schmiedeberg), *digitalosmin*, a stearopten with nauseous, acrid taste and the odor of digitalis, *antirrhinic acid*, volatile and resembling valerianic acid, and *digitalic acid* (malic acid, *Flückiger*), crystallizing in white needles. The fresh and recently dried leaves contain an oxydase ferment.

Pharmaceutical Preparations.—Ethereal Tincture of Digitalis, N. F.; Extract of Digitalis, U. S. P.; Fluidextract of Digitalis, U. S. P.; Infusion of Digitalis, U. S. P.; Tincture of Digitalis, U. S. P.

Valuation of Digitalis.—Owing to the fact that digitalis contains several important constituents, chiefly glucosides, to which its value as a remedial agent is due, and that up to the present time no one of these, when isolated, has been found capable of replacing a corresponding weight of the drug in its own particular action, a chemical method of valuation does not appear very useful, and more reliance should be placed upon carefully conducted physiological tests with the drug itself. Nevertheless, since digitoxin is now known to be the chief heart-stimulating principle of digitalis, a determination of its content in the drug must prove of interest. Keller has suggested the following method: Well-dried digitalis leaves in No. 60 powder are used, and of these 20 Gm. are moistened with 8 Cc. of 70 per cent. alcohol, firmly packed into a cylindrical percolator, and slowly exhausted with the same menstruum. About 300 or 350 Cc. of percolate may be required, which is evaporated with constant stirring, on a water-bath, to 25 Gm., so as to get rid of all alcohol. The residue is mixed with water and washed into a flask of 250 Cc. capacity, sufficient water being added to bring the total weight up to 222 Gm., to which 25 Gm. of solution of lead subacetate are then added and mixed by gentle rotation of the flask. The mixture is poured into a rapidly acting filter of 7 inches diameter, and 132 Gm. of the clear pale-yellow filtrate transferred to an Erlenmeyer flask, a solution of 5 Gm. of crystallized sodium sulphate in 7 Gm. of water being added to remove excess of lead. In order to avoid troublesome filtration, the flask is placed in a slanting position for 4 or 5 hours and 130 Gm. of the clear liquid then carefully decanted and transferred to a separator. After addition of 2 Cc. of 10 per cent. ammonia water the contents are shaken out with 4 or 5 successive portions, of 30 Cc. each, of chloroform. The chloroformic solutions are passed through a double 4 inch filter, previously wetted with chloroform, into a tared Erlenmeyer flask and distilled on a water-bath. Crude digitoxin will remain as a yellow varnish-like residue, which may be purified by redissolving in 3 Gm. of chloroform and then adding 7 Gm. of ether and 50 Gm. of petroleum-ether (benzin). By active shaking

the liquid becomes clear, and the dixitoxin settles on the bottom of the flask in the form of a white flocculent deposit, which is collected on a small filter and the flask and filter washed with a little petroleum-ether. After the filter has drained, the funnel is placed in the flask and the moist precipitate dissolved by means of hot absolute alcohol. The alcoholic solution is evaporated on a water-bath, 5 Cc. of ether added to the residue and also evaporated, when the digitoxin will be obtained partly amorphous and partly in crystalline form, and can be weighed. The weight of digitoxin multiplied by 10 will express the percentage present in the drug. It is not claimed that the digitoxin obtained by the above process is absolutely pure, and it may be contaminated with traces of digitalin.

Fromme has modified Keller's method by macerating 28 Gm. of the drug with 280 Gm. of the menstruum for 3 hours, shaking frequently, and, after filtration, using 207 Gm. of the liquid for evaporation to 25 Gm. From this point the two methods are alike.

Action and Uses.—When digitalis is taken in overdose, it is apt to produce nausea and vomiting. Aside from these manifestations of gastric disorder, the symptoms which follow are connected almost entirely with the circulatory system, and consist in faintness and collapse. Under the influence of excessive doses the pulse becomes at first full, slow, and strong; but as the truly poisonous effects of the drug are manifested, it varies greatly in its character, sometimes being rapid and hobbling, and at others very slow, so that within the space of a minute the pulse may be as low as 40 or 50, and again as high as 120. Any change in the posture of the patient during this time causes very great irregularity in the action of the heart, and sudden death may occur. When the drug is taken in medicinal doses, it increases the force and fulness of the pulse and raises arterial pressure. The increase in pulse force is due to the stimulating effect of the drug on the heart muscle. The increase in the volume of the pulse is due to the wide diastole of the heart, which is produced by the influence of the drug upon the vagi centrically and peripherally; and the rise in arterial pressure is caused first by the increased action of the heart, and second by the stimulant effect exercised by the drug upon the vasomotor centre in the medulla oblongata and upon the muscular coat of the bloodvessels. While the drug slows the pulse, it nevertheless, because of its diastolic and stimulant effect upon the heart, causes a larger quantity of blood to be expelled from this viscus in a given space of time than is expelled under ordinary circumstances, and this is the reason that digitalis is so valuable in patients suffering from deficient and poor circulation.

As has been pointed out in this article, the drug is composed of a number of active ingredients, all of which produce definite effects, but none of which can be used for the purpose of producing an effect identical with that of digitalis itself. The digitalin of Schmiedeberg, digitoxin, and digitalein, all act as powerful stimulants to the heart muscle; digitalin also stimulates the vagus peripherally and centrically; and all of them raise arterial pressure by stimulating the vasomotor system centrically and peripherally. Another active principle, namely, digitonin, does not, however, stimulate the heart muscle, but is rather depressant in its influence on this organ. It also depresses the pneumogastric nerve, and thereby somewhat antagonizes the effect of the other active principles. It is evident, therefore, that when the physician desires to get the full effect of digitalis, he should employ the drug itself rather than one of the active principles that have been named; although if he simply wishes to get increased cardiac power, he may employ the digitalin of Schmiedeberg if he so desires. There does not seem, however, to be any definite view as to the exact strength of this product, some physicians using it in so small doses as $\frac{1}{100}$ of a grain (0.0005 Gm.), while others have given as much as $\frac{1}{4}$ of a grain (0.015 Gm.), or even 1 grain (0.06 Gm.) of it at each dose with asserted advantage.

The slow, full pulse produced by preparations of digitalis are the result of its stimulant effect upon the pneumogastric nerve both centrically and peripherally.

Digitalis increases urinary flow by increasing the supply of blood to the kidney and by increasing the blood-pressure in that organ. It does not, however, cause any true stimulation of the secreting epithelium of the kidney, and therefore does not materially increase the quantity of solids which are eliminated in the urine.

Digitalis is employed in medicine as a cardiac stimulant in conditions in which the heart seems to be failing as the result of exhaustion produced by some prolonged malady, but it is also employed even more commonly for the relief of heart feebleness occurring as the result of valvular disease, whereby the heart muscle becomes feeble and inactive. It is in the treatment of ruptured compensation, as it is called, resulting from valvular disease, that digitalis finds its chief usefulness in medicine, since in those

instances in which the heart is feeble as a result of degeneration of the heart muscle it is not possible for it to produce good results for obvious reasons.

Digitalis may be employed with advantage in all forms of valvular disease of the heart provided the heart muscle is tired and failing. It is least advantageous in cases of aortic regurgitation, since in this malady the prolongation of diastole produced by the drug sometimes increases the quantity of blood which regurgitates from the aorta into the left ventricle. It is in cases of cardiac failure that digitalis acts most efficiently as a diuretic, under these circumstances often removing fully developed dropsy with extraordinary speed and producing its good effect primarily by the improvement in the circulation, and, secondarily, by the improvement in the blood-supply of the kidney, which is, therefore, enabled to pass from the body large quantities of liquid.

Digitalis was at one time largely used as a heart stimulant in the course of infectious diseases, but is less employed at the present time than formerly, because we now recognize that the cardiac failure of these states is often dependent upon degeneration of the heart muscle, and also because digitalis, on further study, has not proved to be always reliable in these conditions. Of all the infectious diseases in which it is employed most commonly and with the best result, croupous pneumonia stands first. The drug is also of value to support the heart in cases of emphysema and asthma. Its use is contra-indicated in those persons who have marked atheromatous or degenerative changes in their bloodvessels.

In cases of aneurism, and in cases of feeble heart dependent upon high arterial pressure, its use is dangerous unless simultaneously with the administration of the digitalis nitroglycerin is given to reduce arterial tension.

The administration of full doses of digitalis causes marked gastric irritability, and even vomiting. This can usually be avoided by the employment of small doses more frequently repeated, and we think that, as a rule, better results can be obtained by small doses given over a considerable period of time than by large doses, which speedily produce effects which necessitate the abrupt stopping of the use of the drug.

As the effects of digitalis are prolonged, it may, when given in full dose for a long time, produce cumulative effects or symptoms of mild poisoning. It is best to stop its use every eighth day for the space of forty-eight hours.

The dose of powdered digitalis leaves is from $\frac{1}{8}$ to 1 grain (0.008–0.06 Gm.); of the fluidextract, 1 to 5 minims (0.05–0.3 Cc.); of the tincture, 5 to 20 minims (0.3–1.3 Cc.); of the infusion, 1 teaspoonful to 1 ounce (4–30 Cc.). There can be little doubt that the most diuretic of the preparations of digitalis is the infusion, probably because it contains less digitalin than the other preparations, for digitalin sometimes causes spasm of the renal bloodvessels, and so temporarily diminishes urinary flow. On the other hand, the infusion is a much more disagreeable preparation to take, and is far more apt to disorder the stomach than are the digitalis leaves themselves, the fluid extract, or the tincture.

The proper beginning dose of digitalin, unless it is known that the patient can take large doses of it with impunity, is $\frac{1}{100}$ of a grain (0.0008 Gm.). In the employment of digitalis, it is important that the physician shall prescribe preparations which have been made from drugs physiologically tested, since digitalis leaves vary very greatly in their physiological effects. (See *Physiological Testing.*)

Allied Species.—The genus *Digitalis* L. is credited with 22 species. A number of these have been investigated by H. Goldenberg, who believes that all the species have similar properties, though differing greatly in activity. *D. eriostachys* Bess., *D. glandulosa*, and especially *D. Fontanesii* Steud., are only slightly active; while *D. nervosa* Steud. is 1½ times and *D. ferruginea* L. 10 times, as active as *D. purpurea*. He finds the stem to contain a different physiological agent ("digital-resin") from the leaves, which at first excites the nerve-centers and finally paralyzes the muscles.

DIOSCOREA.—Wild Yam; True Wild Yam; Colic Root; Rheumatism Root.

The rhizome of *Dioscorea villosa* L. (Fam. *Dioscoreaceæ*), a very slender, dicœcious, twining climber of the eastern and central United States, having broadly ovate, cordate, acute, ribbed leaves, minute greenish flowers in small and slender drooping axillary panicles, and triangular winged capsules about ½ inch long and broad.

Description.—In crooked pieces, mostly from 15 to 50 Cm. (6 In. to nearly 2 Ft.) long, and 6 Mm. to 1 Cm. (¼ to nearly ½ In.) thick, mostly unbranched, slightly flattened

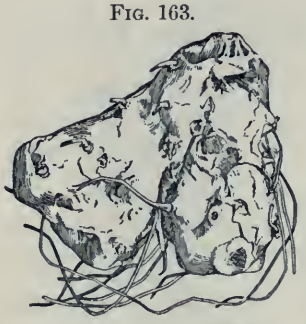
from above downward, bearing upon the upper surface small, nearly circular stem-scars, upon the sides small nodular protuberances, and underneath fine, slender, wiry roots; externally brown, sometimes with the bark exfoliating; internally whitish, very starchy, and with numerous yellowish-white, fine, fibrovascular bundles; inodorous and at first tasteless, afterward somewhat acrid.

Constituents.—These have not been properly investigated. The acridity is due partly to resin, partly to a saponin-like substance, and the medicinal effects are doubtless to be ascribed to the same agents. Starch is present in large quantity.

Action and Uses.—Dioscorea has never been largely employed in medicine, but it is said to possess expectorant, diaphoretic, and in large doses emetic properties. Some practitioners have recommended it as a remedy in the treatment of bilious colic, and the laity occasionally employ it in the treatment of muscular rheumatism. It may be given in doses of from 10 to 40 minims (0.6–2.6 Cc,) of a fluidextract, 3 times daily; or a decoction, made by boiling 1 ounce (30 Gm.) of the rhizome with 1 pint (480 Cc.) of water, may be taken in doses of from 4 to 6 fluidounces (120–180 Cc.). The resinous substance, improperly called "dioscorein," made by precipitating an alcoholic tincture with water, is given in doses of from 1 to 4 grains (0.06–0.25 Gm.).

False wild yam (the rhizome of *D. villosa glabra*) is more abundant southward, where the other gradually disappears. This rhizome sometimes reaches 15 Cm. (6 In.) long, and 2 to 4 Cm. ($\frac{2}{5}$ to $\frac{4}{5}$ In.) thick, flattened from above, crooked, with short branches almost as thick as itself alternating upon the two sides, above bearing crowded, large, depressed circular stem-scars and underneath numerous smooth wiry simple roots; externally whitish to pale yellowish-brown; fracture tough, exhibiting a compact whitish starchy tissue with numerous scattered yellowish wood-bundles; inodorous, at first tasteless but becoming strongly acrid. Its constituents are similar to those of the last, but there are more of the acrid principles, and the drug is probably more active.

Fig. 163.



Dioscorea villosa glabra (¾ Nat.).

Other Species.—About 150 species are known, mostly tropical, in both hemispheres. A number of species yield the valuable yams, while others contain poisonous principles. Of the former, the following are the most important: *D. alata*, L., *White negro yam; D. triphylla* L., *Buck yam; D. pentaphylla* L. (*D. trifida* L.), *Indian yam;* and *D. sativa* L., *Common yam.* The smaller cylindrical tuberous rhizomes of *D. Japonica* Thunb. and *D. quinqueloba* Thunb. are eaten in Japan. The former is about 10 Cm. (4 In.) long, farinaceous, and white; the latter is smaller, externally pale-brown, internally dingy-white, and has a bitterish taste. As nutrients, the yams are almost wholly farinaceous. *D. hirsuta* Blume, though actively poisonous, is used as food in Java after the thin slices have been exposed for 24 hours to the action of running water.. It contains the alkaloid *dioscorine* ($C_{13}H_{19}NO_2$), which occurs in yellowish-green crystals, and is very hygroscopic, and slightly volatile. It acts upon animals somewhat like picrotoxin, but is less active. *D. bulbifera* L. yields a glucoside, and is used in Brazil as an antidysenteric and antisyphilitic, sometimes to poison vermin. A large number of species have been reported as either poisonous or edible, but the extreme difficulty of classifying and identifying them casts grave doubt upon the determination of the species, in most cases.

Dioscoriaceæ (*the Yam Family*).—Genera, 9; species, not more than 20 apart from the large genus *Dioscorea*, just considered. The rhizomes and tubers of several are eaten like yams, or yield starch. The rhizome and seeds of *Tamus communis* L. (*Black bryony, Black bindweed, Adders' meat, Murrain-berries,* or *Ox-berries, Schmeerwurz* (G.), chiefly of the Mediterranean region, are diuretic, emetico-cathartic, and poisonous, although the young shoots, thoroughly cooked, are eaten like asparagus. The root-stock of *T. edulis* Lowe, of the Madeira Islands, is eaten.

DIOSPYROS.—Persimmon.

Winter-, Seeded- or Date-plum, Possum wood, North American ebony, E.; *Persimmonfrüchte, Dattelpflaumen,* G.; *Fruits de plaqueminier de Virginie,* Fr.

The unripe fruit of *Diospyros Virginiana* L. (Fam. *Ebenaceæ*).

Origin.—From a good-sized tree growing in the eastern and east-central United States, from Rhode Island southward. The fruit ripens in November, but should be collected for medicinal purposes in October, while yet green and rich in tannin.

Description.—A globular berry about 2.5 Cm. (1 In.) in diameter, borne upon a short

pedicel and with a persistent basal, 4-lobed, leathery calyx, tipped with a short style-remnant, smooth, green, tough, 4- to 6-celled with a single flattened, ovoid-oblong seed in each cell; fleshy and juicy, the juice viscid and highly astringent. After being ripened by the frost, it becomes of a rich reddish-brown, much wrinkled, soft, sweet, and edible.

Constituents.—The unripe fruit contains, besides much tannin, pectin, malic acid, and sugar.

Action and Uses.—Both the bark and the unripe fruit of the persimmon tree are tonic and astringent. An infusion of the bark (1 ounce to the pint; 30 Gm.–480 Cc.) has been employed as an antiperiodic and as a gargle in sore throat. An infusion made from the green fruit has also been recommended in the treatment of diarrhœa, dysentery, leucorrhœa, and uterine hemorrhage. The infusion made from the fruit (1 ounce to 2 fluidounces—30 Gm.–60 Cc.—of boiling water may be given in 30-minim (2 Cc.) doses to an infant, and in doses of from ½ to 1 fluidounce (16–30 Cc.) to an adult.

Other Species and Allied Products.—The bark of the tree is also rich in tannin, and contains a non-nitrogenous crystalline principle.

The genus contains almost 200 species, mostly tropical, in both hemispheres. They possess generally the astringent properties of the above, and are so used. The ripe fruits of many are edible, several of them being important products of cultivation. That of *D. decandra* Lour., of Cochin China, has peppery qualities. *D. maritima* Blume, of the East Indies, yields a blue dyestuff. *D. melanoxylon* Roxb., of India, yields a gum. *D. Ebenaster* Retz., of the East Indies, is used as a fish poison. *D. Ebenum* Kon. is the source of ebony.

Several other of the 250 species of the family *Ebenaceæ* (*Cavanillea* and *Euclea*) yield edible fruits, and others (*Maba*) yield similar astringent barks.

DIPTERYX.—Tonka.

Semen or Faba tonca.—Tonka ("*Tonquin*") *bean, Coumarouna bean, Snuff bean*, E.; *Tonkabohnen*, G.; *Tonka*, Fr.; *Hava Tonka*, Sp.

The prepared ripe seeds of several species of *Coumarouna* Aubl. (*Dipteryx* Schreb. —Fam. *Leguminosæ*).

Origin.—There are about 8 species of this genus of tropical American trees, some of them of great size and very beautiful, bearing a general resemblance to the licorices. But two species are usually named as yielding tonka, namely, *C. odorata* Aubl. (*Dipteryx o.* Willd.), chiefly of the northern part of the Amazon valley, and yielding the *Dutch tonka*, and *C. oppositifolia* (Aubl.) Taubert (*Turalea o.* Aubl.; *Dipteryx o.* W.), growing chiefly in the Orinoco valley, and yielding *English tonka*. It seems very likely that the commercial article is derived in part from other species. It has, in fact, been stated that the seeds of *C. pteropus* (*Dipteryx p.* Mart.), the *Cambaru seeeds*, and of *C. oleifera* (Benth.) Kuntze (*Dipteryx o.* Benth.), the *Eboes nuts*, are sold as tonka. Tonka trees are somewhat cultivated, but the industry can scarcely be said as yet to have passed the experimental stage. Plantations which we saw in Venezuela developed with great slowness, the trees appearing to lack some essential natural condition. The 1-seeded legume is oval, resembling a mango in appearance, and not very unlike a peach. The mesocarp consists of a tough, stringy flesh, which, when ripe, is sweetish and somewhat edible. The fruit is tardily dehiscent, and is broken open for the collection of the seeds. These, like vanilla, have at first none of the fragrance for which they are valued, the fragrant principle being developed by a process of curing. The usual native custom is to steep the seeds in rum or other native-made spirit for several days, the cumarin being thus developed, quantities of it being also recovered in a crude and impure condition from the liquor, which is used for successive lots of seeds.

Description.—Tonka beans are from 2.5 to 5 Cm. (1 to 2 In.) long, a half or less as broad, oblong-ovoid, somewhat flattened, one edge sharp and one end somewhat pointed, elsewhere rounded, either black and fatty-lustrous, or grayish-black and more or less covered by an efflorescence of cumarin, the leathery testa heavily wrinkled; kernel consisting of 2 brownish fleshy cotyledons, their flat faces usually a little separated except at the edges, the cavity frequently containing large crystals of cumarin; odor strongly vanilla-like, taste sweetish, aromatic, bean-like. The Dutch variety is usually the larger, and more often gray. Angustura tonka is long, slender, black, and shining. Para tonka is similar to the Augustura, but shorter and smaller.

Constituents.—The only important constituent is CUMARIN, which is present to the extent of 1.5 to 2 per cent. The uses are purely dependent upon the properties of this substance

Cumarinum. Cumarin, Cumaric anhydride, Ortho-oxycinnamic anhydride, E.; *Cumarin, Tonkabohnenkampfer*, G. $C_9H_6O_2$ or $C_6H_4\begin{cases}CH:CH\\ |\\ O—CO\end{cases}$.—Cumarin may be readily extracted from coarsely powdered tonka beans by means of boiling 80 per cent. alcohol. The resulting solution is concentrated and the residue mixed with 4 times its volume of boiling water. After filtration through a well-wetted filter, for the removal of fat, the liquid is set aside, when the cumarin will crystallize out, and may be purified by redissolving in hot water, decolorizing with animal charcoal, and again crystallizing.

By far the bulk of cumarin offered on the market is produced synthetically, the following method being generally employed: A mixture of 3 parts of salicylic anhydride, 5 parts of acetic anhydride, and 4 parts of anhydrous sodium acetate, is gently boiled for several hours in a flask provided with a reflux condenser. Upon cooling, the mixture congeals to a crystalline mass, which after addition of water separates an oily liquid consisting of a mixture of acetyl-orthocumaric acid and cumarin. By distillation the acid is split up into acetic acid and cumarin, which latter is then dissolved in hot water and crystallized.

Cumarin occurs in colorless prismatic crystals having a characteristic fragrant odor and bitter, aromatic taste. It melts at 67° C. (152.6° F.), sublimes at 100° C. (212° F.), and boils at 291° C. (555.8° F.) without decomposition. Cumarin is soluble in 400 parts of cold or 45 parts of boiling water, and is readily soluble in alcohol and ether. It is also soluble in chloroform and in fixed and volatile oils. Acetanilid has been found as an adulterant in cumarin, and may be detected by boiling 0.1 Gm. of the suspected article for a few minutes with 1 Cc. of 25 per cent. hydrochloric acid and adding to the clear solution 2 Cc. of a 5 per cent. carbolic acid solution and a small quantity of fresh chlorinated lime solution. The presence of acetanilid would cause a red color to appear, which changes to indigo-blue upon supersaturation with ammonia water.

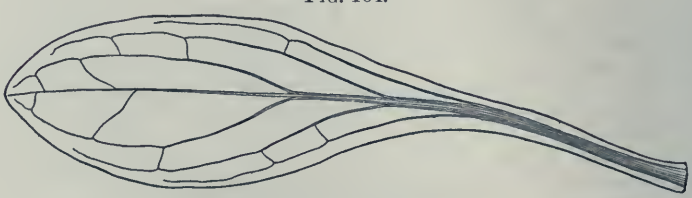
Action and Uses.—Cumarin, the active principle of tonka, is said to be an antispasmodic and narcotic. In full dose it primarily stimulates the circulation, but later acts as a cardiac depressant. A fluid extract of tonka has been given in the treatment of pertussis, in doses of from 5 to 10 minims (0.3–0.6 Cc.). It may also be tried as a remedy for flatulent colic and diarrhœa.

In pharmacy cumarin is sometimes used to disguise the odor of iodoform. It is chiefly employed in perfumery, and has been used in the manufacture of cheap extract of vanilla, which adulteration can be detected by the method given under VANILLA (which see).

Other Sources of Cumarin.—Cumarin is a widely distributed substance in the vegetable kingdom. One of the important sources is Melilotus (see LEGUMINOSÆ). It is also yielded by the seed of *Copaiba Salicounda* Heck., of western Africa, in which the content, chiefly in the embryo, is about 0.75 per cent., and associated with about 4 per cent. of fixed oil. All parts of the tree, except the leaves, are said to possess the cumarin odor. The natives use the seeds as a mild antispasmodic, as well as for perfumery.

In the southeastern United States large quantities of the leaves of *Trilisa odoratissima* (Walt.) Cass. (*Anonymos o.* Walt.; *Liatris o.* Mx.—Fam. *Compositæ*), the *Vanilla plant, Carolina vanilla, Deer's-tongue*, or *Dog's-tongue*, are collected for the cumarin which they contain. The plant is a stout perennial, sometimes nearly a yard in height, the alternate leaves gradually becoming smaller and narrower from the base upward, the handsome purple heads in a corymbose panicle, each about 6 Mm. (¼ In.) high. The radical leaves, which are chiefly collected, are 10 to 25 Cm. (4 to 10 In.) long, and of the form shown in the accompanying illustration, thickish and somewhat fleshy, smooth, and of a strong cumarin odor when dried. Considerable amounts of cumarin are also present in several grasses, and in *Asperula*.

FIG. 164.



Trilisa leaf (½ Nat.).

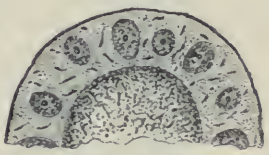
DRACONTIUM.—Dracontium.

Skunk-, Swamp-, or *Meadow-cabbage, Skunk-weed, Pole-cat weed, Collard, Stinking-poke or Hellebore,* E.; *Pothos fetide,* Fr.; *Stinkende Drachenwurz,* G.

The dried rhizome and roots of *Spathyema fœtida* (L.) Raf. (*Dracontium f.* L.; *Ictodes f.* Bigel.; *Symplocarpus f.* Nutt.; *Pothos f.* Mx.—Fam. *Araceæ*).

Origin.—The plant occurs in great abundance in rich swamps of eastern and central North America, and is curious, interesting, and ornamental. The ovoid, pointed, purple or richly purple spotted, smooth and shining spathes, a few inches in length, and half or more as broad, with incurved tips, and of thick and crisp texture, protrude from the soil in earliest spring, and soon contain numerous yellow flowers densely massed upon a globular spadix. Soon after, the leaves appear in a dense, subradical, cabbage-like but loose cluster. They are very large, ovate-cordate, almost or quite as broad as long, thick, smooth, and shining, more or less netted-veined, entire-margined and short-stalked. The entire plant exhales a very strong mephitic odor when bruised.

FIG. 165.



Dracontium fœtidum: section through one-half of upper part of rhizome (Nat.).

Description.—The rhizome is 7 to 15 Cm. (3 to 6 In.) long, 5 Cm. (2 In.) thick, oblong-cylindrical, truncate at both ends and densely beset on all sides with long, coarse, simple, exceedingly strong roots. When dried, both are at first yellowish-white, but may become very dark gray-brown or blackish and strongly wrinkled. The rhizome is hard and heavy. Internally it is white and starchy. Upon being rubbed, it exhales its characteristic odor, but both this and the acrid and biting taste gradually disappear with long keeping. It frequently occurs in market, deprived of its roots and cut into transverse slices.

Constituents.—These are very imperfectly known. J. M. Turner (1836) obtained from it a volatile fatty matter, a little volatile oil, resin, wax, fixed oil, sugar, gum, and starch. The active constituent appears to be the volatile principle, which is dissipated by heating and disappears upon keeping. The seeds apparently contain it in larger amount and are similarly used.

Action and Uses.—Dracontium is asserted to possess the properties of a stimulant, sialagogue, emetic, antispasmodic, and narcotic, but it is rarely employed in medicine. When given internally, it occasions nausea and vomiting, frontal headache, and vertigo. It has been employed as a remedy in the treatment of chorea, hysteria, spasmodic asthma, chronic bronchitis, and rheumatism, but is probably of little value in any of these conditions. The dose of the recently dried drug is from 10 to 20 grains (0.65–1.3 Gm.). As it rapidly deteriorates, the remedy as found in the stores is of variable strength. An infusion made with 1 ounce (30 Gm.) of the drug in 1 pint (480 Cc.) of boiling water is given in doses of from 1 to 8 fluidrachms (4–30 Cc.). An alcoholic tincture of the same strength may be used in 1- to 2-drachm (4–8 Cc.) doses.

DROSERA.—Sundew.

Herba rorellæ, H. roris solis, H. droseræ.—Round-leaved or Common sundew, Youthwort, Moorgrass, Red-rot, Rosa-solis, E.; *Sonnenthau, Sinnthau, Jungfernblüthe,* G.; *Rosolis, Rosée du soleil,* Fr.

The entire plant, *Drosera rotundifolia* L. (Fam. *Droseraceæ*).

Origin.—A diminutive moss-like plant, abounding throughout most of the north-temperate zone, especially in North America, its common name depending upon its strikingly beautiful appearance when covered with dew and glittering in the sunshine.

Description.—Leaves in a radical rosette, the blade 5 to 10 Mm. ($\frac{1}{5}$ to $\frac{2}{5}$ In.) long and equally broad or broader; abruptly narrowed into a broad petiole, rounded at the summit, entire, fleshy, beset with long, stiff, glandular hairs, those of the margin purplish-red; scape 10 to 20 Cm. (4 to 8 In.) long, smooth, slender, bearing a terminal raceme of white flowers about 4 Mm. ($\frac{1}{8}$ In.) broad, the calyx-lobes, petals, and stamens each 5, the ovary 1-celled, the styles 3, the capsule 3-valved and many seeded.

Constituents.—This plant yields a greenish-brown, odorous, very acrid resin, glucose, citric and probably malic acid, and a ferment which converts albumin into peptone. It contains no formic or butyric acid.

Action and Uses.—Sundew has been recommended in the treatment of chronic bronchitis, whooping-cough, and tuberculosis, but probably has no medicinal value in these conditions. The dose is stated to be 5 minims (0.3 Cc.) of a 10 per cent. tincture.

Fig. 166.

Drosera rotundifolia (Nat.).

Allied Species.—The family is of great interest because of the carnivorous habits of its plants, and the proteolytic enzymes which perform this work have been objects of curious interest. It is not unlikely that they may act usefully in the human system. The genus *Drosera* L. contains more than a hundred species, a dozen or more of which are similarly employed. Those which have been examined contain one or more acrid fixed oils or soft oleoresins. *D. filiformis* Raf., of North America, has erect, filiform, densely glandular hairy leaves, often a foot or more long and similar scapes bearing pretty purple flowers, 2 to 4 times as large.

Dionœa muscipula L., the celebrated *Venus' fly-trap* of the southeastern United States, is similarly employed.

Related Families.—Closely related to the *Droseraceæ* are the two small families of pitcher-plants, *Sarraceniaceæ* and *Nepenthaceæ*, both comprising carnivorous plants. These plants are distinguished for the possession of pitcher-shaped cavities, produced by various modifications of the leaf and containing watery liquids holding proteolytic enzymes in solution, by means of which they digest the bodies of such insects as are destroyed in the liquid, the digested albuminoids then being absorbed as food through the leaf-surface. Besides these enzymes, the leaves frequently secrete poisonous or intoxicating baits, which first attract, then stupefy the insects, so that they fall into the digesting solution. Quite a number of these plants have been used as aboriginal medicines, such uses having been suggested probably by their strange forms and habits. Some of them have been found more or less active, and are employed to a moderate extent in regular medicine.

Tunis regards the proteolytic enzyme of nepenthes as the most active known, as well as one of the most stable, resisting powerfully the action of alkalies and of high temperature. True peptone has been found in the product of its digestion.

Sarracenia (*American pitcher-plant*, *Side-saddle plant*, *Huntsman's-*, *Water-*, *Fly-*, *Eve's-*, *Forefather's*, or *Indian-cup*, *Indian-pitcher*, *Sarracenie*) is the plant, *Sarracenia purpurea* L., of eastern North America. It grows in bogs, from an obliquely conical rhizome, which is about 25 Mm. (1 In.) or more long, reddish-brown externally, brownish-white internally, bearing numerous thin, nearly simple, toughish roots, its fracture short and not colored blue by iodine solution, inodorous, bitter, and somewhat astringent. The leaves are radical, 15 to 20 Cm. (6 or 8 In.) long, the upper or stipular part of the petiole, together with the stipules, converted into a pitcher-shaped body which is sharply winged on the inner side, and bearing the leaf-blade as a roundish, heart-shaped hood. The solitary, nodding flower is 1½ to 2 inches broad and borne on the summit of a stout scape which is usually a foot or more long. The leaves are bitter, but less so than the rhizome. The plant contains the alkaloid *sarracenine*, very similar in characters and properties to veratrine, and about 0.16 per cent. of a volatile alkaloid bearing some resemblance to coniine. The yellow coloring-matter has been described as *sarracenic acid*, and *acrylic acid*, which is volatile, has also been reported. Sarracenia is said to possess the properties of a nervous and circulatory stimulant, mild tonic, diuretic, and laxative; but it is of little value in medicine. The drug has been employed to some extent in the treatment of atonic dyspepsia in doses of from 10 to 30 minims (0.6–2 Cc.) of a fluid extract, 3 times daily.

S. flava L. (*Trumpet-plant*, *Trumpet-leaf*, *Yellow trumpet*, *Huntsman's horn*, *Yellow-flowered water-cup*, *Pitcher-plant*, or *Side-saddle flower*), and *S. variolaris* Mx. (*Smallpox plant* or *Spotted trumpet-plant*), both of the southeastern United States, and both possessing much more slender, erect leaves than *S. purpurea*, are largely used as bitter tonics and antispasmodics in domestic practice. The last-named, because of its white-spotted leaves, has been fancifully administered in the treatment of smallpox. Many species of *Nepenthes* L., the *East Indian pitcher-plant*, are variously employed, and the water abstracted from their leaf-pitchers is an article of commerce in the East Indies. The leaves and root of *N. Boschiana* Krthls. is especially employed, chiefly as an astringent.

DULCAMARA.—Dulcamara.

Stipites dulcamaræ. — Bittersweet, True bittersweet, Woody nightshade, Blue bindweed, Poison berry, Wolf-grape, Morrel, Skawcoo, E.; *Tiges de-douce-amere (de morelle grimpante),* Fr.; *Bittersüss Stengel,* G.; *Dulcamaria Gloria,* Sp.; *Talos de Coce-Amargo, Uvc de Cao,* Port.

The dried young branches of *Solanum Dulcamara* L. (*Dulcamara flexuosa* Moench.—Fam. *Solanaceæ*).

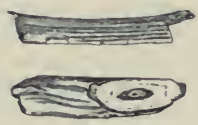
Dulcamaras is official in most pharmacopœias.

Origin.—A soft-shrubby plant, trailing or climbing, sometimes for several yards, over shrubbery, along streams, and in swamps and low grounds, throughout almost the whole of the north-temperate zone, and even extending into the tropics; probably naturalized in North America. Its appearance is well illustrated by the accompanying illustration. The potato-like flowers are of a bright-purple or even of a whitish-blue, and

Fig. 167.

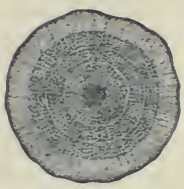
Solanum Dulcamara L.

Fig. 168.



Bittersweet (Nat.).

Fig. 169.



Transverse section.

the fruits are scarlet, shining and somewhat translucent, partly showing the numerous small seeds. The berries are more active than the twigs, their poisonous property probably residing in the seeds. They have been eaten by children, to whom they are highly attractive, with fatal effect, Those branches which are only one or two years old, and which have only partially developed their corky layer, should be collected, in the non-leafy stage.

Description.—Usually occurring in short sections, with a hollow center; about 5 Mm. (⅕ In.) or less thick, cylindraceous, somewhat angular, striate, more or less warty, externally pale-green or greenish-brown, marked by alternate leaf-scars, internally light-green, with 1 or 2 concentric circles of green or yellowish fibrovascular bundles; odor slight, narcotic; taste sweet and bitter, afterward slightly acrid. The bark contains numerous bast-fibers.

The cut rhizome of Saponaria quite closely resembles this drug, and we have known one to be sold for the other. Saponaria can be distinguished by its terete form, with rather regular wrinkles, instead of the unequal angles of Dulcamara, and by its circular nodes and opposite branching, instead of the alternate leaf-nodes of Dulcamara. Hop-stems are said to be sometimes substituted, but are readily distinguished by their rough surface and opposite leaf-scars. The stems of the false *Climbing bittersweet* (*Celastrus scandens*) are not hollow and are more woody in texture.

Constituents.—The constituents are dulcamarin, solanine, gummy, waxy, and resinous matters, and benzoic acid. *Dulcamarin* (*picroglycion* or *dulcarin*, $C_{22}H_{34}O_{10}$) is a bitter glucoside which leaves a persistent after-taste, is soluble in water, alcohol, and acetic ether, but not in ether or chloroform, and with dilute acids splits into glucose and tasteless brown dulcamaretin ($C_{16}H_{26}O_6$). *Solanine* ($C_{42}H_{87}NO_{15}$ or $C_{52}H_{92}NO_{18}$), widely distributed in the genus *Solanum*, and even elsewhere in the family, is a feebly bitter

alkaloidal principle of hot taste, crystallizing in rectangular prisms. It is soluble in 8000 parts of boiling water, in 125 parts of boiling alcohol, freely in amyl alcohol, and in 4000 parts of ether. Its salts react acid and are more soluble. With dilute acids it separates into dextrose and *solanidine* ($C_{26}H_{41}NO_2$), a crystalline alkaloid. The solanine of commerce, and that which has been mostly studied, is obtained from potato sprouts, and may be somewhat different from that of Dulcamara. There is an oxydase ferment in the leaves, stems, and green berries.

Action and Uses.—Bittersweet possesses diuretic and diaphoretic properties, and when given in full dose acts as a sedative and hypnotic. Large amounts produce a sensation of dryness and constriction of the fauces, nausea and vomiting, headache, vertigo, and muscular tremors or convulsions. The circulation becomes enfeebled, the hands and face either pallid or cyanotic, and the temperature subnormal. When lethal doses of solanine are employed, they cause, in addition to the above symptoms, considerable renal irritation, the urine becoming diminished and containing hæmoglobin and numerous casts. The alkaloid *solanidine*, however, is free from irritant properties, and when employed produces, with this exception, the effects of solanine. Dulcamara is of little practical use in medicine. It is now principally employed in the treatment of acne, impetigo, and chronic eczema, for which conditions it is used both locally and internally. Formerly it enjoyed some repute in the treatment of chronic rheumatism, chronic bronchitis, and whooping-cough, and was said to possess anaphrodisiac properties. *Solanine* has been highly recommended in the treatment of the vomiting of pregnancy, spasmodic asthma, chronic cystitis, and various forms of neuralgia. Its administration is said to quiet the lancinating pains of locomotor ataxia, to relieve the pains of gastralgia and sciatica, and to control the tremors and overcome the exaggerated reflexes resulting from insular sclerosis of the cord.

Dulcamara may be given in substance in doses of from $\frac{1}{2}$ to 1 drachm (2–4 Gm.); the fluidextract, in doses of from 30 minims to 1 fluidrachm (2–4 Cc.); and the extract, in doses of from 5 to 10 grains (0.30–0.60 Gm.).

A decoction, made by boiling 1 ounce (30 Gm.) of the drug with 1 pint (480 Cc.) of water, may be given in doses of 1 or 2 fluidounces (30–60 Cc.), several times daily.

Allied Products (see also SOLANACEÆ).—*Solanum* L. is the largest genus of flowering plants. Its species have been reckoned at from 600 to 1200, and the larger number will doubtless be exceeded when all are known. Many of the species are useful in varied and important ways. Dulcamarin and solanine, or allied substances, occur in many, if not in most, species, so that some of them are elsewhere important drugs. Among such drugs, the best known are the two following:

S. Carolinense L. (*Horse-* or *Bull-nettle*, *Apple of Sodom*, *Band-briar*, *Treadleaf*), a perennial stellate-pubescent and yellow-prickly herb of North America, and extending into the tropics. It is disastrously fatal to cattle in our Southern States. Both the berries and the root are used. The former are nearly globose, 1.5 to 2 Cm. ($\frac{3}{5}$ to $\frac{4}{5}$ In.) in diameter, orange-yellow, smooth and somewhat shining, much wrinkled in drying, fleshy, 2-celled and many-seeded, the base enclosed by the persistent deeply 5-lobed, stellate-pubescent calyx, its lance-ovate lobes reaching nearly to the middle of the berry and about half as broad as long. These berries are nearly odorless except when bruised, and have a bitter-sweet taste. The root, sometimes a foot or more in length and nearly a half inch in diameter, is usually very crooked, though vertical in direction, usually with few and small branchlets, of a yellow-brown color, terete and irregularly longitudinally wrinkled, the bark thick and easily separating when dry. It has a narcotic odor and a bitter-sweet taste. Its starch-grains closely resemble those of the potato. The activity of the root appears to reside wholly in the bark. The active constituents appear to be two alkaloids, existing together to the extent of about 1.3 per cent. in the fruit, 0.4 per cent. in the root. About two-thirds of the alkaloid appears to be *solanine*, considered above. The remainder has been thought to be *solanidine*, but J. U. Lloyd believes it distinct, and has proposed that it be provisionally known as *solnine*. "It is practically insoluble in water and diluted ammonia water, soluble in diluted acids and cold chloroform, and crystallizes from boiling alcohol in needles resembling hydrastine. Its melting-point is 131° C. (267.8° F.)" (Lloyd). The same alkaloids are contained, in variable amount, in all parts of the plant. Small quantities of fat, resin, volatile oil, and other common plant-principles also occur. *Solanum Carolinense* closely resembles dulcamara in its action. It has been recommended in epilepsy, but is probably of little value in this condition. The dose of the fluid extract is from 10 to 30 minims (0.65–2 Cc.).

Juribeba, or *Juripepa*, is a highly prized native drug in Brazil. It is the root and berries of *S. insidiosum* Mart., and probably also of *S. Juripeba* Rich. Its properties and uses appear very similar to those of *S. Carolinense*, and the composition is probably the same.

S. nigrum L., the *Black-* or *Garden-nightshade, Hound's berry, Small morrel, Schwartzer Nachtschalten* (G.), *Morelle* (Fr.), is one of the most widely distributed and best known of weeds, and has slight narcotic properties, various animals having been poisoned by eating freely of it. Yet the herbage is said to be sometimes eaten as a potherb, after thorough cooking. The berries are poisonous.

Natre is the fresh herbage of *S. Gayànum* Phil., *S. tomatillo* Phil., and *S. crispum* R. et P., of Chili, containing 0.1 per cent. of solanine, and used for measles, scarlet fever, and other eruptive fevers.

S. Pseudoquina A. St. Hil. is used as a substitute for quinine. *S. stramonifolium* Jacq. is violently poisonous, and is used as an arrow poison in Guiana. *S. mammosum* L. and *S. grandiflorum* R. et P., of tropical America, are also quite poisonous. The fruits of *S. saponaceum* Dun. contain saponin, and are used as a soap-substitute. *S. Quitense* Lam., of Ecuador, is so distinctly sedative that it is chewed by the natives to allay toothache. *S. oleraceum* Vell. is also used to soothe pain and as a mild narcotic, although, when thoroughly cooked, its herbage serves as a potherb. *S. paniculatum* L. is used in South America as a tonic, antiblennorrhagic, antisyphilitic, diuretic, antiperiodic medicine, but particularly in vesical catarrh and as a drastic.

The poisonous properties of the genera are curiously intermingled with edible ones, these pertaining to almost all parts of the plants. The common potato, the tuber of *S. tuberosum* L., some South American varieties perhaps to be traced to a different parentage, has a nutritive composition of starch 80 per cent., albuminous matter 2.25 per cent., and a fractional percentage of fat, and is one of the most largely used of vegetable foods, yet its fruit and young purple shoots are poisonous, and even the potato itself under certain circumstances, as when very immature, or when exposed in the growing condition to the light and air, assuming a greenish-purple color, has proved poisonous, sometimes fatally so. The poisonous principle appears to be chiefly solanine, but there is also *solanidine* ($C_{40}H_{61}NO_2$), soluble in hot alcohol and with difficulty in ether, forming needle-shaped crystals which melt at 191° C. (375.8° F.). A yellow, horny, amorphous glucosidal alkaloid present in it has been called *solanein*. Its action, if any, is not known. Schnell reports that the percentage of solanine in potatoes is normally only 0.006 to 0.0065 per cent. A lot containing 0.038 per cent. (0.024 per cent. after cooking) caused wholesale poisoning at the Strassburg garrison. These potatoes, when sliced, showed black fungous spots, and these spots, assayed separately, showed a one-third larger percentage of solanine, whence it was concluded that the fungus promoted the development of the alkaloid, and potatoes so affected should be rejected. This raises a question as to whether the Irish plague, which resulted from the eating of fungus-infected potatoes, was really due to the poison of the fungus, as commonly supposed, or to the increased amount of solanine. The herbage of the potato is apparently not poisonous. The ripe fruit and the boiled herbage of even *S. nigrum* are eaten.

The fruits of *S. auriculum* Ait. are poisonous if green, edible if ripe. *S. incanum* L. is used, like rennet, to curdle milk. Several species yield edible fruits, notably the common *Egg-plant*, *S. melongena* L., *S. variegatum* R. et P., of the Andes, and *S. violæfolium* Schott., a creeping species of Brazil. Finally, it may be mentioned that the herbage of several species yields dyestuffs.

E.

ELASTICA, *U. S.*—India Rubber; Rubber.

Resina (*s. Gummi*) *elasticum.*—*Caoutchouc*, E., Fr. Cod.; *Kautschuk, Federharz*, G.; *Cahuchu, Goma elastica, Syringay*, Sp.

The prepared milk-juice of several species of *Hevea*, Aubl. (Fam. *Euphorbiaceæ*), known in commerce as *Para rubber.*

Origin.—The *Heveas* are large forest-trees of northern South America, east of the Andes, growing mostly in the vicinity of streams, and possessing very straight trunks, with a smooth or only slightly rough bark. They bear light-green, glaucous, trifoliolate leaves and small greenish flowers, followed by 3-celled capsules, a large oblong seed, of about the form and size of an olive, in each cell. The seeds must be germinated almost at once, at the point of production, for purposes of propagation, and the plants transported. The cultivation of these trees for the production of rubber has been instituted at various points. The rubber is gathered by gently tapping the bark with a small sharp-pointed pick. Care is taken not to penetrate to the wood, which leads to the entrance of a boring insect, which promptly destroys the tree. The milk-juice may therefore be regarded as a protection against such insects. The milk, which, when it exudes, has very much the color and consistency of cows' milk, is caught in small cups fastened to the bark. Twice a day, usually, the cups are emptied into a large vessel at the smoking station. Into the milk is dipped a flat wooden paddle, and the layer of milk caught upon it is held in a column of smoke, and dextrously turned to prevent dripping, until coagulated, when the operation is repeated, a large flask-shaped mass, the *bolacho*, at length accumulating upon the paddle; or, the mass may be suspended in the smoke and fresh milk poured over it as fast as coagulation occurs. This is afterward removed by making a suitable incision in its upper end. The smoke is made by burning, excluded from free access of air, palm fruits or some other oily or fatty fuel. The forming mass is sometimes alternately dipped into sand or other heavy adulterating substances, or heavy bodies are introduced. The freshly coagulated rubber is white, but soon turns yellow, brown, and at length black, the change occurring first at the surface, and gradually extending to the center. At the same time there is a loss of weight, owing to evaporation of water, so that it is deemed profitable to sell the rubber shortly after its production. The bolachos are now mostly cut up into small pieces before exporting, for the detection of adulteration.

Description and Properties.—In flask-shaped masses with a thin, flat central cavity, and a fissure and a large perforation at one end, or in irregularly cut pieces of the same; externally smoothish and blackish, internally varying gradually from brown to whitish toward the center, and showing a layered structure; often slightly porous; very tough and elastic, and requiring a very sharp knife to cut it, the elasticity increasing with the temperature; density, 0.92 to 0.96; heated at 125° C. (257° F.), or a little higher, it melts, but on cooling remains soft and elastic, congealing ultimately to a brittle mass; decomposing at higher temperatures and burning in the atmosphere with a luminous sooty flame; of a faint and peculiar odor; nearly tasteless.

India rubber is insoluble in water and dilute acids and alkalies; it softens and swells when treated with hot alcohol, and dissolves to a soft, jelly-like mass in carbon disulphide, stronger ether, oil of turpentine, and other hydrocarbons, notably in petroleum benzin, benzene, and in the empyreumatic oils obtained in the destructive distillation of India rubber; it dissolves more readily and completely in chloroform, and may be melted together with fats and fixed oils. When pure or nearly so, India rubber floats on water. Rubber tubing is apt to become brittle by use and on exposure, a change which Mareck (1881) found can be prevented by keeping the tubing under water, which is to be occasionally renewed; the outer layer of the rubber assumes a fatty appearance, becomes lighter, then darker, and is improved for practical purposes. A strong solution of India rubber or an ammoniacal solution of shellac may be employed as a *cement* for fastening rubber upon other material.

When finely divided, mixed with sulphur, and afterward heated, *vulcanized* rubber is obtained; this, however, is more generally prepared by softening or dissolving India rubber and combining it with sulphur. Vulcanized rubber is insoluble in the ordinary solvents of India rubber, and its elasticity is not materially affected by a low temperature. Compounds of India rubber and sulphur, with which tar, white lead, chalk, or other substances have been incorporated, form *hard rubber* and *ebonite*, which at an elevated temperature may be molded or rolled into sheets.

Composition.—The recent juice contains about 32 per cent. of caoutchouc, with wax, free acid, nitrogenous bitter substances, etc. The concrete juice usually contains also free carbon or soot, resulting from the smoking process. Pure caoutchouc is a hydrocarbon ($C_{20}H_{32}$), which on destructive distillation yields *caoutchoucin*, consisting of two or more polymeric volatile oils (C_9H_8), also oil of caoutchouc.

Uses.—Rubber is never employed in internal medicine, but has a wide range of uses in the arts and in surgery. It is now largely used in the manufacture of plasters, trusses, orthopedic braces, bougies, catheters, artificial hands, ears, and noses, and the "rubber tissue," sheeting, and bandages prepared from it are almost indispensable in surgical practice.

Other Varieties of Rubber.—The list of plants which have yielded commercial rubber is a long one. In the *Druggists' Circular* for August, 1894, the present writer published a list of 11 in the *Euphorbiaceæ*, 9 in the *Moraceæ*, and 18 in the *Apocynaceæ*, but that list was far from complete. The product of a dozen or twenty species is important in commerce. It is estimated that the total annual production of rubber is about 100 millions of pounds, about three-fifths or more of which is of the sort above considered. Nearly a third comes from central Africa. African rubber is chiefly the product of several species of *Landolphia* (woody vines of the Fam. *Apocynaceæ*), of which about 40 species are known, and of *Kicksia Africana* Benth., in the same family. Next to these, the most important rubber producer is the *Castilloa elastica* Cerv. (Fam. *Moraceæ*), which produces the Central American or Panama rubber. It is a slender tree, only about 50 or 60 feet in height, with a few long horizontal branches near the top. It yields an edible fruit. The percentage of caoutchouc in the milk is about the same as in the Para sort, and the rubber is of very good quality. Not much can be expected before the twelfth to fifteenth year. The trees yield for a very long term of years. They can be tapped twice a year, and yield from 1 to 2 pounds each time. The rubber is prepared in various ways, rarely by heating and smoking. The common method is to run it into holes in the ground, sometimes into a barrel, and to use alum or the juice of a native plant to cause coagulation. Even ashes and earth are sometimes used, yielding a vile-smelling "nigger-head" mass. It is often precipitated by pouring into water, but a spongy mass results, from which the water must be squeezed. It is regarded as practicable to secure this sort by extraction of the twigs and leaves. Eight kinds are reported as being collected in Mexico, but this is the only one of importance. A very good Brazilian rubber, produced in considerable quantity, is that known as Mangabeira, Pernambuco, or Bahia rubber, from *Hancornia speciosa* Gomez (Fam. *Apocynaceæ*). This is a small tree, about 15 to 20 feet high, and yields an edible, plum-like fruit. The *Kew Bulletin* states that it is tapped at from 5 to 6 years of age, and yields from 2 to 10 pounds at a tapping. It is prepared, like that of *Castilloa*, in various ways. Manicoba rubber, often called Ceara rubber, is the product of *Manihot Glaziovii* Müll. Arg. (Fam. *Euphorbiaceæ*), also a native of Brazil, and a relative of *Hevea*. It is a very small tree, and begins to yield in the third or fourth year, when the annual yield is about 50 Gm. per tree, increasing in half a dozen years to from 5 to 7 times this amount. It continues to bear for many years, it is said as many as 50. This rubber is very inferior to the official.

East Indian or Assam rubber is from *Ficus elastica* Roxb. (*Urostigma e.* Miq.—Fam. *Moraceæ*), the common rubber plant of house-cultivation. Very many other species of *Ficus*, in both the old and new worlds, are capable of yielding rubber. Fiji rubber is the product of *Alstonia plumosa* Labill. (Fam. *Apocynaceæ*).

Penang and Borneo rubber is from *Urceola elastica* Roxb. and *U. esculenta* Benth. (*Chavannesis e.* DC.—Fam. *Apocynaceæ*).

Very many artificial substitutes for rubber have been prepared, and some of them, especially those with some genuine rubber as a basis, are largely used. None of them is a good substitute for the genuine, and the use of none is to be thought of for pharmaceutical purposes.

ELATERINUM, *U. S., Br.*—Elaterin.

Elaterin, G.; *Elaterine, Elatine*, Fr.; *Elaterina*, Sp.

A neutral principle ($C_{20}H_{28}O_5 = 345.60$), obtained from elaterium, a substance deposited by the juice of the fruit of *Ecballium Elaterium* (L.) A. Richard (Fam. *Cucurbitaceæ*).

Elaterin, which is considered as the anhydride of elateric acid, does not pre-exist in the juice of the squirting cucumber, but results from the hydrolysis of a glucoside by a ferment, both of which are present in the juice, the hydrolysis occurring during the sedimentation of the latter. It is chiefly obtained from elaterium by treating the same with boiling alcohol and precipitating the elaterin from the resulting solution by addition of water and then purifying it by washing with ether and recrystallizing from absolute alcohol. Elaterin may also be extracted from elaterium with hot chloroform and precipitated by addition of ether, being subsequently recrystallized from alcohol or chloroform.

A more complicated process for obtaining elaterin consists in precipitating the ferment

from the juice, freshly expressed, by means of alcohol, extracting and purifying the glucoside, and then bringing the two together in form of solution, when elaterin will be produced together with dextrose.

Elaterin occurs in small white hexagonal scales or prismatic crystals, without odor, and permanent in air. It has a slightly acrid, bitter taste, and is soluble at 25° C. (77° F.) in 262 parts of alcohol; also soluble in 22 parts of chloroform, 272 parts of benzene, and 200 parts of amyl alcohol, but requiring 318 parts of ether for solution; also soluble in 75 parts of alcohol at 60° C. (140° F.), U. S. Schmidt states that elaterin is soluble in 15 parts of cold or 2 parts of boiling alcohol and in 290 parts of ether. It is insoluble in glycerin. Elaterin is dissolved by solutions of the alkalies, and reprecipitated on supersaturating with an acid. "Elaterin is neutral to litmus-paper and melts at 216° C. (420.8° F.), forming a yellowish-brown liquid, and when ignited burns without residue. If a crystal of elaterin be added to a little hydrochloric acid and this evaporated to dryness, the residue washed with hot water, and afterward treated with sulphuric acid, a brownish-red (amaranth) color will be produced. Concentrated sulphuric acid dissolves elaterin, forming a yellow solution, which gradually changes to scarlet."—U. S. Elaterin imparts a green color to Fröhde's reagent and a blue color to vanadin-sulphuric acid, which afterward changes to green, and then to brown. Dissolved in melted phenol, it develops a crimson color on addition of strong sulphuric acid, which rapidly changes to scarlet. Elaterin is not precipitated from its alcoholic solution by tannic acid, mercuric chloride, or platinic chloride, showing absence of and difference from alkaloids.

Pharmaceutical Preparation.—Trituration of Elaterin, U. S. P.

Action and Uses.—Elaterin is employed under the same conditions and for the same purposes as Elaterium (which see). The dose is from $\frac{1}{30}$ to $\frac{1}{20}$ grain (0.002–0.003 Gm.), best given in pill-form.

ELATERIUM, *Br.*—Elaterium.

Extractum Elaterii. Elaterium, Fr., G.; *Elatterio*, It., Sp.

A sediment from the juice of the fruit of *Ecballium Elaterium* (L.) A. Richard (*Momordica E.* L.; *E. officinale* Nees; *E. agreste* Reich.; *E. cordifolium* Moench.—Fam. *Cucurbitaceæ*).

Origin and Preparation.—This fruit (*Ecballii Fructus, Cucumis asininus, Cucumis agrestis.—Squirting* or *Wild cucumber*, E.; *Springgurke, Esels-Kürbis, Spritzgurke*, G.; *Concombre sauvage purgatif d'âne*, Fr.; *Cohambrillo amargo*, Sp.) is the product of a succulent, bristly, trailing, tendril-bearing, perennial, squash-like vine, abundant in dry waste places in the Mediterranean basin, and slightly cultivated for medicinal purposes in various European countries. The fruit is nodding from the recurved stalk, 5 Cm. (2 In.) or less in length, and half as thick, oblong, and somewhat tapering above, pale-green, beset with fleshy prickles and 3-celled. As the fruit matures, a bitter, watery, or slightly mucilaginous juice is developed in increasing amount and collects in a basal cavity, with the seeds immersed in it, a high outward tension finally existing. In this condition the slightest disturbance causes violent rupture of the base of the fruit, and the discharge of the juice and seeds, a provision, doubtless, for the protection of the latter against being eaten, as well as for dissemination. The highly and promptly purgative properties of the juice are doubtless designed for the same purpose, in case of the ingestion of it with the seeds. This peculiarity necessitates the collection of the fruit just previous to maturity, for the extraction of elaterin. Various processes are employed for this purpose, but all depend upon the requirement that only the thin, watery juice which exudes spontaneously be used, and

Fig. 170.

Ecballium Elaterium.

that the impure elaterin be allowed to subside, then be quickly separated, drained, and dried, this sediment constituting *elaterium.*

For its extemporaneous preparation, the following process is recommended: Take of squirting cucumber fruit, very nearly ripe, 1 pound. Moisten the surface with water, to prevent the juice from adhering. Cut the fruit lengthwise and lightly press out the juice. Rinse off the cut surfaces with water. Strain the liquid through a hair-sieve and set it aside to deposit. Carefully pour off the supernatant liquor, pour the sediment on a linen filter, and dry it on porous tiles with a gentle heat. The decanted fluid may deposit a second portion of sediment, which can be dried in the same way. With an increased pressure, a larger amount of juice and of deposit is obtained, but the latter is then of inferior quality. Exposure of the drying elaterium to the sunshine should be avoided. Clutterbuck obtained only 6 grains of elaterium from 40 specimens of squirting cucumber; with slight pressure, 40 pounds of the fruit will generally yield $\frac{1}{2}$ ounce, and in warm, dry seasons even $\frac{3}{4}$ ounce of elaterium.

Description.—Elaterium is in light, friable, flat or slightly incurved cake-like fragments, frequently marked on their surfaces with the impression of the linen or paper on which they were dried. When fresh, it has a pale-green color, changing by age to gray, and then often containing minute sparkling crystals on the surface. It breaks with a fine granular fracture, and has a slight tea-like odor and an acrid and bitter taste. It does not effervesce with acids; a cooled decoction of it is not colored blue or is but slightly tinged by solution of iodine, showing the presence of but very little starch. It yields half its weight to boiling rectified spirit; and this solution, on being concentrated and added to a warm solution of potassium hydroxide, deposits on cooling not less than 20 per cent. of elaterin in colorless crystals.

Constituents.—Elaterium consists of 44 per cent. of elaterin (see ELATERINUM), 17 per cent. of green resin, 6 per cent. of starch, etc. Besides these, the juice of the fruit and herb contains *prophetin*, a crystallizable bitter yellow glucoside; *ecballin* or *elateric acid* ($C_{20}H_{34}O_4$?), bitter, acrid, amorphous, resin-like, soluble in 20 parts of water, and in alcohol, ether, and alkaline hydroxides; *hydro-elaterin* ($C_{20}H_{30}O_6$?), yellow, amorphous, not bitter, and soluble in water, alcohol, and ether; and very bitter amorphous *elaterid* ($C_{20}H_{32}O_{12}$?), which is soluble in dilute alcohol, but not in water or ether, and is precipitated by tannic acid.

Action and Uses.—Elaterium is an irritant hydragogue purge. That is to say, it produces large watery stools and is distinctly drastic in its influence. As it is very irritating to mucous membranes with which it comes in contact, it ought not to be given if there is present irritation or inflammation of the stomach or bowels. Its field of usefulness is to produce free watery evacuations in cases of dropsy, and also to relieve congestion at the base of the brain and in the lungs, when congestion of these parts is produced by renal or cardiac disease.

Elaterium is not a purge which is to be used for the purpose of moving the bowels under ordinary circumstances. Where obstinate constipation is present, it sometimes produces watery stools, but leaves in the bowel considerable quantities of hardened fecal matter. It is thought by some that elaterium causes a greater elimination of urea through the bowels, when it produces its purgative effect, than any other hydragogue cathartic, and that it is therefore particularly advantageous in cases of Bright's disease with dropsy.

The dose of elaterium is $\frac{1}{6}$ grain (0.01 Gm.), given with a little confection, in a powder with sugar of milk, in capsule or in pill.

ELEMI.—Manila Elemi.

Resina (*s. Gummi*) *Elemi.*—*Elemi*, G.; *Elémi, Resine elemi*, Fr.; *Goma de limon*, Sp. A concrete resinous exudation from *Canarium commune* L. (Fam. *Burseraceæ*).

Origin.—The name of elemi has been given to many resinous products which have from time to time appeared in commerce. Some of them, of semisolid consistence, have been called *soft elemis;* others, about like common rosin, or harder, are known as *hard elemis.* To the latter class belongs that here considered. It is obtained, chiefly in the Philippines, from incisions in the bark of a tall tree, growing also in the Moluccas and other of the old-world tropics. Artificial heat is said to be used to make the juice flow more freely. The fruit of this tree is said to be the cathartic *Java almond* or *Amendra.*

Description.—Manila elemi is in soft granular transparent masses when fresh, but is generally met with in the shops in solid pieces, which are externally pale lemon-yellow and clear, internally opaque, nearly white, and mixed with chips and other impurities. It breaks with a dull granular fracture and readily fuses to a transparent liquid. Moistened with alcohol, it disintegrates and shows a large number of small acicular crystals. It has a strong aromatic, somewhat terebinthinate odor, and a warm, aromatic, and acrid taste.

Constituents.—About one-fourth of its weight is *amyrin*, separable into *α-amyrin* and *β-amyrin*. Most of the remainder is *amorphous resin*, with 10 to 15 per cent. of volatile oil. *Elemic acid* ($C_{35}H_{46}O_4$), *breïdin*, *bryoidin*, and an amaroid, are present in small amount.

Action and Uses.—Elemi is rarely employed in medicine in this country, but in Europe is used to some extent in the preparation of plasters and ointments, which are said to be advantageous as a dressing for fissures, blisters, and ulcers. The drug possesses properties which are analogous to those of turpentine, but it is never employed in internal medicine.

Other Elemis.—Karl Dieterich, who has recently investigated these resins, regards a number of others as being "genuine Elemi," as follows: Yucatan or West Indian Elemi, from *Protium Icicariba* (DC.) March. (*Icica I.* DC.), which is usually soft. Part of this is probably derived, as is Mexican or Vera Cruz Elemi, from *Amyris Plumieri* DC. (*Amyris elemifera* L.); Rio or Brazilian Elemi, from various species of *Protium;* African Elemi, from *Canarium Zephyricum* March. Very similar to these are the Tacamahac resins, East Indian from *Calophyllum inophyllum* L. and Bourbon from *C. Tacamahaca* W. Similar, but with the odor of *Olibanum*, are the following: Cayenne incense or West Indian tacamahaca, from *Protium heptaphylla* March. and Resin of accume, from unknown *Burseraceæ* of the West Indies. Mauritius Elemi, much like the Manila, is from *Colophonia Mauritiana* Commerson. *Calophyllum* is in the *Guttiferæ*, all the others in *Burseraceæ*, except that Engler has, we think with poor judgment, referred *Amyris* to the *Rutaceæ*.

Canarium strictum Roxb. is the source of the *Black dammar* of India.

ELIXIR ADJUVANS, *U. S.*—Adjuvant Elixir.

Elixir adjuvant, Fr.; *Gewürzhaftes Lakritzenelixir*, G.

Preparation.—Fluidextract of glycyrrhiza, 120 Cc.; Aromatic elixir, 880 Cc. Mix them, and filter if necessary.—U. S.

Adjuvant elixir is of a yellowish-brown color and has a very sweet, aromatic taste.

Uses.—It is intended as a vehicle to disguise the unpleasant saline or bitter taste of medicines, but should not be used in connection with acid liquids, as these will cause precipitation.

ELIXIR AMARUM, *P. G.*—Bitter Elixir.

Elixir amère, Fr.; *Bitteres Elixir*, G.

Preparation.—Extract of absinth, 2 parts; oil-sugar of peppermint, 1 part; water, 5 parts; aromatic tincture, bitter tincture, of each, 1 part. Triturate the extract and oil-sugar with the water until dissolved, add the tinctures, and filter.—P. G.

This preparation should be allowed to stand 2 or 3 days before filtration, and then yields a clear dark-brown liquid.

Uses.—It is used as a bitter tonic.

ELIXIR AROMATICUM, *U. S.*—Aromatic Elixir.

Simple Elixir, E.; *Elixir aromatique*, Fr.; *Aromatisches Elixir*, G.

Preparation.—Compound spirit of orange, 12 Cc.; syrup, 375 Cc.; purified talc, 15 Gm.; alcohol, distilled water, of each a sufficient quantity to make 1000 Cc. To the compound spirit of orange add sufficient alcohol to make 250 Cc. To this solution add the syrup in several portions, agitating after each addition, and afterward add, in the same manner, 375 Cc. of distilled water. Mix the purified talc intimately with the liquid and then filter through a wetted filter, returning the first portions of the filtrate until it passes through clear. Lastly, wash the filter with a mixture of 1 volume of alcohol and 3 volumes of distilled water, until the product measures 1000 Cc.—U. S.

To prepare 2 pints of aromatic elixir will require 3 fluidrachms of compound spirit of orange, 12 fluidounces of syrup, 8 fluidounces of alcohol, ½ ounce of purified talc, and sufficient distilled water to make the volume 32 fluidounces.

Uses.—This preparation is very largely used as a vehicle.

ELIXIR AURANTII COMPOSITUM, *P. G.*—Compound Elixir of Bitter Orange.

Elixir d'orange amère composé, Fr.; *Pomeranzenelixir*, G.

Preparation.—Bitter-orange peel, in very coarse powder, 20 parts; cassia, in coarse powder, 4 parts; potassium carbonate, 1 part; extract of gentian, extract of absinth, extract of buckbean, extract of cascarilla, of each, 2 parts; sherry wine, a sufficient quantity to make 100 parts. Macerate the orange peel, cassia, and potassium carbonate with 100 parts of sherry wine for 8 days in a closed vessel at a temperature of 15°–20° C. (59°–68° F.); express, add sufficient sherry wine to bring the weight of the liquid up to 92 parts, and in this dissolve the extracts. After standing a few days, filter.—P. G.

Uses.—This elixir is used as a bitter tonic and as a vehicle.

ELIXIR FERRI, QUININÆ, ET STRYCHNINÆ PHOSPHATUM, *U. S.*—Elixir of Iron, Quinine, and Strychnine Phosphates.

Elixir des phosphates de fer, de quinine et de strychnine, Fr.; *Elixir von phosphorsauren Eisen, Chinin und Strychnin*, G.

Preparation.—Soluble ferric phosphate, 17.5 Gm.; quinine, 8.75 Gm.; strychnine, 0.275 Gm.; phosphoric acid, 2 Cc.; ammonium carbonate, in translucent pieces, 9 Gm.; alcohol, 60 Cc.; acetic acid, 28.65 Gm.; distilled water, aromatic elixir, each a sufficient quantity to make 1000 Cc. Dissolve the quinine and strychnine in the alcohol, then add the phosphoric acid and 350 Cc. of aromatic elixir. Add the acetic acid to the ammonium carbonate, contained in a suitable vessel, and when solution is complete add enough distilled water to make the product measure 50 Cc. Mix the neutral solution of ammonium acetate with the solution of the alkaloids, and add sufficient aromatic elixir to make the liquid measure 850 Cc. Dissolve the ferric phosphate in 30 Cc. of distilled water, by the aid of a gentle heat, and if the solution be acid to litmus-paper neutralize exactly with ammonia-water, and add sufficient aromatic elixir to make the product measure 120 Cc. Finally, mix the two solutions and filter, if necessary.—U. S.

To make a gallon of the official elixir, dissolve 512 grains of quinine alkaloid and 16 grains of strychnine alkaloid in 8 fluidounces of alcohol, add 48 fluidounces of aromatic elixir, and then 2 fluidrachms of official (85 per cent.) phosphoric acid. Add 568 grains of ammonium carbonate, in clear firm pieces, to 1792 grains of 36 per cent. acetic acid, and when solution is complete add sufficient distilled water to bring the volume up to 6 fluidounces. Mix the ammonium acetate solution with the solution of quinine and strychnine phosphates, and add sufficient aromatic elixir to make the liquid measure 112 fluidounces or 7 pints. Dissolve 1024 grains of soluble phosphate of iron in 4 fluidounces of distilled water by the aid of a gentle heat, and, if necessary, neutralize the solution carefully with ammonia-water, and add sufficient aromatic elixir to bring the volume up to 16 fluidounces. Finally, mix the two solutions.

The finished product will represent in each cubic centimeter 0.00875 Gm. of quinine and 0.000275 Gm. of strychnine, in the form of phosphates, and 0.0175 Gm. of soluble phosphate of iron, or in each teaspoonful $\frac{1}{2}$ grain of quinine, $\frac{1}{64}$ grain of strychnine, and 1 grain of iron phosphate.

Elixir of iron, quinine, and strychnine phosphates, prepared by the above formula, is of a pale greenish-yellow color, and has a pleasant aromatic odor and a bitter taste. It should be kept in a dark place and be dispensed in amber-colored bottles, as all elixirs containing soluble phosphate of iron darken materially if exposed to light.

If the official directions are carefully followed, no difficulty will be experienced in obtaining a perfectly clear preparation, which is miscible in all proportions with water and keeps well at all seasons. Elixir of the phosphates of iron, quinine, and strychnine has been very popular with physicians for over a quarter of a century, and its introduction into the Pharmacopœia is particularly desirable to insure uniformity in composition. The various elixirs of the above name placed on the market by the different manufacturing firms do not agree in composition nor in strength of the more active ingredients, and in some cases the salts are not even present as phosphates. If an elixir is desired containing the quinine and strychnine as phosphates, in perfect solution with phos-

phate of iron, and yet not unpleasantly acid (for a large excess of phosphoric acid will accomplish the purpose), some other substance must be added which shall prevent precipitation. Ammonium acetate has been found to produce the best results, and to yield an elixir which remains clear at the freezing temperature. The very small proportion of ammonium acetate required is not in any way hurtful, and need not be considered any more than the alkali citrate in the phosphate of iron.

Uses.—This elixir affords a palatable form in which to administer its three important ingredients. It is a valuable tonic and stimulant, to be given during convalescence from exhausting diseases, or in any condition characterized by anæmia, nervous debility, general asthenia, or impaired appetite. The dose is from 1 to 2 drachms (4–8 Cc.).

ELIXIRIA.—Elixirs.

Elixirs, Fr.; *Elixire*, G.

The word "elixir" is of ancient origin, and, according to the late Charles Rice, was derived by the Arabs from the Greek word *ξήριον*. It was formerly used by chemists to designate the wonderful transformation-powder, a pinch of which was claimed to be sufficient to convert large quantities of base metal into silver and gold. Gradually the term was applied also to liquids claimed to possess the same magical powers, and still later the word "elixir" was used to designate certain compound tinctures possessing rare medicinal properties, as, for instance, Elixir ad longam vitam, which was supposed to induce longevity. In this latter sense the term elixir is still used to some extent in continental Europe, and, as a rule, such preparations are characterized by an unpleasant taste. In modern American pharmacy the word has come to mean an entirely different class of preparations, the distinguishing features of which are a pleasantly aromatic sweet taste and the presence of alcohol, varying from 20 to 25 per cent. by volume. Prior to 1865 only two elixirs of this kind were used to any extent in this country—namely, elixir of calisaya and elixir of ammonium valerianate. Through the efforts of enterprising manufacturers the list of elixirs was rapidly augmented, and reached its height between 1870 and 1875. Gradually, however, a reaction set in, and at the present day many once-popular elixirs have fallen into disuse. There can be no doubt that a sweet, aromatic, and slightly alcoholic liquid forms a pleasant vehicle for many remedies, but the presence of alcohol in some instances is positively injurious, and, moreover, the active ingredients are frequently present only in minute quantities. The U. S. P. recognizes but three elixirs—adjuvant elixir, the aromatic elixir, and the elixir of iron, quinine, and strychnine phosphates—the two former chiefly as bases for the ready preparation of many others.

As it is desirable in many instances to impart a color to the elixir, it should be borne in mind that not all coloring-agents are equally well suited for acid and alkaline liquids; for the former class as well as for neutral liquids, the National Formulary recommends the simple or compound tincture of cudbear, of either of which 2 drachms will suffice to color a pint of elixir. For alkaline liquids it is best to use a solution made as follows: carmine No. 40, 60 grains; glycerin and distilled water, each, 4 fluidounces; ammonia water, a sufficient quantity; triturate the carmine with the water, gradually adding ammonia water until the carmine has all been dissolved and a dark-red liquid is obtained; to this add the glycerin and mix (Lloyd).

EMPLASTRA.—Plasters.

Emplâtres, Fr.; *Pflaster*, G.; *Empiastri*, It.; *Emplastos*, Sp.

Plasters are preparations intended for external application, which, although firmer and more tenacious than cerates, become adhesive by the heat of the body, and may be made to serve the purpose of offering both support and medication to the parts to which they are applied. They are firm solids at ordinary temperature, and cannot be spread without the aid of heat, but retain a certain degree of flexibility when applied to the body. The base or mass of nearly all the official plasters is either simple lead plaster or a mixture of the same with wax, resin, and gum-resins; in large manufactories a rubber-mass is specially prepared from caoutchouc and certain aromatic resins and vegetable powders, which is to be preferred in some cases on account of its flexibility and adhesiveness. In the preparation of the rubber plaster-base the crude India rubber of commerce

is first freed from impurities by steaming and continuous washing with warm water in suitable machinery until all foreign matter has been removed, after which it is repeatedly passed between heavy steel rollers kept at a temperature of about 35° or 37° C. (95° or 98.6° F.); during this kneading process the rubber gradually softens and assumes a plastic condition which fits it admirably for the incorporation of very finely powdered olibanum, orris root, and resin or Burgundy pitch, this being also effected between warm smooth rollers.

Some authorities contend that plasters made with a rubber base are wholly inefficient where systemic or even endermatic effects are desired, since, as they claim, the rubber combination does not permit the release and subsequent absorption of the medicinal agent present. Opinions are divided on this point, and while there is no doubt that a volatile or a fatty vehicle will permit the absorption of any medicinal agent in admixture more readily than an insoluble mass of rubber, resin and wax, or lead oleate, many physicians claim to have observed positive good effects from rubber-base plasters, and the testimony of many hundred laymen is in favor of this decidedly more pleasant and convenient form of plasters.

As in the case of ointments, plasters may be divided into three groups with regard to their therapeutic action:

1. Plasters intended to exercise a supportive, protective, antiseptic, counterirritant, or vesicant effect. These will act only epidermatically, and a mass possessing the property of ready and continued adhesiveness is to be preferred; hence rubber combinations and the official resin plaster are well adapted for this group, the former possessing the advantage of greater adhesiveness, especially in the presence of moisture.

2. Plasters intended to produce an endermatic effect, such as anodyne, astringent, alterative, sedative, or stimulant. This group includes the official plasters of arnica, belladonna, lead, opium, and pitch; and while lead oleate, together with its admixtures of resin or soap, is preferred by many as a vehicle, it is safe to assume that the large quantities of plasters of this group made with rubber-mass are not used without good results.

3. Plasters intended for constitutional and systemic effects. As these require penetration not only into but also through the skin, it is absolutely necessary that the vehicle be one of recognized absorbability. The only official representatives of this group are mercurial plaster and ammoniac plaster with mercury, neither of which it is claimed possesses much value on account of the vehicle employed.

The preparation of plaster-masses by pharmacists is very similar to that of cerates, being preferably conducted with water-bath heat, those constituents having the highest fusing-point being first introduced into the pan or dish, and others of greater fusibility being gradually incorporated. All wholly or partly volatile substances, as oleoresins or essential oils, must be added last, and non-fusible substances must be incorporated in the form of very fine powder whenever possible; as gum-resins are frequently added to plaster mixtures, and as they cannot be reduced to fine powder without injury, they must either be treated in coarse powder with alcohol, and the resulting solution of resinous matter then evaporated to a syrupy consistence, as in the case of asafetida, myrrh, and galbanum, or be emulsionized with diluted acetic acid and then evaporated until the liquid hardens on cooling, as in the case of ammoniac. In either case the concentrated liquid should be added to the fused mixture when it begins to cool, the mass being well stirred to insure uniform distribution.

Fluid and solid extracts must be incorporated as in the case of ointments, the former after evaporation to a syrupy consistence, the latter after softening with a little water or diluted alcohol, as the case may be. As in the case of ointments, the extinguishment of metallic mercury in plasters is mostly effected by trituration with mercuric oleate.

If any foreign matter, such as sand, pieces of wood, and the like, should be found in the melted plaster, this is best removed by decantation or straining, which must always be done before the insoluble and non-fusible substances are added; if straining be resorted to, it will be advisable to perform this operation with the smallest bulk possible, the strained material being always received in a warm pan or dish.

If plasters are to be preserved for stock, they are usually rolled into cylindrical pieces of convenient thickness weighing about 4 or 8 ounces; this operation is performed on a slab or board previously moistened with water or expressed oil of almond; these sticks or rolls should be wrapped in waxed or paraffined paper to protect them from the air.

Although, with two exceptions, the term plaster is officially applied to the mass or combination to be spread upon leather or muslin, it is more extensively used in trade to designate the finished spread plaster, ready for application. The spreading of plasters has almost entirely passed out of the hands of pharmacists, hence it does not now appear necessary to describe and illustrate the various appliances which thirty-five or forty years ago were considered a very essential and important part of every educated pharmacist's outfit. Plaster-masses, official and otherwise, may now be purchased of reliable quality, spread on muslin or other material, in one- and five-yard rolls, or in definite and convenient sizes, from large manufacturers, and there is to-day no more reason why a pharmacist should make and spread belladonna plasters than that he should return to the spreading of adhesive plaster, as was done many years ago. Moreover, plasters are prescribed but rarely now by physicians, and, when some new combination is ordered, the pharmacist will probably have little difficulty in spreading a plaster of fair quality and appearance by following the few general directions here given.

For extemporaneously spread plasters the best material is soft white leather, the kind known in the trade as plaster skin. A piece should be cut 1 inch larger each way than the size of the plaster ordered; thus a 4 × 6 plaster would require a piece of leather 5 × 7 inches; now prepare 4 strips, $\frac{1}{2}$ inch in width, of stiff paper, preferably glazed, and having previously prepared the plaster-mass on a water-bath, as directed above, apply the paper strips to the rough side of the plaster skin in such a manner that the desired space shall remain uncovered, and carefully pour the melted plaster-mass on the leather, smoothing the surface with a warm spatula, or by holding the spread plaster near a stove or furnace-register and allowing the soft material to run smooth. Then, having placed the spread plaster on a level surface, with a quick motion remove the paper strips before the plaster surface hardens, so that a clean half-inch margin around the plaster proper may be obtained. In place of a spatula, the roller shown in Fig. 171 may be used with advantage for smoothing the spread plaster-mass; it should be dipped in hot water, so as to become warm, before it is used, and then be moistened with a mixture of 1 volume of glycerin and 2 volumes of water to prevent adhesion.

Fig. 171.

Plaster-roller.

If the paper strips be attached before the melted mass is ready to be applied, the paste is likely to dry out, when subsequent removal of the paper from the rough leather becomes difficult, and hence some pharmacists prefer to moisten the strips with a damp sponge just previous to spreading the plaster-mass; this plan has been found very advantageous. Instead of using paper strips, some prefer to cut a frame of thin cardboard, with a central opening of the required shape and size of the plaster, which is tacked down on the plaster skin. The amount of material necessary for spreading a plaster of the required thickness need not exceed 12 or 15 grains for each square inch, or about 0.165 Gm. for each square centimeter. Plaster-spreading requires manipulative skill, and practice alone can bring success.

Mammary or breast plasters are always made circular in form, about 8 inches in diameter, with a 1-inch margin; a hole $1\frac{1}{2}$ inches in diameter is cut in the center, and from this point to the outer edge the plaster is slit to admit folding over the breast. Such plasters are preferably spread on chamois skin, which is softer.

Fly-plaster is the name frequently applied to cantharides or blistering cerate when the same has been spread upon adhesive plaster ready for use. The spreading of the cerate is done in the manner already outlined for regular plaster-masses, except that heat is unnecessary, since the cerate is sufficiently soft to permit of being spread by simple pressure of a spatula; in cold weather the spatula may be slightly warmed with advantage. The amount of blistering cerate necessary for a given space should not exceed 10 or 12 grains for each square inch, or about 0.120 Gm. for each square centimeter. As

fly-plasters are not intended for prolonged application, ordinary muslin or adhesive plaster will answer on which to spread the cerate, the latter material being preferable on account of the adhesive edges, which serve to keep the plaster from slipping. A piece of tarletan, a trifle larger than the surface of the cerate, should be firmly pressed over the same, which, while not interfering with the blistering action of the cantharides, protects the skin from being much soiled, and prevents any of the cerate from getting under the skin if the blistered surface should be lacerated by sudden removal of the plaster.

Porous plasters, which have become very popular, differ from ordinary spread plasters in having numerous small holes punched through them, rendering them more comfortable for prolonged application, by allowing exhalations of the skin to pass off freely. They are prepared on an extensive scale by special machinery.

European dermatologists some years ago introduced a class of preparations known as *plaster-mulls*, which are intermediate in consistence between plasters and cerates. These plaster-mulls, sometimes also called salve-mulls, are especially indicated in cases in which prolonged application is necessary, since, owing to the porous character of the mull or gauze employed, they permit ready evaporation, and thus prevent maceration of the epidermis, which is likely to occur in the case of more occlusive dressings. The vehicle for these plaster-mulls is usually a mixture of suet and lard, containing 70 to 90 per cent. of the former, which is easily spread when heated, but does not melt nor run when applied to the body. As medicating agents, ichthyol, salicylic acid, mercury, and similar substances are employed in various proportions. The general mode of preparation is about as follows: a piece of mull or gauze is spread on a piece of parchment paper which has been previously moistened and pressed; the medicated mass, having been melted, is spread over the gauze by means of a broad brush when upon the point of congealing. The surface is afterward made smooth with a spatula dipped in warm water, and after having lain in a cool place for a few hours the parchment paper is removed. Very similar to plaster mulls are the *collemplastra*, introduced from Germany, in which the vehicle intended for medication is composed of caoutchouc, pine resin, rosin-oil, Venice turpentine, copaiba balsam, and yellow wax, made into a semifluid uniform mixture with the aid of ether. After the vehicle has been medicated as desired and spread on the proper material, the ether is allowed to evaporate, and the surface, as in the case of plaster mulls, is then covered with gauze.

EMPLASTRUM ADHÆSIVUM, *U. S., P. G.*—Adhesive Plaster.

Emplastrum Resinæ, Br. (U. S., 1890).—*Resin plaster*, E.; *Emplâtre adhésif, Emplâtre résineux*, Fr.; *Heftpflaster*, G.; *Empiastro adesivo*, It.

Preparation.—Rubber, 20 Gm.; petrolatum, 20 Gm.; lead plaster, 960 Gm. Melt the rubber at a temperature not exceeding 150° C. (302° F.); add the petrolatum, and continue the heat until the rubber is dissolved. Add the lead plaster to the hot mixture; continue the heat until it becomes liquid, then let it cool, and stir until it stiffens.—U. S.

To make 25 ounces of adhesive plaster will require ½ ounce each of rubber and petrolatum, and 24 ounces of lead plaster.

The formula for adhesive plaster has been materially changed, the yellow wax and rosin formerly used having been replaced by rubber and petrolatum, whereby the adhesive properties of the plaster are increased, and also the tendency to become hard and brittle overcome.

Adhesive plaster of the British Pharmacopœia is composed of hard soap 5 parts, rosin 10 parts, and lead plaster 80 parts, each melted separately at as low a temperature as possible, and then mixed.

The German Pharmacopœia directs that 40 parts of lead plaster, freed from water by heating on a water-bath, shall be melted together with 2½ parts each of hard and liquid paraffin, to which mixture are then added 35 parts of rosin and 10 parts of dammar. While still warm the mass is added to a solution of 10 parts of caoutchouc in 75 parts of petroleum benzin. The mixture is finally heated on a water-bath and constantly stirred until the benzin has all evaporated. This process, while yielding a satisfactory product, requires great care on account of the ready inflammability of the benzin vapor, and contact with flame must be avoided.

The present official adhesive plaster, also known as sticking plaster, when spread upon muslin resembles the commercial rubber adhesive plaster. The latter is now frequently manufactured in combination with zinc oxide, and sold as zinc-oxide adhesive plaster, for the purpose of avoiding the irritation usually caused by plain rubber plaster.

Uses.—Adhesive plaster may be employed for the purpose of holding surgical dressings in place. It has practically been replaced by the unofficial rubber plaster, which is much more efficient, although somewhat more irritating. It is also used for the immobilization of parts, such as the chest in acute pleurisy or fracture of the ribs.

EMPLASTRUM AMMONIACI CUM HYDRARGYRO, *Br.*—Ammoniac Plaster with Mercury.

Ammoniacum and mercury plaster, E.; *Emplâtre de gomme ammoniaque mercuriel*, Fr.; *Quecksilberhaltiges Ammoniakpflaster*, G.

Preparation.—Take of ammoniacum, 12 ounces; mercury, 3 ounces; olive oil, 56 grains; sublimed sulphur, 8 grains. Heat the oil, and add the sulphur to it gradually, stirring till they unite. With the mixture triturate the mercury until globules are no longer visible; add the ammoniacum, previously purified by boiling with successive portions of water, passing the resulting emulsion through a hair-sieve, and, after mixing, evaporating the emulsion to a suitable consistence.—Br.

Ammoniac plaster with mercury has been dropped from the U. S. Pharmacopœia.

Action and Uses.—This plaster possesses the combined alterative and irritant properties of mercury and ammoniac, and may be employed in the treatment of enlarged glands, enlarged joints, and for other swellings dependent upon syphilitic infection. If applied too long or over too large an area it may, in susceptible persons, produce ptyalism.

EMPLASTRUM BELLADONNÆ, *U. S., Br.*—Belladonna Plaster.

Emplâtre de belladone, Fr.; *Belladonnapflaster*, G.; *Emplasto de belladonna*, Sp.

Preparation.—Extract of belladonna leaves, 300 Gm.; adhesive plaster, 700 Gm.; to make 1000 Gm. Melt the adhesive plaster on a water-bath; then add the extract of belladonna, and continue the heat, stirring constantly, until a homogeneous mass results. —U. S.

Belladonna plaster may be conveniently prepared of official strength by incorporating $1\frac{1}{2}$ avoirdupois ounces of extract of belladonna leaves with $3\frac{1}{2}$ avoirdupois ounces of adhesive plaster; to insure a perfectly smooth plaster it may be necessary to soften the extract with a small quantity of water if it appears to have become tough.

Take of liquid extract of belladonna, 4 fluidounces; resin plaster, 5 ounces. Evaporate the liquid extract of belladonna on a water-bath until it is reduced in weight to 1 ounce; add the resin plaster, previously melted, and mix. This plaster contains 0.5 per cent. of the alkaloids of belladonna root.—Br.

The two plasters differ in composition as well as in appearance, the former being of a dark-green and the latter of a brown color.

The U. S. P. plaster, if made from standardized extract of belladonna leaves, will contain 0.42 per cent. of mydriatic alkaloids, and the official requirement is for not less than 0.38 and not more than 0.42 per cent. when assayed by the method given below. While the Pharmacopœia does not give a process for the preparation of machine-spread belladonna plasters made with a rubber base, it demands that all such plasters shall conform to the official alkaloidal standard when assayed by the same method.

Assay of Belladonna Plaster (Rubber Base).—Belladonna plaster, spread upon cloth, 10 Gm.; chloroform, ammonia-water, alcohol, distilled water, normal sulphuric acid, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, hematoxylin test-solution, each a sufficient quantity. Into a suitable beaker containing 50 Cc. of chloroform and 3 Cc. of ammonia-water introduce the belladonna plaster cut into strips. Stir until the plaster is entirely removed from the cloth; then pour off the chloroform into another beaker, wash the cloth with 25 Cc. of chloroform and 1 Cc. of ammonia-water carefully, and add the washings to the chloroformic solution first obtained. If necessary, repeat the washing

with 25 Cc. of chloroform, and add this also to the chloroformic solutions. Then dry the cloth at a low temperature; cool and weigh it, and subtract its weight from the original weight of the plaster. To the chloroformic solution add four-fifths of its volume of alcohol, stir gently, and allow the liquid to stand until all of the rubber has separated in a compact mass. Then pour off the supernatant liquid into a separator of 250 Cc. capacity, and having prepared a solution of sulphuric acid by diluting 40 Cc. of normal sulphuric acid with 60 Cc. of distilled water, add 20 Cc. of the solution to the separator, and agitate for 2 minutes, rotating gently. Draw off the chloroformic solution into another separator, shake this with 10 Cc. of the sulphuric acid solution, and add the acid solution to that in the first separator. Repeat until the acid washings cease to give a reaction with mercuric-potassium-iodide test-solution; combine the acid liquids, and having rendered this solution alkaline with ammonia-water, wash out the alkaloids with three successive portions of 25, 15, and 10 Cc. of chloroform. Collect these in a flask and distil off all the chloroform with the aid of a water-bath. To the alkaloidal residue add a slight excess of tenth-normal sulphuric acid, noting the quantity used, then add 10 drops of chloroform and, after rotating, evaporate the latter by means of a water-bath. Then add 5 drops of a hematoxylin test-solution and, rotating, titrate the excess of acid with fiftieth-normal potassium-hydroxide solution. Divide the number of cubic centimeters of fiftieth-normal potassium-hydroxide solution used by 5, subtract the quotient from the number of cubic centimeters of tenth-normal sulphuric acid first added, and divide the difference by the number of grammes of belladonna plaster separated from the cloth, multiply the quotient by 0.0287, and this product by 100, which will give the percentage of mydriatic alkaloids in the belladonna plaster.—U. S.

Action and Uses.—The action of this plaster is fully described under BELLADONNA (which see). It is frequently applied for the relief of rheumatism and neuralgic pains, and serves also as a useful application in the early stages of acute inflammatory conditions, especially when occurring in glands, as in the mammæ or testicles. It is also useful when applied over the heart to relieve cardiac palpitation.

EMPLASTRUM CALEFACIENS, *Br.*—Warming Plaster.

Emplastrum picis cantharidatum, U. S. 1890. *Cantharidal pitch plaster*, E.; *Emplâtre de poix cantharide*, Fr.; *Pechpflaster mit Canthariden*, G.

Preparation.—Cantharides, in coarse powder, 4 ounces; yellow wax, 4 ounces; resin, 4 ounces; resin plaster, 3½ pounds; soap plaster, 2 pounds; distilled water, boiling, 1 pint. Infuse the cantharides in the distilled water for 6 hours; squeeze strongly through calico; evaporate the expressed liquid on a water-bath till reduced to one-third; add the other ingredients; melt on a water-bath; stir until the ingredients are thoroughly mixed.—Br.

The above formula appears unnecessarily complicated, and an equally efficient plaster can be made by following the directions of the U. S. P. of 1890, which were as follows: Melt 80 Gm. of cerate of cantharides on a boiling water-bath and continue the heat for 15 minutes; strain through close muslin, so that the cantharides will be retained. To the strained liquid add sufficient Burgundy pitch to make the whole weigh 1000 Gm. and render the mixture homogeneous by stirring; then remove the heat and stir until the mass thickens. The addition of 65 Gm. of hot water, or olive oil, in place of a like weight of the pitch, will improve the product materially.

Uses.—Warming plaster may be applied as a counterirritant in the treatment of chronic joint-affections, in cases of chronic bronchitis, pleurisy, and other pectoral affections, and in lumbago. Its application should not be continued very long, as it may produce vesication.

EMPLASTRUM CAPSICI, *U. S.*—Capsicum Plaster.

Sparadrapum capsici.—Sparadrap de capsique, Fr.; *Capsicumpflaster*, G.

Preparation.—Oleoresin of capsicum, 0.25 Gm.; adhesive plaster, spread on fabric, a sufficient quantity.

Apply the oleoresin of capsicum by means of a brush, so as to form a thin coating over an area 15 Cm. square, leaving a margin around the sides.—U. S.

4 grains of oleoresin of capsicum will suffice to cover 4 inches square of adhesive plaster.

Uses.—Capsicum plaster is stimulant and rubefacient, and has been used in the treatment of neuralgia, muscular rheumatism, and colic.

EMPLASTRUM CERUSSÆ, *P. G.*—White Lead Plaster.

Emplastrum plumbi carbonatis, Emplastrum album coctum. Plaster of lead carbonate, E.; *Emplâtre de céruse, Emplâtre blanc cuit,* Fr.; *Bleiweisspflaster,* G.

Preparation.—Lead carbonate, in very fine powder, 7 parts; olive oil, 2 parts; lead plaster, 12 parts. Rub the lead carbonate into a smooth mixture with the olive oil, and add to the lead plaster previously melted. Boil the mixture over a direct fire, with constant stirring and occasional addition of hot water, until a perfect plaster-mass results. —P. G.

The plaster if carefully made should be free from dark color. A similar preparation, containing some wax and powdered orris root, is known as *Mahy's plaster.*

Uses.—White lead plaster may be employed as a soothing application to superficial burns and other localized inflammatory conditions.

EMPLASTRUM FUSCUM CAMPHORATUM, *P. G.*—Camphorated Brown Plaster.

Emplastrum matris camphoratum. Camphorated mother plaster, E.; *Mutterpflaster,* G.

Preparation.—Take of red oxide of lead, 300 Gm.; olive oil, 600 Gm.; yellow wax, 150 Gm.; camphor, 10 Gm. Triturate the red oxide of lead with a portion of the oil in a capacious copper kettle until a smooth paste results. Then add the remainder of the oil, excepting a small quantity required for trituration with the camphor, and boil the whole over a naked fire, with constant stirring, until gas bubbles rise, or until the red color of the mixture begins to turn brown. Then moderate the heat, but continue the stirring until the mixture has acquired a dark-brown color, and from time to time allow some drops of it to fall into cold water to test its consistence. When this is satisfactory, remove the vessel from the fire, add the wax in small pieces, and finally the camphor, previously rubbed to a smooth paste with a little olive oil. Mix thoroughly, allow the mixture to become somewhat cool, and while it is still warm, pour the plaster into paper-moulds previously coated with mucilage containing about 5 per cent. of glycerin, and dried.

The formula and directions of the German Pharmacopœia and National Formulary are practically identical.

Uses.—Camphorated brown plaster has been employed in the treatment of mastitis. It may also be used for the same purposes as lead plaster, but is probably somewhat more stimulating.

EMPLASTRUM HYDRARGYRI, *U. S., Br., P. G.*—Mercurial Plaster.

Emplastrum mercuriale.—Emplâtre mercuriel, Fr.; *Quecksilberpflaster,* G.; *Empiastro mercurial,* It.

Preparation.—Mercury, 30 Gm.; oleate of mercury, 1 Gm.; hydrous wool-fat, 10 Gm.; lead plaster, 59 Gm.; to make 100 Gm. Triturate the mercury with the oleate of mercury in a tared capsule until the former is thoroughly divided, then add the hydrous wool-fat, and continue the trituration until globules of mercury are no longer visible. Add the mixture to the lead plaster, which has previously been melted in a tared dish with the aid of a water-bath, and incorporate thoroughly, adding, if necessary, sufficient lead plaster to make the product weigh 100 Gm.—U. S.

The extinguishment of mercury by means of mercuric oleate presents no difficulty, and a smooth, uniform plaster can be readily obtained.

To make 4 avoirdupois ounces of mercurial plaster, triturate 525 grains of mercury with 18 grains of mercuric oleate, and after the globules have all been extinguished, incorporate with 175 grains of hydrous wool-fat and 1032 grains of lead plaster previously melted.

The Br. P. directs that 3 ounces of mercury be extinguished by trituration with a previously blended mixture of 8 grains of sulphur and 56 grains of olive oil. When

globules are no longer visible, 6 ounces of lead plaster, previously liquefied, are added, and the whole thoroughly mixed.

The P. G. directs that 6 parts of mercury shall be triturated with 3 parts of anhydrous wool-fat until uniformly mixed, and then added to 18 parts of lead plaster and 3 parts of yellow wax previously melted together.

The French Codex gives a formula for *Emplastrum de Vigo cum mercurio*, which is occasionally used here. It is made by fusing together: lead plaster, 200 parts; yellow wax and resin, each, 10 parts; add thereto the following powders: olibanum, ammoniac, bdellium, and myrrh, of each, 3 parts; and saffron, 2 parts; also 60 parts of mercury extinguished by 10 parts of turpentine; and finally 30 parts of liquid storax and 1 part of oil of lavender.

Uses.—The use of mercury plaster is fully discussed under HYDRARGYRUM (which see).

EMPLASTRUM LITHARGYRI COMPOSITUM, *P. G.*—Compound Lead Plaster.

Emplastrum galbani compositum. Emplastrum diachylum gummatum, Fr. Cod.; *Compound galbanum plaster, Compound diachylon plaster*, E.; *Emplâtre diachylon gommé*, Fr.; *Gummipflaster, Mutterharzpflaster, Zugpflaster*, G.

Preparation.—Melt together on a water-bath 24 parts of lead plaster and 3 parts of yellow wax; to the partly cooled mass add a mixture of 2 parts each of ammoniac, galbanum, and turpentine, previously melted, with addition of a little water, and strained.—P. G.

It must be borne in mind that the turpentine of the P. G. is not identical with the solid oleoresin known as white turpentine in this country, but is a thick, somewhat viscid fluid containing 70–85 per cent. of resin and 30–15 per cent. of oil of turpentine.

The admixture of gum-resins with lead plaster presents some difficulties; by heating them with about one-third of their weight of water at a moderate temperature, they soften and can then readily be mixed with the turpentine; the mixture, after straining to remove foreign matter, permits of uniform incorporation with the melted wax and lead plaster. The finished product is of tenacious consistence and yellowish color, becoming gradually harder and darker. It is best preserved in small rolls wrapped in paraffined paper.

Uses.—Compound galbanum plaster may be employed as a stimulant application to enlarged glands resulting from scrofulosis. It is said to be efficient also in removing the induration frequently seen around long-standing sinuses.

EMPLASTRUM MENTHOL, *Br.*—Menthol Plaster.

Emplâtre de menthol, Fr.; *Mentholpflaster*, G.

Preparation.—Take of menthol, 1½ ounces; yellow wax, 1 ounce; resin, 7½ ounces. Melt the wax and resin together; when the mixture approaches the temperature of 71.1°–76.7° C. (160°–170° F.) stir in the menthol until dissolved.—Br.

Uses.—This plaster is employed as a counterirritant for the relief of migraine, supra-orbital and other superficial neuralgias.

EMPLASTRUM OPII, *U. S., Br.*—Opium Plaster.

Emplastrum opiatum s. cephalicum s. odontalgicum.—Emplâtre d'opium, Emplâtre céphalique (temporal, adontalgique, calmant), Fr.; *Opiumpflaster, Hauptpflaster*, G.

Preparation.—Extract of opium, 6 Gm.; water, 8 Cc.; adhesive plaster, 90 Gm. Rub the extract of opium with the water until it is uniformly soft; add it to the adhesive plaster, which has been previously melted in a tared dish on a water-bath, and continue the heat with constant stirring until the product weighs 100 Gm.—U. S.

The British Pharmacopœia directs that very finely powdered opium, 1 ounce, be gradually stirred into 9 ounces of melted rosin plaster.

Besides the change in composition of opium plaster in the present official formula (replacement of Burgundy pitch and lead plaster by adhesive plaster), the strength is slightly increased on account of the change in the morphine standard of the extract of

opium. The present opium plaster contains 1.20 per cent. of morphine, while the plaster of 1890 contained 1.08 per cent.

Uses.—The local application of opium is fully described under this drug (which see).

EMPLASTRUM PICIS, *Br.*—Pitch Plaster.

Emplastrum picatum, Fr. Cod.; *Emplastrum picis Burgundicæ*, U. S. 1890.—*Burgundy pitch plaster*, E.; *Emplâtre de poix de Bourgogne*, Fr.; *Burgunder Pechpflaster*, G.

Preparation.—Burgundy pitch, 26 ounces; frankincense, 13 ounces; resin, 4½ ounces; yellow wax, 4½ ounces; olive oil, 2 ounces; distilled water, 2 fluidounces. Add the olive oil and the water to the frankincense, Burgundy pitch, resin, and beeswax, previously melted together; evaporate with constant stirring to a proper consistence.—Br.

The French Codex directs that 1 part of yellow wax and 3 parts of Burgundy pitch be melted together.

The Burgundy pitch plaster of the U. S. P. of 1890 was very similar to the plaster of the Br. P., being composed of Burgundy pitch 80 parts, yellow wax 15 parts, and olive oil 5 parts, melted together and stirred until the mass thickens on cooling.

Uses.—This plaster is a mild counter-irritant, but is mainly applied for the support which it gives.

EMPLASTRUM PLUMBI, *U. S., Br.*—Lead Plaster.

Emplastrum lithargyri (*simplex*), P. G.; *Emplastrum simplex*, Fr. Cod.; *Emplastrum diachylon simplex.—Diachylon plaster, Litharge plaster*, E.; *Emplâtre simple, Emplâtre de plomb* (*de litharge*), Fr.; *Bleipflaster, Diachylonpflaster*, G.; *Empiastro diachilon*, It.; *Emplasto de la Vireina*, Sp.

Preparation.—Soap, dried and in coarse powder, 100 Gm.; lead acetate, 60 Gm.; water, a sufficient quantity. Dissolve the soap in 350 Cc. of hot water and strain the solution. Dissolve the lead acetate in 250 Cc. of hot water, and at once filter the solution into the warm soap solution, stirring constantly. When the precipitate has subsided decant the liquid, and wash the precipitate thoroughly with hot water. Transfer the mass to a warm slab, kneading it thoroughly to free it from water; finally, roll the plaster into cylindrical forms and wrap them in paraffin paper.—U. S.

If avoirdupois weight is more convenient, 6 ounces of lead acetate may be dissolved in 25 ounces of hot water, and this solution filtered into a previously prepared solution of 10 ounces of soap in 35 ounces of hot water.

The present official lead plaster is identical in composition with that made by the former process, and is whiter in appearance. By wrapping the plaster in paraffin paper darkening of the color is prevented or at least retarded. The yield by the official formula is theoretically 190 Gm. of lead plaster, but in practice some loss occurs, and scarcely more than 165 Gm. will be obtained.

Lead plaster of the Br. P. is made by boiling together gently lead oxide 400 Gm., olive oil 800 Gm., and distilled water 400 Cc., by the aid of a steam-bath; the mixture is kept simmering for 4 or 5 hours, stirring constantly until the product acquires a proper consistence for plaster; more water is added during the process, if necessary.

The French and German pharmacopœias use equal parts of olive oil and lard in place of olive oil alone, which is directed by the British Pharmacopœia. A much greater discrepancy, however, exists in the proportion of the fat to the other ingredients. Calculated for 100 parts of fat, there are ordered of water 100 (Fr. Cod.), 50 (Br.), and 10 (P. G.) parts; of litharge, 50 (Br., Fr. Cod., and P. G.) parts. A much smaller amount is decidedly insufficient, and yields a plaster which is and remains sticky. The litharge should not be less than half of the weight of the fat used, and in view of its variable quality may very properly be increased somewhat beyond that proportion.

The P. G. provides for the removal of all glycerin by subsequent kneading of the plaster with water; the Br. P. allows the glycerin to remain mixed with the plaster, and this accounts for the softer condition of the English article.

The chemical reactions involved in the manufacture of lead plaster from lead oxide

and olive oil are clearly the same as are noticed whenever a fat is saponified by means of alkali hydroxides or moist metallic oxides; the presence of water is essential for chemical action, although it also aids in keeping down the temperature, and thus prevents decomposition of the fat. In order to demonstrate the formation of lead plaster (lead oleate or lead soap), olive oil may be looked upon as olein or glyceryl trioleate, leaving out of consideration the presence of very small quantities of palmitin; the following equation then will show the reaction: $2C_3H_5(C_{18}H_{33}O_2)_3 + 3PbO + 3H_2O = 3Pb(C_{18}H_{33}O_2)_2 + 2C_3H_5(OH)_3$. The basylous radical C_3H_5 is trivalent, and is known as propenyl or glyceryl; being displaced from its combination with oleic acid by the lead, it readily unites with the oxygen and hydrogen present to form the alcohol glycerin or propenyltrihydroxide, $C_3H_5(OH)_3$.

Chemically, lead plaster is a mixture of lead oleate and palmitate, containing also stearate if lard has been used in its preparation.

Uses.—Lead plaster is a protective and discutient. It is sometimes used as an application to leg ulcers, and has been employed for the prevention of bedsores and other ulcers resulting from the application of surgical apparatus. If continually employed over a larger area for a long period of time, it may produce chronic lead-poisoning.

EMPLASTRUM PLUMBI IODIDI, *Br.*—Lead Iodide Plaster.

Emplâtre d'iodure de plomb, Fr.; *Jodbleipflaster*, G.

Preparation.—The directions of the British Pharmacopœia for making this plaster are to add 2 ounces of finely powdered lead iodide to a mixture of 2 ounces of resin and 16 ounces of lead plaster, previously melted at as low a temperature as possible, and to mix intimately.

The present formula was proposed by A. W. Gerrard (1874), who showed that the plaster, as formerly prepared with soap plaster, contained very little lead iodide, which was nearly all decomposed by the soap.

Uses.—This plaster is employed for promoting the resolution of chronic inflammatory exudates.

EMPLASTRUM SAPONIS, *U. S., Br.*—Soap Plaster.

Emplastrum saponatum, P. G.; *Emplastrum cum sapone*, Fr. Cod.—*Emplâtre de savon*, Fr.; *Seifenpflaster*, G.

Preparation.—Soap, dried and in coarse powder, 10 Gm.; lead plaster, 90 Gm.; water, a sufficient quantity. Rub the soap with water until brought to a semiliquid state; then mix it with the lead plaster, previously melted, and evaporate to the proper consistence.—U. S.

To make 4 avoirdupois ounces of soap plaster would require 175 grains of powdered soap and 1575 grains of lead plaster.

It is important that the soap be used in the form of powder, so as to insure a smooth mixture with water, and that subsequently the water be again expelled by evaporation, otherwise the plaster loses it adhesive properties.

Soap plaster of the British Pharmacopœia contains nearly 50 per cent. more of soap and also a small quantity of resin, the proportions being: soap, 6 ounces; resin, 1 ounce; and lead plaster, 3 ounces, which are melted and mixed.

The proportion of soap directed is 5.6 (Fr. Cod.), 5.8 (P. G.), 10 (U. S.), and 14 (Br.) per cent. The French Codex orders also 4.5 per cent. of white wax, while the German Pharmacopœia uses yellow wax 1.15 and camphor 1.15 per cent. The U. S. P. alone requires the soap to be rubbed up with water; the P. G. orders the soap to be powdered, and mixed with the camphor and one-fifth of its weight of olive oil before it is incorporated with the melted plaster and wax. Soap plaster has a whitish color, and should be nearly free from water, which renders the plaster slippery.

Uses.—Soap plaster is a discutient, and may be employed for the same purposes as Emplastrum Plumbi (which see).

EMULSA.—Emulsions.

Emulsiones, P. G.; *Émulsions*, Fr.; *Emulsionen*, G.; *Emulsiones*, It., Sp.; *Horchatas*, Sp.

The term "emulsion" is used to designate mixtures of liquids insoluble in one another, where one is suspended in the other in the form of minute globules, as fat in milk, and also mixtures in which solid particles of substances are suspended in liquids in which they are insoluble, as in the case of camphor or resin emulsions. Formerly emulsions were included under the general head of mixtures, "Misturæ," but a distinction is now very properly made, so as to restrict the term emulsion to such mixtures mentioned above as have a milk-like appearance, and in which the suspension of the insoluble liquid or solid is more or less permanent. Nature provides types of emulsions in the form of milk, the natural food of all young mammalia, and the milk-like juices of certain plants from which the official and other gum-resins are obtained. Fixed and volatile oils, as well as ethereal liquids and resinous substances, are suitable for exhibition in the form of emulsion, and the suspension in water is accomplished by the use of appropriate excipients, such as acacia, tragacanth, yolk of egg, etc.; many oil-yielding seeds, as well as the natural gum-resins, contain gummy and albuminous matter by means of which the oil and resin can be brought into perfect suspension in water. The theory of emulsification is as follows: The insoluble liquid or solid in a state of minute division is completely surrounded or enveloped by the vehicle consisting of water and excipient, and thus an opaque mixture is produced from which the particles cannot separate by mere force of cohesion; the stability of the emulsion depends to some extent upon the density of the vehicle, and it will be found that the presence of sugar increases the suspending power of gum, while the addition of alcohol or glycerin in the proportion of 1 or 2 fluidounces in a pint, will prevent fermentative changes likely to arise in vegetable solutions if kept on hand for some time.

With the exception of those composed of volatile oils or ethereal liquids, emulsions should always be made in a mortar, either of unglazed Wedgewood or hard porcelain, having a flat bottom, and, in the case of seed or gum-resin emulsions, one of deep shape provided with a hard-wood pestle is to be preferred, in order to avoid injury from the force often necessary in crushing and manipulating the material. For making gum-resin emulsions, the cleanest and best tears should be selected, as the commercial fine powders are unfit for this purpose, partly because they are inferior in quality, and partly because they have been so modified by drying that when triturated with water they form simply an ordinary mixture from which the powder separates rapidly on standing; this change is due to dehydration, whereby the natural association of gum and resin has been broken up and their intimate union destroyed. For seed emulsions, when no other proportions are specified, 1 part of seed is used to 10 parts of water, all dirt and dust being carefully removed, if necessary, by washing with cold water. In both cases the material is crushed into a coarse powder, and, after the addition of a small quantity of water, beaten into a perfectly smooth pasty mass; to this, the remainder of the water is then added in divided portions, triturating the mass thoroughly and keeping it well scraped from the pestle and sides of the mortar, so that a uniform mixture may result, which is finally passed through a previously wetted strainer of flannel or cheesecloth, to remove the inert woody fiber and possible impurities. In making emulsion of lycopodium, it becomes necessary to triturate the seed *dry, with some pressure*, in order to rupture the hard seed-envelope; when the powder changes in color and becomes damp and adhesive from the oil, a little water is added, with which a smooth soft paste can be formed, to be further diluted by the addition of water as directed above. Emulsion of lycopodium *should never be strained*, and, if properly made, will show no particles floating on the surface; the insoluble matter which settles upon standing is readily reincorporated by agitation.

Oil emulsions, which are far more frequently used than those made from seed or gum-resins, require more care in their preparation, as success depends not only on the manipulation, but also on the judicious choice of an excipient. As a general rule, it may be stated that acacia produces the whitest and most stable emulsions, because its perfect and ready solubility in water enables the operator to divide the oil quickly into minute globules, which are at once surrounded by an envelope of the mucilaginous liquid and thus kept from coalescing. The oil-globules of a well-made acacia emulsion, when compared with milk under a magnifying lens, more closely resemble its fat-globules than would be the case if made with other excipients. To insure success, it is essential that definite

proportions of oil, gum, and water be used for making the primary emulsion, which can then be diluted with water as desired. *Not less than one-fourth nor more than one-half* as much acacia as oil should be used, and *not less than one and a half times nor more than twice as much* water as acacia. The mixing of oil, gum, and water should not be effected by the usual method of trituration, which involves pressure of the pestle against the material on the bottom and sides of the mortar, and consequent development of heat, but should be brought about by a rapid light rotary movement of the wrist, communicated to the pestle held loosely in the hand; this motion partakes more of that of an egg-whip, and the oil is thus rapidly broken up into minute globules in the presence of a viscid solution.

As stated before, emulsions of fats and fixed oils are best made in a flat-bottomed mortar, three distinct methods being in use to effect the desired object, namely, a milk-like liquid, miscible with water without separation of oil-globules. By many the method usually recommended in Great Britain is preferred; this consists in making a smooth thick mucilage of granulated acacia and water, and then adding the oil by degrees, stirring assiduously until each portion of oil is emulsified—lastly adding the water for dilution, in divided portions. The two others are sometimes called the "Continental" methods, from the fact that they are used almost exclusively in Continental Europe. They do not direct the previous solution of the gum in water, and adhere strictly to definite proportions. While the so-called "English" method yields satisfactory results in the hands of those accustomed to it, for the inexperienced either of the following methods is much to be preferred:

Place in a mortar one-fourth as much *finely powdered* acacia as the oil to be used (7.5 Gm. of acacia for 30 Cc. of oil, or ʒij for fʒj), then add the oil and triturate well together into a smooth mixture. Now add *all at once*, not gradually, twice as much water as the acacia which has been used (15 Cc. of water for 7.5 Gm. of acacia, or fʒiv for ʒij), and stir rapidly until a perfect emulsion has been formed, which is known by the appearance of a white pasty mass, free from oil particles, and a peculiar crackling noise as the pestle is drawn through the adhesive mixture. This primary emulsion should be well scraped with a spatula from the pestle and sides of the mortar, again stirred, and then the remainder of the water slowly added with constant stirring. Granulated acacia cannot be used in this method, as with so small a quantity of gum it is necessary that it dissolve almost immediately, which will not occur with the granulated variety.

The second of the so-called "Continental" methods directs increased proportions of acacia and water, by which means an equally perfect, and at the same time denser, primary emulsion is obtained. One-half as much granulated acacia as oil is used, and one and a half times as much water as gum, or one-half as much water as oil and gum together; thus, oil 30 Cc. or fʒj, granulated acacia 15 Gm. or ʒiv, and water 22.5 Cc. or fʒvj. Place the acacia in a dry mortar, add the oil and water, and stir briskly until a perfect emulsion results, which dilute with the remaining water, as in the preceding method.

If from any cause the primary emulsion should fail, it will prove a loss of time and labor to endeavor to save it by the addition of gum or water, provided the right proportions were used in the first place; the best plan is to begin over again and observe care in details. Assiduous stirring or shaking is of no avail in trying to save a "cracked" emulsion, which has a pearly appearance in the mortar, and the further addition of gum, while increasing the density of the mixture, does not always remedy the trouble.

The above methods are equally well adapted for liquid oleoresins, such as copaiba, oleoresin of cubeb, etc. If solid fats, camphor, some oleoresins and resinous extracts, as, for instance, extract of Indian cannabis, are to be administered in aqueous liquids, it will be found advantageous to dissolve them in a small quantity of fixed oil (oil of sweet almond or olive oil), and then to emulsify them in the manner directed for these oils. Salol, menthol, thymol, phosphorus, and other substances can likewise conveniently be emulsified after solution in some fixed oil. The emulsification of Peru balsam will materially be facilitated by the addition of a little alcohol or oil of sweet almond, about 10 per cent. of the volume of balsam being sufficient. Whenever double emulsions are ordered, as, for instance, a seed emulsion with that of a fixed oil, better results will be obtained if separate emulsions be made and then mixed; when castor oil is to be mixed with emulsion of almond as a vehicle, the oil should be emulsionized with the requisite quantity of acacia and water, and this primary emulsion then diluted with the almond emulsion, out of which the water necessary for the previous emulsification of the oil has been retained.

Whenever an oil emulsion is made, the rule should be observed never to measure the water in an oily graduate, as otherwise oil particles might subsequently be carried into the mixture, and, failing to be emulsified, eventually rise to the surface. The view held by some authorities, that a good emulsion is capable of emulsifying additional quantities of oil, requires modification, as pointed out by Mr. Gerrard, of England; for, although a perfect fixed-oil emulsion admits of the incorporation of more oil, this latter oil will not undergo emulsification, but simply be mixed intimately, as can be proved by the addition of water, when the newly added oil will separate. A perfect artificial emulsion should have a milk-like appearance and consistence, be miscible with water without separation, should flow readily from the mortar without leaving adhering particles, so that it can be washed with plain water, and, if separation takes place after standing at rest for some time, a cream-like layer should rise to the surface, which can be quickly reincorporated by agitation. Heat is detrimental to the permanence of emulsions and causes separation, so also large quantities of alcohol or saline matter. Substances which have a tendency to absorb water, such as magnesia, should not be mixed with the emulsion, unless previously completely hydrated. All salts should be added in the form of solution, and, together with tinctures and other alcoholic liquids, not until the primary emulsion has been properly diluted.

Emulsions of ether, chloroform, oil of turpentine, and other volatile liquids are best prepared by agitation in a bottle after the manner first suggested by Forbes. The liquid to be emulsionized is poured into a *perfectly dry* bottle and the powdered acacia added, after which the bottle is well shaken so that the acacia may become saturated with the volatile liquid; water is then added and agitation continued until a homogeneous emulsion results, which may further be diluted by the gradual addition of water. Volatile oils and ethereal liquids never form as perfect an emulsion as fixed oils, and separation of the mixture takes place more speedily; if care has been observed, however, in making the mixture, only a dense, creamy layer will rise to the surface, which can be reincorporated by agitation. As a rule, volatile oils and ethers require more gum than fixed oils, and less than 30 grains of powdered acacia should not be used for each fluidrachm; the amount of water first added should always be equal to twice that of the acacia used. Oil of turpentine unites very readily with water and gum, and it is surprising to see how small a quantity of gum will suffice to form a perfect emulsion from which no oil will separate in an uncombined form, only a dense, creamy layer rising, composed of the oil of turpentine, gum, and some water in intimate union; 20 grains of powdered acacia shaken in a bottle with 1 fluidounce of oil of turpentine, and 4 fluidrachms of water then added, will yield a very satisfactory emulsion, which can be kept for days without separating an oily layer. All emulsions of volatile oils are more permanent if made with the aid of some fixed oil previously added to the volatile oil; such emulsions are preferably made in a mortar.

When powdered tragacanth is preferred as an emulsifying agent, it may be used in the proportion of one-tenth or one-eighth of the necessary weight of acacia, and requires from 10 to 20 times its weight of water; it should be thoroughly mixed with the oil in the mortar or bottle, as the case may be, and after the addition of water the mixture should be stirred rapidly or shaken until the primary emulsion has been formed. The division of oil-globules by means of mucilage of tragacanth is much coarser than with acacia, hence tragacanth emulsions are never so white nor seemingly so perfect; but owing to the viscosity and magma-like condition of mucilage of tragacanth the oil-globules, although not finely divided, are kept from reuniting, and thus separation of an oily layer is prevented. Mixtures of tragacanth and acacia are often employed, particularly in the emulsification of cod-liver oil, to obtain greater protection against separation.

Yolk of egg has long been known as a valuable excipient in emulsions, particularly when acids or large proportions of alcoholic liquids are to be added. The yolk from one egg of average size will suffice for 1 fluidounce of a fixed oil or for ½ fluidounce of a volatile oil; in place of the simple yoke, the official glycerite of yolk of egg, also known as glyconin, of which 2½ fluidrachms are necessary for 1 ounce of fixed oil, has been used with decided advantage. In either case the oil should be added in small quantities to the yolk of egg or glyconin, previously rubbed smooth in a mortar, each portion being thoroughly incorporated before another addition is made; if the mixture should become inconveniently thick, a small quantity of water may be introduced, and after all the oil

has been emulsified the prescribed amount of water is added, likewise in divided portions, with constant stirring. The readiness with which yolk of egg unites with fixed oils is due to the fact that it is itself a natural emulsion of an oil and albuminous matter. Some little care is necessary in removing the yolk of egg from the shell, to avoid contamination with the white or albumin, which has a tendency to form clots in the emulsions.

Of other emulsifying agents introduced during the last twenty years, none has been more extensively used, particularly on a large scale by manufacturers, than mucilage of Irish moss. Toward fixed oils the mucilaginous matter of Irish moss behaves somewhat like tragacanth, particularly if the solution of the former be made somewhat thick.

Cod-liver oil emulsions are made more frequently than any other, and in order to disguise the taste use is made of various flavoring agents. The National Formulary suggests the following selection, the quantities named being sufficient for 1000 Cc. (about 33½ fluidounces) of finished emulsion:

Oil of gaultheria, 4 Cc.

Oil of gaultheria, 2 Cc., and oil of sassafras, 2 Cc.

Compound spirit of orange, 1.5 Cc.

Oil of gaultheria, 2 Cc.; oil of bitter almond, 0.25 Cc.; oil of coriander, 0.25 Cc.

Oil of gaultheria, 1.5 Cc.; oil of sassafras, 1.5 Cc.; oil of bitter almond, 0.25 Cc.

Oil of gaultheria, 2.5 Cc.; oil of bitter almond, 2.5 Cc.

Oil of neroli, 1.5 Cc.; oil of bitter almond, 1.5 Cc.; oil of cloves, 0.25 Cc.

EMULSUM AMYGDALÆ, *U. S.*—Emulsion of Almond.

Mistura amygdalæ, Br.; *Emulsio amygdalæ s. amygdalarum, Emulsio simplex.—Milk of almonds, Almond mixture*, E.; *Emulsion simple, Lait d'amandes*, Fr.; *Mandelemulsion, Mandelmilch*, G.

Preparation.—Sweet almond, 60 Gm.; acacia, in fine powder, 10 Gm.; sugar, 30 Gm.; water, a sufficient quantity to make 1000 Cc. Having blanched the almond, add the acacia and sugar, and beat them in a mortar until they are thoroughly mixed. Then rub the mass with 900 Cc. of water, at first very gradually added, until a uniform mixture results. Strain this into a graduated vessel, and wash the mortar and strainer with sufficient water to make the product measure 1000 Cc. Mix the whole thoroughly.—U. S.

To make 1 pint of emulsion of almond will require 460 grains of sweet almonds, 77 grains of acacia, and 230 grains of sugar.

Take of compound powder of almonds, 2½ ounces; distilled water, 20 fluidounces. Rub the powder with a little of the water into a thin paste, then add the remainder of the water, and strain through muslin.—Br.

Uses.—Almond emulsion possesses little medicinal properties other than that of a demulcent. It has been recommended in the treatment of laryngeal, bronchial, intestinal, and urethral irritations, but to be of service should be given in large quantities. The preparation is sometimes employed as a vehicle for more potent or disagreeable remedies. As a nutrient demulcent it should be given in doses of from 4 to 8 fluidounces (120–240 Cc.), several times daily.

Allied Preparation.—Looch Album. *White linctus*, E.; *Potion émulsive gommée, Looch blanc*, Fr.—30 parts of sweet and 2 parts of bitter almonds are blanched, triturated with 20 parts of sugar and 120 parts of water, and the emulsion strained and gradually added, with continued trituration, to a mixture of 10 parts of sugar and ½ part of powdered tragacanth. Finally, add 10 parts of orange-flower water. The finished preparation weighs 150 parts.—Fr. Cod.

EMULSUM ASAFŒTIDÆ, *U. S.*—Emulsion of Asafetida.

Mistura asafœtidæ, Lac asafœtidæ.—Asafetida mixture, Milk of asafetida, E.; *Mixture (Lait) d'asafœtida*, Fr.; *Asafœtidaemulsion, Stinkasantmilch*, G.

Preparation.—Asafetida, in selected tears, 40 Gm.; water, a sufficient quantity to make 1000 Cc. Rub the asafetida, in a mortar, with 900 Cc. of water, at first very

gradually added, until a uniform emulsion results. Then strain the mixture into a graduated vessel, and wash the mortar and strainer with sufficient water to make the product measure 1000 Cc. Mix the whole thoroughly.—U. S.

The formula corresponds to 18.24 grains of asafetida for each fluidounce of water.

A *syrup of asafetida*, of the same strength as the emulsion, may be prepared by triturating 150 grains of selected tears with small quantities of water, decanting the concentrated emulsion until 4 fluidounces are obtained, in which 6 troyounces of sugar are dissolved by agitation. While at first milk-white, it acquires after exposure a pinkish color; the resin, which partially separates on standing, is easily incorporated by agitation. If desired, the asafetida odor may be covered by the addition of a little oil of bitter almond.

Uses.—The uses of this preparation are enumerated under ASAFŒTIDA (which see). The emulsion is quite commonly employed as an enema in the treatment of tympanites. It has also been given by the mouth in the treatment of hysteria. The dose is from 2 to 8 fluidrachms (8–30 Cc.).

EMULSUM CHLOROFORMI, *U. S.*—Emulsion of Chloroform.

Mistura chloroformi, Emulsio chloroformi.—Emulsion de chloroforme, Fr ; *Chloroformemulsion*, G.

Preparation.—Chloroform, 40 Cc.; expressed oil of almond, 60 Cc.; tragacanth, in very fine powder, 10 Gm.; water, a sufficient quantity to make 1000 Cc. Introduce the tragacanth into a perfectly dry bottle of sufficient capacity, add the chloroform, and shake the bottle thoroughly, so that every part of the surface may become wetted. Then add about 250 Cc. of water, and incorporate it by a vigorous shaking. Next add the expressed oil of almond in several portions, shaking after each addition, and when the oil has been thoroughly emulsified, add sufficient water, in divided portions, shaking after each addition, until the product measures 1000 Cc.—U. S.

Since the Pharmacopœia directs 4 and 6 per cent. by volume of chloroform and oil of sweet almond, respectively, $\frac{1}{2}$ pint of the emulsion may be conveniently prepared by shaking 154 minims of chloroform with 38 grains of tragacanth, adding 2 ounces of water, then 230 minims of expressed oil of almond, and finally sufficient water to bring the volume of the finished product up to 8 fluidounces.

Uses.—Emulsion of chloroform forms a convenient and permanent preparation for the internal administration of chloroform. It may be given for the treatment of flatulent colic, gastralgia, hysteria, and other nervous conditions. The dose is from 4 to 8 fluidrachms (16–30 Cc.), as needed.

EMULSUM OLEI MORRHUÆ, *U. S.*—Emulsion of Cod-liver Oil.

Emulsion de huile de foie de morue, Fr.; *Leberthranemulsion*, G.

Preparation.—Cod-liver oil, 500 Cc.; acacia, in fine powder, 125 Gm.; syrup, 100 Cc.; oil of gaultheria, 4 Cc.; water, a sufficient quantity to make 1000 Cc. Rub the acacia with the cod-liver oil in a dry mortar until uniformly mixed, then add at once 250 Cc. of water and triturate lightly and rapidly until a thick homogeneous emulsion is produced; to this add the oil of gaultheria and the syrup, with enough water to make the product measure 1000 Cc., and mix thoroughly.

Note.—The oil of gaultheria may be replaced, if desired, by oil of bitter almond or other suitable flavoring.—U. S.

There seems to be no necessity for this formula in the Pharmacopœia, as physicians are apt to vary the proportion of cod-liver oil to be given at one dose, and any one entrusted with the compounding of medicines should be expected to be able to make a perfect emulsion without official directions. The emulsion directed above contains 50 per cent. by volume of cod-liver oil, and if properly made is a thick homogeneous liquid, almost white, and having the peculiar odor and taste of the particular flavoring agent employed. To many persons the flavor of oil of wintergreen is unpleasant, and oil of bitter almond is less objectionable; of the latter oil 2.5 or 3 Cc. will be found sufficient for 1000 Cc. of emulsion. If the emulsion is to be kept on hand for some

time, the addition of 50 or 60 Cc. of alcohol in place of a like quantity of water becomes necessary.

Uses.—For the action and uses of this preparation, see OLEUM MORRHUÆ. The dose of the emulsion is from 1 to 4 drachms (4–16 Cc.).

EMULSUM OLEI MORRHUÆ CUM HYPOPHOSPHITIBUS, *U. S.*—Emulsion of Cod-liver Oil with Hypophosphites.

Emulsion de huile de foie de morue avec les hypophosphites de chaux, de soude et de potasse, Fr.; *Leberthranemulsion mit unterphosphorigsauren Salzen*, G.

Preparation.—Cod-liver oil, 500 Cc.; acacia, in fine powder, 125 Gm.; calcium hypophosphite, 10 Gm.; potassium hypophosphite, 5 Gm.; sodium hypophosphite, 5 Gm.; syrup, 100 Cc.; oil of gaultheria, 4 Cc.; water, a sufficient quantity to make 1000 Cc. Rub the acacia with the cod-liver oil in a dry mortar until uniformly mixed, then add at once 250 Cc. of water and triturate lightly and rapidly until a thick, homogeneous emulsion is produced; add the oil of gaultheria and incorporate thoroughly; dissolve the hypophosphites in 100 Cc. of water, mix the solution with the syrup, and add the liquid gradually to the emulsion with continued trituration. Lastly, add enough water to make the product measure 1000 Cc., and mix thoroughly.

Note.—The oil of gaultheria may be replaced, if desired, by oil of bitter almond or other suitable flavoring.—U. S.

As in the case of the preceding emulsion, there seems to be no occasion for this formula in the Pharmacopœia, except to insure uniformity in the proportion of the hypophosphites to be present, which amounts to about 10 grains of the combined salts in each fluidounce. In physical properties this emulsion is identical with the plain emulsion of cod-liver oil, and, like the latter, it is apt to spoil if kept on hand for some time, unless preserved by means of alcohol.

Uses.—This emulsion combines the medicinal virtues of cod-liver oil with the tonic properties of the hypophosphites. It may be used with benefit in secondary anæmia, scrofulosis, beginning pulmonary tuberculosis, and other debilitated conditions. The dose is from 1 to 4 drachms (4–16 Cc.). (See OLEUM MORRHUÆ; CALCII HYPOPHOSPHIS.)

EMULSUM OLEI TEREBINTHINÆ, *U. S.*—Emulsion of Oil of Turpentine.

Emulsion d'essence de térébenthine, Fr.; *Terpentinölemulsion*, G.

Preparation.—Rectified oil of turpentine, 15 Cc.; expressed oil of almond, 5 Cc.; syrup, 25 Cc.; acacia, in fine powder, 15 Gm.; water, a sufficient quantity to make 100 Cc. Introduce the acacia into a perfectly dry bottle of sufficient capacity, add the rectified oil of turpentine and the expressed oil of almond and shake the bottle thoroughly, so that every part of the surface may become wetted. Then add about 25 Cc. of water and incorporate it by vigorous shaking. When the oil has been thoroughly emulsified, add first the syrup, in several portions, shaking after each addition, and then enough water, in divided portions, shaking after each addition, to make the product measure 100 Cc.—U. S.

Emulsion of oil of turpentine oil made by the above formula is a perfectly white liquid which flows readily from a bottle and keeps quite well. The addition of expressed oil of almond insures greater stability, and separation is less likely to occur than if it were omitted. Only the rectified oil of turpentine should be used, as the mixture is intended for internal use. It is questionable whether physicians will use the official emulsion, which contains about 72 minims (4.45 Cc.) of oil of turpentine in each fluidounce, or prefer to vary the proportion to suit individual cases.

Uses.—This emulsion may be employed whenever oil of turpentine is to be given internally. The dose is from 1 to 4 drachms (4–16 Cc.). (See OLEUM TEREBINTHINÆ.)

ENEMATA.

The term "enema" is applied to fluid injected into the rectum, for the purpose of emptying the bowel of gas or feces, or administering drugs which are designed to exercise a local or systemic influence. It is also a means for the giving of nourishment when food cannot be taken by the stomach. An enema is sometimes called a clyster or lavement. An enema for emptying of the bowel is, in many cases, composed of soap and water, or of soapy water with a small amount of turpentine. When a more active enema is desired, the enema asafœtidæ may be used, particularly if tympanites is present; while in cases in which this fails the enema terebinthinæ may be employed. These enemata are prepared as follows: Take of asafetida, 30 grains (2 Gm.); distilled water, 4 fluidounces (120 Cc.). Rub the asafetida in a mortar, and add the water gradually, so as to form an emulsion. This is identical with a mixture of equal parts of water and milk of asafetida. Often pure milk of asafetida may be employed instead of this formula. The ordinary formula for the turpentine enema is: Oil of turpentine, 1 fluidounce (30 Cc.); mucilage of starch, 15 fluidounces (450 Cc.); but the quantity of the turpentine must vary with the irritability of the patient's rectum and the needs of the case. Great care should be exercised that the turpentine is well mixed with the starch, and it is advantageous often to add a little soap and water.

When an active purgative enema is desired, an ounce of magnesium sulphate may be added to 1 pint of warm water; and if it is desirable to increase the activity of this mixture half an ounce of glycerin may be added to it.

When pain is to be relieved, from 30 minims to 2 fluidrachms (2–8 Cc.) of deodorized tincture of opium may be placed in 4 ounces (120 Gm.) of starch water and injected into the bowel. If very speedy relief of the pain is necessary, ½ grain (0.03 Gm.) of morphine may be used instead of the opium, as it is more rapidly absorbed.

When nutrient enemata are required, the following formulæ may be used, but it is always to be recalled that very little sustenance is absorbed from the rectum even under the most favorable circumstances. Before the injection is given the bowel should be gently washed out with soap and water if any fecal matter is present.

Place in an empty bottle 12 ounces of milk, and add to it an egg which has been beaten till its yolk and white are thoroughly mixed. Shake the bottle to diffuse the egg with the milk, and add the contents of a peptonizing tube, such as is found in the market, or a peptonizing tablet of about 5 grains of pancreatin with 10 grains of sodium bicarbonate. Immerse the bottle in a bowl of water at the temperature of 38.3° C. (101° F.), in order that the peptonizing process may be active. After half an hour the liquid is sufficiently peptonized for use. Not more than 4 ounces should be injected at a time; the remainder should be placed in an ice-box until it is needed. Before this chilled mixture is employed, it should be heated to the temperature of the body, but the degree of heat should not be high enough to destroy the peptonizing ferment. In other instances 3 or 4 ounces of lean meat and 2 or 3 tablespoonfuls of warm water may be rubbed up together, pancreatic extract with sodium bicarbonate added, and this injection may be given at once. Still another nutrient enema consists of from 3 to 5 eggs beaten up with 4 ounces of a 20 per cent. solution of grape-sugar. Here again the peptonizing agent must be added in order that the eggs may be digested, and thereby made ready for absorption by the intestinal wall.

ERGOTA, *U. S., Br.*—Ergot.

Secale cornutum, P. G.; *Secale clavatum, Mater secalis, Clavus secalinus.—Spurred rye, Rye smut, Cockspur rye, Mother of rye*, E.; *Ergot de seigle, Seigle ergoté (noir), Blé cornu*, Fr.; *Mutterkorn, Rogenmutter, Kornmutter, Zapfenkorn, Hungerkorn*, G.; *Spermoedia*, Nor.; *Segata cornuta, Grano speronato*, It.; *Cuernecillo (Tizon) de centeno*, Sp.; *Cravagem (or Esperao) de Centeio*, Port.

The sclerotium of *Claviceps purpurea* (Fries) Tulasne (*Cordiceps p.* Fries; *Sphacelia segetum* Leveille.—Class *Fungi*, Fam. *Hippocreaceæ*), replacing the grain of rye (*Secale cereale* L.—Fam. *Gramineæ*). Ergot should be moderately dried and not

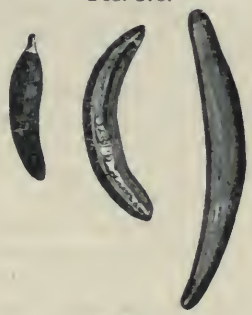
exposed to a damp atmosphere. After being kept for more than one year it is unfit for use. This plant has received various other names from botanists, through mistaken identity, due to its growth upon different grasses, and more especially because of its totally different appearance in different stages of development. Ergot is official in all pharmacopœias.

Origin.—In the first, or *mycelial*, stage of ergot, its filamentous cells (*hyphæ*) ramify through the young grain, their mass constituting the *mycelium*. Innumerable reproductive bodies, called *conidia*, are now formed, and a honey-like liquid (*honey-dew*) is abundantly produced upon the surface of the grain. Though of disagreeable odor, this is sought by certain insects, the conidia being thus distributed and propagation secured. The second, or *sclerotial*, stage is developed by the formation of the *mycelium* into a hard and relatively dry mass, containing a large amount of stored reserve food, and covered by a protecting layer, the whole well calculated to resist decay and the destruction of the vitality of the plant. This is the *sclerotium*, which constitutes the drug. In the third, or *thallus*, stage, this body develops upon its surface small wart-like excrescences containing the apertures of bottle-shaped cavities or conceptacles, the *perithecia:* each one of these conceptacles contains a large number of somewhat fusiform cells or spore-sacs, the *asci*, and each of these contains 8 filiform spores, which are discharged from the aperture of the conceptacle agglutinated in a bundle. The formation of the spores takes place about the time of the flowering of the rye, and when brought in contact with its flowers the spores again develop the mycelium. The spore-producing heads are nourished from the contents of tissues of the sclerotium, which at first becomes loose and spongy from the disappearance of the oil, and finally shrivels and is destroyed.

Fig. 172.

Ergotized rye.

Fig. 173.



Ergot.

Fig. 174.

Ergot: fruiting stage.

Fig. 175.

Longitudinal section of fruiting head, showing conceptacles.

The drying of ergot has to be carefully performed. Its quality is injuriously affected by too great a desiccation, wherefore the official requirement that it be "only moderately dried," whereas incomplete drying subjects it to danger of mouldiness. Its oil is subject to rancidity, and insects are very liable to destroy it. The Pharmacopœia therefore directs that it be preserved in a close vessel and a few drops of chloroform added from time to time, and that it be not used after being kept longer than a year. Various suggestions for its preservation have been made: One is that it be kept over unslaked lime; another, that it be dipped into an ethereal solution of tolu, dried, and preserved in a close vessel; still another, that a small tube filled with potassium sulphate be introduced to the container and a few drops of formaldehyde solution be poured over the potassium

sulphate from time to time. Again, it has been recommended that the oil be removed from it. The Russian Pharmacopœia has recognized an exoleated ergot, but it is very doubtful if this change can be made without detracting from its quality. The German Pharmacopœia has forbidden its being kept in the form of fine powder, as this is liable to quickly deteriorate.

Description.—From 1.5 to 3 Cm. (½ to a little more than 1 In.) long and 3 Mm. (⅛ In.) thick, oblong, tapering toward, but obtuse at both ends, triangular-cylindraceous, the sides unequally grooved; externally purple-black, nearly smooth; internally whitish, with purplish tinge or striæ, the fracture short, not sharp nor snapping; odor peculiar, disagreeable, especially upon trituration with potassium or sodium hydroxide test-solution; taste oily and disagreeable.

The microscopical detection of ergot in flour is often necessary. Genter claims that any amount likely to be injurious can be so detected. It is recognized by the highly refractive properties of the particles, due to their fat, and their greenish-yellow color, and by the deep-violet color and peculiarly notched form of the integument. After being placed upon the slide with water, a boiling heat should be applied, so as to rupture the starch-cells.

The important commercial varieties of ergot are the Spanish, Russian, and German. The first is distinguished by the large size and more blue or violet shade of the purple, the others by a more reddish-purple tint. Although the Spanish looks better and usually commands a higher price, the predominant opinion is that the Russian is more active.

Constituents.*—In the present state of the chemistry of ergot it is impossible to pronounce definitely regarding its active principle. The great diversity of opinion among scientists of recognized ability and the seeming inability of any one to adduce successive evidence of such nature as to force general recognition, are probably due to the low development of the plant itself, and to its consequent inability to produce stable, well-defined, active constituents of definite constitution.

What are at present generally regarded as the more important constituents, most of them physiologically active, are as follows:

Cornutine (Keller, *Schweiz. Wochenschr. f. Chem. u. Pharm.*, 1894).—Alkaloid, readily soluble in ether before crystallization, less so in crystalline form, readily soluble in alcohol and chloroform, insoluble in water and petroleum ether; dilute alcoholic solutions show strong bluish fluorescence; chloroform extracts the alkaloid from slightly acid or neutral aqueous solutions. It is precipitated from acid solutions by alkalies, but is dissolved by an excess of these agents; precipitated by picric acid, iodopotassium iodide, bromine water, tannic acid, potassium ferricyanide, and Mayer's reagent. Concentrated sulphuric acid, when brought in contact with a few milligrammes of the alkaloid on a porcelain surface, gives, on standing a few hours, a violet-blue color. Sulphuric acid plus the alkaloid, with the addition of a minute drop of solution of ferric chloride, gives an orange-red coloration, with a zone of bluish-green around the edge. This last reaction is stated by Keller to be very characteristic. This author rejects the theory of preceding investigators, that ergot contains a number of active principles, and claims that the specific action of this drug is due to a single alkaloid, for which he retains the name of cornutine. At the same time, he denies the purity of the substance experimented with by Kobert, to which the latter investigator assigned the name of cornutine. Keller states that it was undoubtedly due to the presence of this alkaloid (*cornutine*, Keller) in varying proportions that picrosclerotin (Dragendorff), ergotinine (Tanret), and cornutine (Kobert) owed the activity announced by their respective discoverers. Finally, Keller states that cornutine is much more stable than the statements of his predecessors give reason to suppose.

Cornutine (Kobert).—Alkaloid; insoluble in water, soluble in alcohol, ether, and chloroform; readily forms water-soluble salts with acids; physiological action convulsive in nature and distinct from that of the other constituents of the drug. While the author originally considered sphacelinic acid to be the substance exerting the desired specific action upon the uterus, he has lately modified his views to the extent of supposing that this action is contributed to somewhat by cornutine.

Sphacelotoxin (Jacobi, *Arch. Path. u. Pharm.*, vol. 39, p. 85).—A very active substance of acid nature; combines with basic, neutral, or feebly acid substances; decomposed with great ease by chemical agents and probably by age; considered to be quite

* Contributed by Dr. John M. Francis, of Detroit.

stable when combined with ergochrysin or with secaline. The resemblance of the action of sphacelotoxin, as outlined by the author, to that obtained with sphacelinic acid by Kobert, at once suggests the identity or close relationship of these bodies.

Ergochrysin (Jacobi).—Inactive yellow substance.

Secaline ($C_{19}H_{55}N_6O_{14}$, Jacobi).—Crystals; freely soluble in chloroform, sparingly in ether, alcohol, or benzol; practically insoluble in petroleum ether, water, or dilute alkalies; physiologically inactive.

Sphacelinic Acid (Kobert).—Non-nitrogenous acid of resinous nature; insoluble in water and dilute acids, soluble in alcohol, difficultly soluble in ether and chloroform; readily converted by age or chemical manipulation into resinous decomposition-products. Its most marked physiological action consists in the production of gangrene, probably due to blood-stasis through prolonged contraction of the arterioles. The uterine contractions characteristic of ergot, the author ascribes largely to this acid, and his conclusions seem to be confirmed by the experiments of Jacobi with the similar or identical substance which he denominates sphacelotoxin.

Secalintoxin (Sphacelotoxin + Secalin, $C_{18}H_{24}N_2O_2$, Jacobi).—Colorless powder, freely soluble in alcohol, acetic ether, benzol, and chloroform, less soluble in ether, insoluble in petroleum ether. Inasmuch as this body contains sphacelotoxin, it must be possessed of decided activity.

Chrysotoxin ($C_{21}H_{55}N_6O_{10}$, Jacobi).—Possibly a phenolic substance; crystallizes with difficulty; odorless and tasteless; soluble in ether, alcohol, chloroform, and benzol, insoluble in water, petroleum ether, or dilute acids; converted into ergochrysinic acid by alkalies.

Ecboline (Wenzell, 1864; *Jahresb. de Pharm.*, 1872).—Alkaloid. Wenzell demonstrated that it affected the brain and caused contraction of the muscles. Genzer (1870) found this substance to exist in ergot to the extent of 0.16 per cent.

Ergotinic Acid (Kobert, *Arch. f. exp. Path. u. Pharm.*, xviii. p. 316; *Pharm. Centbl.*, 1884).—Not to be confused with ergotinic acid (Wenzell). A nitrogenous glucosidal acid; amorphous, hygroscopic, forming mucilaginous or gummy masses; soluble in water, and in less degree in diluted alcohol; precipitated by concentrated alcohol; decomposed by stronger alkalies, also by acids, with the formation of sugar and a base. The author states that his ergotinic acid is the basis of the sclerotic acid of Dragendorff and Podwissotsky; also that it is the principal medicinal ingredient of the extract generally known as ergotin bonjean, or purified extract of ergot. The experiments of this author also demonstrated that ergotinic acid, when administered internally, exerted no therapeutic action, being in all probability decomposed by the digestive secretions. On the other hand, when injected subcutaneously, its physiological action is quite marked and undesirable, as it exerts a depressant and paralyzant action upon the spinal cord, and to a less degree upon the brain; the blood-pressure is reduced through depression of the motor centers; in sufficient doses, death follows from paralysis of the respiratory center. Kobert also states that this acid has a distinct narcotic action. More important still, the author could not demonstrate that ergotinic acid had the slightest influence upon the gravid uterus, even when injected in quantities sufficient to produce narcosis and paralysis of the spinal cord.

Ergotine (Wenzell).—Constitution assigned by Manassewitz, $C_{50}H_{52}N_2O_3$. Genzer (1870) found this alkaloid in the drug to the extent of 0.04 per cent. Ecboline and ergotine were supposed by Wenzell to exist in ergot in natural combination with ergotinic acid (this ergotinic acid is not to be confounded with the ergotinic acid of Kobert). These are both insoluble in water, soluble in alcohol. Wenzell's experiments with ergotine demonstrated pulse reduction. Some investigators are inclined to identify ecboline (Wenzell) with cornutine (Kobert), and ergotine (Wenzell) with Tanret's ergotinine. Blumberg, on the other hand, insists that ecboline and ergotine (Wenzell) are identical (*Jahresb. de Pharm.*, 1878, p. 51). It is probable that the substances experimented with were too impure to yield results of scientific value.

In addition to the above, the following are more or less active, though their precise nature is doubtful:

Ergotinine (Tanret, according to Villiere, $C_{35}H_{40}N_4O_6$).—Alkaloid; crystalline.

Ergotinine (Tanret, *Jahresb. de Pharm.*, 1875, p. 36).—Alkaloid; amorphous; soluble in alcohol, ether, and chloroform, forming fluorescent solutions; reacts with sul-

phuric acid, forming red to violet to blue color. Kobert's statement that ergotinine (Tanret) is inactive is probably extreme. Like other active principles discovered in ergot, this is probably also an impure product; its characteristic point is its close relationship to ergotine (Wenzell) and picrosclerotine (Dragendorff).

Picrosclerotine.—Alkaloid; stated by Dragendorff to be highly toxic. Its constitution and physiological action have not been thoroughly studied. It seems probable that the substance denominated as above by Dragendorff and Podwissotsky was a very crude product and related in some measure to ergotinine (Tanret) and cornutine (Kobert).

Sclerotic Acid (Dragendorff and Podwissotsky).—3.5 to 4 per cent.; soluble in water, insoluble in strong alcohol, by which it is precipitated from aqueous solutions as a gummy or mucilaginous mass. If Kobert's surmise as to ergotinic acid is correct, the presence of sclerotic acid is sufficient to condemn all aqueous extracts for hypodermic injection.

Scleromucin (Dragendorff and Podwissotsky).—2 to 3 per cent.; similar in physical properties to sclerotic acid. Dragendorff and Podwissotsky ascribed to this and the preceding substance the desirable therapeutic effects of ergot (*Arch. f. exp. Path. u. Pharm.*, 1876, vi. p. 176). Later investigators have asserted this view to be erroneous, and claimed that the two bodies investigated were very impure, and, in fact, that neither of them exerts any of the effects of ergot, but rather that they act as depressants and paralyzants of the spinal cord when injected subcutaneously (see under Cornutine).

The following substances are either inactive or their activity does not contribute materially to the uses of ergot.

Oil.—Estimated variously at from 13 to 35 per cent. Yellowish, fixed, non-drying oil; bland in taste when purified. As separated by some through the use of solvents, this oil is possessed of a slightly bitter or acrid taste. This acridity, as well as the slight physiological activity sometimes reported, is undoubtedly due to small quantities of the active bodies of the drug held in solution. Analysis of the oil gives as its constitution, olein, palmitin, with traces of glycerin-esters of butyric and acetic acids; also traces of lactic and formic acids. As this oil readily undergoes oxidation, which many observers regard as conducive to decomposition of the active bodies, its removal from the drug before storing has been advised.

Mycose (Ergot-sugar), $C_{12}H_{22}O_{11} + 2(H_2O)$.—Crystallizes in rhombic octahedra; melting-point about 100° C. (212° F.); occurs in varying quantity up to 2 per cent.

Choline.—Basic substance giving rise by decomposition to methylamine and trimethylamine; reported by several investigators.

Leucine (Amido-caproic Acid).—Obtained by extracting the drug with warm water, shaking with milk of lime, filtering, and adding alcohol to the filtrate. The filtrate is condensed, and to this is added a solution of basic lead acetate so long as a precipitate forms. After filtration and removal of lead by ammonium carbonate, the filtered solution is evaporated to a syrup. On standing, leucine separates in the form of flakes. Its melting-point is 170° C. (338° F.).

Phytosterin ($C_{26}H_{43}OH$).—Sometimes denominated cholesterin (*Zeit. analyt. Chem.*, 1887, p. 572). Crystallizes in leaflets; melting-point 133° to 145° C. (271.4°–293° F.).

Ergosterin (Tanret, *Jour. de Pharm.*, 1889, xix. p. 225).—Crystals melting at a temperature of 154° C. (309.2° F.).

Sclererythrin.—Red coloring-matter; amorphous powder; insoluble in water and petroleum ether; soluble in alkaline aqueous solutions, in alcohol and sulphuric ether; physiologically inert.

Fusco-sclerotinic Acid, Scleroidin, Sclerocrystalin, Scleroxanthin (Dragendorff and Podwissotsky, *Arch. f. exp. Path. u. Pharm.*, 1876, vi. p. 170).—Identity questionable; coloring-matters, soluble in alkaline solution; presumably inactive.

A *camphor*, claimed to have been isolated by Tanret; identity and constitution doubtful.

Valuation of Ergot.—Recent physiological tests have demonstrated the fact that the alkaloid cornutine (Keller) exhibits about the same vasoconstrictor power as an equivalent amount of the drug itself, and hence the determination of the proportion of such alkaloid present in a sample of ergot or its preparations should be a guide as to their value. Although the alkaloid is supposed to exist in the drug in the free state and is readily soluble in ether, direct treatment with this solvent cannot be employed, since ergot contains a considerable amount of fixed oil. Keller has proposed the following method: 25 Gm. of dry powdered ergot are treated in a percolator with petroleum-ether (benzin) until a few drops of the per-

colate no longer leave a residue upon evaporation. The fixed oil, having thus been removed, the powder is dried and put into a 250 Cc. flask and 125 Cc. of ether added and well shaken. After 10 minutes a mixture of 1 Gm. of calcined magnesia and 20 Cc. of water is added, and the contents of the flask frequently shaken during 30 minutes, which causes the powder to ball together. 100 Cc. of the ethereal liquid are decanted and passed through a pledget of cotton into a separator containing 25 Cc. of 0.5 per cent. hydrochloric acid, the measuring cylinder and cotton being rinsed with a little ether. After thorough agitation and separation, the acid fluid is drawn off into another separator, and the shaking out with acid repeated twice, using 15 and 10 Cc., respectively. The united acid liquids are made alkaline with ammonia water and shaken out with several portions, 50, 25, 20, and 15 Cc., of ether, which is collected in a tared Erlenmeyer flask and distilled to dryness on a water-bath. The residue is treated twice with 5 Cc. of ether, again dried, and weighed. The weight of dry residue multiplied by 5 expresses the percentage of alkaloid present, which in good ergot should not be less than 0.2 per cent.

That the above method of assay is of some value has been shown by the fact that a fluid extract of ergot possessing decided vasoconstrictor virtue lost the same almost entirely when deprived of cornutine by the above method (modified for the fluid preparation); while the removed alkaloid, dissolved in very dilute acid, exhibited the full action on the arterioles.

Pharmaceutical Preparations.—Extract of Ergot, U. S. P.; Fluidextract of Ergot, U. S. P.; Wine of Ergot, U. S. P.

Action and Uses.—Ergot is employed in medicine for two purposes—the arrest of hemorrhage and the contraction of dilated bloodvessels. Of these uses, by far the most important is the arrest of hemorrhage through contraction of muscular tissues. It is important to remember that the drug is of little value in checking hemorrhages from large bloodvessels. Indeed, there is reason to believe that under these circumstances it increases the flow of blood by raising arterial pressure all over the body. When, however, the hemorrhage is from capillary networks, then the ergot, by contracting the minute arterioles, prevents the blood from reaching the capillaries, and so the hemorrhage may be diminished. It finds its most valuable and frequent employment in medicine for the prevention and arrest of post-partum hemorrhage, since under these circumstances it causes powerful contraction of the muscular fibers of the uterus, both by stimulating the cells in the spinal cord which govern this organ, and also by stimulating the muscular fibers of the organ itself.

Ergot ought not to be employed in the first or second stage of labor, since by causing unduly powerful uterine contractions it may cause too rapid delivery of the child, with injury both to the child and to the maternal soft parts. Toward the end of the second stage, or the beginning of the third stage of labor, when the child's head has been born, ergot may be administered, since, by the time it is absorbed, it will produce uterine contraction, aid in the expulsion of the placenta, and diminish the tendency to post-partum hemorrhage. Some obstetricians give it as a routine measure at this stage of labor, but others believe that its administration to every parturient woman at this time is unnecessary, and perhaps unwise in that it may cause retention of tissue or clots which should be expelled from the uterine cavity, by causing undue contraction of the uterine cervix. It is worthy of note that the uterine contractions produced by full doses of ergot are tetanic or tonic in character, and do not permit the periods of relaxation which are so necessary in normal labor for the re-establishment of a circulation in the maternal soft parts and in the placenta.

Ergot has been used in association with the bromides in the treatment of certain forms of vertigo, with asserted success.

Sometimes chronic ergot-poisoning occurs as the result of eating rye bread which is contaminated by ergot. Such varieties of poisoning are exceedingly rare in England and America, but have been met with on the continent of Europe. The chief symptoms consist in the development of dry gangrene in the fingers or toes; or in other cases, in the production of chronic or spastic contraction of the muscles. As ergot is a drug which varies greatly in its physiological activity, it is important to employ a preparation which has been physiologically tested, since much of the ergot upon the market is practically inert (see *Valuation of Ergot*).

When it is necessary to employ ergot hypodermically, it is better to employ a preparation known as "Ergot Aseptic," which contains the physiological activities of active ergot, and is marketed in hermetically sealed aseptic tubes. When this preparation cannot

be obtained, and the case is urgent, fluidextract of ergot may be filtered and administered hypodermically; but under these circumstances the drug is apt to produce an abscess, and it is doubtful whether it is absorbed with sufficient rapidity and in adequate strength to be of material value.

The dose of the extract of ergot is from $\frac{1}{4}$ to 1 grain (0.015–0.06 Gm.); of the fluidextract, $\frac{1}{2}$ to 2 fluidrachms (2–8 Cc.); of the wine of ergot, from a tablespoonful to a wineglassful (16–60 Cc.). The dose of "Ergot Aseptic" is from 15 minims to a fluidrachm (1–4 Cc.).

Allied Drugs.—Innumerable smuts of this and related genera are known, and various of them have been noted as poisonous, but the only other that has found a place in medicine is the following:

Ustilago maydis Leveille (*Uredo m.* DC.—Fam. *Ustilaginaceæ*), *Corn-smut* or *Corn-ergot*, E.; *Ergot de mais*, Fr.; *Maisbrand*, *Beulenbrand*, G.; *Rizon de Maiz*, Sp.—It is a very well-known substance wherever Indian corn is grown, deforming the young ears into huge, misshapen, irregularly lobed or branched bluish-black masses, covered by a delicate, transparent, shining, sometimes whitish integument. Enclosed by this membrane is found a blackish-brown or brownish-black powder, consisting of innumerable spores, which are globular or oval, and when observed under the microscope have a nodular or spiny appearance, from the projections of the exosporium. Corn-smut has a peculiar, rather heavy odor and an unpleasant taste. It should be preserved in a dry place, and should be kept on hand not longer than a year. C. H. Cressler (1881) showed the presence of a volatile base, which is probably identical with *trimethylamine*, and a sugar which crystallizes in needles, is very sweet, and does not reduce Trommer's test-solution—probably *mycose*. Fixed oil, resin, and gummy matter were likewise obtained. Examined by J. H. Hahn (1881) and H. B. Parsons (1882), air-dry corn-smut yielded 9 to 10 per cent. of moisture, 2.5 to 4.2 per cent. of ether extract, and 4 to 5.5 per cent. of ash. Alcohol takes up about 10 per cent. and water about 6.6 per cent. of soluble matter, from the latter of which Parsons obtained 5.5 per cent. of an acid compound which is probably identical with sclerotic acid, and is prepared by the same process.

ERICACEÆ.—The Heath Family.

Genera about 75, species nearly 1500, inclusive of the *Vacciniaceæ*, regarded by many botanists as a distinct family (the Whortleberry Family). This group of plants is calculated to excite the most intense interest. Its relationship to a former flora is indicated by the existence of a large group of monotypical or very small genera. Its anatomical characters are peculiar, exhibiting similarities to other and remotely connected families. The mechanism of the floral structures exhibits the most varied and perfect adaptations to pollination. The flowers, and their relations to the plants producing them, possess a peculiar beauty, and many of them (Kalmia, Azalea, Rhododendron) are showy to the degree of magnificence. Many also are deliciously fragrant. The value of the fruits of the *Vacciniaceæ* (blueberries, huckleberries, cranberries) is great. From a medicinal point of view, the family is interesting because of its poisonous properties and from the large number of domestic remedies which it contributes. A number of species take rather important rank in materia medica (see GAULTHERIA, UVA URSI, CHIMAPHILA). The important poisonous constituent of the family is *andromedotoxin*, which is wholly or practically wanting from the more important drugs. It is an amaroid ($C_{31}H_{51}O_{10}$), occurring in needles melting at 229° C. (444.2° F.), neutral, soluble in 35 parts of water, 9 of alcohol, and quite freely in ether and chloroform. It is not affected by alkaloidal reagents, and gives a fine red color with mineral acids. Bullock obtained it from Kalmia by precipitating the infusion with neutral and basic lead acetates, treating the filtrate with hydrogen sulphide, concentrating, and extracting with chloroform. Pure andromedotoxin has been declared more emetic than emetine or apomorphine, and more toxic than aconitine. Andromedotoxin produces violent vomiting when given in overdose. It at first causes a rise in arterial tension, which may be the result of vomiting. Later it acts as a powerful cardiac depressant, decreasing the force and frequency of the heart's action and lowering blood-pressure.

Ericolin ($C_{34}H_{56}C_{21}$) is a brown amorphous glucoside, partly melting at 100° C. (212° F.), soluble in benzene, yellowish-brown with concentrated sulphuric acid, and giving a characteristic odor with warm dilute acids, due to the freeing of the volatile constituent *ericinol*. It is one of the more important constituents of the medicinal species. *Asebofuscin* ($C_{18}H_{18}O_8$) is a reddish-brown glucoside, insoluble in water, ether, and chloroform, soluble in alcohol, acetic acid, and caustic alkalies, violet with alcoholic hydrochloric acid, and yielding asebogenin. *Asebotin* ($C_{24}H_{28}O_{12}$) is a bitter glucoside, occurring in needles melting at 145.5° C. (294° F.), soluble in alcohol, hot water, and acetic acid, and with difficulty in ether and chloroform, and precipitated by acids from alkaline solution. (*Arbutin* and *Urson* are con-

sidered under UVA URSI.) Tannin is general and abundant, and contributes largely to the value of the more important drugs.

Other Medicinal Species.—*Oxydendrum* (*Sour-wood* or *Sour-tree, Sorrel-tree, Elk-tree*) is the leaves of *O. arboreum* (L.) DC. (*Andromeda a.* L.), a small tree of the southern Allegheny region. They are 12 to 15 Cm. (5 to 6 In.) long and nearly a third as broad, oblong to lanceolate, acute, rather coarsely serrate, smooth, except when young, thickish, almost odorless, and of a very sour taste. They have a high repute among eclectics for their diuretic properties. Sour wood is said to be diuretic and laxative, and is employed by the eclectics for the relief of anasarca, hydrocele, hydrocephalus, and other dropsical effusions. The beginning dose is 2 grains (0.12 Gm.) of an extract, 3 times daily, and gradually increased until 30 grains (2 Gm.) are taken daily. This amount may then be gradually decreased until the beginning dose is arrived at.

Ledum, L.—The two eastern species of this genus have a somewhat interesting physiological and medicinal history. The leaves of *L. Grœnlandicum* Oeder. (*L. latifolium* Ait.), of Greenland and northwestern North America, the *Labrador* or *Continental tea*, or *James' tea*, have been used as a beverage, substituting tea. The shrub is a rather stout, branching evergreen of bog-lands, occasionally reaching a height of 5 or 6 feet. The showy white flowers are borne in dense terminal corymbs and are slenderly pedicelled. The leaves are alternate, almost sessile, 2 to 5 Cm. (1 to 2 In.) long and nearly a third as broad, oblong or oval, obtuse, entire, strongly revolute, smooth above, rusty-tomentose underneath. They contain considerable tannin, with ericolin, and probably some unknown constituent, since they are somewhat narcotic. It is claimed that andromedotoxin is wanting, but the properties of the plant would certainly indicate its presence. The leaves of *L. palustre* L., the *Narrow-leaved Labrador tea, Marsh* or *Swamp tea, Wild rosemary, Marsh cistus, Porsch, Mattenkraut, Ledon, Romarin sauvage*, and known to medicine as *Herba ledi palustris* and *Herba rosmarine silvestris*, are still more active. This plant abounds in swamps of the north-temperate zone. Its leaves are much narrower than those of the last. They have a similar though more aromatic odor, and have been found to contain the same principles as those of the last, together with a peculiar camphor which has been called *Ledum camphor* ($C_{15}H_{26}O$). Ledum produces, when given in full doses, headache, vertigo, restlessness, and a peculiar sort of delirium. It is claimed that it augments the secretion of the saliva, sweat, and urine, and that it causes dilatation of the pupil. It is rarely employed in internal medicine at the present time, but may be tried in 10 grain (0.6 Gm.) doses in the treatment of chronic bronchitis. A decoction is sometimes employed as a vermin exterminator, and the fresh twigs are laid among woollen clothing to protect it from moths.

Poisonous Ericaceæ.—The more important poisonous plants of the family are the following: *Kalmia latifolia* L., the *Mountain, American, Broad-leaved, Wood, Rose*, or *Spurge laurel, Calico bush, Ivy bush, Spoonwood*, or *Clamoun*, very abundant in rocky woods in eastern North America, and the *K. angustifolia* L., the *Narrow-leaved, Dwarf*, or *Sheep laurel, Lambkill* or *Calfkill*, of the same region. The other and rarer species, *K. glauca* Ait. and *K. hirsuta* Walt., doubtless share the properties. The first-named is a hard-wooded, tortuous, stout shrub, ordinarily 6 to 8 feet high, occasionally attaining 2 to 4 times that size in woods. The alternate leaves are shortly and stoutly petioled, 5 to 8 Cm. (2 to 3 In.) long, and rather more than a third as broad, oblong or oval-lanceolate, acute at both ends, entire, very thick and tough, smooth and green, nearly odorless, bitter and astringent. They contain little arbutin, relatively much andromedotoxin, tannin, resin, gum, mannit, etc. Sheep and other animals occasionally eat them with fatal effects. The second-named species grows more in open or exposed situations, especially in hill-pastures, and is usually less than 2 feet in height. Its leaves are opposite or in threes, are smaller, relatively narrower, pale underneath. Its flowers are of a rose-red, those of the former usually pink or whitish. Closely similar, in history and effects, to Kalmia, are several species of *Pieris*, particularly *P. Mariana* (L.) B. et H. (*Andromeda M.* L.), the *Stagger-bush* or *Lambkill*, a native of sandy districts, especially along the coast, of the eastern and southern United States. It is more slender and erect-branched than laurel, nearly as tall, the branches and lower leaf-surfaces black-dotted, the leaves alternate, oblong or oval, smooth above, sparsely hairy underneath, the beautiful, waxy, ovoid-bell-shaped, white or reddish-tinted flowers densely pendulous on the lower sides of the paniculately disposed branches of the preceding season. *Andromeda polifolia* L., the *Wild rosemary, Moorwort*, or *Marsh holy rose*, a low shrub of cranberry bogs of the northern parts of both hemispheres, the leaves linear, strongly revolute, bluish-green above, white underneath, is credited with similar properties.

Rhododendron.—Various species of this genus have records as poisonous plants similar to those of the species just described, and cases of poisoning are recorded from the eating of honey made by bees feeding upon the flowers of a European species. *R. maximum* L., the *Wild rose-bay, Rose laurel, Deer, Horse*, or *Great laurel*, abundant along streams in the eastern United States, has been found to contain andromedotoxin. The recorded symptoms of poisoning by this genus are also characteristic of this constituent. Arbutin, ericolin, ursон, and other constituents of the family also occur in these leaves.

Related Families.—In connection with the *Ericaceæ*, may be mentioned two other small families, long associated with it by systematists as subfamilies. The family *Clethraceæ* is represented by the single genus *Clethra* L., of about 25 or 30 species, of temperate and tropical or subtropical regions. The leaves of *C. arborea* Ait., of tropical America, contain ericolin, and are used somewhat like *Ledum*, under the name *Folha deiro*. Half a dozen other species have been similarly employed, to a slight extent, in their respective homes. Associated with *Chimaphila*, in the family *Pyrolaceæ*, are about a dozen species of *Pyrola* L., several of which have been employed like Chimaphila and Uva ursi. Those which have been examined have also been found to contain the same constituents as those drugs. That most used is *P. rotundifolia* L. (*False, Round*, or *Large-leaved wintergreen, Copper-leaf* or *Dollar-leaf, Waldmangold, Pyrole*), which grows in dry woods throughout the north-temperate zone. It resembles an herb, but its low, short stem is perennial, and its cluster of radical leaves are evergreen. They are 5 to 8 Cm. (2 to 3 In.) long, more or less rotund or broadly oval, rounded at the summit, very abruptly contracted into a long, channelled petiole, very finely crenate, thick and leathery, shining and of a very dark-green, or brownish after drying. The pretty, fragrant, nodding, white flowers are borne upon a scape which is sometimes nearly a foot in length, and are about 1.5 Cm. ($\frac{3}{5}$ In.) broad. *P. elliptica* Nutt. (*Shin-leaf*), of North America, is very similar, but somewhat more slender and smaller in all ways, the leaves about two-thirds as long, and oval or broadly oblong. They are also less thick and leathery, and of a lighter green. The subfamily *Monotropoideæ* contains several interesting genera of saprophytic plants. The curious and beautiful snow-plant, *Pine-drops* or *Albany beech-drops, Pterospora Andromedea* Nutt. (*Monotropa procera* Torr.), the flower-stem of which is commonly seen projecting above the snow in Alpine and high northern regions, is used as a diuretic, anthelmintic, and astringent. *Monotropa uniflora* L., the *Indian pipe* or *Pipe plant, Corpse plant, Ghost flower*, or *American ice-plant*, the drug known as *Fit-* or *Convulsion-root* or *Ova-ova*, abundant in damp woods throughout North America and eastern Asia, is a curious and well-known plant. It is wholly of a ghostly white color, grows in clumps, and is a few inches in height. The stem is thickish, fleshy, bears small erect or appressed scales, the vestiges of leaves, and terminates in a recurved bell-shaped flower about an inch in length and nearly as broad. It contains andromedotoxin, and the root has been used as an antispasmodic and mild hypnotic; *M. Hypopitys* L. resembles it, but bears several smaller and erect flowers. It doubtless contains the same constituent.

ERIGERON.—Fleabane; Colt's-tail.

Canada erigeron or Fleabane, Mare's-tail, Cow's-tail, Horse-weed, Pride-weed, Butter-weed, Blood-stanneh, Seabious, E.; *Besehreikraut, Canadisches Berufkraut*, G.

The dried leaves and flowering tops of *Leptilon Canadense* (L.) Britton (*Erigeron C.* L.—Fam. *Compositæ*).

Origin and Description.—An annual or biennial, more or less rough-hairy herb, native and exceedingly common and abundant as a weed throughout almost the whole of North America, and naturalized in most other countries. It varies in height, when in flower, from a few inches to 6 or 8 feet, the stem being simple up to the flowering branches and densely clothed with alternate, erect leaves, the inflorescence paniculately branched and mostly dense; leaves 1 to 3 or even 4 inches long, the lower oblanceolate and tapering into a short petiole, mostly sparsely serrate-dentate, the upper successively smaller and narrower and more inclined to be acute and entire; heads peduncled, campanulate, about 4 Mm. ($\frac{1}{6}$ In.) long and broad, the involucre with 5 or 6 series of narrow erect scales, the white pistillate rays numerous, shorter than the head and inconspicuous, the disk-flowers tubular, very small, with flattened akenes and a fine bristly pappus, the receptacle very small, naked; odor slightly aromatic, taste astringent, aromatic, somewhat bitter.

The genus was long confused with *Erigeron*, several species of which are also used similarly, though very inferior, and which are occasionally supplied for it. They are readily distinguished by their larger heads with long, showy, spreading rays.

Constituents.—Canada fleabane contains considerable tannin, though its astringent or styptic action is mostly due to its peculiar oil (see Oleum Erigerontis), of which it contains about 0.3 to 0.4 per cent. There are also a little gallic acid and an amaroid.

Action and Uses.—Erigeron is somewhat aromatic, and has been used as a diaphoretic and expectorant. Because of its acrid properties, large doses produce nausea and vomiting. In the form of a decoction ($\frac{1}{2}$ ounce of the root to 1 pint of water) it is given in doses of 1 to 2 tablespoonfuls (16–30 Cc.) in the treatment of dropsy and chronic bronchitis. Its common use in country districts is as an intestinal astringent in diarrhœa.

Allied Drugs.—The *Erigerons* which have been chiefly used are *E. Philadelphicus* L. (*Sweet scabious, Daisy-* or *Philadelphia fleabane*), which is softly hairy, with large, oblanceolate, coarsely serrate-dentate leaves and heads mostly few, 1.5 to 2.5 Cm. ($\frac{3}{5}$ to 1 In.) broad, the very numerous narrow rays light-purple; and *E. annuus* (L.) Persoon (*Aster a.* L.), somewhat like the last, but with few hairs, the leaves more sharply serrate, the heads only about half as large, the rays half as numerous (about 50), white or purplish-white. Both have a composition similar to that of Canada fleabane, but the oil lacks the astringent properties, and the herb is diuretic rather than astringent.

The genus *Leptilon* contains about 20 species, *Erigeron* about 130.

ERIODICTYON, *U. S.*—Eriodictyon; Yerba Santa; Mountain-balm.

Consumptive's weed, Bear's weed, Gum-bush, E.

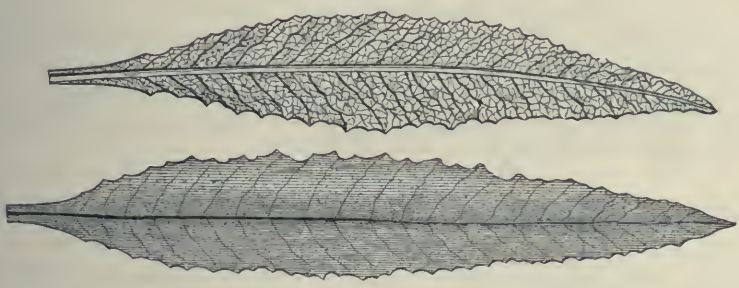
The dried leaves of *Eriodictyon Californicum* (H. et A.) Greene (*Wigandia C.* H. et A.; *E. glutinosum* Benth.—Fam. *Hydrophyllaceæ*).

Eriodictyon is not elsewhere official.

Origin.—A slender, brittle, evergreen, aromatic shrub growing on dry hills of our southwestern States and territories and extending into Mexico, and having pale bluish-purple, bell-shaped or short funnel-shaped, 5-merous flowers. It is notable for the shining coating of gum-resin borne by all its green parts.

Description.—Usually much broken; blade narrowed into a very short and broad petiole, 5 to 12 Cm. (2 to 5 In.) long and rarely exceeding 3 Cm. (1¼ In.) in breadth, oblong-lanceolate, gradually tapering to an acutish point, most irregularly serrate- or crenate-dentate, thick and brittle, or flexible in a damp and warm atmosphere, the margins more or less incurved; upper surface yellowish-green, more or less resinous, smooth, the veins somewhat impressed; lower surface whitish or yellowish-white, with finely and conspicuously reticulate dark veins, densely but very shortly tomentose; many of the hairs glandular; odor somewhat aromatic, strongly balsamic if heated in the closed hand; taste balsamic, sweetish, somewhat tea-like.

Fig. 176.



Eriodictyon leaves: lower and upper surfaces (Nat.).

Constituents.—These leaves contain 9 per cent. of a greenish-yellow, acrid and bitter resin, which forms soluble salts with bases, and, by double decomposition, precipitates quinine from solutions of its salts as salts of a quinine-resin. Eriodictyon also contains an inert resin, a trace of volatile oil, sugar, amorphous brown *ericolin* ($C_{34}H_{56}O_{21}$), and 2.4 per cent. of *eriodictyonic acid* ($C_{14}H_{18}O_5$), which crystallizes in yellow deliquescent plates of sweet-acid taste, soluble in benzol, not precipitated by tannin or most metallic salts, and turning red-black with ferric chloride.

Pharmaceutical Preparations.—Aromatic Elixir of Eriodictyon, N. F.; Fluidextract of Eriodictyon, U. S. P.; Aromatic Syrup of Eriodictyon, N. F.

Action and Uses.—Yerba santa was formerly employed to a limited extent as a bitter tonic and stimulating expectorant. It has been highly recommended in the treatment of asthma and in subacute and chronic inflammations of the respiratory and genito-urinary tracts. Its employment in these conditions, however, is of doubtful efficacy, and at present it is rarely prescribed. In the form of the Syrupus Eriodictyii Aromaticus (N. F.) it is largely employed to disguise the taste of quinine, and is probably the best vehicle we have for this purpose. The drug is usually given in the form of the fluidextract (Extractum Eriodictyi Fluidum, U. S.), in the dose of from ½ to 1 drachm (2–4 Cc.). An extract has also been occasionally employed in doses of from 5 to 15 grains (0.30–1 Gm.).

ERYTHROPHLEUM.—Sassy Bark.

Mancona-bark, Red-water tree bark, E.; *Écorce de Mancone*, Fr.; *Mancona-Rinde*, G.

The dried bark of *Erythrophlœum Guineense* Don (*E. judiciale* Procter; *Fillœa suaveolens* Guill. et Per.—Fam. *Leguminosæ*).

Origin and Description.—From a large, legume-bearing tree of western and central Africa, where it is used as an ordeal (see PHYSOSTIGMA) and as an arrow poison. It occurs in irregular flat or curved pieces, about 6 Mm. ($\frac{1}{4}$ In.) thick; outer surface variously fissured and warty and dark-gray if the corky layer be present, or of a dull red-brown when this is removed; inner surface reddish-brown, striate, hard and heavy, the fracture brittle but somewhat fibrous, exhibiting pale yellow-brown spots; inodorous, but the powder highly sternutatory; taste astringent, somewhat bitter, acrid.

Constituents.—Sassy bark contains erythrophlœine, tannic and gallic acids, gum, and resin. *Erythrophlœine* is a colorless crystalline alkaloid, soluble in water, alcohol, and acetic ether, and almost insoluble in ether and chloroform. When boiled with dilute acids or alkalies it yields erythrophlœic acid and *manconine*, a volatile base resembling pyridine and nicotine.

Action and Uses.—Experiments seem to prove that sassy bark is closely allied to digitalis in its action upon the circulation. It increases the force of the heart action, slows the pulse, and produces a rise in blood-pressure. Respiration is notably decreased and peristaltic action increased. The drug is stated to be astringent, narcotic, and emetic. Erythrophlœine, its active principle, is also said to possess local anæsthetic properties to a greater degree than cocaine, but because of its poisonous character it is not employed for local anæsthesia. Overdoses produce great circulatory depression, respiratory difficulty, nausea and vomiting, and convulsions. Clinically this remedy has been found of little benefit in the treatment of cardiac disease, but it is asserted to be of some value in the treatment of spasmodic asthma. The alkaloid may be given in doses of from $\frac{1}{60}$ to $\frac{1}{30}$ grain (0.001–0.002 Gm.), and an extract prepared from the bark in doses of from $\frac{1}{5}$ to $\frac{1}{3}$ grain (0.012–0.021 Gm.).

Other Species.—The genus *Erythrophlœum*, Don, contains 5 species, all of tropical Africa, and those which have been examined appear to contain constituents acting more or less like erythrophlœine, if they be not even identical.

ESSENTIÆ FRUCTUUM FACTITIÆ.—Artificial Fruit Essences.

Artificial fruit flavors, E.; *Künstliche Fruchtessenzen*, G.

The name artificial fruit essences or flavoring extracts is applied to a class of alcoholic solutions of volatile oils and compound ethers, which are frequently employed for imparting the desired fruit flavor to lozenges, cordials, ices, jellies, etc. They should be used with care, since a very small quantity suffices to give the desired odor and taste. The alcohol used in their preparation should be of not less than 90 per cent. strength and free from foreign odor. The addition of glycerin has been found advantageous in several cases.

The following formulas have been found serviceable, and if the solutions are set aside for some time before using them a better blending of the odors will result.

Whenever alcoholic solution of benzoic, oxalic, succinic, or tartaric acid is directed, it must be understood to refer to a saturated solution of the respective acid, prepared without the aid of heat.

Essence of Apple.—Take of chloroform, 1 fluidrachm; spirit of nitrous ether, 1 fluidrachm; aldehyde, 2 fluidrachms; ethyl acetate (acetic ether), 1 fluidrachm; amyl valerate (apple oil), 10 fluidrachms; alcoholic solution of oxalic acid, 1 fluidrachm; glycerin, 4 fluidrachms; alcohol, 12½ fluidounces.

Essence of Apricot.—Take of chloroform, 1 fluidrachm; ethyl butyrate (butyric ether), 10 fluidrachms; ethyl valerate (valerianic ether), 5 fluidrachms; oil of persicot, 1 fluidrachm; amyl alcohol, 2 fluidrachms; amyl butyrate, 1 fluidrachm; alcoholic solution of tartaric acid, 1 fluidrachm; glycerin, 4 fluidrachms; alcohol, 12½ fluidounces.

Essence of Cherry.—Take of ethyl acetate (acetic ether), 5 fluidrachms; ethyl benzoate (benzoic ether), 5 fluidrachms; oil of persicot, 1 fluidrachm; alcoholic solution of benzoic acid, 1 fluidrachm; glycerin, 3 fluidrachms; alcohol, 12½ fluidounces.

Essence of Currant.—Take of aldehyde, 1 fluidrachm; ethyl acetate (acetic ether), 5 fluidrachms; ethyl benzoate (benzoic ether), 1 fluidrachm; œnanthylic ether, 1 fluidrachm; alcoholic solution of tartaric acid, 5 fluidrachms; alcoholic solution of succinic acid, 1 fluidrachm; alcoholic solution of benzoic acid, 1 fluidrachm; alcohol, 12½ fluidounces.

Essence of Peach.—Take of aldehyde, 2 fluidrachms; ethyl acetate (acetic ether), 5 fluidrachms; ethyl formate (formic ether), 5 fluidrachms; ethyl butyrate (butyric ether), 5 fluidrachms; ethyl valerate (valerianic ether), 5 fluidrachms; oil of persicot, 5 fluidrachms; amyl alcohol, 2 fluidrachms; glycerin, 5 fluidrachms; alcohol, 12½ fluidounces.

Essence of Pear.—Take of ethyl acetate (acetic ether), 5 fluidrachms; amyl acetate (oil of pear), 2 fluidrachms; glycerin, 10 fluidrachms; alcohol, 12½ fluidounces.

Essence of Pineapple.—Take of chloroform, 1 fluidrachm; aldehyde, 1 fluidrachm; amyl butyrate, 10 fluidrachms; ethyl butyrate (butyric ether), 5 fluidrachms; glycerin, 3 fluidrachms; alcohol, 12½ fluidounces.

Essence of Plum.—Take of aldehyde, 5 fluidrachms; ethyl acetate (acetic ether), 5 fluidrachms; ethyl formate (formic ether), 1 fluidrachm; ethyl butyrate (butyric ether), 2 fluidrachms; oil of persicot, 4 fluidrachms; glycerin, 8 fluidrachms; alcohol, 12½ fluidounces.

Essence of Quince.—Take of ethyl pelargonate (œnanthic or pelargonic ether), 1 fluidrachm; alcohol, 19 fluidrachms.

Essence of Raspberry.—Take of spirit of nitrous ether, 1 fluidrachm; aldehyde, 1 fluidrachm; ethyl acetate (acetic ether), 5 fluidrachms; ethyl formate (formic ether), 1 fluidrachm; ethyl butyrate (butyric ether), 1 fluidrachm; oil of wintergreen, 1 fluidrachm; amyl acetate (oil of pear), 1 fluidrachm; amyl butyrate, 1 fluidrachm; alcoholic solution of tartaric acid, 5 fluidrachms; alcoholic solution of succinic acid, 1 fluidrachm; glycerin, 4 fluidrachms; alcohol, 12½ fluidounces.

Essence of Strawberry.—Take of spirit of nitrous ether, 1 fluidrachm; ethyl acetate (acetic ether), 5 fluidrachms; ethyl formate (formic ether), 1 fluidrachm; ethyl butyrate (butyric ether), 5 fluidrachms; oil of wintergreen, 1 fluidrachm; amyl acetate (oil of pear), 3 fluidrachms; amyl butyrate, 2 fluidrachms; glycerin, 2 fluidrachms; alcohol, 12½ fluidounces.

EUCAINA.—Eucaine.

Eucaines are synthetic alkaloidal derivatives of *triacetonamine* and *vinyl-diacetonalkalamine*, and occur commercially respectively as the hydrochlorides of Eucaine A and Eucaine B. Both are used as substitutes for cocaine, and have the advantage over the latter in being less toxic, and the aqueous solutions not suffering decomposition on boiling. For tests of distinction between *α*- and *β*-eucaine and cocaine, see *Proc. Amer. Pharm. Assoc.*, 1904, p. 943.

Eucainæ Hydrochloridum A.—*Eucaine hydrochloride A, Alpha-eucainum, Alpha-eucaine, Eucaine A.—Hydrochloride of benzoyl-n-methyltetramethyl-y-oxypiperidinecarboxylicmethylester.* Formula, $C_{19}H_{27}NO_4.HCl + H_2O$. Molecular weight, 384.80.

Preparation.—Triacetonamine is treated with hydrocyanic acid, the product hydrolyzed by boiling with water, and the benzoyl and methyl groups then introduced by successive treatment with benzoyl chloride and methyl iodide, the resultant product—*benzoyl-n-methyltetramethyl-y-oxypiperidinecarboxylicmethylester*—being the free base *alpha-eucaine*, or *eucaine-A*. This alkaloid crystallized from ether or alcohol presents large glossy colorless prisms which are difficultly soluble in water, soluble in ether, alcohol,

chloroform, and benzene. The alkaloid melts at 104° C. (219.2° F.), and forms crystallizable salts with acids. Eucaine hydrochloride A, the first of these salts introduced commercially in 1896, forms glossy neutral scales or plates, soluble in 10 parts of water at 15° C. (59° F.). The aqueous solutions of the salt are not decomposed on boiling, yield a precipitate of the free base on the addition of the alkali hydroxides and carbonates, and a yellow to orange-red coloration when heated with a few drops of solution of ferric chloride. The salt is distinguished from cocaine hydrochloride, which it resembles in appearance, by its lesser solubility in water, and by yielding a yellow crystalline precipitate when 3 drops of a 5 per cent. aqueous solution of chromic acid are added to 5 Cc. of a 1 per cent. solution of eucaine hydrochloride A. Addition of 3 Cc. of a 10 per cent. aqueous solution of potassium iodide to 5 Cc. of a 1 per cent. solution of eucaine hydrochloride causes an immediate turbidity, which disappears, and after a short time reappears as a crystalline mass. Mercuric chloride causes a white precipitate, and potassium permanganate a violet crystalline precipitate ((Hager).

Tests.—The crystals should be colorless, neutral in reaction, give no discoloration on the addition of sulphuric acid; burn without residue on incineration, and the free base obtained from the aqueous solution by extraction with a volatile solvent after the addition of ammonia should melt at 104° C. (219.2° F.).

Action and Uses.—Full doses of alpha-eucaine produce considerable excitation of the entire central nervous system, and toxic amounts may produce both tonic and clonic convulsions, followed by paralysis and death, the latter resulting from paralysis of the respiratory muscles. If the dose is not a fatal one, the convulsions gradually cease and the paresis slowly disappears. When injected into the circulation, it decreases the rapidity but not the force of the heart action, and has little effect upon the peripheral bloodvessels. Locally applied to mucous membranes or employed by the infiltration-method (see COCA), it causes hyperæmia of the part, while cocaine produces a marked primary contraction of the bloodvessels. Its application is more painful and its action is somewhat slower than that of cocaine, while the anæsthesia produced is equal to that of the latter drug. When dropped in the eye in 2 per cent. solution it may cause irritation of the conjunctiva and roughening of the cornea. It does not paralyze accommodation nor produce mydriasis. Eucaine is considered three and three-fourths less toxic than cocaine, but its great advantage over the latter remedy lies in the fact that it does not cause a primary contraction of the bloodvessels. It may be used as a substitute for cocaine either as a local application or by infiltration in aqueous solutions varying in strength from 0.5 to 10 per cent., but not more than 30 minims (2 Cc.) of a 4 per cent. solution should be used at one time. Eucaine solutions are permanent, and may be boiled without injury for the purpose of sterilization. This drug has not met with favor for intraspinal anæsthesia, as its effects have proved less uniform and lasting than those of cocaine. Poisoning by eucaine should be treated by the use of hot strong coffee, alcohol, strychnine, and digitalis. If the symptoms demand them, ether, ammonia, and nitroglycerin may be employed.

Eucainæ Hydrochloridum B.—*Eucaine hydrochloride B, Beta-eucainum, Beta-eucaine, Eucaine-B, Benzoylvinyldiacetonalkamine hydrochloride.* Formula, $C_{14}H_{21}NO_2$·HCl. Molecular weight, 269.61.

Preparation.—Diacetonamine is treated with paraldehyde, the resulting product reduced with metallic sodium to vinyldiacetonalkamine, and the latter benzoylated by treatment with benzoyl chloride. The free base *benzoylvinyldiacctonalkamine* is dissolved and neutralized with hydrochloric acid and the salt crystallized, forming a white, neutral, crystalline powder, soluble in about 20 parts of water at ordinary temperatures, more soluble in hot water. The 5 per cent. aqueous solution yields no precipitate with mercuric chloride (distinction from eucaine-A); yields amorphous precipitates with the alkali hydroxides and carbonates, the precipitates being soluble in ether. It yields no color-reactions with sulphuric or nitric acid, or with Froehde's reagent. Chromic acid produces a yellow amorphous precipitate soluble in hot water. Bismuth-potassium iodide gives an orange-yellow, picric acid a lemon-yellow, and phosphomolybdic acid a white precipitate.

Action and Uses.—With the exception of the fact that it is less irritating, eucaine-B possesses properties identical with those of eucaine-A. It may be employed in stronger solution, and is the one chiefly used in the eye.

Allied Compounds.—Acoinum.—*Acoine.*—A local anæsthetic and substitute for cocaine, introduced by Trolldenier in 1899. It is a synthetic hydrochloride of *dipara-anisyl-monophenetyl-guanidine.* A large number of oxyphenylguanidines have been prepared by Hesse and Trolldenier, and found to have similar properties to cocaine as local anæsthetics, but have the disadvantage of producing caustic effects in concentrated solutions and in being decomposed on exposure to light. Acoine has been employed in the eye as a local anæsthetic. It produces anæsthesia in about the same length of time as cocaine or eucaine, but does not increase intraocular tension, paralyze accommodation, nor increase the size of the pupil. When instilled into the eye it probably causes more pain than the latter drugs, and it is stated that the newer drug is less satisfactory than the older anæsthetics when congestion or inflammation is present. Acoine is commonly employed in solutions varying in strength from 1 to 300 to 1 to 100 parts of distilled water or normal saline solution. It is stated that subconjunctival injections of it are equally as efficient and less painful than those of any other remedy heretofore employed.

Euphthalmina.—*Euphthalmine. Phenylglycolyl-n-methyl-β-vinyldiacetonalkamine.* Formula, $C_{17}H_{25}NO_3$.—This is a derivative of beta-eucaine, obtained by methylating vinyldiacetonalkamine and treating the resulting product with a very dilute solution of mandelic acid. Two salts of euphthalmine are used, the hydrochloride, $C_{17}H_{25}NO_3.HCl$, and the salicylate, $C_{17}H_{25}NO_3.C_7H_6O_3$. The former is prepared by passing hydrochloric acid gas into an ethereal solution of euphthalmine and recrystallizing the resulting salt from ether. It occurs as a white crystalline powder, readily soluble in water and soluble in 2 parts of alcohol. The salicylate is made by mixing euphthalmine and salicylic acid, in molecular proportions, in ether solution, and recrystallizing the reprecipitated salt. It is readily soluble in water. This alkaloid is employed as an active mydriatic, but it is said to exercise no effect on accommodation. Under its influence the mydriasis begins in from 10 to 20 minutes, is complete in about an hour, and disappears after 5 or 6 hours. A 2 per cent. solution is usually instilled, but a 10 per cent. preparation may be employed. The drug is said to closely resemble atropine in its effects upon the general system.

Holocainæ hydrochloridum. *Holocaine hydrochloride. p-Diethoxyethenyl-diphenyl-amidine hydrochloride.* Formula, $C_6H_4OC_2H_5NH.C(CH_3):N.C_6H_4.OC_2H_5.HCl$. Molecular weight, 332.18. Prepared by the action of molecular proportions of phenacetin and p-phenetidin upon each other in presence of phosphoric chloride, water being eliminated. The resulting free base *holocaine* is recrystallized from alcohol and dissolved and neutralized with hydrochloric acid to form the hydrochloride. Holocaine hydrochloride occurs as a colorless, odorless, neutral, crystalline powder, having a slightly bitter taste, and produces a numbness when applied to the tongue. It is soluble in 40 parts of water, the solution yielding amorphous, changing to crystalline, precipitates with alkali hydroxides and carbonates, a resinous orange-yellow precipitate with chromic acid, and gives the indophenol reaction with chlorinated lime. The salt should be colorless, neutral in reaction, dissolve without color in sulphuric acid, leave no residue on ignition, and the separated free base have the melting-point of 121° C. (249.8° F.). Holocaine has been employed as a substitute for cocaine in ophthalmic practice. Five minims of a 1 per cent. solution when instilled into the eye are usually sufficient to cause anæsthesia in from 1 to 10 minutes. It is claimed by those who have employed it that no scaliness of the cornea results from its use, as is the case with the older remedy.

EUCALYPTOL, *U. S.*—Eucalyptol.

Cajuputol, Cineol, E., G., Fr.; *Terpan; Eucalyptuskampfer,* G.

Formula, $C_{10}H_{18}O$. Molecular weight, 152.98.

A neutral body obtained from the volatile oil of *Eucalyptus globulus* Labillardière.—Fam. *Myrtaceæ,* and from other sources. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.—U. S.

Origin.—The Pharmacopœia directs eucalyptol to be obtained from the oil of various species of *Eucalyptus,* but does not mention that it may be prepared from other oils, one of which is composed almost wholly of eucalyptol—the oil of santonica, *Artemisia pauciflora* Weber. Eucalyptol is also a constituent of the oils of rosemary and cajuput.

Preparation.—Eucalyptol is prepared from oil of eucalyptus by distillation, and placing the portion going over between 150° and 175° C. (302° and 347° F.) in a freezing mixture, when it crystallizes in long, colorless needles. This is repeated a number of times, always draining the crystals to get rid of the adhering oil. It may also be prepared by the process of Wallach and Brass (1884), by conducting gaseous hydrochloric acid into oil of eucalyptus, pressing out the crystalline hydrochloride formed to free it from the adherent oil, and then decomposing the crystals by treatment with water, which separates the eucalyptol. The latter is then warmed with an alcoholic

solution of potassium hydroxide and distilled with steam. The process of L. R. Scammel also depends upon the formation of a crystalline compound by means of phosphoric acid. Phosphoric acid of specific gravity 1.75–1.785 is added to the oil in slight excess at a temperature not exceeding 15° C. (59° F.), and the eucalyptol phosphate formed pressed out, freed from adherent oil, and then decomposed with water.

Properties.—Eucalyptol is a colorless liquid, having a characteristic aromatic, camphoraceous odor, and a pungent, spicy, and cooling taste. Its specific gravity at 25° C. (77° F.) is 0.925 (U. S.). Cooled to a temperature a few degrees below 0° C. (32° F.) it congeals to a crystalline mass, and liquefies again at —1° C. (30.2° F.); it boils at 176°–177° C. (348.8°–350.6° F.); is optically inactive (distinction from oil of eucalyptus); is miscible in all proportions with alcohol, ether, chloroform, carbon disulphide, turpentine, glacial acetic acid, and fixed and volatile oils. It forms 2 crystalline addition-products with gaseous hydrochloric acid, a crystalline compound with concentrated phosphoric acid of specific gravity 1.75–1.785, and is converted by phosphoric anhydride into *eucalyptene*, $C_{10}H_{16}$, cymene, and *eucalyptolen*. If a solution of eucalyptol be shaken with iodo-potassium iodide, a magma of small green glossy crystals separates. With bromine eucalyptol forms a deep-red crystalline addition-product, $C_{10}H_{18}OBr_2$. It also forms addition-products with α- and β-naphtol.

Tests.—In addition to the above properties eucalyptol should answer the following tests: If a portion of eucalyptol be shaken with an equal volume of sodium hydroxide test-solution, it should not diminish in volume. Its alcoholic solution should be neutral to litmus paper, and should not assume a brownish or violet color on the addition of a drop of ferric chloride test-solution (absence of phenols).—U. S. Mixed with an equal volume of liquid paraffin (paraffinum liquidum) the mixture should remain clear (absence of water).

Action and Uses.—Eucalyptol has been successfully employed as a stimulant expectorant and antiseptic. Internally it may be given in doses of from 5 to 10 minims (0.30–0.60 Cc.), several times daily, in the treatment of chronic pulmonary and bronchial affections. It has also been used as a remedy for the later stages of gonorrhœa. It has been applied as an antiseptic dressing to foul ulcers, and an embrocation containing it may be used in the treatment of sciatica and chronic rheumatism.

EUCALYPTUS, *U. S.*—Eucalyptus Leaves.

Blue gum-tree leaves, Australian fever-tree leaves, E.; *Feuilles d'eucalyptus,* Fr.; *Eukalyptus-Blätter,* G.; *Eucalypto,* Sp.; *Eucalitto,* It.

The dried leaves of *Eucalyptus globulus* Labillardière (Fam. *Myrtaceæ*), collected from the older parts of the tree.

Official in several other pharmacopœias, which specially caution against the use of the ovate leaves, from the younger parts of the tree.

Origin.—From a large forest-tree of Tasmania and southern Australia, often attaining a height of from 200 to 300 feet, and a diameter of from 15 to 25 feet. It has also been very extensively planted in tropical and warm countries, especially in India and California, for its valuable timber, and in malarial regions as a purifier of the soil and atmosphere. Where it grows in sufficient abundance, the soil and the atmosphere become charged with the antiseptic constituents of its fallen leaves and bark, and malaria is unknown. The same result could probably be secured elsewhere by planting it abundantly over a sufficiently extensive area. It was an imperfect understanding of this antimalarial property which suggested the internal use of the leaves as an antiperiodic. As is true of many trees, the youngest growth produces a "junior" leaf, differing markedly from that of the older growth. It is ovate, equilateral, thin and sessile, and is greatly deficient in active constituents. It clothes many young trees completely, and the younger parts of them for some years thereafter. Information is scarce as to the relative quality of the leaves produced from cultivated trees in other countries, but there is good reason to believe that it is deficient in some cases, and the use of the native leaves should be insisted upon. As a matter of fact, our leaves come mostly from California.

Description.—Shortly and stoutly petioled, the petiole twisted, 15 to 30 Cm. (6 to 12 In.) long and 2 to 4 Cm. ($\frac{3}{4}$ to $1\frac{1}{2}$ In.) broad, falcate-lanceolate, rounded or very abruptly contracted at the oblique base, tapering regularly to the acutish or obtusish summit, entire, very thick and coriaceous, smooth, of a dull, pale-green and somewhat glaucous, the venation fine

and inconspicuous, anastomosing near the margin, finely pellucid-punctate; odor aromatic and somewhat camphoraceous; taste camphoraceous, pungent; bitterish.

Leaves which are ovate, equilateral, and only slightly thickened, should be rejected.

FIG. 177.

Eucalyptus globulus Labill.: leaf, about half natural size.

The presence of the objectionable leaves, as of all others used as adulterants of the powder, can be detected by the appearance of their stomata, on a level with the leaf-surface, instead of deeply depressed, as in the genuine. A fine powder should exhibit no fragments of epidermis in which the guard-cells of the stomata can be distinctly seen upon a vertical view, nor any fragments which, not possessing stomata, exhibit wavy epidermal cells upon vertical view.

Constituents (for *volatile constituents*, see OLEUM EUCALYPTI).—The leaves yield tannin, cerylic or an allied alcohol, an acid crystallizable resin, 2 other resins, eucalyptic acid, and about 6 per cent. of volatile oil.

Pharmaceutical Preparations.—ELIXIR OF EUCALYPTUS, N. F.; FLUIDEXTRACT OF EUCALYPTUS, U. S. P.

Action and Uses.—Eucalyptus depends principally upon a volatile oil for its medicinal properties. The local application of the oil causes burning pain and irritation. Taken internally, the drug produces a sense of warmth in the stomach, an increased flow of saliva, and eructation of gas. In ordinary dose it produces slight stimulation, followed by a period of calm. A sense of well-being is experienced, the mind is clear and active, the pulse is increased in frequency, and aphrodisiac effects are noted. Overdose sometimes causes intestinal indigestion, with loose oily stools, fever, great excitement, respiratory difficulty, symptoms of cerebral congestion, and partial palsy of the lower extremities. The drug is eliminated by the lungs, bowels, and kidneys, the urine sometimes having an odor like that of violets after its ingestion. Eucalyptus may be given internally in the treatment of malarial fever, and is especially useful in those cases possessing an idiosyncrasy to quinine. It may also be employed in rheumatic and malarial headache, in migraine and other neuralgic conditions. The remedy has been recommended also in the treatment of subacute and chronic bronchitis, spasmodic asthma, and the later stages of gonorrhœa. As an antiseptic it is said to be superior to carbolic acid, but the drug has never been largely employed as such. A local application containing the oil is valuable in the treatment of chronic skin affections, ulcers, and other conditions in which a stimulating antiseptic is required. The dose of the oil is from 10 to 20 minims (0.6–1.3 Cc.); of the fluid extract, from ½ to 2 fluidrachms (2–8 Cc.).

Other Species and Products (*for other eucalyptus oils, see* OLEUM EUCALYPTI; *for eucalyptus gum, see* KINO; *for eucalyptus honey, see* MEL; *for eucalyptus manna, see* MANNA).—The genus *Eucalyptus* contains in the neighborhood of 150 species, nearly all of Australasia, a few in the East Indies. The products of the genus are invaluable in the countries where they originate. The many volatile oils which have been distilled from other species differ greatly in composition, and this is also true of those leaves which have been analyzed. Those of no other species have come into use, but the barks of several are in use under the name of *Stringy bark*, for their aromatic properties, and for the distillation of their oil, especially those of *E. eugenioides* Sieber (*White stringy bark*), *E. capitellata* Sm. (*Brown s. b.*), *E. macrorhyncha* J. Muell. (*Red s. b.*), *E. piperita* Sm., and *E. punctata* DC. Their content of oil scarcely ever exceeds 0.75 per cent.

EUGENOL, *U. S.*—Eugenol.

Oleum Caryophyllorum, P. G.—*Allylguaiacol, Allylmethylpyrocatechol*, E.; *Eugenol*, Fr., G.

Formula, $C_{10}H_{12}O_2$ or $C_6H_3(OH)(OCH_3).C_3H_5$. Molecular weight, 162.86.

An unsaturated, aromatic phenol obtained from oil of cloves and other sources. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light.—U. S.

Besides being the chief constituent (80–90 per cent.) of oil of cloves, eugenol is also found in the oils of pimento, bay, Ceylon cinnamon, camphor, canella alba, sassafras, and Massoi bark.

Source.—Eugenol is mainly obtained from oil of cloves by the following process: The oil is shaken with an excess of 5 or 10 per cent. of sodium hydroxide solution in a separator and the resulting solution of eugenol sodium drawn off. After washing the aqueous liquid with ether it is decomposed by means of diluted sulphuric acid, and the separated eugenol washed with solution of sodium carbonate to remove adhering acid, and finally distilled with steam or in vacuo.

Properties.—Eugenol is a colorless or pale-yellow, thin liquid, having a strongly aromatic odor of cloves, and a pungent and spicy taste. Exposure to air causes it to become darker and thicker. Its specific gravity at 25° C. (77° F.) is 1.072 to 1.074, and it boils at 251° to 253° C. (483.8°–487.4° F.). Eugenol is optically inactive, and is miscible with alcohol in all proportions; it should be soluble in 2 parts of 70 per cent. alcohol. When 1 part of eugenol is dissolved in 12 parts of sodium hydroxide test-solution previously diluted with 18 parts of water a clear solution should result, which becomes turbid when exposed to the air. A mixture of 1 part of eugenol and 20 parts of hot water should redden litmus-paper very slightly. 5 Cc. of the cold, clear filtrate from this mixture, upon addition of 1 drop of ferric chloride test-solution, should show a transient grayish-green color, but not a blue or violet color (absence of phenol).—U. S. Eugenol is a monatomic phenol, and as such is capable of forming saline compounds with sodium or potassium hydroxide, having the composition $C_6H_3(C_3H_5)(OCH_3)O$—Na or K. It is readily soluble in ether, chloroform, and glacial acetic acid. When boiled with acetic anhydride it is converted into aceto-eugenol, $C_{10}H_{11}(C_2H_3O)O_2$, which melts at 30.5° C. (86.9° F.) and boils at 270° C. (518° F.). 5 Gm. of eugenol shaken with 20 Gm. of 15 per cent. sodium hydroxide solution and 6 Gm. of benzoyl chloride forms benzoyl-eugenol, $C_{10}H_{11}(C_7H_5O)O_2$, which, being insoluble in water, may be washed with the latter and then recrystallized from alcohol in the form of colorless needles, melting at 70.5° C. (158.9° F.). Upon oxidation with potassium permanganate eugenol yields vanillin; it is used for the manufacture of the latter substance.

Action and Uses.—Eugenol may be employed as a substitute for oil of cloves. (See OLEUM CARYOPHYLLI.)

EUONYMUS, *U. S.*—Euonymus.

Euonymi Cortex, Br.; *Cortex euonymi.*—*Wahoo, Spindle-tree, Strawberry-tree, Burning bush, Arrow-wood, Bursting heart*, E.; *Écorce de fusain (de bonnet de prêtre)*, Fr.; *Spillbaumrinde, Spindelbaum, Pfaffenhütchen*, G.

The dried bark of the root of *Euonymus atropurpurea* Jacq. (Fam. *Celastraceæ*).

Origin.—A large shrub or small tree growing abundantly east of the Mississippi and extending westward of it to some extent, especially northward. It inhabits slopes, preferably in the vicinity of streams. It is considerably cultivated as an ornamental shrub, the pendulous, 4-lobed, persistent fruit bursting in the fall to display the scarlet arils of the seeds. Its branchlets are slightly quadrangular, the leaves opposite, petioled, elliptic-ovate, serrate, and pointed; the flowers are dark-purple, in loose cymes of 3 to 6, and appear in June. Both the stem-bark and root-bark are collected, but the use of the latter only is authorized. The root-bark yields a brown extract ("Brown Euonymin"), the stem-bark a greenish one ("Green E.").

Description.—In quilled strips or pieces of very irregular size, usually with a few fine, hair-like roots adhering; bark 1 to 5 Mm. ($\frac{1}{25}$ to $\frac{1}{5}$ In.) thick; outer surface ashy or pale brownish-gray, usually with some small dark patches, shallowly fissured and ridged, with a somewhat scaly and soft friable cork; inner surface whitish or slightly tawny, indistinctly

short-striate; fracture short, whitish, or the inner layer pale brownish in bark which has been long kept; when slowly broken, the ends are held together by fine, somewhat elastic fibers; odor distinct and characteristic, somewhat saponaceous; somewhat gummy in the mouth, the taste sweetish, bitter, somewhat acrid.

The stem-bark, which is in long, tough strips, with a dark-gray or blackish fissured cork, should be rejected.

The greenish-gray powder of the stem-bark contains numerous bast-fibers, that of the root-bark few, and the latter is of a lighter color.

Constituents.—The bark yields euonymin, euonic acid crystallizing in needles, citric, tartaric, and malic acids, fixed oil, 1.3 per cent. of volatile oil (Cassaday), crystalline free fatty acids, yellow and brown resin, an acrid principle, bitter extractive, wax, pectin, and starch. Naylor and Chaplin found *atropurpurin*, which they afterward proved to be *dulcit*, a sweet substance. Cassaday found 1.48 per cent. of euonic acid and resin, and 2.16 per cent. of euonymin and resin. *Euonymin* is an amorphous, odorless, bitter principle, soluble in alcohol, and slightly in water and ether. Meyer and Romm (1885) considered it a crystalline glucoside.

Pharmaceutical Preparations.—Elixir of Euonymus, N. F.; Extract of Euonymus; Fluidextract of Euonymus, U. S. P.

Action and Uses.—Wahoo is said to act as a direct stimulant to the liver, increasing biliary flow. When given in overdose, it irritates the gastro-intestinal tract. It is somewhat uncertain in its action, at times causing severe purgation, at others only acting as a mild laxative. It may be employed as a remedy for mild hepatic torpor in doses of from 3 to 10 grains (0.20–0.60 Gm.). As a laxative, ½ fluidrachm (2 Cc.); as a purge, 2 fluidrachms (8 Cc.) of a fluidextract may be given. Euonymin is occasionally given in doses of from ½ to 1 grain (0.03–0.06 Gm.).

Other Species.—The genus contains about 60 species, widely distributed through the old and new worlds, in both temperate and tropical regions, the greatest number in the East Indies.

E. Europæus L. (*Dog-wood, Prick-wood, Skewer-wood*) is 2.4 to 6 M. (8 to 20 Ft.) high, occasionally cultivated in gardens, has greenish-yellow flowers and pale-red capsules, the arillus being orange-red. All parts of it are emetic and purgative. The fruit, made into an ointment, has been used for the destruction of pediculi. The arillus yields by pressure an orange-colored oil which has a bitter taste. The orange-red coloring-matter, which is quite prevalent in this natural order, seems to deserve careful investigation.

E. Japonica L. (*Tu-chung, Muh-mien*) is used in oriental countries in the treatment of spermatorrhœa. The bark of *E. tingens* Wall. (*Barphali, Sikhi*) is used in India to produce a yellow dye.

EUPATORIUM, *U. S.*—Eupatorium.

Herba eupatorii perfoliati.—Thorough-wort, Thorough-stem, or Thorough-wax, Boneset, Indian sage, Cross-wort, Sweating-herb, E.; *Herbe d'eupatoire perfolies, Herbe à fièvre*, Fr.; *Durchwachsener Wasserdost*, G.; *Eupatorio*, Sp.

The dried leaves and flowering tops of *Eupatorium perfoliatum* L. (*E. connatum* Mx.—Fam. *Compositæ*).

Eupatorium is not elsewhere official.

Origin and Description.—A rather stout, simple-stemmed (except for the inflorescence branching), coarsely gray-hairy, perennial herb, with broad whitish inflorescence, abundant in low, open lands throughout eastern and central North America, its medicinal use derived from the aborigines. The drug loses 75 to 80 per cent. of its weight in drying. Leaves opposite, the 2 united by their broad bases, the uppermost often distinct, those of the inflorescence mostly alternate and greatly reduced; 8 to 15 Cm. (3 to 6 In.) long and 1.5 to 5 Cm. (¾ to 2 In.) broad, tapering regularly from near the base to an acute apex, crenate-serrate, above bright-green or somewhat yellowish-green, rugose and finely bullate; underneath yellowish-gray-green; densely short-hairy and resinous-dotted, the prominent, rounded, crooked, fine veins conspicuously reticulated; flower-heads very numerous, in broad corymbs, the branches rough-hairy; mature involucre campanulate, the imbricated scales lance-oblong, obtusish, green, hairy, the inner longer and with whitish tips and margins; flowers of the head about 10 to 16, tubular, yellowish-white, the pappus in a single row, white, bristly; odor weak, aromatic; taste bitter, astringent, aromatic.

Its connate leaves, with their rugose and grayish-hairy surfaces, distinguish it from all the numerous species similarly used, and which may be supplied for it.

FIG. 178.

Boneset herb (½ Nat.): *a*, flower-head (× 2); *b*, floret (× 3).

Constituents.—Thorough-wort contains a trace of volatile oil, some tannin, resin, yellow coloring-matter, $C_{27}H_{30}O_{17}$, of the nature of a glucosidal tannin, gum, and *eupatorin*, a very bitter glucoside, $C_{35}H_{58}NO_{10}$, soluble in alcohol, ether, chloroform, and boiling water, and insoluble in cold water. The root yields 5 per cent. of inulin. For account of complete proximate analysis of the drug, see *Proc. Amer. Pharm. Assoc.*, 1900, vol. 48, pp. 216–232.

Pharmaceutical Preparation.—FLUIDEXTRACT OF EUPATORIUM, U. S. P.

Action and Uses.—Eupatorium is rarely prescribed by the physician, but is largely employed by the laity. It is a stimulant tonic in small doses, a laxative in large doses, and an emetic or diaphoretic in warm infusion. A hot infusion is most commonly employed for the purpose of aborting beginning colds, early bronchitis, sore throat, and similar acute inflammations. Boneset has also been used in the treatment of influenza, but its efficacy is questionable. Like other simple bitters, it may be employed in atonic dyspepsia, but it has no especial advantage over the others.

The infusion is made by macerating 1 ounce (30 Gm.) of the drug with 1 pint (480 Cc.) of boiling water for 2 hours. The dose of the drug in substance is stated to be from 20 to 30 grains (1.3–2 Gm.); of the infusion, from 1 to 2 ounces (30–60 Cc.); of the fluidextract, from 20 to 30 minims (1.30–2 Cc.).

Other Species.—The genus *Eupatorium*, L., as at present regarded, contains some 400 species, but we believe it should be divided. All but about a dozen are American, and most of them are tropical. In almost every part of America, and in some other countries, one or more species are used domestically as thoroughwort is used here. The use of nearly 50 species has been so recorded, but we can here mention only the most important of them.

The roots of *E. purpureum* L. and *E. maculatum* L., both known as *Purple boneset*, *Joe-pye weed*, *Queen-of-the-meadow*, *Near-weed*, *Skunk-weed*, or *Devil's-root*, both with reddish-purple flowers and whorled leaves, the former very abundant in low lands throughout eastern and central North America, the latter (*Spotted joe-pye weed*, etc.) in the middle-eastern coast region, are used partly for their astringent, partly for their diuretic effects. It yielded to assay 0.07 per cent. of volatile oil, 0.25 per cent. of resin, 0.53 per cent. of fat, 0.29 per cent. of wax, 2.76

per cent. of gum, 2.88 per cent. of dextrin, 2.04 per cent. of saccharose, 2.29 per cent. of glucose, 1.82 per cent. of calcium oxalate, euparin, and 14.9 per cent. of ash. *Euparin* ($C_{12}H_{11}O_3$) is a yellow neutral crystalline principle, soluble in hot alcohol, slightly so in cold alcohol, and insoluble in water. It is distinct from quercitrin or quercetin, which it was formerly thought to be. Its crystals may deposit from the fluid extract.

The following species are rather richer in volatile oil than *E. perfoliatum*, and are used rather for their aromatic and diuretic properties: *E. ageratoides* L. f., the *White* or *Indian sanicle*, *White snake-root*, or *Pool-root*, common, chiefly in rich rocky woodlands of eastern North America, slender, weak, widely branching, nearly or quite smooth, the leaves slenderly petioled, thin, 7 to 15 Cm. (3 to 6 In.) long, broadly ovate, acuminate and acute, sharply and irregularly dentate-serrate, 3-ribbed, the flowers beautiful, snow-white, about 10 to 30 in the head, the involucre narrowly bell-shaped, about 4 Mm. ($\frac{1}{6}$ In.) long; *E. aromaticum* L., the *Small boneset* or *Wild horehound*, chiefly of the Atlantic coast region, is slender, erect, nearly simple, very finely hairy, the leaves 4 to 8 Cm. ($1\frac{1}{2}$ to 3 In.) long, broadly ovate, with mostly cordate base and acute or obtuse summit, thickish, shortly and stoutly petioled, serrate, 3-nerved, the heads crowded, dull-white, scarcely so large as the last, about 10–25-flowered; *E. cœlestinum* L., the *Blue boneset* or *Mist flower*, abundant in damp lands of the southern Atlantic and Gulf States, the flowers like those of *E. ageratoides*, but bright-blue; *E. capillifolium* (Lam.) Small (*Artemisia c.* Lam.; *E. fœniculoides* Walt.; *E. fœniculaceum* Willd.), the *Dog-fennel* or *Hog-weed* of our southern coast region and the West Indies, the heads very small and innumerable, the leaves divided into numerous capillary divisions several inches in length, its volatile oil peppery-biting; *E. cannabinum* L., the *Hemp*, *Water*, or *Dutch agrimony*, *Water* or *Bastard hemp*, *-Wasserdost* or *Wasserhanf*, is a European species similarly used; *E. Aya-Pana* Vent., the *Aya-pana*, *Nya-pana*, *Heilsamer Wasserdost*, of Brazil, is used there almost exactly as thoroughwort is here, its composition being very similar. It is also one of the very numerous plants there credited with alexipharmic properties.

EUPHORBIACEÆ.—The Spurge Family.

Genera more than 200; species more than 3000, representing almost all habits of growth and exhibiting a high degree of adaptability to varying environment. By its combination of botanical characteristics, the family is peculiarly isolated and its position in the system is problematical. Its economic importance depends almost wholly upon the substances extracted and upon the medicinal uses of its members. Edible products, other than starchy roots (see Tapioca, under AMYLUM), are few, and there are few useful woods or fibers, though some of the former enjoy special uses.

A number of dyes have in past times possessed some degree of importance. The valuable rubbers produced by this family are considered under ELASTICA. The medicinal properties depend chiefly upon two classes of constituents: first, fixed oils or the fatty acids freed by their decomposition, for the typical properties of which see OLEUM RICINI and OLEUM TIGLII; second, substances carried in the milk-juices which characterize the entire family. These medicinal constituents are also in great part responsible for the prevailing and severely poisonous properties, external and internal, though the latter are in some cases due to albuminous substances similar to *ricin* (see OLEUM RICINI).

Cascarilla and some others are used as bitter tonics, but the important medicinal properties may be grouped under two heads: counterirritants, and purgatives or laxatives; depending upon which latter are many and important uses as alteratives, well illustrated in STILLINGIA.

FIXED OILS.

Of the numerous fixed oils which have been expressed from the seeds of these plants the following are of importance:

Aleurites, *Candle-berry*, *Kakuin*, *Lambang*, or *Artist's oil*, is a fixed oil expressed from the seeds of *Aleurites Moluccana* (L.) W. (*Jatropha M.* L.; *A. triloba* Forst.; *Juglans Camirum* Lour.). This is a small tree of the East Indies and Pacific islands, bearing a fruit resembling a small orange in appearance and containing 2 large seeds known as *Candle-nuts*, *Indian Belgaum*, *Tahiti*, *Spanish*, or *Country walnuts*, *Lambang nuts*, *Kukuli*, *Firniss*, or *Kerzennuss*. They yield 60 per cent. of the oil, which belongs to the drying class, is of a clear amber-yellow color, free from odor, and of a bland and pleasant taste. Its properties vary greatly with its character. The seeds are frequently eaten for the sake of the oil, and the oil itself, if obtained without artificial heat and fresh, has no medicinal action; but if expressed between hot plates, perhaps because of the freeing of its fat-acid, perhaps because of the removal with it of some resinous matter, it is a mild and useful purgative in doses of from $\frac{1}{2}$ to 2 ounces. A similar oil is obtained from the seeds of *A. laccifera* W., which yields a kind of lac (see LACCA).

Chinese wood oil is a very similar fixed oil expressed from the seeds of *A. cordata* Steud. (*Elæococca c.* A. Juss.; *E. vernicia* A. Juss.; *Dryandra c.* Thunb.; *D. vernicia* Correa), one of the *Tung-trees* of the East Indies. This oil is a very important article of commerce in Eastern countries, almost wholly replacing paint in Central China. It is brownish and of a disagreeable odor, if extracted by the aid of heat; or nearly odorless and colorless, if cold-drawn. It is somewhat more fluid than castor oil. It has a specific gravity of 0.94 at 15.55° C. (60° F.), remains liquid at —13.3° C. (8° F.). 100 Gm. of the oil require 0.39 Gm. of caustic potash for neutralization and 21.1 Gm. for complete saponification (Davies). Wood oil is said to be the most perfectly drying oil known.

Chinese Tallow.—This is a fat which comprises almost the whole of the pulp of the fruit of *Sapium sebiferum* (L.) Roxb. (*Croton s.* L.; *Excœcaria s.* Muell. Arg.; *Stillingia s.* Mx.), of China and the East Indies. It is white, consists chiefly of palmitin, with a little stearin, and melts at 44.5° C. (112° F.). The seeds contain a drying oil very similar to that of *Aleurites*.

Other fixed oils more or less resembling those of croton and castor are chiefly or wholly responsible for the activity of certain seeds considered under those two titles.

CATHARTIC DRUGS.

Besides the cathartic properties resident in the fixed oils of the seeds already considered, somewhat similar properties, almost always accompanied by more or less emesis, exist in the plant-parts generally, the active constituents being usually carried in the milk-juices, so that the family has yielded a large number of drugs used somewhat like ipecac. Although these uses are at present chiefly by the laity, some of the drugs have occupied a prominent place in professional medicine.

Euphorbia, L.—This genus, which will at length probably be found to comprise nearly a thousand species, has yielded the principal drugs of the group under consideration. The following are the most important of them, the two first described having been long official in the U. S. P.:

E. corollata L. is the *Large-flowering*, *Blooming*, or *Purslane spurge*, or *White purslane* or *Parsley*, *Purging-* or *Emetic-root*, *Apple-root*, or *Wild hippo*, of eastern and central North America. Although all parts of the plant are active, the root has been chiefly employed. The plant is a smooth perennial, growing in sandy and mostly in low situations, with a slender, more or less branched stem, nearly a yard high, bearing alternate, linear-oblong, obtuse leaves, and umbellate-cymose flowers, their involucres white, showy and petal-like, a greenish gland at the base of each bract. The root should be collected in autumn. It is vertical and mostly simple, reaches as much as 2 feet in length and about an inch in thickness, is cylindrical, dark-brown or even blackish, and wrinkled externally. The fracture is nearly smooth and exhibits a thickish white bark underneath the cork, enclosing a whitish, spongy, porous, many-radiate wood. It is almost odorless, sweetish, and afterward warming to the mouth. The root abounds in laticiferous ducts, the latter containing, as usual in the family, resin and gum. There is also considerable starch. The resin is, or carries, the active principle. The presence of a glucoside is conjectural. *Euphorbon* (see *Euphorbium*, below) is present in this and the related drugs. *Euphorbia corollata* is rarely employed in medicine at the present time. Formerly it was occasionally used as an emetic in doses of 20 grains (1.30 Gm.), but because of its irritant and uncertain properties its use has practically been abandoned.

E. Ipecacuanha L., the *North American*, *Carolina*, *Milk*, *Spurge*, *White* or *Wild ipecac*, *Black* or *Ipecac spurge*, occurs abundantly in pure sand along the Atlantic coast. It is quite smooth, the peculiar, slender, cymosely branching, at length diffusely prostrate stems bearing extremely variable leaves, ranging from narrowly linear to broadly oval or obovate. The inflorescence is greenish or more or less purplish, small and inconspicuous. The root is much like the last, but becomes two or three times as long, and is usually not so thick, the outer surface grayish-yellow or brown, the wood yellowish. Its constituents are practically the same as those of the last.

E. Cyparisias L., the *Cypress*, *Balsam*, or *Quacksalver's spurge*, *Graveyard weed*, *Bonaparte's crown*, or *Tree moss*, is a well-known European species of cultivation, frequently seen in cemeteries, its densely tufted slender stems occasionally reaching a foot in height, and densely leafy, the leaves linear, an inch or two in length and bluish-green, the terminal umbellate inflorescence bright-yellow. Its root is light-colored, slender, and somewhat crooked.

E. Lathyrus L. (see also under Oleum Tiglii) is purgative in all its parts, and both the roots and herbage have long been used in Europe.

E. maculata L., the *Spotted spurge*, an exceedingly common annual prostrate weed, found in nearly all cultivated grounds throughout America, represents a group used by eclectics and homœopaths, with claims for properties more or less special, but all probably closely similar as to both constituents and properties. It has been found to contain caout-

chouc, resin, tannin, and apparently euphorbon. To this medicinal group belong the following: *E. Esculа* L., the *Leafy spurge* of Europe; *E. Helioscopia* L., the *Sun* or *Wart spurge, Wart weed, Churn staff, Seven sisters*, etc., of Europe; *E. humistrata* Engl., of central North America; *E. hypericifolia* L., commonly growing with *E. maculata* and very abundant; *E. portulacoides* Gay, of Chile; *E. lata* Engelm, of the United States; *E. marginata* Pursh, the *White-margined spurge* or *Mountain snow*, a plant of striking appearance, growing throughout the western United States; *E. Peplus* L., native of Europe and almost invariably naturalized. *Euphorbia maculata* is said to be a valuable astringent in the treatment of chronic diarrhœa, and an infusion of it may be employed as an injection in the treatment of leucorrhœa.

Jatropha, L.—The seeds of several species of this genus are considered in connection with Oleum Tiglii. The roots, and in some cases the herbage, of several species are also employed. In Honduras, the large cylindrical root of one is called *Ruibarbo* (rhubarb), and is there generally employed as a substitute for that drug, which it closely resembles in the fresh state. *J. macrorhiza* Benth., of the southwestern United States and Mexico, is similarly employed, and has been introduced to the American profession. The root is described as tuberous, short, and very thick. Its fluid extract is said to be a laxative-cholagogue in doses of ½ to 2 fluidrachms. The seeds and their oil are also employed, the action of the latter being apparently similar to that of croton oil.

Croton dioicum Cav.—The roots and seeds of this Mexican plant, *Yerba del Zorillo*, are there employed as a purgative and alterative. The dose of the powdered dried root is ½ to 1½ Gm.

Phyllanthus Niruri L., the *Bhuimy-amali, Daou Marasin*, or *Pombinha*, of various tropical countries, is a much used laxative-alterative, especially against jaundice. Many species of *Phyllanthus* are employed as diuretics.

Acalypha Indica L., the *Kuppi, Dadaro, Chalmari*, or *Brennkraut*, is very largely employed in the East Indies as a purgative and anthelmintic, as are several species of *Tragia*, of both the Old and New World tropics.

ALTERATIVE DRUGS.

Under this term, a large number of species of *Euphorbia* and related genera have been employed in syphilis and related diseases, and are still so used by many physicians. The alterative effects, which are undoubtedly produced, appear to result from the depurative action dependent upon laxation or mild catharsis.

Mercurialis annua L., the *Mercury herb* or *French mercury*, and *M. perennis* L., the *Dog's mercury, Kentish balsam, Bristol weed*, or *Cheadle*, both of Europe, are thus employed. They have been found to contain the volatile alkaloid *monomethylamine*, with a little *trimethylamine*, to which are doubtless due the acrid properties, which are destroyed by boiling.

Euphorbia pilulifera L. is commonly known as the *Pill-bearing spurge*, in allusion to its small globular axillary inflorescences. It is called *Queensland asthma weed, Cat's hair*, etc. It is an exceedingly common little hairy weed, in all tropical countries, the stems about a foot long and covered with long, rather coarse yellowish hairs, the entire plant, including the root, otherwise of a red or reddish-green color. Its principal constituents are resins, which are indefinitely described as "glucosidal." It is distinguished by its transversely wrinkled seeds from the closely similar *E. parviflora*, which have been falsely substituted, the seeds of which are merely granular or slightly papillose. *Euphorbia pilulifera* has been employed by some practitioners with asserted success in the treatment of subacute and chronic inflammation of the respiratory tract. It may be given in doses of from ½ to 1 drachm (2–4 Cc.) of a fluidextract, 3 times daily; but because of its acrid properties this amount may occasion gastric pain and nausea. Because of the fact that it stimulates the circulation and respiration it has also been given with good results in the treatment of asthma.

The bark of *Croton erythæma* Mart. is used in Brazil as an astringent in intestinal and genito-urinary diseases, under the name *Casca de sangre de Drago*, in the form of a syrupy extract.

COUNTERIRRITANTS.

The milk-juices of many of the *Euphorbiaceæ* are more or less irritant to the skin, some of them so intensely as to be dangerous cutaneous poisons. The name *Blinding-tree* has been applied to the *Excœcaria Agallocha* L., of the East Indian tidal forests, because of the destruction of eyesight sometimes caused by the accidental contact of its milky juice. An examination of this latex has failed to reveal anything of importance, with the exception of 25 to 30 per cent. of the resin *fluavil*, and nothing to account for its irritant action.

Hura.—Precisely similar to the blinding-tree, as to accidents to sight, is *Hura crepitans* L. (*H. Brasiliensis* W.), the *Sandbox-tree, Monkey's dinner-bell, Ajuapar, Assacu, Javilla, Solimán, Habilla de San Ignacio*. This is a good-sized forest-tree, very common and abundant throughout tropical America. Its trunk is beset with short, stout, pyramidal spines, and the

caustic milky juice of the bark appears to be retained under pressure, since it spatters out with some slight violence. Since the wood is very quickly destroyed by borers and decays when the continuity of the bark is destroyed, the juice and the spines together apparently constitute a needed defensive provision. The apple-shaped fruit is peculiar for its habit of bursting, when dry, with a loud report. The juice, and hence the bark, contain two acrid principles, one oily and volatile, and the other (*hurin*) crystallizable. Both bark and leaves are used externally as counterirritants and for their anthelmintic properties. For internal use, ½ ounce of the bark is boiled in 1 pint of water down to ½ pint; while for external use, as an antirheumatic lotion, a saturated aqueous infusion is employed. Overdoses are dangerously emetico-cathartic. The fixed oil of the seeds is occasionally used as a drastic.

Alvelos, or *Alveloz*, is the very similar juice, used fresh or preserved by the aid of salicylic acid, of *Euphorbia heterodoxa* Muell. Arg., of Brazil. It has been largely employed by resident physicians as an escharotic application to morbid growths, especially those of a malignant nature. It is applied either pure or in the form of the resinous precipitate. For a mild action, a 3 per cent. ointment of the resin is commonly employed. That absorption can occur is evident from an irritant and peculiarly odorous renal excretion which often appears after continued application.

Euphorbium, P. G. (*Euphorbe, Gomme-résine d'euphorbe*, Fr.; *Euforbio*, Sp.), is a gum-resin obtained from *Euphorbia resinifera* Berg., a peculiar, cactus-like plant of Morocco, with quadrangular stems, and very spiny from its modified stipules, otherwise leafless. The milk-juice exudes and coagulates upon the spines, and is collected as *Euphorbium*. So intensely irritating is the dust that the mouth and nose of the collector require careful protection. It occurs in conical or triangular-conical pieces, often containing a perforation where it was removed from the spine, or in irregular fragments of such forms. The spines themselves are often imbedded in the fragments. It is of a light brownish-yellow, somewhat waxy and translucent, brittle, almost odorless, but violently sternutatory, and leaving an acrid and burning after-taste. When heated, it emits a slightly benzoin-like odor, and it is fusible and combustible like other resins. It yields a turbid mixture, but not an emulsion, with water, and is not perfectly soluble in any of the ordinary solvents. Euphorbium consists principally of two resins: one (about 40 per cent.) amorphous, bitter and acrid, apparently of the formula $C_{10}H_{16}O_2$; the other (about 22 per cent.), *euphorbon* ($C_{13}H_{22}O$), crystalline and soluble in ether, benzene, benzin, amyl alcohol, chloroform, and hot alcohol, but requiring 60 parts of alcohol at the ordinary temperature. The acridity of the first-mentioned resin is destroyed by boiling in a weak solution of potassium permanganate. There are also 18 per cent. of gum, 12 per cent. of malates, chiefly of calcium and sodium, and 10 per cent. of mineral matter.

The euphorbium district, upon the lower slopes of the Atlas Mountains, appears capable of supplying any reasonable demand, but for various reasons commercial supplies have been very irregular, and a number of other products, very similar and all apparently from related species of *Euphorbia*, have appeared. It is highly probable that many species of the genus are capable of yielding substances practically identical with euphorbium. The fresh juice and the powdered dry plant are powerful stimulants and irritant cathartics and emetics. When locally applied to the skin they produce vesication, and ointments and plasters containing this drug may be used as counterirritants in the treatment of sciatica and similar conditions. Because of its irritant properties it is no longer employed in internal medicine. This drug is of considerable commercial value, as it is used in coating the bottom of vessels and other objects liable to the destructive attacks of marine worms.

Manchineel, or *Manzanillo*, is the resinous exudation, also the fruit, of *Hippomane Mancinella* L., a large West Indian tree. Marvellous stories are told of the intensity of its poisonous properties. The fruit poisons the fish of the waters into which it falls. An arrow poison is said to be made from the milky juice, which is externally caustic and internally an emetico-cathartic poison. The principal poisonous constituent is claimed to be volatile, but the correctness of the statement is very doubtful.

The milky juice of *Euphorbia Drummondii* Boisa, of Australia, is externally irritant and is a destructive cattle poison, locally known as *Caustic creeper*. A peculiar symptom of poisoning by it is said to be the enormous swelling of the head, followed by suppuration. A claim has been made that it contains a crystalline alkaloid. According to Maiden, E. *alsiniflora* Baill. acts similarly.

MISCELLANEOUS SUBSTANCES.

Jatropha urens L. (*Cnidoscolus neglectus* Pohl.), the *Fructo de Arradiabo* of tropical America, has its leaves and fruit beset with peculiar glandular hairs, which sting violently, blister, and, due partly to the irritation and partly apparently to absorption, cause severe fever. The fresh leaves, thoroughly macerated, are applied as a rubefacient or stimulating poultice. The

seeds, as in so many other species, contain a purgative fixed oil to the extent of about 31 per cent.

Crozophora tinctoria A. Juss. yields an indigo, and is a fatal poison, the symptoms being great abdominal pain, constipation, jaundice, and bilious vomiting, bloody and bilious urine, bleeding at the nose, dilated pupil, and stupor.

Cleistanthus collinus Benth. (*Lebedieropsis orbicularis* Muell. Arg.), the *Kodarsi*, *Telugu*, or *Oduvan*, is an excellent timber-tree of India, all parts of which are poisonous, the pericarp especially so, and used for criminal purposes. An infusion, or powder, of the bark, is promptly fatal to insect parasites on animals. This bark is dark-brown externally, otherwise reddish-brown, its powder light-red, without special odor, the taste merely astringent. It yields one-third of its weight of an excellent tannin. It has been claimed that this tannin is the poisonous constituent, but the statement is open to doubt, there being probably some poisonous constituent associated with it.

Toxicodendron Capense Thunb. (*Hyænanche globosa* Lamb.), of South Africa, is highly poisonous. Its active principle is the amaroid *hyænanchin*, which acts like strychnine, though affecting the cerebrum more than that substance.

The bark of *Flueggia leucopirus* W., of the East Indies, is a fish poison, and many species of the genus *Phyllanthus* are also so used. *Phyllanthus Urinaria* L., the *Jaramla* or *Tamravalli* of the East Indies, is used as a powerful diuretic, carminative, and antispasmodic, and is abortifacient.

Not less than 300 other species of this remarkable family are recorded in literature as having more or less important aboriginal or domestic uses as fish poisons, or as being otherwise poisonous, as purgatives, diuretics, anthelmintics, carminatives, antispasmodics, counter-irritants, vulneraries, insecticides, etc.

Buxaceæ.—This is a very small family of only 6 genera and about 30 species, and is closely related to the *Euphorbiaceæ*. A single species, *Buxus sempervirens* L., has been utilized in medicine. This is the well-known evergreen shrub cultivated under the name of *Box*. Its twigs are very densely leafy, and the leaves, the part used, are about half an inch in length, ovate, entire, smooth, thick and coriaceous, and dark-green. They have a peculiar, rather disagreeable odor, and a bitter and somewhat astringent taste. They have been found to contain, besides a small amount of tannin and unimportant constituents, a butyraceous volatile oil, and two alkaloids, *buxine* and *parabuxine*, the former being the important constituent and chiefly responsible for the bitter taste. Buxine is now regarded as identical with beberine, an account of which is given in connection with Nectandra Bark. Box has been found narcotic and sedative in full doses, emetico-cathartic and convulsant in overdose. It has been used as a bitter tonic and antiperiodic, and also as an alterative in rheumatism, syphilis, etc. Given in decoction, it exerts a diaphoretic action.

EXTRACTA.—Extracts.

Extraits, Fr.; *Extrakte*, G.; *Estratto*, It.; *Extractos*, Sp.

Extracts are permanent, soft, solid, or dry preparations obtained by evaporation of a solution of the medicinal principles of drugs. These solutions are prepared, as a rule, from the powdered dry drugs by exhausting them with appropriate solvents, preferably by percolation, the solvents or menstrua employed being either water, water and alcohol, alcohol, or ether. According to the different menstrua used in the manufacture, extracts are designated as aqueous, hydro-alcoholic, alcoholic, and ethereal extracts, the last-named class being recognized more particularly under the name of oleoresins. In fresh plants the solution of the medicinal principle is represented by the juice, and may be obtained by expression; extracts prepared by simple evaporation of the fresh juice of a plant are known as inspissated juices.

The U. S. Pharmacopœia does not recognize inspissated juices, since the narcotic herbs which are extensively used in Europe for this purpose are not indigenous in the United States. The juice is obtained from the fresh plant, after removal of extraneous matter, by bruising in a stone mortar with the aid of a hard-wood pestle until reduced to a smooth pulpy mass, which is then strongly expressed in canvas bags; in order to recover all the juice, the residue is often mixed with water and again expressed. When the plant is not sufficiently moist to enable the formation of a soft pulp, water is sprinkled over it from time to time.

Besides the medicinal principles, the expressed juices of fresh herbs contain also mucilaginous and albuminous matter in solution and variable quantities of chlorophyl or green coloring-matter in suspension; of these, the albuminous principles are most objectionable, as upon concentration of the juice they undergo change and are likely to render the finished extract tough and insoluble. When roots are expressed, as in the case of the corm of colchicum, starch, which is present in the juice in place of chlorophyl, passes

through the press-cloth, and must be removed by subsidence and decantation. The British, German, and French pharmacopœias direct the removal of albuminous matter by heating the juice to from 80° to 90° C. (176° to 194° F.) and filtering. The coagulated albumin envelops the green coloring-matter and removes it also, which fact is disregarded in Germany and France, and accounts for the brown color of the extracts made from fresh herbs in those countries. In Great Britain the chlorophyl is carefully separated by heating the fresh juice to 55° C. (131° F.) and straining through calico; the liquid is then heated to 94° C. (201.2° F.), and, after filtering out the coagulated albumin, evaporated to a thin syrup, the chlorophyl is reincorporated, and evaporation continued, with constant stirring, at a temperature not exceeding 60° C. (140° F.), to the proper consistence. This explains the firm condition and fine green color of some of the British narcotic extracts. The German Pharmacopœia alone provides for the removal of the gummy matter, and hence its narcotic extracts are relatively much stronger than those of the British and French pharmacopœias. The solubility of gummy matter is not in any way affected by heating, and therefore the filtered liquid, after removal of the coagulated albumin and chlorophyl, is evaporated to 10 per cent. of the original weight of the fresh herb used, mixed with an equal volume of alcohol, and set aside for 24 hours to allow the precipitated gum to subside. After decantation the precipitate is washed with diluted alcohol, which is added to the other clear liquid, and the whole evaporated to the condition of a soft solid.

Consistence of Extracts.—The U. S. Pharmacopœia recognizes two kinds of solid extracts, those of pilular consistence and those evaporated to complete dryness. A pilular consistence is such a condition as will allow the extract to be rolled into masses of pilular form without adhering to the fingers or subsequently losing shape; this is rarely met with in the market, except in the case of British narcotic extracts, which derive their firmness chiefly from the chlorophyl and gummy matter present. Pilular consistence for the extracts made in this country, by the official formulas, is practically unattainable at all seasons, for extracts made in summer are likely to become too hard in winter, while those evaporated to the proper consistence in winter are prone to soften in summer. Some extracts become tough and hard in the course of time, but may be retained in proper condition by incorporating with them, while still warm, 10 per cent. of their weight of glycerin. The condition of complete dryness is not applicable to all extracts, but can be readily maintained for all those so directed by the Pharmacopœia, provided heat and moisture be excluded.

Of late years, powdered extracts have come extensively into demand, and their convenience in dispensing pharmacy cannot be denied. Sugar of milk is to be preferred, wherever possible, as a diluent on account of its perfect solubility, but in some cases finely powdered licorice root has been found much better for maintaining the pulverulent condition of the extract, especially during damp or warm weather. The respective finely powdered drugs have also been used with success as diluents. Large manufacturers, as a rule, now prepare powdered extracts by evaporating the percolate to dryness in vacuum stills, where concentration and desiccation can be effected at a low temperature without possible injury to the constituents in solution; the dry extract is subsequently reduced to fine powder in pebble-mills, whereby heat is avoided. Powdered extracts may readily be prepared of definite strength, especially those which owe their medicinal value to alkaloidal or resinous constituents; and in the absence of specific constituents to be used as a basis for standardization, the Pharmacopœia has directed that they shall bear a definite relation to the crude drugs from which they have been respectively made. Such relation represents in some cases 4 times and in others 10 times the weight of crude drug. In Germany, powdered narcotic extracts are prepared of one-half the original strength of the extract, by addition of finely powdered licorice root.

The Abstracts of the U. S. Pharmacopœia for 1880 were closely allied to the present powdered extracts. They were much weaker preparations, being made to represent twice their weight of crude drug. The general plan for preparing abstracts was to make a fluidextract of the drug with strong alcohol, mix this with some sugar of milk, dry by spontaneous evaporation in a warm place, then add sufficient sugar of milk to bring the product up to one-half the weight of the powdered drug used, and finally reduce to a fine powder.

To avoid the tendency of powdered extracts to cake, caused by their hygroscopic nature, A. B. Lyons, in 1899, introduced a line of extracts in the form of scales, for

which it is claimed that they are in many respects superior to powdered extracts. These scale extracts are obtained, according to the statement of Lyons, by first preparing a highly concentrated liquid extract of the respective drugs by the use of menstrua which leave behind as much inert constituents as possible. Having ascertained by experiment how much dry residue is obtainable from these liquid extracts, sufficient acacia is added to insure a definite standard of strength, which has previously been fixed upon, in the finished product. The solution is then spread on plates of glass and dried in a current of warm air. The particular menstrua used for the different drugs have thus far not been made known. Scale extracts somewhat resemble the iron scale salts in appearance, and with warm water readily form more or less turbid solutions. As in the case of powdered extracts, those owing their value to alkaloids are brought to a definite standard of alkaloidal percentage; but in the case of other scale extracts a uniform strength has been adopted corresponding to 4 times the weight of the drug represented.

Changes by Evaporation.—All plants contain one or more principles, which, though originally colorless, are very easily altered under the influence of air and heat, acquiring a yellow or brown color. It is not known whether the so-called *colorless extractive* is alike in all plants, neither is its composition or the nature of the changes produced under the conditions mentioned known, except that the heat of boiling water and the prolonged action of oxygen will convert it ultimately into a blackish insoluble substance, to which the name *apotheme* has been given, and which appears to be allied to *humin*. Extractive is almost insoluble in absolute alcohol and ether, but dissolves freely in weaker alcohol and water, and is removed from its solution by animal charcoal and aluminum hydroxide, the more readily after it has become colored by oxidation. It is with difficulty freed from admixtures, and the terms sweet, bitter, acrid, etc., as applied to extractives, refer to the same body in a more or less altered condition, combined or intimately mixed with other principles to which the peculiar taste is due. The injurious influence of air and heat upon the vegetable juices is mainly confined to the alterations of this extractive, and extends, in a limited degree only, to the majority of the well-defined principles. Its effects have been much overrated, except as regards the appearance of the extracts. The color of the different extracts varies with the nature of the drug from which they have been made, but should never be black. The characteristic taste, and to some extent also the odor of the drug, should be perceived in its extract, and it should yield a nearly clear or moderately turbid solution with the menstruum used in its preparation.

Aqueous Extracts.—While decoction in some cases increases the yield of extract, by bringing into solution starch and other inert matter, it more frequently injures the quality of the product by inducing changes in certain principles which do not occur by infusion at lower temperatures. There is but one instance, that of extract of logwood, in which the Pharmacopœia directs extraction by boiling, and this is on account of the difficulty of exhausting the tough wood. In Europe, digestion is still preferred for a few aqueous extracts, but, as a rule, maceration and percolation with cold water have been found to yield superior extracts. For the better extraction of the active virtues of the drug, an addition of acid or alkali is sometimes made, as in the case of the official extract of colchicum root and pure extract of glycyrrhiza. In the preparation of aqueous extracts the solution is freed from objectionable matter, whenever necessary, by heating to the boiling-point and straining before final evaporation.

In 1889, the plan of concentrating large volumes of aqueous solutions of extracts by means of cold was formulated by M. Adrian, a French pharmacist, and put into practice on a large scale. Following the suggestions of Herrera (1877), M. Adrian subjects the filtered aqueous solutions to a temperature of —20° C. (—4° F.), in an ammonia ice-apparatus, and thus obtains large blocks of ice in which the extractive solution is enveloped, the pure water alone freezing; these blocks of ice are rapidly converted into snow by means of large shaving machines. Another French pharmacist, M. Vee, prefers to convert the aqueous solution into a crystalline magma instead of solid blocks of ice, and accomplishes this by keeping the liquid in constant agitation during the freezing process. The snow-like mass is placed in centrifugal extractors, where about 75 per cent. of water is removed. The remaining solution is again subjected to cold (even a lower temperature than at first), when a syrupy liquid is obtained, which can readily be evaporated to a solid extract, in a vacuum apparatus, at a temperature not exceeding 30° C. (86° F.). Extracts thus prepared are lighter in color than those obtained by ordinary vacuum or

open-air evaporation, form almost clear solutions with water, and possess the odor and taste of the drug in a marked degree. It has been found that all vegetable matter in solution is retained in its original condition, even the albumin, water alone being removed.

Alcoholic and Hydro-alcoholic Extracts.—For these two classes of extracts percolation is decidedly the best method of extracting the medicinal principles of the drugs, the operation being continued to complete exhaustion. If percolation be conducted at the rate of 5 drops per minute, from 3 to 4 Cc. of percolate should suffice for each Gm. of drug. In many cases, particularly those of the mydriatic drugs, active principles of which are easily split up by prolonged application of heat, it is very desirable to set aside the first third of the percolate as reserve, to be incorporated with the remainder when this has been reduced to the condition of a syrupy fluid. The recovery of the alcohol is effected, as in the case of fluidextracts, by distillation in a suitable still, the final evaporation being conducted in porcelain dishes, with constant stirring, so as to insure a homogeneous mass and prevent the separation of resinous and other matter. As the concentration of the solution approaches the condition of a thick syrup, continuous stirring is also necessary, to prevent the formation of a film, which, becoming gradually thicker, retards evaporation of moisture, and consequently causes an accumulation of heat within the mass, to the possible injury of some of the constituents. In large manufacturing establishments mechanical stirrers are conveniently operated by steam, electric, or water motors. Metallic stirrers should never be employed, only those of porcelain, glass, or wood being permissible. To guard against the separation of coloring-matter or changes in other constituents of the solution, concentration should always be effected on a water-bath, at a temperature not exceeding 55° C. (131° F.).

EXTRACTUM ALOES, *U. S., P. G.*—Extract of Aloes.

Extractum aloes barbadensis, Br.; *Extrait d'aloès*, Fr.; *Aloeextrakt*, G.; *Estratto di aloe acquosa*, It.

Preparation.—Aloes, 100 Gm.; boiling distilled water, 1000 Cc. Mix the aloes with the water in a suitable vessel, stirring constantly, until the particles of aloes are thoroughly disintegrated, and let the mixture stand for 12 hours; then pour off the clear liquor, strain the residue, mix the liquids, and evaporate to dryness by means of a water- or steam-bath.—U. S.

The Br. P. process is almost identical with the foregoing, except that the mixture is set aside for 24 hours and the decanted and strained liquid is directed to be evaporated at a temperature not exceeding 60° C. (140° F.). The P. G. directs that the aloes be dissolved in 5 parts of boiling water, the solution then mixed with 5 parts of cold water and set aside for 2 days, after which it is decanted and evaporated to dryness. German extract of aloes is made from Cape aloes, since that variety only is officially recognized.

The object of using so large a proportion of water is to avoid the admixture of resin, for a concentrated aqueous solution of aloes retains in solution the resin present, whereas a dilute solution again deposits it on cooling. Complete separation of resinous matter is impossible, and hence the extract does not yield a perfectly clear solution with water.

The yield of dry extract varies from 20 to 50 per cent. according to the variety of aloes and care used in manufacture. When powdered, the extract is of a yellowish-brown color.

Action and Uses.—See ALOES. Dose, from 1 to 2 grains (0.06–0.12 Gm.).

EXTRACTUM ANTHEMIDIS, *Br.*—Extract of Chamomile.

Extractum chamomillæ Romanæ.—Extrait de camomille romaine, Fr.; *Römisch-Kamillenextrakt*, G.

Preparation.—Take of chamomile flowers, 1 pound; oil of chamomile, 15 minims; distilled water, 1 gallon. Boil the chamomile flowers with the water until the volume is reduced to one-half, then strain, press, and filter. Evaporate the filtrate to the consistence of a soft extract, adding the oil of chamomile toward the end of the process.—Br.

It is a dark-brown extract having the odor and bitter taste of chamomile. It would seem not to be very difficult to work out a better process, in which the protracted boiling should be avoided.

Action and Uses.—See ANTHEMIS. Dose, from 2 to 10 grains (0.12–0.60 Gm.).

EXTRACTUM BELLADONNÆ FOLIORUM, *U. S.*—Extract of Belladonna Leaves.

Extractum belladonnæ foliorum alcoholicum, U. S., 1890.—*Extrait de belladone alcoolique*, Fr.; *Spirituöses Tollkirschenextrakt*, G.; *Estratto di belladonna*, It.

Preparation.—Belladonna leaves, in No. 60 powder, 1000 Gm.; alcohol, water, each a sufficient quantity. Mix 2000 Cc. of alcohol with 1000 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until 3000 Cc. of tincture are obtained or the belladonna leaves are exhausted. Reserve the first 900 Cc. of the percolate, evaporate the remainder to 100 Cc. at a temperature not exceeding 50° C. (122° F.), mix the residue with the reserved portion, and evaporate at or below the above-mentioned temperature to a pilular consistence.

When assayed by the process which follows, extract of belladonna leaves should be found to contain not less than 1.4 per cent. of total alkaloids. Should it be found by assay to contain more than this percentage, sufficient sugar of milk should be added to reduce it to the standard of 1.4 per cent.

Assay of Extract of Belladonna Leaves.—Extract of belladonna leaves, 5 Gm.; alcohol, ammonia water, distilled water, chloroform, normal sulphuric acid, one-tenth normal sulphuric acid, one-fiftieth normal potassium hydroxide solution, hæmatoxylin or iodeosin test-solution, of each a sufficient quantity. Weigh into a small dish 5 Gm. of extract of belladonna leaves and dissolve it in a mixture of alcohol 5 Cc., distilled water 10 Cc., ammonia water 2 Cc., and chloroform 20 Cc. When dissolved, transfer it to a separator, rinsing the dish with a little alcohol. Cork the separator and shake for several minutes. Draw off the chloroformic layer into a second separator, and add to the contents of the first separator 10 Cc. more of chloroform. Shake for several minutes, allow to separate, and again draw off the chloroformic layer into the second separator. Repeat this with 10 Cc. more of chloroform. To the united chloroformic solutions in the second separator add 10 Cc. of normal sulphuric acid and 10 Cc. of distilled water, and shake for several minutes. Draw off the chloroformic layer, after the liquids have separated, into a clean separator, and the aqueous fluid into a beaker, and repeat the process by adding to the chloroformic fluid 10 Cc. of distilled water and 1 Cc. of normal sulphuric acid. Draw off the chloroformic layer, rejecting the same, and then draw the acid fluid into the beaker. Filter the combined acid aqueous solutions in the beaker through a pledget of cotton into a clean separator, washing the last separator, beaker, and funnel with about 10 Cc. of distilled water. To the acid fluid in the separator add 10 Cc. of chloroform and sufficient ammonia water to produce a distinctly alkaline reaction. Shake for several minutes, and when the liquids have separated, draw off the chloroformic layer into a beaker. Repeat this process with 2 portions of 10 Cc. of each of chloroform, and evaporate the combined chloroformic liquids in the beaker to dryness on a water-bath containing warm water; dissolve the residue in 3 Cc. of ether, and allow the latter to evaporate completely. To the alkaloidal residue add 5 Cc. of tenth-normal sulphuric acid and 5 drops of hematoxylin test-solution, then titrate the excess of acid with fiftieth-normal potassium hydroxide solution. Divide the number of Cc. of fiftieth-normal potassium hydroxide solution used by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid used), and multiply the remainder by 0.0287, and this product by 20, to obtain the percentage of mydriatic alkaloids contained in the extract of belladonna leaves. The figure 0.0287 represents the weight in grammes of mydriatic alkaloids (mainly atropine) required to neutralize 1 Cc. of tenth-normal sulphuric acid.—U. S.

25 avoirdupois ounces of the powdered leaves should be moistened with about 10 fluidounces of the menstruum, composed of alcohol 2 volumes and water 1 volume, and the first 22 fluidounces of the percolate set aside as a reserve; the remainder of the percolate is to be evaporated to $2\frac{1}{2}$ fluidounces before it is incorporated with the reserve portion for final evaporation to a pilular consistence.

Extract of belladonna, made by the above formula, has a brown-green color and the characteristic odor and bitter taste of belladonna leaves. It is admirably adapted for use in the form of solutions, pill-masses, ointments, and suppositories, and for administration in powders may be rubbed down with sugar of milk.

The quantity of extract (5 Gm.) directed for the assay by the U. S. P. is too large, as the liquid will be too deeply colored to note the separation of the chloroformic solu-

tion. 2 Gm. will be quite sufficient, in which case the final weight of alkaloids must be multiplied by 50 instead of 20.

Extractum Belladonnæ Alcoholicum of the Br. P. is made by carefully evaporating standardized liquid extract of belladonna root to a thin syrup, adding to it the required quantity of sugar of milk (as previously determined from the data obtained in a separate experiment), and continuing the evaporation until the extract weighs 15 ounces for every 20 fluidounces of the liquid extract used. This alcoholic extract of belladonna contains 1 per cent. of the alkaloids of the root, and is of about one-third the strength of the same preparation of the Br. P. of 1885.

Extractum Belladonnæ Viride of the Br. P. is an inspissated juice of fresh belladonna herb, prepared in accordance with the method given on page 590 It has a brownish-green color, and is used in the same dose as the alcoholic extract, although no definite alkaloidal content is officially required.

Extractum Belladonnæ of the P. G. is an alcoholic extract obtained by treating the juice of fresh belladonna herb, after concentration by heating to 80° C. (176° F.), with an equal weight of alcohol for 24 hours, then straining and treating the residue with diluted alcohol and decanting. The mixed clear liquids are evaporated to a pilular extract, which is required to contain about 1.5 per cent. of alkaloids. The extract has a dark-brown color and yields an almost clear solution with water.

Action and Uses.—See BELLADONNA. Dose, from $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.008–0.015 Gm.).

EXTRACTUM CANNABIS INDICÆ, *U. S.*, *Br.*—Extract of Indian Cannabis.

Extract of Indian hemp, E.; *Extrait de chanvre indien*, Fr.; *Indisch-Hanfextrakt*, G.

Preparation.—Indian cannabis, in No. 20 powder, 1000 Gm.; alcohol, a sufficient quantity. Moisten the powder with 300 Cc. of alcohol and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol until the cannabis is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of alcohol.

The process of the Br. P. is practically identical with the foregoing. The yield is from 12 to 14 per cent. The extract is of a blackish-green color, and has a slight but heavy narcotic odor and a bitter taste. It should be completely insoluble in water, and dissolve in alcohol, ether, chloroform, and oil of turpentine; its alcoholic solution should be precipitated by aqueous solution of potassium or sodium hydroxide, the resin being insoluble in alkalies. Nitric acid converts the extract into an orange-red resin, which after washing with water has the color of gamboge (Procter, 1864).

It is well known that liquid preparations of Indian cannabis deteriorate during evaporation, especially if the latter be conducted at ordinary atmospheric pressure. The active constituents of the drug undergo oxidation, and hence the resulting extract is often met with of indifferent quality. Concentration of the percolate at a low temperature, and preferably in a vacuum apparatus, will yield the best preparation, provided the drug has not deteriorated from age.

While chiefly exhibited in pill-form, extract of Indian cannabis is sometimes prescribed in mixtures, and can then be best kept in suspension by dissolving it in a small quantity of oil of sweet almond and emulsifying the solution.

Action and Uses.—See CANNABIS INDICA. Beginning dose, from $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.008–0.015 Gm.), which may be increased as needed.

EXTRACTUM CARNIS.—Extract of Beef.

Extract of beef, E.; *Extrait de viande, Extrait de bœuf*, Fr.; *Fleischextrakt*, G.

Extract of meat is said to have been brought into notice and described by Proust in 1801. Since then various suggestions have been offered as improvements in manufacture, and about 1855 Liebig published a process for making extract of meat on a large com-

mercial scale, which is probably still followed, with slight modifications, by the leading manufacturers, notably those of South America—the Liebig Company at Fray-Bentos, in Uraguay, and the Kemmerich Company in Argentina. Since 1870 considerable quantities of extract of meat have been manufactured by the large packing firms of the western United States, which closely resemble the South American preparations and are largely used. In Australia mutton has been used for many years in place of beef for making extract of meat. In addition to the solid beef-extracts, several fluid preparations have been marketed and found considerable favor among physicians, as Valentine's Meat Juice, Cibil's Fluid Beef, Johnston's Fluid Beef, Wyeth's Beef Juice, etc.

Preparation.—Solid extracts of meat, of the type of the Liebig extract, are usually made as follows: Fresh lean beef, freed from sinews, is thoroughly chopped or minced in suitable apparatus and extracted with 10 times its weight of water heated by steam. The mixture is strained and the liquid set aside for a few hours to become cold, when fat and gelatin separate and are removed. Finally the liquid is evaporated in a vacuum apparatus to the consistence of a soft extract. In some establishments the original mixture of meat and water, or the subsequent strained liquid, is boiled for some time to get rid of the coagulable albumin.

The yield of extract, which, when obtained by the above process, consists wholly of the water-soluble constituents of the meat, varies from 2.25 to 3 per cent. of the weight of meat used, so that 1 Gm. should represent about 30 Gm., or 1 ounce represent nearly 2 pounds, of lean beef.

The fluid meat extracts, better known as meat juices or beef juices, are evidently prepared by a different process, since nearly all of them contain coagulable albumin, sometimes in considerable quantity, and varying proportions of peptone. In at least one instance the fluid also contains the finely divided residue of the dried meat.

Properties.—Extract of meat is of a brown color, usually somewhat granular, and has a pleasant odor suggestive of roasted meat, and a characteristic, distinctly saline taste. It is completely soluble in water, yielding a clear solution, which on the addition of a little table-salt has the flavor of beef-broth. When dried at 110° C. (230° F.) it loses about 20 to 22 per cent. in weight, due to moisture, and when incinerated leaves about 20 per cent. of ash.

The appearance of the fluid meat extracts or meat juices is that of a dark-red liquid, which mixes clear with cold water and in most cases becomes turbid upon heating, due to coagulation of albumin.

Constituents.—The valuable constituents of extract of meat are the nitrogenous bases: creatine, $C_4H_9N_3O_2 + H_2O$; creatinine, $C_4H_7N_3O$; xanthine, $C_5H_4N_4O_2$; hypoxanthine or sarkine, $C_5H_4N_4O$; and carnine, $C_7H_8N_4O_3 + H_2O$; in addition to which are present variable proportions of albumoses, also phosphocarnic and inosic acids, and mineral salts composed chiefly of phosphates. Only very small quantities of sodium chloride should be present. Some commercial extracts of meat have been found to contain large amounts of gelatin, which according to some authorities is desirable. The amount of nitrogen present, which is determined according to Kjeldahl's method (see NITROGEN), varies considerably; while sometimes found as low as 2.6 per cent., it should reach from 8 to 10 per cent. in extracts made from good beef. Extracts of meat have been frequently examined, and interesting papers may be found, giving the composition of commercial products, in *Proc. Am. Pharm. Assoc.*, vol. xix. p. 512, vol. xli. p. 99, vol. xlix. p. 394.

Action and Uses.—Beef extract is very extensively employed in the preparation of soups. It possesses stimulant but little nutritious properties. It may be employed during acute febrile conditions, but is of less value than fresh meat juice, because the former has been deprived of the nitrogenous elements of the flesh. Beef tea may also be used for the same purposes, and is prepared by macerating 1 pound of minced lean beef and its juice with 1 pint of tepid water for an hour, straining, bringing the strained liquid to the boiling-point and then cooling. After cooling, the fat should be removed and the tea seasoned to suit the taste.

Allied Preparations.—Beef tea or beef essence may be conveniently prepared extemporaneously as follows: Fat-free meat (beef, mutton, or chicken may be used) is cut into small pieces and put into a wide-mouth bottle with a long neck, until the bottle is nearly filled. The bottle is then closed with a sound cork and set upright in boiling water for 2 hours, in such a manner that the top of the bottle is above the surface of the water. At the end of

this time the meat is expressed and the resulting liquid is ready for use, and may be flavored with a little salt. It will keep for a short time in a cool place.

To prepare beef tea cold, Liebig proposed the following method: 60 Gm. of fat-free, finely chopped beef are added to a solution of 10 Gm. of table salt and 5 drops of hydrochloric acid in 120 Gm. of cold water; the mixture is allowed to stand for 1 hour with occasional stirring, then expressed and filtered, sufficient water being added to bring the weight of the filtrate up to 100 Gm. This preparation is also known as *Liebig's beef broth.*

EXTRACTUM CIMICIFUGÆ, *U. S.*—Extract of Cimicifuga.

Extract of black cohosh, E.; *Extrait d'actée à grappes*, Fr.; *Cimicifugaextrakt*, G.

Preparation.—Fluidextract of cimicifuga, 100 Cc.; glycyrrhiza, peeled and in No. 80 powder, a sufficient quantity. Evaporate the fluidextract of cimicifuga in a porcelain capsule, on a water-bath, at a temperature not exceeding 70° C. (158° F.), to dryness and reduce to fine powder. Add sufficient glycyrrhiza to bring the total weight up to 25 Gm.—U. S.

Extract of cimicifuga, which is admirably adapted to the pulverulent form on account of its strongly resinous character, should be preserved in tightly corked bottles in a cool dry place. It is of a brownish-yellow color, has the characteristic odor of the drug, and represents 4 times its weight of the crude drug.

Action and Uses.—See CIMICIFUGA. Dose, from 2 to 8 grains (0.12–0.50 Gm.).

EXTRACTUM CINCHONÆ.—Extract of Cinchona.

Extractum chinæ spirituosum, P. G.—*Extract of calisaya bark*, E.; *Extrait de quinquina jaune*, Fr.; *Weingeistiges Chinaextrakt*, G.; *Estratto di china*, It.

Preparation.—Extract of cinchona has been dropped from the U. S. P. The directions of the P. G. are to exhaust 1 part of coarsely powdered cinchona bark with two successive portions, of 5 parts each, of 69 per cent. alcohol by maceration for 6 and 3 days respectively, at a temperature of 15°–20° C. (59°–68° F.). The expressed fluids are mixed, set aside for 2 days, filtered, and then evaporated to dryness. When thus prepared, extract of cinchona is of reddish-brown color and forms a turbid solution with water. The P. G. demands that the alkaloidal content of this extract shall be sufficient to neutralize 5.4 Cc. of one-tenth normal acid for every Gm. of extract used in the assay.

An aqueous extract of cinchona is also recognized in the P. G. as *Extractum Chinæ Aquosum*, which is made by exhausting the coarsely powdered bark with cold water by maceration and evaporating the infusion, after filtration, to the consistence of thick honey. The requirement for alkaloidal content of this extract is slightly lower than that of the former, since 1 Gm. need neutralize but 4.6 Cc. of one-tenth normal acid in the official assay process.

Extract of cinchona, U. S. P. 1890, was prepared from yellow cinchona with a menstruum composed of alcohol 3 volumes and water 1 volume; it was of pilular consistence and if made from rich bark frequently contained from 20 to 25 per cent. of total alkaloids.

Action and Uses.—See CINCHONA. Dose, from 10 to 30 grains (0.60–2 Gm.).

EXTRACTUM COLCHICI CORMI, *U. S.*—Extract of Colchicum Corm.

Extractum colchici, Br.; *Acetic extract of colchicum*, E.; *Extrait de colchique acétique*, Fr.; *Zeitlosen-Essigextrakt*, G.

Preparation.—Colchicum corm, in No. 60 powder, 1000 Gm.; acetic acid, 350 Cc.; water, a sufficient quantity. Mix the acetic acid with 1500 Cc. of water, and, having moistened the powder with 500 Cc. of the mixture, pack it moderately in a cylindrical glass percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then water, until the colchicum corm is exhausted. Evaporate the percolate in a porcelain vessel by means of a water-bath, at a temperature not exceeding 80° C. (176° F.), to a pilular consistence.

When assayed by the process given below, extract of colchicum corm should contain 1.4 per cent. of colchicine. If the extract should be found by assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 1.4 per cent.

Assay of Extract of Colchicum Corm.—Extract of colchicum corm, 4 Gm.; chloroform, alcohol, ether, distilled water, ammonia-water each a sufficient quantity. Dissolve the extract of colchicum corm in 20 Cc. of distilled water, carefully transfer the solution to a graduated flask, and add sufficient alcohol to make the liquid measure 100 Cc. Shake the flask well, allow it to stand for 5 minutes, filter, and collect 50 Cc. of the filtrate (representing 2 Gm. of the extract), and evaporate it to dryness in a porcelain dish by means of a water-bath. Add to the residue 10 Cc. of ether and 5 Cc. of distilled water, stir the mixture well, and heat it gently until the ether is evaporated. After cooling, pour off the aqueous solution, filtering it into a separator, retaining as much of the insoluble matter in the dish as possible. Again treat the residue with 10 Cc. of ether and 5 Cc. of water, and proceed as before; rinse the dish and filter with a little water and collect all of the aqueous liquids in the separator. Introduce a small piece of red litmus-paper into the separator, add enough ammonia-water to render the liquid alkaline, and then shake it out with three successive portions of chloroform, of 20, 15, and 10 Cc., respectively. Collect the combined chloroformic solutions in an Erlenmeyer flask, evaporate the chloroform, and add to the alkaloidal residue two successive small portions of alcohol, evaporating the alcohol each time. Now add to the residue a mixture of 5 Cc. of distilled water and 10 Cc. of ether, agitate the liquid gently and evaporate the ether, filtering the aqueous liquid into a separator. Rinse the flask with distilled water, pass the rinsing through the filter into the separator, and shake out the aqueous solution with three successive portions of chloroform, 20, 15, and 10 Cc., respectively. Collect the combined chloroformic solutions in a tared Erlenmeyer flask, evaporate the chloroform, and treat the alkaloidal residue with two successive small portions of alcohol, evaporating the alcohol each time, and dry the residue at 100° C. (212° F.) to a constant weight. The weight multiplied by 50 will give the percentage of colchicum in the extract of colchicum corm.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 12 fluidounces of the menstruum (acetic acid, 3½ volumes; water, 15 volumes).

Extract of colchicum of the Br. P. is the inspissated juice of the fresh corms. It is prepared by depriving the corms of their coats, expressing the juice, allowing the feculence to subside, decanting, heating the clear liquid to 100° C. (212° F.), straining through flannel, and evaporating at a temperature not exceeding 71° C. (160° F.) to the consistence of a soft extract.

The extract of colchicum of the French Codex is prepared from the seeds with alcohol of 60 per cent.

Action and Uses.—See COLCHICUM. Dose, from 2 to 3 grains (0.10–0.20 Gm.).

EXTRACTUM COLOCYNTHIDIS, *U. S., P. G.*—Extract of Colocynth.

Extractum colocynthidis alcoholicum. — Extrait de coloquinte, Fr.; *Koloquinthenextrakt,* G.; *Estratto di coloquintide,* It.

Preparation.—Colocynth, dried and freed from the seeds, 1000 Gm.; diluted alcohol, a sufficient quantity. Reduce the colocynth to a coarse powder by grinding or bruising, and macerate it in 3500 Cc. of diluted alcohol for 4 days, with occasional stirring; then express strongly and strain through flannel. Pack the residue, previously broken up with the hands, firmly in a cylindrical percolator, cover it with the strainer, and gradually pour diluted alcohol upon it until the tincture and expressed liquid, mixed together, measure 5000 Cc. Having recovered from the mixture 3000 Cc. of alcohol by distillation, evaporate the residue to dryness by means of a water-bath. Lastly, reduce the dry mass to powder. Extract of colocynth should be kept in well-stoppered bottles.—U. S.

25 avoirdupois ounces of the coarsely powdered colocynth pulp should be macerated with 5½ pints of diluted alcohol for 4 days, and after expression percolated with diluted alcohol until the volume of tincture and expressed liquid, mixed together, measures 8 pints; 4½ pints of alcohol should be recovered from the mixture by distillation, and the residue evaporated to dryness and powdered.

The proportion of diluted alcohol directed by the Pharmacopœia for maceration

might be increased to 4500 Cc. (for 25 avoirdupois ounces to 7 pints) with advantage, as the experiments of Klie and others have shown; subsequent percolation should be extended correspondingly until the drug is exhausted.

Maceration and expression being considered necessary in the beginning, it would seem that the extract remaining in the press-cake could be more expeditiously obtained, and with a smaller amount of menstruum, by repeating the operation once or twice. This is the process of the German Pharmacopœia, which directs for 2 parts of colocynth, with the seeds, for the first maceration, 45 parts of alcohol, specific gravity 0.894, and for the second maceration, 15 parts each of the same alcohol and of water. With some care colocynth may be treated at once by percolation, but owing to the spongy character of its tissues it is advisable to express the absorbed liquid with a good press as soon as the greater portion of the active matter is exhausted. When the extract is made on a large scale the removal of the seeds is a tedious operation, if not impossible. For this reason the colocynth is ground, care being taken not to crush the seeds, which would load the extract with much oily matter. Dr. Squibb (1867) obtained from very dry colocynth 20.6 per cent. of extract; the general yield from the commercial article is about 14 to 14.5 per cent. The pulp alone yields usually from 30 to 40 per cent., the seeds about 5 per cent., of extract, the latter being far less bitter than the former.

Action and Uses.—See COLOCYNTH. Dose, as a purge, from 2 to 5 grains (0.12–0.30 Gm.).

EXTRACTUM COLOCYNTHIDIS COMPOSITUM, *U. S., Br.*— Compound Extract of Colocynth.

Extrait de coloquinte composé, Fr.; *Zusammengesetztes Koloquinthenextrakt*, G.

Preparation.—Extract of colocynth, 160 Gm.; purified aloes, 500 Gm.; cardamom, in No. 60 powder, 60 Gm.; resin of scammony, in fine powder, 140 Gm.; soap, dried and in coarse powder, 140 Gm.; alcohol, 100 Cc. Heat the aloes on a water-bath until it is completely melted; then add the alcohol, soap, extract of colocynth, and resin of scammony, and heat the mixture, at a temperature not exceeding 120° C. (248° F.), until it is perfectly homogeneous, and a thread taken from the mass appears brittle when cool. Then withdraw the heat, thoroughly incorporate the cardamom with the mixture, and cover the vessel until the contents are cool. Finally, reduce the product to a fine powder. Compound extract of colocynth should be kept in well-stoppered bottles.—U. S.

To make 4 avoirdupois ounces of compound extract of colocynth, the following formula may be used, yielding a preparation of official strength: Warm 875 grains of purified aloes, in a covered vessel on a water-bath, with 2½ fluidrachms of alcohol; add 280 grains of extract of colocynth, 245 grains each of powdered soap and resin of scammony, and heat the mixture (not above 248° F.) until it is perfectly homogeneous and brittle. Withdraw the heat, incorporate 105 grains of powdered cardamom, and cover the vessel until the contents are cold. Finally, reduce to fine powder.

Take of colocynth pulp, 6 ounces; extract of socotrine aloes, 12 ounces; resin of scammony, 4 ounces; curd soap, in shavings, 4 ounces; cardamom seeds, in fine powder, 1 ounce; alcohol (60 per cent.), 1 gallon. Macerate the colocynth in the spirit for 4 days; press out the tincture and distil off the spirit; then add the aloes, scammony, and soap, and evaporate by a water-bath until the extract is of a suitable consistence for forming pills, adding the cardamom seeds toward the end of the process.—Br.

The first formula is preferable for directing a definite amount of the extract of colocynth, instead of the extract obtained from a definite weight of colocynth pulp, which may vary considerably (see above). By mixing the ingredients in the state of fine powder a preparation uniform in appearance cannot be obtained; but by melting them together with the assistance of a little alcohol, and by subsequently drying and powdering, an unobjectionable compound extract is produced.

Action and Uses.—Compound extract of colocynth has been employed as a purge when it is desired to produce copious secretion and rapid evacuation from the bowels, and at the same time a derivative operation upon other organs. It may be employed as a revulsive in cerebral congestion and apoplexy, and is especially useful in certain mental conditions, particularly hypochondriasis and melancholia, when associated with fecal accumulations resulting from intestinal torpor. It is also a favorite remedy with many practitioners for the constipation dependent upon a sluggish portal circulation.

The drug should never be prescribed during the existence of pregnancy, and it is contraindicated in all inflammatory conditions of the intestinal tract.

It is given in the dose of from 2 to 5 grains (0.12–0.30 Gm.) as a purge. As a drastic the dose is from 5 to 20 grains (0.30–1.3 Gm.).

EXTRACTUM DIGITALIS, *U. S.*—Extract of Digitalis.

Extractum digitalis alcoholicum.—Extrait alcoolique de digitale, Fr.; *Digitalis extrakt*, G.; *Estratto di digitale*, It.; *Extracto di digitale*, Sp,

Preparation.—Fluidextract of digitalis, 100 Cc. Evaporate the fluidextract of digitalis in a porcelain capsule by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to a pilular consistence.—U. S.

The yield is usually from 22 to 25 per cent. The extract is of a green-brown color, and with ordinary care retains a good consistence without having glycerin incorporated with it.

Action and Uses.—See DIGITALIS. Dose, ¼ grain (0.015 Gm.).

EXTRACTUM ERGOTÆ, *U. S.*, *Br.*—Extract of Ergot.

Extractum secalis cornuti, P. G.; *Extractum hæmostaticum.—Ergotin*, Br.; *Extrait de seigle ergoté*, Fr.; *Mutterkornextrakt*, G.

Preparation.—Ergot, in No. 40 powder, 1000 Gm.; diluted hydrochloric acid, 50 Gm.; monohydrated sodium carbonate, 8.5 Gm.; glycerin, 12.5 Gm.; alcohol, water, each a sufficient quantity. Mix alcohol and water in the proportion of 1000 Cc. of the former and 400 Cc. of the latter, and, having moistened the powder with 500 Cc. of the mixture, pack the damp powder in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the ergot is exhausted. Evaporate the percolate in a porcelain capsule by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), to 250 Gm.; add 250 Cc. of water; filter when cold, washing the residue with a little water. Add the diluted hydrochloric acid to the filtrate; set aside for 24 hours; filter; wash the residue with water until the washings no longer have an acid reaction; add the washings to the filtrate; add the sodium carbonate gradually to the latter. When the evolution of carbon dioxide has ceased, evaporate the liquid to 150 Gm., add the glycerin and continue evaporation, at the temperature above named, until the weight of the extract is reduced to 125 Gm.—U. S.

The Br. P. formula is practically identical with the above, except that glycerin is not added, and evaporation is directed to be continued until a soft extract is obtained, instead of to a definite weight.

The German Pharmacopœia directs that coarsely ground ergot shall be exhausted with water by macerating twice with double its weight of cold water, for 6 hours each time. The expressed liquids are mixed, strained, and evaporated to half the weight of drug used. The residue is mixed with an equal weight of alcohol and set aside for 3 days, the mixture being frequently shaken; it is then filtered and evaporated to a soft, but non-fluid consistence. This formula corresponds to that of the French Codex.

Extract of ergot made according to the U. S. P. represents 8 times its weight of ergot and is admirably adapted for hypodermatic use, as it forms a clear solution with water and has been freed from inert matter. It is of the consistence of very thick honey and is relatively one-third stronger than the extract of the last Pharmacopœia, which was made by evaporating fluidextract of ergot to a pilular consistence. The sodium carbonate directed in the above formula is the official monohydrated variety; if the former official salt (U. S. P., 1890) containing 10 molecules of water be used, 20 Gm. will be necessary to neutralize the excess of acid. The presence of 10 per cent. of glycerin prevents the extract from drying out, and thus preserves the relation toward crude ergot.

The term *ergotin* is officially applied as a synonym for the extract in the British and French pharmacopœias.

Action and Uses.—See ERGOT. Dose, from 5 to 20 grains (0.30–1.3 Gm.).

EXTRACTUM EUONYMI, *U. S.*—Extract of Euonymus.

Extractum Euonymi Siccum—Dry Extract of Euonymus, Br.—*Extract of wahoo*, E.; *Extrait d'écorce de fusain*, Fr.; *Spillbaumrindenextrakt*, G.

Preparation.—Fluidextract of euonymus, 100 Cc.; glycyrrhiza, peeled, in No. 80 powder, a sufficient quantity. Evaporate the fluidextract of euonymus in a porcelain capsule by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), constantly stirring, to complete dryness. Reduce the residue to fine powder and add sufficient glycyrrhiza to bring the weight up to 25 Gm. Mix thoroughly.—U. S.

The dry extract of euonymus of the Br. P. is made by exhausting the bark in No. 20 powder in a percolator with 45 per cent. alcohol, evaporating the percolate to dryness, powdering the residue as far as possible, adding one-fourth of its weight of calcium phosphate, and continuing the drying and powdering until a uniform product results.

In our experience the latter process does not yield a satisfactory powder, and besides involves much tedious labor. A menstruum composed of 4 volumes of alcohol and 1 volume of water, used in making the fluidextract of euonymus, exhausts the drug of all its valuable constituents, which are resinous in character, and yields an extract readily powdered, which by addition of finely powdered licorice root may be made to retain its pulverulent condition during all seasons.

Action and Uses.—See EUONYMUS. Dose, from 1 to 8 grains (0.06–0.50 Gm.).

EXTRACTUM GENTIANÆ, *U. S., Br., P. G.*—Extract of Gentian.

Extrait de gentiane, Fr.; *Enzianextrakt*, G.; *Estratto di genziana*, It.; *Extracto di genciana*, Sp.

Preparation.—Gentian, in No. 20 powder, 1000 Gm.; water, a sufficient quantity. Moisten the powder with 400 Cc. of water and let it macerate for 48 hours; then pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the properties of the gentian. Reduce the liquid to three-fourths of its weight by boiling, and strain; then by means of a water-bath evaporate to a pilular consistence.—U. S.

25 avoirdupois ounces of gentian should be macerated with 10 fluidounces of cold water for 48 hours before being packed for percolation.

The British Pharmacopœia alone directs boiling with water for exhausting gentian root, while the United States, French, and German pharmacopœias exhaust with cold water, the albumin being removed from the infusion by boiling. The long-continued boiling directed by the U. S. P. until one-fourth of the solution has evaporated is not necessary. Cold water is preferable for exhausting gentian, since it dissolves all of the bitter principle without taking up the whole of the pectin compounds, which enter into solution in hot water. An extract prepared with the latter has a gelatinous appearance, though not in the same degree as if made by prolonged boiling with water. The yield by cold water approaches, or sometimes exceeds, 30 per cent. of the weight of the dry root, and the yellowish-brown extract yields with water a nearly clear solution.

Action and Uses.—See GENTIAN. Dose, from 1 to 8 grains (0.06–0.50 Gm.).

EXTRACTUM GLYCYRRHIZÆ, *U. S., Br.*—Extract of Glycyrrhiza.

Succus liquiritiæ, P. G.; *Extractum liquiritiæ.—Extract of licorice, Liquorice, Licorice*, E.; *Suc de réglisse, Extrait de réglisse, Sucre noir*, Fr.; *Süssholzsaft, Lakritzensaft*, G.; *Estratto di liquirizia, Sugo di liquirizia*, It.; *Regaliza en ballos*, Sp.

The U. S. and nearly all other pharmacopœias recognize the commercial extract of the root of *Glycyrrhiza glabra*, but the Br. P. does not, and instead gives a process for making an extract which somewhat resembles the purified extract of licorice of the United States.

Preparation.—For commercial purposes extract of licorice is made as follows: The root, either fresh or dried and freed from dirt, is crushed and boiled with water over a naked fire or with steam. The decoction is expressed, allowed to settle, and decanted or strained, after which the liquid is evaporated to the proper consistence. To impart firmness to the extract finely powdered licorice root, starch, and other sub-

stances are frequently added; in some of the common varieties the pulpy material from the decoction is added for the same purpose.

The Br. P. gives a process for preparing extract of licorice which consists in macerating licorice root in No. 20 powder twice with double its weight of cold distilled water. The first maceration is continued for 24 hours and the second for 6 hours. Each time the mixture is strained and expressed, the united liquids being heated to 100° C. (212° F.), strained through flannel, and evaporated to the consistence of a soft extract. Experiments of D. B. Dott (*Pharm. Jour.*, March, 1902, p. 239) have shown that this method is unsatisfactory, since the sweet principle is incompletely extracted.

While considerable extract of licorice is imported from Italy, Spain, and Greece, large quantities are also manufactured in this country, and the latter, as a rule, is of superior quality, no doubt due to improved methods and greater care. Prior to 1876 the annual importations amounted to more than 1,000,000 pounds, but they have materially decreased since then.

Description.—Extract of licorice occurs in commerce both in the form of a semi-firm mass and in sticks or rolls varying in size from $\frac{1}{4}$ inch by 4 inches to 1 inch by 8 inches, and usually stamped with the initials or name of the manufacturer or of the town where made. The former, better known as licorice mass or paste, is wholly used by tobacco manufacturers, while the drug trade consumes the rolls or sticks, which constitute by far the smaller proportion of the total quantity of extract made.

Extract of licorice in rolls has a black color, is somewhat glossy, and has a sharp conchoidal and shining fracture. Some small cavities are frequently found in the interior. The product of the different manufacturers of stick licorice differ from one another not only in size, but often by marked differences in their odor and taste; while some specimens are almost purely sweet, others are persistently acrid and empyreumatic. For medicinal purposes extract of licorice should be almost devoid of acridity.

When sticks of licorice are placed in cold water a portion is dissolved, but the residue retains the shape of the sticks. The amount soluble in cold water varies considerably, and reaches in the best brands about 70 or 75 per cent. The U. S. P. demands that not less than 60 per cent. of the extract shall be soluble in cold water, and the P. G. requires that on exhausting air-dry licorice with water of not over 50° C. (122° F.) the residue dried on a water-bath should not exceed 25 per cent., which corresponds to 75 per cent. of water-soluble matter.

Constituents.—The sweet principle is known as *glycyrrhizin*, which exists partly free and partly in combination. It is a tribasic acid, and has the composition $C_{44}H_{63}NO_{18}$. The amount of glycyrrhizin present in extract of liquorice varies from 5 to 24 per cent. For the complete extraction of glycyrrhizin a menstruum composed of 10 per cent. ammonia-water 4 volumes, alcohol 24 volumes, and water 72 volumes, has been found satisfactory. When boiled with dilute acid, glycyrrhizin splits up into glycyrrhetin, $C_{32}H_{47}NO_4$, and parasaccharic acid, $C_6H_{10}O_8$, which latter reduces Fehling's Solution. This behavior gave rise to the former view that glycyrrhizin was a glucoside. The amount of moisture in extract of licorice varies from 8 to 17 per cent., and upon ignition the extract yields from 5 to 9 per cent. of ash. A little acrid resinous matter is also present. For methods and results of analyses of extract of licorice, see *Am. Jour. Pharm.*, 1898, pages 23 and 136.

Action and Uses.—For the action and uses of Extractum Glycyrrhizæ, see EXTRACTUM GLYCYRRHIZÆ PURUM.

EXTRACTUM GLYCYRRHIZÆ PURUM, *U. S.*—Pure Extract of Glycyrrhiza.

Extrait de réglisse pur, Fr.; *Gereinigter Süssholzsaft*, G.

Preparation.—Glycyrrhiza, peeled, and in No. 20 powder, 1000 Gm.; ammonia-water, 150 Cc.; glycerin, water, of each a sufficient quantity. Mix the ammonia-water with 3000 Cc. of water, and, having moistened the powder with 1000 Cc. of the mixture, let it macerate in a closed vessel for 24 hours. Then pack it moderately in a cylindrical glass percolator, and gradually pour upon it, first, the remainder of the menstruum, and then water, collecting the percolate at the rate of about 10 drops per minute, until the glycyrrhiza is exhausted. Lastly, evaporate the liquid in a porcelain capsule, by means

of a water-bath, to a pilular consistence, and while the mass is still warm incorporate with it 5 per cent. of its weight of glycerin.—U. S.

The ammonia is intended to dissolve any glycyrrhizin which may be present in the powdered root in the insoluble condition, and to prevent its becoming insoluble from the loss of ammonia during evaporation. The yield is from 16 to 20, or even 25 per cent. The extract is of a brown color and of a sweet taste; it is used for preparing Mistura Glycyrrhizæ Composita, U. S. It yields a clear solution with water, as also does the following:

Succus Liquiritiæ Depuratus, P. G.—*Purified liquorice,* E.; *Extrait de suc de réglisse,* Fr.; *Gereinigter Süssholzsaft,* G.—This preparation is extensively used in Europe, and is made by alternately placing layers of washed straw and broken licorice in a cylindrical vessel and covering the material with cold water. As the water becomes saturated it is withdrawn through a faucet below, and replaced by fresh water until but little color and taste are imparted to it. The perfectly clear liquids are then evaporated to the consistence of an extract, which should yield a clear solution with water. The yield varies from 50 to 70 per cent. For making the *Elixir e succo liquiritiæ* of the P. G., 10 parts of the above extract are dissolved in 30 parts of fennel-water, and to the solution are added 10 parts of anisated spirit of ammonia.

Action and Uses.—Extract of licorice is employed in medicine as a demulcent. It is largely used in conjunction with infusion of flaxseed in the treatment of irritable coughs, sore throat, and laryngitis. Because of its sweet taste, it is frequently employed for the purpose of disguising the taste of nauseating drugs.

EXTRACTUM HÆMATOXYLI, *U. S.*—Extract of Hematoxylon.

Extractum ligni campechiani.—Extract of logwood, E.; *Extrait de bois de Campêche,* Fr.; *Campecheholzextrakt,* G.

Preparation.—Hematoxylon, rasped, 1000 Gm.; water, 1000 Cc. Macerate the hematoxylon with the water for 48 hours. Then boil, avoiding the use of metallic vessels, until one-half of the water has evaporated; strain the decoction while hot, and evaporate to dryness.—U. S.

25 avoirdupois ounces of rasped logwood should be macerated with 2 gallons of water for 48 hours, and then boiled, as directed above.

The medicinal value of logwood lies in its astringent principle, which cannot be entirely extracted with cold water; hence boiling is directed. It is important that all contact with metal be avoided on account of the tannin. The yield is about 12 per cent., occasionally as low as 6 per cent. Extract of hematoxylon is well adapted for the dry condition, as it is non-hygroscopic. Its taste is sweetish and afterward astringent, and it should yield a clear, purplish-red solution with water. The extract is prepared on a large scale for use in the arts, but the commercial article sold in boxes is not suitable for medicinal purposes, being only partly soluble in cold water.

Action and Uses.—This extract preserves the properties of logwood, and may be employed as a convenient substitute for the latter. The dose is 10 grains (0.60 Gm.).

EXTRACTUM HYOSCYAMI, *U. S., P. G.*—Extract of Hyoscyamus.

Extractum Hyoscyami Viride—Green Extract of Hyoscyamus, Br. *Extract of henbane,* E.; *Extrait de feuilles de jusquiame,* Fr.; *Bilsenkrautextrakt,* G.; *Estratto di guisquiamo,* It.

Preparation.—Fluidextract of hyoscyamus, 100 Cc. Evaporate the fluidextract of hyoscyamus in a porcelain capsule by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to a pilular consistence. When assayed by the method given below, extract of hyoscyamus should be found to contain 0.3 per cent. of total alkaloids. If the extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 0.3 per cent.

Assay of Extract of Hyoscyamus.—Extract of hyoscyamus, 10 Gm.; alcohol, ammonia-water, distilled water, chloroform, normal sulphuric acid, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, hematoxylin or iodeosin test-solution,

of each a sufficient quantity. Weigh into a small dish 10 Gm. of extract of hyoscyamus and dissolve it in a mixture containing alcohol 5 Cc., distilled water 10 Cc., ammonia-water 2 Cc., and chloroform 20 Cc. When dissolved, transfer it to a separator, rinsing the beaker with a little alcohol. Cork the separator, and shake for 2 minutes. Draw off the chloroformic layer into a second separator, and add to the contents of the first separator 10 Cc. more of chloroform. Shake for several minutes, allow to separate, and again draw off the chloroformic layer into the second separator. Repeat this with 10 Cc. more of chloroform. To the united chloroformic solutions in the second separator add 5 Cc. of normal sulphuric acid and 10 Cc. of distilled water, and shake for several minutes. Draw off the chloroformic layer after the liquids have separated into a clean separator, and the aqueous fluid into a beaker, and repeat the process by adding to the chloroformic fluid 10 Cc. of distilled water and 1 Cc. of normal sulphuric acid. Draw off the chloroformic layer, rejecting the same, and then draw the acid fluid into the beaker. Filter the combined acid aqueous solutions in the beaker through a pledget of cotton wool into a clean separator, washing the last separator, the beaker, and the funnel with about 10 Cc. of distilled water. To the first separator add 15 Cc. of chloroform, a small piece of red litmus-paper, and sufficient ammonia-water to produce a distinctly alkaline reaction. Shake for 2 minutes, and when the liquids have separated, draw off the chloroformic layer into a beaker. Repeat this process twice with 10 Cc. more of chloroform, and evaporate the combined chloroformic extracts in the beaker to dryness on a moderately warm water-bath. Dissolve the residual alkaloids in 5 Cc. of tenth-normal sulphuric acid and titrate the excess of acid with fiftieth-normal potassium hydroxide solution, using 5 drops of the hematoxylin or iodeosin test-solution as indicator. Divide the number of Cc. of fiftieth-normal potassium-hydroxide solution used by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid used), and multiply the remainder by 0.0287, and this product by 10, to obtain the percentage of mydriatic alkaloids contained in the extract of hyoscyamus.—U. S.

The extract has an olive-green color and the heavy odor of hyoscyamus. The leaves yield from 20 to 25 per cent. of extract. The alkaloidal content of the leaves being quite variable and at times very inferior, the resulting extract will at times prove unsatisfactory unless it has been standardized.

Green Extract of Hyoscyamus of the Br. P. is the inspissated juice of fresh leaves, flowering tops, and young branches. It is prepared by the general method given on page 590, the yield being from 2.5 to 4 per cent. No alkaloidal standard is required.

The extract of hyoscyamus of the P. G. is an alcoholic extract of the inspissated juice of fresh hyoscyamus herb, prepared exactly like the corresponding extract of belladonna (see page 594). This extract is required to contain about 0.75 per cent. of the alkaloids of henbane.

Action and Uses.—See HYOSCYAMUS. Dose, from 1 to 2 grains (0.06–0.12 Gm.).

EXTRACTUM JALAPÆ, *Br.*—Extract of Jalap.

Extrait de jalap, Fr.; *Jalapenextrakt*, G.

Preparation.—Jalap, in coarse powder, 1 pound; alcohol (90 per cent.), 4 pints; distilled water, 1 gallon. Macerate the jalap in the spirit for 7 days, press out the tincture, then filter, and distil off the spirit, leaving a soft extract. Again macerate the residual jalap in the water for 4 hours, express, strain through flannel, and evaporate on a water-bath to a soft extract. Mix the two extracts and evaporate, at a temperature not exceeding 60° C. (140° F.), to the consistence of a firm extract.—Br.

No advantage whatever results from treating jalap with water after it has been exhausted by alcohol. 240 grains of such an aqueous extract were taken by A. B. Taylor (1864) in the course of 8 hours without producing any noticeable effect. Alcohol alone will yield between 12 and 18 or 22 per cent. of active extract, and cold water will subsequently extract 30 to 35 per cent. of inert matter.

Extract of jalap has been dropped from the U. S. P., and we think very properly, since there was little difference between the official resin of jalap and the former extract, except that the latter contained a small proportion of water-soluble matter, which is removed in the manufacture of the resin. Official alcohol was used in the preparation of the former extract, the resulting percolate being evaporated to a pilular consistence.

Action and Uses.—Extract of jalap is preferred by many to the powdered drug, because of its concentration. It possesses all the properties of JALAPA (which see). The dose is from 5 to 15 grains (0.30–1 Gm.).

EXTRACTUM KRAMERIÆ, *U. S., Br.*—Extract of Krameria.

Extractum ratanhiæ.—Extract of rhatany, E.; *Extrait de ratanhia*, Fr.; *Ratanhiaextrakt*, G.

Preparation.—Krameria, in No. 40 powder, 1000 Gm.; water, a sufficient quantity. Moisten the powder with 300 Cc. of water, pack it in a conical glass percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the astringency of the krameria. Heat the liquid to the boiling-point, strain, and by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), evaporate to dryness.—U. S.

25 avoirdupois ounces of krameria should be moistened with about 7½ fluidounces of water before being packed in a percolator.

The processes of the other pharmacopœias are practically identical with this, but the Br. P. and Fr. Cod. order distilled in place of common water.

It is important that the root be exhausted with *cold* water. Hot water will yield about 5 or 6 per cent. more extract, which, however, is but incompletely soluble in water, while the official extract yields a somewhat turbid solution with warm water, but a clear solution in the presence of sugar. The amount of extract obtainable depends on the size and the variety of rhatany-root used, the woody part of which contains but little soluble matter. The smaller branches of Peruvian rhatany yield about 12 per cent. of *dry* extract, but the thick main root yields only 5 or 6 per cent.; Savanilla and Para rhatany give a larger yield, about 12 to 18 per cent. The extract is of a red-brown color, glossy, resembling kino in appearance, and is not hygroscopic. Iron utensils must not be used in its preparation.

Action and Uses.—Extract of krameria is employed in all cases in which the drug itself is indicated. The dose is from 5 to 20 grains (0.30–1.3 Gm.).

EXTRACTUM LEPTANDRÆ, *U. S.*—Extract of Leptandra.

Extrait de leptandra, Fr.; *Leptandraextrakt*, G.

Preparation.—Fluidextract of leptandra, 100 Cc.; glycyrrhiza, peeled, in No. 80 powder, a sufficient quantity. Evaporate the fluidextract of leptandra in a porcelain capsule, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), constantly stirring, to complete dryness. Reduce the residue to fine powder and add sufficient glycyrrhiza to bring the weight up to 25 Gm. Mix thoroughly.—U. S.

Powdered extract of leptandra must be kept in well-stoppered bottles in a dry cool place to avoid caking. With diluents other than licorice root the results are unsatisfactory, the powder soon showing a disposition to cake, especially in warm weather. The extract has a blackish-brown color and a very bitter taste, and represents 4 times its weight of the crude drug.

Action and Uses.—The uses of this extract are fully described under LEPTANDRA (which see). The dose is from 2 to 5 grains (0.12–0.30 Gm.).

EXTRACTUM MALTI, *U. S.*—Extract of Malt.

Essence (Extrait) de malt, Fr.; *Malzextrakt*, G.

Preparation.—Malt, in coarse powder, not finer than No. 12, 1000 Gm.; water, a sufficient quantity. Upon the powder, contained in a suitable vessel, pour 1000 Cc. of water, and macerate for 6 hours. Then add 4000 Cc. of water heated to about 30° C. (86° F.), and digest for an hour at a temperature not exceeding 55° C. (131° F.). Strain the mixture with strong expression. Finally, by means of a water-bath or vacuum-apparatus, at a temperature not exceeding 55° C. (131° F.), evaporate the strained liquid rapidly to the consistence of thick honey. Keep the product in well-closed vessels in a cool place.—U. S.

In making this extract it is of the utmost importance that the temperature should never exceed 65° C. (149° F.), and it is safer, for the preservation of the diastase, to keep it at or below 55° (131° F.) until the starch of the malt has been converted into glucose and dextrin. According to Payen and Persoz, good malt contains 2 per cent. of diastase, and since 1 part of this compound is estimated to convert 2000 parts of starch, it is obvious that properly prepared malt extract should contain nearly the entire amount

of diastase which was originally present in the malt. This is only accomplished by the rapid evaporation of the infusion at a temperature which does not act injuriously upon diastase, as is directed in the above process. The yield is from 65 to 75 per cent.

Properties.—Extract of malt is a brown-yellow or light amber-colored, thick liquid or semifluid mass, having a slight peculiar odor, a sweet mucilaginous taste, and a distinct acid reaction to litmus-paper. It dissolves in water in all proportions, yielding a nearly transparent solution, in which alcohol produces a milky turbidity, after a short time becoming clear, with the separation of a flocculent precipitate. The aqueous solution also yields precipitates with picric acid, tannin, most alkaloidal reagents, and mercuric chloride and other metallic salts. When the extract is added to starch-paste, this is gradually liquefied, and will finally not acquire a blue color on the addition of iodine solution. On heating the extract it is decomposed, giving off the odor of burning sugar, and finally leaving a small amount of ash.

Constituents.—Good extract of malt contains 20 to 25 per cent. of water, 48 to 70 of maltose, 2 to 16 of dextrin, 0.3 to 0.4 of phosphoric acid, and 0.75 to 1.5 of lactic acid.

Valuation.—The value of extract of malt resides in the maltose and diastase present. For method of analysis, see article by J. F. C. Jungk in *Amer. Pharm. Jour.*, June, 1883, p. 289. The diastasic value of extract of malt is determined by its power of converting starch into dextrose. The following method is recommended for comparative testing of malt extracts: dissolve 5 Gm. of extract of malt in sufficient distilled water to yield 100 Cc. of solution; of this, add 5 Cc., representing 0.25 Gm. of the extract, to 250 Cc. of cold starch mucilage (prepared by dissolving 30 Gm. of Bermuda arrow-root in 1000 Cc. of boiling distilled water) and keep the mixture at a temperature of 55° to 60° C. (131°–140° F.) for 30 minutes; then stop the diastasic action by raising the temperature to 100° C. (212° F.) or by addition of 2 or 3 Cc. of a 10 per cent. sodium hydroxide solution, and dilute the mixture to a given volume by addition of water. Titrate an aliquot part of the liquid with Fehling's Solution (alkaline cupric tartrate volumetric solution, U. S. P.) and ascertain the amount of dextrose present, from which deduct the amount found in a corresponding amount of the extract of malt by previous titration with Fehling's Solution; the difference indicates the amount of sugar produced by the diastase present in the extract. Each Cc. of Fehling's Solution corresponds to 0.005 Gm. of anhydrous dextrose, or 0.0045 Gm. of starch converted thereinto.

According to Jungk, properly prepared extract of malt should convert its own weight of starch into dextrose at 16.6° C. (62° F.) in 40 minutes, or at 37.8° C. (100° F.) in 10 minutes. Some commercial malt extracts are scarcely superior to glucose; others consist of a stronger or weaker beer.

Pharmaceutical Uses.—Extract of Malt is serviceable in emulsionizing cod-liver oil and as a vehicle for various remedial agents.

Action and Uses.—Extract of malt has been largely employed by the laity as a general tonic. It is employed by some physicians for the purpose of increasing the milk of nursing women, and as a stimulant tonic during convalescence from acute infectious diseases.

EXTRACTUM NUCIS VOMICÆ, *U. S., Br.*—Extract of Nux Vomica.

Extractum strychni, P. G.; *Extractum nucum vomicarum spirituosum.—Extrait de noix vomique*, Fr.; *Brechnussextrakt, Strychnossamenextrakt, Krähenaugenextrakt*, G.; *Estratto di noce vomica*, It.

Preparation.—Nux vomica, in No. 20 powder, 1000 Gm.; acetic acid, water, alcohol, sugar of milk, dried and in fine powder, each a sufficient quantity. Mix 500 Cc. of acetic acid with 1300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then water, until the percolate passes but faintly imbued with bitterness, or the nux vomica is exhausted. Reserve the first 750 Cc. of the percolate and, having heated the remainder to boiling,

filter, and evaporate the filtrate to a soft extract; dissolve this in the reserved portion, and add enough water to make the liquid measure 900 Cc. To the liquid thus obtained add 3000 Cc. of alcohol, shake the mixture well, and set it aside for 24 hours, with occasional agitation. Filter the liquid through paper, and wash the residue in the filter with a mixture of alcohol 3 volumes and water 1 volume, until the washings are only faintly bitter. Evaporate the filtrate and washings in a porcelain dish, on a water-bath, to dryness. Determine, by the method given below, the percentage of strychnine in the dry extract; ascertain, by calculation, the amount of strychnine in the remainder of the extract, add to this enough well-dried sugar of milk to bring the quantity of strychnine in the final dry extract of nux vomica to 5 per cent.; and, when thoroughly powdered and mixed, transfer the extract to small, well-stoppered vials.

Extract of nux vomica, when assayed by the following process, should be found to contain 5 per cent. of strychnine.

Assay of Extract of Nux Vomica.—Extract of nux vomica, 2 Gm.; distilled water, ether, chloroform, ammonia-water, normal sulphuric acid, sulphuric acid solution (3 per cent.), nitric acid (specic gravity, 1.40), sodium hydroxide solution (1 in 10), tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, iodeosin test-solution, each a sufficient quantity. Introduce the extract of nux vomica into a beaker, and dissolve it in 25 Cc. of a mixture of 16 Cc. of ether, 5 Cc. of chloroform, and 4 Cc. of ammonia-water. When dissolved, transfer it to a separator, rinsing the beaker with a little chloroform, and adding the rinsings to the separator. Insert the stopper securely and shake the separator carefully for a few minutes. Draw off the aqueous layer into another separator, washing the ether solution and separator with a little water, and adding this to the second separator. Then shake out the aqueous liquid with two portions of 15 and 10 Cc., respectively, of chloroform, and add these to the first separator. If a few drops of the liquid left in the second separator still give a reaction with mercuric potassium iodide test-solution after acidulating, repeat the shaking out with 10 Cc. more of chloroform. Now shake out the chloroformic solution in the first separator with three portions of 15, 10, and 10 Cc. each of sulphuric acid (3 per cent.), and collect the combined acid solutions in another separator. Introduce a small piece of red litmus-paper, add enough ammonia-water to render the liquid alkaline, and extract the mixture with three portions, respectively, of 15, 10, and 10 Cc. each of chloroform. Draw off the chloroformic solutions into a beaker, and evapornte the chloroform with the aid of a water-bath. Dissolve the alkaloidal residue in the beaker in 15 Cc. of 3 per cent sulphuric acid solution by the aid of a water-bath, and allow the liquid to cool. To this solution add 3 Cc. of a cooled mixture of equal parts of nitric acid (specific gravity, 1.40) and distilled water, and after rotating the liquid a few times, set it aside for exactly 10 minutes, shaking it gently three times during this interval. Transfer the resulting red liquid to a separator containing 25 Cc. of an aqueous solution of sodium hydroxide (1 in 10), and wash the beaker three times with very small amounts of distilled water, and add the washings to the separator. If the liquid be not quite turbid, add 2 Cc. more of the solution of sodium hydroxide. Now add 20 Cc. of chloroform to the separator, and shake it well by a rotating motion for a few minutes, allow the liquids to separate, and draw off the chloroform through a small filter, wetted with chloroform, into a beaker. Repeat this twice, using 10 Cc. of chloroform each time, and draw off both portions into the beaker, using the same filter. Finally, wash the filter and funnel with 5 Cc. of chloroform, and then evaporate all the chloroform by means of a water-bath, very carefully, to avoid decrepitation. To the alkaloidal residue add 10 Cc. of tenth-normal sulphuric acid, 5 drops of iodeosin test-solution, about 90 Cc. of distilled water, and 20 Cc. of ether. When all the alkaloid is dissolved titrate the excess of acid with fiftieth-normal potassium hydroxide solution until aqueous liquid just turns pink. Divide the number of Cc. of fiftieth-normal potassium hydroxide solution used by 5, subtract this number from 10 (the 10 Cc. of tenth-normal sulphuric acid used), multiply the remainder by 0.033, and this product by 50, which will give the percentage of strychnine contained in the extract of nux vomica.—U. S.

The preparation of extract of nux vomica with an acid aqueous menstruum avoids the extraction of fixed oil and subsequent removal of the same in making the powdered extract. The addition of alcohol to the concentrated aqueous percolate is made for the purpose of precipitating certain inert matters taken up by the aqueous menstruum. The assay process is that suggested by H. M. Gordin (*Proc. Amer. Pharm. Assoc.*, 1902), and is a modification of the method first proposed by Gerock in 1889.

Extract of nux vomica of the Br. P. is made from a standardized hydro-alcoholic liquid extract by direct evaporation. Since the Br. liquid extract of nux vomica must contain 1.5 Gm. of strychnine in 100 Cc., 100 Cc. of the same should upon evaporation and admixture of sugar of milk yield an extract weighing 30 Gm. and containing 5 per

cent. of strychnine, the amount officially required. The exact quantity of sugar of milk necessary for a given volume of the liquid extract is determined by evaporating 50 Cc. of the latter to a firm extract and then subtracting the weight of the firm extract from 15, the difference indicating the weight of sugar of milk to be added to every 50 Cc. of liquid extract used. The final product is directed to be in the form of a firm extract.

The German Pharmacopœia directs exhaustion of the nux vomica with alcohol of 68.5 per cent. by volume, while the Fr. Codex orders maceration with 80 per cent. alcohol. The former recognizes a dry extract containing not less than 17 per cent. of total alkaloids, whereas the French extract is of pilular consistence and not standardized.

Action and Uses.—The employment of this extract is identical with that of NUX VOMICA (which see). It forms a convenient method for administration in pill form. Dose, from $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015–0.03 Gm.).

EXTRACTUM OPII, *U. S., Br., P. G.*—Extract of Opium.

Extractum thebaicum.—Extrait d'opium, Extrait thebaïque, Fr.; *Opiumextrakt,* G.; *Estretto di oppio acquosa,* It.

Preparation.—Powdered opium, 100 Gm.; sugar of milk, recently dried and in fine powder, water, each a sufficient quantity. Place the powdered opium in a mortar and rub into a smooth paste with 250 Cc. of water; then transfer to a flask or bottle, wash the mortar with 750 Cc. of water in successive portions, and add the washings to the contents of the flask or bottle. Cork the flask or bottle, and shake vigorously every hour or two during 12 hours. Then filter through a rapidly acting double filter, and percolate the magma on the filter slowly with water until the filtrate passes nearly colorless and only faintly bitter.

Concentrate the filtrate and washings in a tared capsule, on a water-bath, until the residue weighs about 200 Gm. and allow it to become cold. Then determine the weight exactly, transfer 12 Gm. of it to an Erlenmeyer flask having a capacity of about 100 Cc., and determine in this portion the amount of morphine by the process of assay given below, using the quantities of liquids there directed for 4 Gm. of the dry extract. In another portion of 5 Gm. determine the amount of water by drying it in a flat-bottomed capsule, at 100° C. (212° F.), until it ceases to lose weight. From the results thus obtained ascertain, by calculation, the amount of morphine and of water contained in the remainder of the extract, add to this sufficient well-dried sugar of milk to bring the quantity of morphine in the final dry extract to 20 per cent., then evaporate the whole to dryness, reduce it to powder, and transfer it to small, well-stoppered vials.

Assay of Extract of Opium.—Extract of opium, dried at 100° C. (212° F.), 4 Gm., ammonia-water, 2.2 Cc.; alcohol, ether, water, lime-water, each a sufficient quantity. Dissolve the extract of opium in 30 Cc. of water, filter the solution through a small filter, and wash the filter and residue with water until all soluble matters are extracted, collecting the washings separately. Evaporate, in a tared capsule, first, the washings to a small volume, then add the first filtrate, and evaporate the whole to a weight of 10 Gm. Rotate the concentrated solution about in the capsule until the rings of extract are redissolved, pour the liquid into a tared Erlenmeyer flask having a capacity of about 100 Cc., and rinse the capsule with a few drops of water at a time, until the entire solution weighs 15 Gm. Then add 7 Gm. (8.5 Cc.) of alcohol, shake well, add 20 Cc. of ether, and shake again. Now add the ammonia-water from a graduated pipette or burette, stopper the flask with a sound cork, shake it thoroughly during 10 minutes, and then set it aside, in a moderately cool place, for at least 6 hours, or over night.

Remove the stopper carefully, and should any crystals adhere to it, brush them into the flask. Place in a small funnel two rapidly acting filters, of a diameter of 7 Gm., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), wet them well with ether, and decant the ethereal solution as completely as possible upon the inner filter. Add 10 Cc. of ether to the contents of the flask, rotate it, and again decant the ethereal layer upon the inner filter. Repeat this operation with another portion of 10 Cc. of ether. Then pour into the filter the liquid in the flask, in portions, in such a way as to transfer the greater portion of the crystals to the filter, and, when this has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water, using not more than about 10 Cc. in all. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother-water, and afterward wash them, drop by drop, from a pipette, with alcohol previously saturated with powdered morphine. When this has passed through, dis-

place the remaining alcohol by ether, using about 10 Cc. or more if necessary. Allow the filter to dry in a moderately warm place, at a temperature not exceeding 60° C. (140° F.), until its weight remains constant, then carefully transfer the crystals to a tared watch-glass and weigh them.

Transfer the crystals (which are not quite pure) to an Erlenmeyer flask, add lime-water in the proportion of 10 Cc. for each 0.1 Gm. of morphine, and shake the flask at intervals for 25 minutes. Filter through two counterpoised, rapidly acting, plainly folded filters, one within the other (the triple fold of the inner filter being laid against the single fold of the outer filter). Rinse flask with more lime-water and wash filter with the same fluid until filtrate, after acidulating, yields no more precipitate with Mayer's Solution. Press the filters until nearly dry between bibulous paper and dry them to constant weight, counterpoising with outer filter, and weigh. Deduct the weight of the insoluble matter on the filter from the weight of the impure morphine previously found, and the difference, multiplied by 25, represents the percentage of pure crystallized morphine contained in the extract of opium.—U. S.

Four avoirdupois ounces of opium may be macerated with 2½ pints of cold water during 12 hours with frequent trituration, and then exhausted on a filter as directed; the filtrate should be concentrated to 8 avoirdupois ounces, allowed to become cold, and then assayed.

The pharmacopœias agree in ordering cold water for the extraction of crude opium; only the U. S. P. and the P. G. direct the use of powdered opium and common water, the other authorities directing distilled water. The manipulation does not differ materially except in the number of macerations and the proportion of water used. For 1 part of opium 2 macerations are directed with 8 and 4 parts, Fr. Cod. (with 5 and 2½ parts, P. G.), of water; 3 macerations each with 2½ parts of water, Br., and 1 maceration with 10 parts of water, U. S. The macerations should be effected at a low temperature, say about 60° F. At a higher temperature a larger amount of extract is obtained, more largely contaminated with narcotine and other principles, and of an inferior quality.

The U. S. and German extracts are in dry form, while the British and French extracts are of pilular consistence. The amount of extractive matter yielded by opium to water varies from 40 to 60 per cent., and hence the great desirability of a standardized extract. The U. S. and Br. pharmacopœias both demand 20 per cent. of morphine in the extract, and the German requires not less than 17 per cent.

The necessary amount of sugar of milk to be added to the soft extract to bring the final product up to the official standard may be readily ascertained. Suppose the soft residue is found to contain 70 per cent. of moisture and 7 per cent. of morphine, then every 10 Gm. (or grains) of residue require the addition of 0.5 Gm. (or grain) of sugar of milk before final evaporation to dryness. The final product will weigh 3.5 Gm. (or grains), containing 0.7 Gm. (or grains) of morphine, which is equivalent to 20 per cent.

Extractum Opii Liquidum.—*Liquid Extract of Opium*, Br.—The British Pharmacopœia recognizes a liquid extract of opium, which is prepared in the following manner: Mix 18.75 Gm. of extract of opium with 400 Cc. of distilled water; set aside for an hour, stirring frequently; add 100 Cc. of 90 per cent. alcohol; set aside in a cool place for 24 hours and then filter. The product should measure 500 Cc. and have a specific gravity of 0.985 to 0.995. When assayed by the method given under TINCTURE OF OPIUM the above liquid extract of opium should yield an amount of morphine, reckoned as anhydrous, corresponding to not less than 0.7 Gm. nor more than 0.8 Gm. in 100 Cc.

Each Imperial fluidounce of liquid extract of opium represents 16⅔ grains of extract of opium, or 20 Cc. represent 0.75 Gm.—Br.

Action and Uses.—Extract of opium possesses no advantages over the powdered drug, except that it is given in smaller quantities and is less liable to cause nausea and vomiting, headache, and insomnia. The dose is from ¼ to ½ grain (0.015–0.03 Gm.).

EXTRACTUM PHYSOSTIGMATIS, *U. S., Br.*—Extract of Physostigma.

Extractum fabæ Calabaricæ.—Extrait de fève de Calabar, Fr.; *Kalabarbohnenextrakt, Physostigmaextrakt,* G.

Preparation.—Physostigma, in No. 80 powder, 1000 Gm.; alcohol, glycyrrhiza, peeled, in No. 80 powder, each a sufficient quantity. Moisten the physostigma with 400 Cc. of alcohol and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 3000 Cc. of tincture are obtained, or the physostigma is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 100 Cc.; mix this with the reserved portion, and evaporate, at or below the before-mentioned temperature, on a water-bath, to dryness. Remove 1 Gm. of the extract, and assay this by the process given below; from the results thus obtained ascertain, by calculation, the amount of ether-soluble alkaloids contained in the remainder of the extract. Add to this enough glycyrrhiza to bring the quantity of alkaloids in the finished extract to 2 per cent.; reduce to powder, mix thoroughly, and transfer it at once to well-stoppered vials.

Extract of physostigma, when assayed by the following process, should be found to contain 2 per cent. of ether-soluble alkaloids:

Assay of Extract of Physostigma.—Extract of physostigma, 1 Gm.; alcohol, ether, 5 per cent. sodium bicarbonate solution, normal sulphuric acid, distilled water, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, iodeosin test-solution, each a sufficient quantity. Dissolve the extract of physostigma in as little diluted alcohol as possible in a porcelain dish, and then add about 5 Gm. of pure, clean, sharp-quartz sand, and evaporate to dryness on a water-bath, rubbing carefully with a pestle so as to get the extract thoroughly distributed over the sand. When dry, transfer the entire contents of the dish to a flask, add 100 Cc. of ether, cork well, and shake thoroughly for several minutes. Then add 20 Cc. of a 5 per cent. sodium bicarbonate solution, and shake vigorously at intervals for 1 hour. Let settle and decant 50 Cc. of the ethereal solution into a separator, and add 10 Cc. of distilled water and sufficient normal sulphuric acid to make the liquid acid. Shake well for 5 minutes and draw off the aqueous layer into another separator. Repeat the extraction, using 5 Cc. each of normal sulphuric acid and distilled water, and adding the acid aqueous layer to the contents of the second separator. Finally, repeat again, using 1 Cc. of normal sulphuric acid and 9 Cc. of distilled water, and draw this off also into the second separator. To the combined acid liquids in the second separator add 25 Cc. of ether and sufficient 5 per cent. sodium bicarbonate solution to make the liquid alkaline. Shake for a few minutes, let separate, and transfer the ether into a beaker. Repeat with 20 Cc., and again with 15 Cc. more of ether added to the aqueous fluid in the separator, shake for 2 minutes, let separate, and transfer the ethereal liquid to the beaker. Evaporate the ether from the combined solutions in the beaker carefully on a water-bath, and when dry dissolve the residue in 2 Cc. of tenth-normal sulphuric acid; rinse the solution into a 100 Cc. flask with distilled water, add enough distilled water to bring the volume to about 40 Cc., add 15 Cc. of ether, and, having shaken the flask, add 5 drops of iodeosin test-solution, then titrate the excess of acid with fiftieth-normal potassium hydroxide solution, until, after shaking, the aqueous liquid just acquires a pink color. Divide the number of Cc. of fiftieth-normal solution used by 5, subtract the quotient from 2 (the 2 Cc. of tenth-normal sulphuric acid taken), and multiply the remainder by 0.0273, and this product by 200; the result will be the percentage of ether-soluble alkaloids contained in the extract of physostigma.—U. S.

Extract of physostigma, thus prepared, should be kept in amber-colored bottles protected against light.—U. S.

The Br. P. directs the exhaustion of calabar bean with 90 per cent. alcohol, percolation being preceded by maceration in a closed vessel with an equal weight of the menstruum. The alcohol is recovered by distillation, and the residue evaporated to a very soft extract, which is then mixed with 3 times its weight of milk sugar to form a firm extract.

On account of the considerable amount of fat in the calabar bean, it is impossible to produce a perfect pilular or powdered extract without the addition of some diluent. Milk sugar in the proportion directed in the Br. P. answers for a firm extract, but a more absorptive substance is required for the powdered article. In our experience the

use of glycyrrhiza yields a very satisfactory product, which has kept well for nearly two years.

While the powdered extract of the U. S. P. is standardized to a definite alkaloidal strength, the British extract bears no relation either to the crude drug or its alkaloid content; moreover, the latter extract is about one-fourth as strong as that of the Br. P. of 1885.

Action and Uses.—The properties and uses of this drug are fully described under PHYSOSTIGMA (which see). The dose is from $\frac{1}{12}$ to $\frac{1}{8}$ of a grain (0.005–0.008 Gm.).

EXTRACTUM QUASSIÆ, *U. S.*—Extract of Quassia.

Extrait de quassie (bois amer), Fr.; *Quassiaextrakt*, G.; *Estratto di quassia acquosa*, It.

Preparation.—Quassia, in No. 20 powder, 1000 Gm.; water, sugar of milk, recently dried and in fine powder, each a sufficient quantity. Moisten the quassia with 400 Cc. of water, pack it firmly in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with bitterness. Reduce the liquid to three-fourths of its bulk by boiling, and strain; then evaporate, by means of a water-bath, to dryness, and add sufficient sugar of milk to bring the total weight up to 100 Gm. Mix thoroughly and reduce the extract to fine powder.—U. S.

Although the present extract of quassia is much weaker than the pilular extract of the preceding pharmacopœia, it is to be preferred for dispensing purposes. Pilular extract of quassia becomes very tough in the course of time. Exhausted with cold water, quassia yields from 3 to 5 per cent. of extractive, which yield may be more than doubled if boiling water be used, but the resulting extract has a jelly-like appearance. Diluted alcohol also increases the yield of extract, but the resulting product does not give a clear solution with water. Powdered extract of quassia represents 10 times its weight of crude drug, and may conveniently be administered in pills or in the dry form in capsules.

Action and Uses.—Extract of quassia is employed as a simple bitter, usually in conjunction with other remedies, such as iron and quinine. The dose is from 1 to 3 grains (0.06–0.20 Gm.).

EXTRACTUM RHAMNI PURSHIANÆ, *U. S.*—Extract of Rhamnus Purshiana.

Extractum Cascaræ Sagradæ—Extract of Cascara Sagrada, Br.—*Extrait de cascara sagrada*, Fr.; *Cascara Sagrada-Extrakt, Amerikanisch Faulbaumrindenextrakt*, G.

Preparation.—Rhamnus purshiana, in No. 60 powder, 1000 Gm.; alcohol, water, glycyrrhiza, peeled, in No. 80 powder, each a sufficient quantity. Mix 125 Cc. of alcohol with 875 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed at the rate of about 5 drops per minute, gradually adding menstruum, using the same proportions of alcohol and water as before, until the tincture passes tasteless and the drug is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder on a water-bath, at a temperature not exceeding 70° C. (158° F.), to the consistence of syrup. Mix this with the reserved portion and continue the evaporation, at or below the above-mentioned temperature, to dryness. Reduce the extract to fine powder, and add sufficient glycyrrhiza to bring the weight of the mixture up to 250 Gm. Mix thoroughly.—U. S.

The British Pharmacopœia directs that cascara sagrada in No. 20 powder be moistened with distilled water and allowed to soften during a few hours; it is then placed loosely in a percolator and percolated with more distilled water until exhausted. The infusion is finally evaporated on a water-bath to dryness.

Cascara sagrada yields to water and to weak alcohol somewhat less than 25 per cent. of dry extractive. The latter menstruum has the advantage of preventing fermentative changes during the prolonged contact with the drug, especially in warm weather.

The powdered extract is of a yellowish- to reddish-brown color and has the characteristic bitter taste of the drug. It keeps admirably in all seasons. If made with cold or even with boiling water, the color of the extract is grayish brown, devoid of all yellow and red.

Action and Uses.—This extract is employed principally as a laxative. Its properties and uses are fully described under RHAMNUS PURSHIANA (which see). The dose is from 2 to 8 grains (0.12–0.50 Gm.), given once or twice daily.

EXTRACTUM RHEI, *U. S., Br., P. G.*—Extract of Rhubarb.

Extractum rhei alcoholicum.—Extrait de rhubarbe, Fr.; *Rhabarberextrakt,* G.; *Estratto di rabarbaro,* It.

Preparation.—Fluidextract of rhubarb, 100 Cc. Evaporate the fluidextract of rhubarb in a porcelain capsule by means of a water-bath, constantly stirring, at a temperature not exceeding 50° C. (122° F.), to a pilular consistence.—U. S.

The Br. P. directs rhubarb in No. 20 powder to be macerated for 48 hours with 60 per cent. alcohol, and then percolated with the same menstruum until exhausted. The resulting tincture is evaporated to dryness. The P. G. directs a menstruum of alcohol 2 parts and water 3 parts with maceration for 24 hours. This process is repeated and the united infusions set aside for 2 days, then filtered, and evaporated to dryness. French extract of rhubarb is made with cold distilled water.

The amount of extractive obtainable from rhubarb depends upon the quality of the drug and the menstruum employed. Good commercial rhubarb has been found to yield, with the U. S. menstruum, from 30 to 40 per cent. of dry extractive. Extract of rhubarb is well adapted for the pulverulent form, as it remains in that condition almost indefinitely if prepared as directed above. It is equally useful for exhibition in pill or powder form, and is to be preferred to the pilular extract, which has a tendency to become hard and tough. The official extract is of a yellowish-brown color and has the decided odor of rhubarb and a bitter taste.

Extractum Rhei Compositum, P. G.—Extract of rhubarb, 30 parts; extract of aloes, 10 parts; resin of jalap, 5 parts; and soap, 20 parts; triturate together, moisten with diluted alcohol, mix well, and dry. It is of a blackish-brown color, and is also known as *Extractum catholicum s. panchymagogum.*

Action and Uses.—Extract of rhubarb is in many cases less effective as a purge than the powdered drug. It may be employed for the same purposes as RHEUM (which see). The dose is from 5 to 10 grains (0.3–0.60 Gm.).

EXTRACTUM SCOPOLÆ, *U. S.*—Extract of Scopola.

Extrait de racine de scopola, Fr.; *Skopolawurzelextrakt,* G.

Preparation.—Fluidextract of scopola, 100 Cc. Evaporate the fluidextract of scopola in a porcelain capsule by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to a pilular consistence.

When assayed by the method given under EXTRACT OF BELLADONNA LEAVES, extract of scopola should contain 2 per cent. of mydriatic alkaloids. If the extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 2 per cent.—U. S.

Scopola extract appears for the first time in the U. S. P. It was introduced for the purpose of permitting its use in plasters, being almost identical in composition and medicinal effect with the extract of belladonna root. Scopola offers an advantage over belladonna root in containing fully as much alkaloid and in being more uniform in the proportion present. The yield of the extract equals about 16 or 20 per cent., the color being light brown.

Action and Uses.—For the action and uses of Extractum Scopolæ, see BELLADONNA. Dose, $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.008–0.015 Gm.).

EXTRACTUM STRAMONII, *U. S.*—Extract of Stramonium.

Extrait de feuilles de stramoine, Fr.; *Stechapfelblätterextrakt*, G.

Preparation.—Fluidextract of stramonium, 100 Cc. Evaporate the fluidextract of stramonium in a porcelain capsule by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to a pilular consistence.

When assayed by the method given under EXTRACT OF BELLADONNA LEAVES, extract of stramonium should contain 1.4 per cent. of mydriatic alkaloids. If the extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 1.4 per cent.—U. S.

Extractum Stramonii of the Br. P. (*Extractum Stramonii Seminis*, U. S., 1890) is made from the seed of the stramonium plant by reducing the same to No. 40 powder, and exhausting by slow percolation with 70 per cent. alcohol. Most of the alcohol is recovered by distillation, after which the residual liquid is evaporated to the consistence of a firm extract. On account of the large amount of fixed oil in stramonium seed, the U. S. P. of 1890 directed the use of diluted alcohol as a menstruum, but even with this change extract of stramonium seed is an unsatisfactory preparation. Moreover, it has been shown that the leaves of stramonium contain more alkaloid than the seed, and hence the extract has been dropped from the 1900 edition of the U. S. P.

The yield of extract of stramonium leaves is about 20 per cent. It has a brownish-green color and a characteristic rather heavy odor. On account of the large proportion of resinous matter in the leaves, it is essential that the percolate be constantly stirred during evaporation, especially toward the end of the operation, otherwise a granular product may result from separation of the resin as the alcoholic strength changes. The extract is used almost exclusively for the preparation of stramonium ointment.

Action and Uses.—For the action and uses of Extractum Stramonii, see STRAMONIUM. The dose is from $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.008–0.015 Gm.).

EXTRACTUM STROPHANTHI, *Br.*—Extract of Strophanthus.

Extrait de semences de strophantus, Fr.; *Strophantusextrakt*, G.

Preparation.—Strophanthus seeds, reduced to No. 30 powder and dried at 43.3° C. (110° F.), 1 ounce; purified ether, alcohol (90 per cent.), milk sugar, of each a sufficient quantity. Pack the dried powder in a percolator, and, having moistened it with the ether, macerate for 24 hours; then allow percolation to proceed, continuing the addition of ether until the liquid passes through colorless. Remove the marc from the percolator, and dry it, gradually heating it to 48.9° C. (120° F.). Again reduce it to powder, repack in the percolator, and moisten with the alcohol. Macerate for 48 hours, then pour on successive quantities of the alcohol, percolating slowly, until 10 fluidounces of liquid are obtained. Evaporate most of the alcohol; transfer the residual liquid to a counterpoised basin; concentrate until the liquid begins to thicken; then add sufficient finely powdered milk sugar to produce 2 ounces of extract, in powder.—Br.

The treatment of the powdered seeds with ether is for the purpose of removing the fixed oil, the presence of which would interfere with final powdering of the extract. Purified ether, freed as far as possible from alcohol and water, is directed so as to avoid solution of the active principle strophanthin. The finished extract represents one-half its weight of strophanthus seed, and is a very convenient form of administration of the drug.

Action and Uses.—This extract is employed for the same purposes as STROPHANTHUS (which see). The dose is from $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.008–0.015 Gm.).

EXTRACTUM SUMBUL, *U. S.*—Extract of Sumbul.

Extract of muskroot, E.; *Extrait de racine de sumbul*, Fr.; *Sumbulwurzelextrakt, Moschuswurzelextrakt*, G.

Preparation.—Fluidextract of sumbul, 100 Cc. Evaporate the fluidextract of sumbul in a porcelain capsule by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to a pilular consistence.—U. S.

The yield of extract of sumbul is about 15 per cent. It is impossible to obtain a perfect pilular condition in the case of this extract, owing to the peculiar nature of the resin and oil present in the drug. It is of a yellowish-brown color and has the characteristic strong odor of the root, reminding of musk.

Action and Uses.—Extract of sumbul is employed principally in the treatment of nervous exhaustion. The dose is from 1 to 5 grains (0.05–0.30 Gm.).

EXTRACTUM TARAXACI, *U. S., Br., P. G.*—Extract of Taraxacum.

Extract of dandelion, E.; *Extrait de pissenlit* (*de dent de lion*), Fr.; *Löwenzahnextrakt*, G.; *Estratto di tarassaco*, It.

Preparation.—Taraxacum, in No. 30 powder, 1000 Gm.; alcohol, water, each a sufficient quantity. . Mix 125 Cc. of alcohol with 875 Cc. of water, and, having moistened the powder with 250 Cc. of the mixture, pack it in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the taraxacum is exhausted. Evaporate the percolate, by means of a water-bath, to a pilular consistence.—U. S.

The Br. P. directs fresh taraxacum root to be crushed and expressed; after subsidence of the starchy matter the juice is heated to 100° C. (212° F.) for 10 minutes, strained, and evaporated to the consistence of a soft extract. Collected in the autumn, the fresh root yields 8 to 10 per cent. of extract; the fresh spring root yields a smaller amount. The P. G. directs the dried root to be exhausted with cold water by maceration and subsequent expression, the united infusions being evaporated to twice the weight of the drug, mixed with alcohol, allowed to deposit, filtered, and evaporated to a pilular consistence.

The present official directions differ materially from those of the last pharmacopœia, which consisted in expression and evaporation of the juice of the root freshly gathered, without provision for removal of the starchy and albuminous constituents. Very little extract was probably made from the fresh root. The above treatment with a weak alcoholic menstruum guards against fermentative changes during the period of maceration and percolation, and yields a satisfactory product.

Extract of taraxacum is of a brown color and yields a nearly clear solution with water. It has a decidedly bitter taste.

Action and Uses.—See TARAXACUM. This preparation does not keep well; for this reason a freshly prepared article should be employed. The dose is from 10 to 20 grains (0.60–1.3 Gm.).

F.

FABIANA.—Pichi.

The dried leafy twigs of *Fabiana imbricata* R. et P. (Fam. *Solanaceæ*).

Origin.—From a large terebinthinate shrub of northern Chile, somewhat resembling a Juniper and somewhat a Tamarisk shrub. Botanically, it is closely related to tobacco.

FIG. 179.

Fabiana (slightly reduced).

Description.—Branches, the largest not exceeding 6 Mm. ($\frac{1}{4}$ In.) in diameter, light brown-gray, smoothish or somewhat warty, enclosing a yellowish tough wood, to which the bark tightly adheres; branchlets very numerous, short, mostly erect, terminating in solitary flowers, very leafy; leaves scale-like, closely imbricated, about 1 Mm. ($\frac{1}{25}$ In.) long, sessile, ovate, entire, smooth, bluish-green; flowers about 1.25 Cm. ($\frac{1}{2}$ In.) long, the calyx very small, the white or purplish corolla tubular, 5-toothed; fruit a small 2-celled and 2-valved capsule, containing a few angularly subglobular seeds; odor peculiarly aromatic; taste bitter, terebinthinate, and disagreeable.

The large branches, and even the trunks, are frequently included, but should be rejected, since the wood is nearly inert, notwithstanding that it is often employed by the natives.

Constituents.—Besides 2 per cent. of gum, fat, a caoutchouc-like body, and a small quantity of volatile oil containing *fabianol*, pichi yields 0.1 per cent. of a bitter ether-soluble alkaloid, *fabianine*, with crystalline salts (Lyons), a tasteless, neutral, inert resin ($C_{18}H_{31}O_2$) in white acicular crystals, much bitter resin soluble in alcohol, ether, chloroform, and alkalies, and a bitter fluorescent glucoside resembling æsculin. This fluoresces blue with ammonia water, and pink with acids, and forms light nearly white crystals. Some investigators have failed to find the alkaloid.

Action and Uses.—Pichi has been employed as a diuretic, lithontriptic, tonic, and cholagogue. This remedy has been recommended especially in the treatment of subacute and chronic vesical catarrh and in renal disease resulting from the presence of calculi. Some practitioners assert that it is of great value in hæmaturia and renal congestion. The drug is said to be useful also in the later stages of gonorrhœa and in gonorrhœal prostatitis. Pichi may be employed in the treatment of hepatic torpor accompanied by indigestion. The dose of the fluid extract is from $\frac{1}{2}$ to 1 drachm (2–4 Cc.), 3 times daily, and of the extract from 5 to 10 grains (0.30–0.60 Gm.).

FARINA AVENÆ.—Oatmeal.

Farina d'avoine, Fr.; *Hafermehl*, G.

The meal prepared from the grain of *Avena sativa* L. (Fam. *Gramineæ*).

Oatmeal was official in the U. S. P. of 1870.

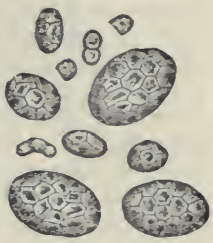
The common oat of cultivation, its nativity doubtful, is too well known to require discussion. *Groats* are oats deprived of their husk.

Description.—Oatmeal is a grayish-white not uniform powder, in which fragments of the tissue are observed by the naked eye; it has a slight odor and a somewhat bitterish taste. Viewed under the microscope, the starch consists of medium-sized polyhedral or muller-shaped granules, with a rather distinct hilum, but without observable laminæ. Frequently two or

three are united, or even a larger number, forming a nearly spherical mass with a checkered surface, and readily separating by pressure into the separate granules.

Constituents.—Oats consist on an average of 25 per cent. of husks and 75 per cent. of grain; the former contains 1 to 1.5 per cent. of fixed oil, 0.5 to 0.75 per cent. of sugar and gum, nearly 2 per cent. of protein compounds, and 6.5 to 7 per cent. of ash, the remainder being cellulose. The grain contains 64.5 to 66 per cent. of starch, 5 to 7 per cent. of fat, 18 to 21 per cent. of protein compounds, 1 to 3 per cent. of salts, the remainder being sugar, gum, and cellulose. The largest portion of the protein compounds is *avenin*, which may be obtained from oatmeal by treating it in the cold with a weak solution of potassium hydroxide, decanting from the sediment, and precipitating by acetic acid; the impure avenin is washed with diluted and strong alcohol and ether, redissolved in weak potassium hydroxide solution, and precipitated by acetic acid (Kreusler, 1869). Avenin closely resembles legumin in its behavior to solvents; it contains 17 per cent. of nitrogen and 0.75 to 1 per cent. of oxygen.

FIG. 180.



Oat starch (× 250).

Action and Uses.—Gruel prepared from oatmeal affords a nutritious, easily digested food which is admirably adapted to certain inflammatory conditions of the alimentary tract. Because of its laxative properties it may be of advantage in the treatment of chronic constipation, and may also be given with purgatives to modify their action. An emollient poultice is sometimes prepared by boiling oatmeal with water to a thick paste, and a thin paste prepared in the same manner has been used as an enema. Oatmeal gruel may be made by boiling 2 ounces (60 Gm.) of the meal with 3 pints (1440 Cc.) of water until only 2 pints (960 Cc.) remain, after which it is cooled and strained. The supernatant liquid is then decanted, and the remaining portion may be flavored with sugar, lemon, vanilla, etc., to suit the taste.

FARINA TRITICI, *Br.*—Wheaten Flour.

Wheat flour, E.; *Farine de blé (de froment)*, Fr.; *Weizenmehl*, G.; *Harina de trigo*, Sp.

The grain of wheat, *Triticum sativum* Lam. (*T. vulgare* Villars.—Fam. *Gramineæ*), ground and sifted.

The origin and general appearance of this substance are too well known to require discussion. Several other species, with their hybrids, contribute a portion of the wheat of cultivation. The identity of wheat flour can be determined from the appearance of its starch-grains (see AMYLUM).

Wheat grain, like the similar graminaceous fruits, has the integuments of the fruit and seed united; underneath this covering is a layer of cells containing *gluten*, and then follows the cellular tissue of the so-called albumen or endosperm, this being filled with *starch;* the embryo is located at the base of the endosperm. Wheat is most generally prepared for food by grinding, and separating by means of sieves the broken integuments, or *bran*, from the fine amylaceous white portion, or *flour*.

Composition.—The relative amounts of the different constituents differ considerably in winter and spring wheats; also according to the variety and hardness, and the producing locality. The following average composition of entire wheat given by König is accepted: water, 13.56 per cent.; nitrogenous substances, 12.42; fat, 1.7; sugar, 1.44; gum and dextrin, 2.38; starch, 64.07; fiber, 2.66; ash, 1.79. The bran, separated, contains, approximately: water, 12 per cent.; insoluble nitrogen, 13.5; soluble nitrogen, 3; fat, 4; carbohydrates, 64; fiber, 9; ash, 7.

If wheat flour be kneaded with cold water as long as the liquid becomes milky, a yellowish-gray elastic and glutinous mass remains, which is the *gluten* of Beccaria, retains about 70 per cent. of water, and consists, according to von Bibra, in the dry state, of about 70 per cent. of *vegetable fibrin*, 3.8 to 9.3 of *vegetable casein*, 7.5 to 19.5 of *glutin*, and 4.6 to 8.2 of fat. On drying, it assumes a horn-like appearance and partly loses its solubility in phosphoric acid and potassium hydroxide solution. To purify it, Ritthausen (1862–67) dissolves it in cold very dilute potassium hydroxide solution (1 to 1000 parts of water), decants from the undissolved starch, and pre-

cipitates with acetic acid. The precipitate is repeatedly treated with fresh portions of alcohol, commencing with specific gravity 0.914, and increasing the strength finally to absolute alcohol. After another washing with ether the insoluble portion constitutes *gluten-casein*, which is slightly soluble in acetic acid, freely soluble in potassium hydroxide solution, and becomes insoluble by heat. On evaporating the united alcoholic liquids to one-half and cooling, *gluten-fibrin* is separated, which is purified by dissolving it repeatedly in 50 and 60 per cent. alcohol. It is freely soluble in dilute acetic acid, and when boiled with water, in which it is insoluble, it is converted into a jelly. After the separation of gluten-fibrin the greater portion of the alcohol is evaporated; the precipitate appearing on cooling is treated with a little alcohol, washed with ether, dissolved in a little 65 per cent. alcohol, and precipitated by absolute alcohol. The precipitate is *mucedin;* the solution contains *gliadin.* Both principles are freely soluble in diluted alcohol and in weak acids and alkalies. The above are the most important *vegetable protein compounds*, and contain between 0.5 and 1 per cent. of sulphur, and between 15 and 18 per cent. of nitrogen.

Action and Uses.—Wheat flour is rarely employed in the treatment of disease, but as a dusting-powder has been used to relieve the burning pain of erysipelas, superficial burns, and other inflammations of the skin attended with burning and itching. In the form of toasted bread or an uncooked paste it may be used for the relief of summer diarrhœa or that depending upon debility. As an emollient poultice it may be wet with milk and directly applied. Bread-crumbs are also employed to give bulk and consistence when minute doses of drugs are prescribed in pill-form.

Horse bran is an article of food, and may be tried as a domestic remedy for constipation. The ash obtained from the burned stalks and husks has been mixed with white wine and given as a diuretic.

FEL BOVIS, *U. S.*—Ox-gall.

Fel bovinum, Fel tauri, Bilis bubula.—Ox-bile, E.; *Bile (Fiel) de bœuf,* Fr. Cod.; *Ochsengalle, Rindsgalle,* G.; *Hiel de toro, Bilis de buey,* Sp.; *Fel de Boi,* Port.

The fresh bile of *Bos Taurus* L. (Ord. *Ruminantia*).

Ox-gall is official in but few pharmacopœias.

Properties.—A green, or brownish-green, viscid, transparent or more frequently translucent liquid, of a peculiar odor, more prominent on heating, a nauseous sweet and bitter taste, a specific gravity of 1.015 to 1.025 at 25° C. (77° F.), a slight alkaline or sometimes a neutral reaction, dissolving completely when agitated with water; becoming thinner on warming, and then readily strained through moistened muslin, whereby fragments of tissue, epithelium, etc., are removed; mixed with its own weight or twice its bulk of alcohol, a precipitate is produced consisting almost exclusively of mucilaginous matter, and the liquid filtered from it and freed from alcohol by evaporation resists putrefaction for a long time. A mixture of 2 drops of ox-gall and 10 Cc. of water, when treated, first, with a drop of freshly prepared solution of 1 part of sugar in 4 parts of water, and afterward with sulphuric acid, cautiously added until the precipitate first formed is redissolved, gradually acquires a brownish-red color, changing successively to carmine, purple, and violet.—U. S.

Constituents.—The most important constituents are about 3 per cent. each of the glycocholates and taurocholates of sodium and potassium, and the bile-pigments bilirubin and biliverdin. Besides these, bile contains fat (the glycerides of acetic and propionic acids), soaps, mucin, albuminous matter, choline, cholesterin ($C_{26}H_{43}OH$), traces of urea, the potassium, sodium, magnesium, and calcium phosphates, the potassium and sodium chlorides, and iron, manganese, and silica. *Bilirubin* ($C_{32}H_{36}N_4O_6$) is an orange or red substance insoluble in water, soluble in chloroform and alkalies, and slightly soluble in alcohol and ether. *Biliverdin* ($C_{32}H_{36}N_4O_9$), of dark-green color, is soluble in alcohol and alkalies, but not in water, chloroform, or ether. The relative proportion of these pigments gives the bile a yellow, brown, or green color, ox-gall being brown from a preponderance of bilirubin. This latter pigment is quickly changed to biliverdin by oxidation, as when exposed to air in alkaline solution. Other bile-pigments described are dark-brown *bilifuscin*, greenish-black *biliprasin*, blackish *bilihumin*, and bluish *bilicyanin*. Glycocholic acid ($C_{26}H_{43}NO_6$) may be split up into cholic acid ($C_{24}H_{40}O_5$) and glycine or glycocoll or amidoacetic acid ($C_2H_5NO_2$); taurocholic acid

($C_{26}H_{45}NSO_7$) splits into cholic acid and taurine ($C_2H_7NSO_3$). Pigs' bile yields also hyoglycocholic ($C_{27}H_{43}NO_5$) and hyotaurocholic ($C_{27}H_{45}NSO_6$) acids.

Action and Uses.—Ox-gall has been largely employed in the treatment of atonic dyspepsia, constipation, and many other complaints depending upon hepatic torpor or functional obstruction of the biliary passages. Some obstetricians think it especially valuable if given in water as an enema to unload the large bowel. It has been given as a vermifuge, tonic, and laxative, in doses of from 5 to 10 grains (0.30–0.60 Gm.). While all experimenters are agreed that it increases the flow of bile, clinicians are by no means convinced of this.

FEL BOVIS PURIFICATUM, *U. S.*—Purified Ox-gall.

Fel bovinum purificatum, Br.; *Purified ox-bile*, E.; *Fiel de bœuf purifié*, Fr.; *Gereinigte Ochsengalle*, G.

Preparation.—Fresh ox-gall, 300 Cc.; alcohol, 100 Cc. Evaporate the ox-gall in a tared porcelain capsule, on a water-bath, to about 100 Gm., then add to it the alcohol, mix the whole thoroughly, and set it aside, well covered, for 3 or 4 days. Then decant the clear solution, filter the remainder, and, having mixed the liquids, and distilled off the alcohol, evaporate the remainder to a pilular consistence.—U. S.

The Br. P. directs that 1 pint of fresh ox-bile shall be evaporated to $\frac{1}{4}$ its volume and then mixed with $\frac{1}{2}$ pint of 90 per cent. alcohol and set aside until the solid matter has subsided, after which the process is continued as stated above, except that the final liquid mixture is evaporated to the consistence of a thick extract, instead of a pilular consistence.

The object of the purification is the removal of mucilaginous and inorganic matter, which former would render the ox-gall tough upon evaporation.

Properties.—It is a yellowish-green hygroscopic solid, having a partly sweet and partly bitter taste and a peculiar odor, and is very soluble in water and alcohol. A solution of purified ox-gall in water (1 per cent., U. S.; 3 or 5 per cent., Br.), when treated with fresh solution of sugar and then with sulphuric acid, as directed in the preceding article, will develop the same play of colors as there mentioned. The quality of purified ox-gall may be readily tested by addition of water, when a clear solution should result, which remains clear upon admixture with an equal volume of alcohol.

Action and Uses.—The employment of purified ox-gall is discussed under FEL BOVIS (which see).

FERRI ARSENAS, *Br.*—Iron Arsenate.

Ferrum arsenicum. — *Ferrous arsenate*, E.; *Arséniate ferreux*, Fr.; *Arsensaures Eisenoxydul*, G.

Ferrous arsenate, $Fe_3(AsO_4)_2.6H_2O_9$, with ferric arsenate and some iron oxide.—Br.

Preparation.—Dissolve 530 Gm. of anhydrous sodium arsenate in 2 liters, and 415 Gm. of crystallized ferrous sulphate in $2\frac{1}{2}$ liters, of distilled water; mix the solutions and add 90 Gm. of sodium bicarbonate dissolved in a little cold distilled water, stirring thoroughly. Collect the precipitate on a calico filter, and wash until barium chloride shows the absence of sulphate in the filtrate, squeeze the water from the precipitate, and dry on porous tiles in an air-bath not above 37.8° C. (100° F.).—Br.

The reaction taking place primarily is as follows: $3(FeSO_4.7H_2O) + 2Na_2HAsO_4 + 2NaHCO_3 = Fe_3(AsO_4)_2.6H_2O + 3Na_2SO_4 + 17H_2O + 2CO_2$. By this reaction, theoretically 1 part of crystallized ferrous sulphate requires 0.45 part of anhydrous sodium arsenate, while the proportion in the Br. P. is 1 part of ferrous sulphate to 1.27 part of arsenate, which seems to be an excess of about 182 per cent. of arsenate. The excessive quantity of arsenate and method of preparation have been criticised by Thomas S. Barrie (*Chemist and Druggist*, 1900) and F. B. Power (*Pharm. Jour.*, 1900).

The directions in the Fr. Cod. are still more inconsistent, and it is improbable that the compound obtained has the formula given, namely, $FeHAsO_4$. No other pharmacopœias recognize ferrous arsenate.

The object of the sodium bicarbonate in the Br. process is to neutralize the free sulphuric acid which would be formed in the reaction. The Fr. Cod. omits the bicarbonate. The white precipitate of ferrous arsenate is very bulky, and while being washed to free

it from the mother-liquor and dried, it is oxidized and converted into ferroso-ferric arsenate. The change is indicated by the gradual disappearance of the white color until the salt finally becomes olive-green or blue-green. In the reaction and final result the process corresponds nearly with the one for the blue iron phosphate.

Properties.—Iron arsenate is a green or blue-green amorphous powder insoluble in water and in alcohol, but dissolving readily in dilute hydrochloric acid, yielding a bright-yellow solution in which blue precipitates are produced with both ferrocyanide and ferricyanide of potassium, and which yields with hydrogen sulphide first a milkiness (sulphur), and afterward a yellow precipitate of arsenic sulphide. It may be distinguished from iron phosphate, which resembles it in appearance, by boiling a small portion with an excess of caustic soda, filtering, and neutralizing exactly with nitric acid, when a brick-red precipitate of silver arsenate will be produced on the addition of silver nitrate. Iron phosphate similarly treated yields a yellow precipitate. The Br. P., oddly enough, gives directions for determining the amount of ferrous arsenate, instead of the more potent arsenic acid. 1 Gm. dissolved in an excess of sulphuric acid and diluted, should require at least 6.7 Cc. of decinormal potassium dichromate solution before it ceases to give a blue color with solution of potassium ferricyanide, corresponding to about 12.5 per cent. of hydrous, or 10 per cent. of anhydrous ferrous arsenate. No sulphate should be present.

Action and Uses.—Iron arsenate is of little value in medicine. It is said to combine the properties of both iron and arsenic, but the quantity of the former is probably too small to be of material value. The remedy may be employed for the same conditions in which arsenic is used. The beginning dose is $\frac{1}{20}$ grain (0.003 Gm.), which may be gradually increased to ½ grain 0.03 Gm.).

FERRI CARBONAS SACCHARATUS, *U. S.*, *Br.*—Saccharated Ferrous Carbonate.

Ferrum carbonicum saccharatum, P. G.—*Saccharated carbonate of iron*, E.; *Saccharure de proto-carbonate de fer* (*de carbonate ferreux*), Fr.; *Zuckerhaltiges Ferrocarbonat*, G.

Formula of pure ferrous carbonate, $FeCO_3$ (anhydrous). Molecular weight, 115.05.

The Br. P. product is described as a more or less oxidized ferrous oxycarbonate, $(FeCO_3)Fe(OH)_2$, the ferrous salt, calculated as ferrous carbonate, forming about one-third of the saccharated mixture.

The saccharated mixture contains 16.1 per cent. (Br.), about 7.25 per cent. (U. S.), of metallic iron in the ferrous state; 9.5–10 per cent. (P. G.) of total iron.

About 33 per cent. (Br.), about 15 per cent. (U. S.), of ferrous carbonate.

Preparation.—Dissolve 50 parts of ferrous sulphate in 200 parts of boiling distilled water and filter; dissolve 35 parts of sodium bicarbonate in 500 parts of distilled water at 50° C. (122° F.) and filter; add the former solution gradually to the latter and mix thoroughly by rotating the flask. Fill the flask with boiling distilled water, cork it loosely, and set the mixture aside. When the precipitate has subsided, draw off the clear, supernatant liquid by means of a syphon, and then fill the flask again with hot distilled water in the same manner, until the decanted liquid gives not more than a slight cloudiness with barium chloride test-solution. Finally bring the precipitate on a muslin strainer, and, when it has thoroughly drained, transfer it to a porcelain capsule containing 80 parts of sugar in fine powder, and mix intimately. Evaporate the mixture to dryness by means of a water-bath, reduce it to powder, and mix intimately with it, if necessary, sufficient well-dried sugar to make the final product weigh 100 parts. Keep the product in small, well-stoppered bottles. The proportions used above are identical with those of the U. S. P., in which weight in Gm. is directed.

Both the British and German Pharmacopœias mix the iron and alkali solutions while hot, and thereby avoid absorption of oxygen during cooling; in other respects the manipulations do not materially differ. For 10 parts of ferrous sulphate there are ordered 7 parts of sodium bicarbonate (P. G.), 6¼ parts of ammonium carbonate (Br.); and the ferrous carbonate thus obtained is mixed with sugar 5 parts (Br.) (yield 9¾ parts); first with milk-sugar 2 parts and cane-sugar 6 parts, and when dry with sufficient cane-sugar to make 20 parts (P. G.).

Ferrous sulphate and sodium bicarbonate decompose each other, forming ferrous carbonate, carbon dioxide, and sodium sulphate; thus, $FeSO_4 + 2NaHCO_3 = FeCO_3 + CO_2 + H_2O + Na_2SO_4$. The operation must be performed with the air excluded as much as possible; hence the importance of employing boiling water from which the air has been expelled, of generating carbon dioxide during the operation by the use of sodium bicarbonate, of performing the washing by decantation in deep cylindrical and well-covered vessels, and of collecting and draining, or, as directed by the Br. P., expressing the precipitate rapidly; the subsequent addition of sugar will, in a measure, protect it against oxidation until it has been finally dried.

Properties.—Ferrous carbonate forms small lumps or a gray or greenish-gray inodorous powder, having a neutral reaction to moistened litmus-paper, and a sweet taste like that of sugar, followed by a very feeble chalybeate taste. On exposure to dry air it is slowly, or in damp air rapidly, oxidized, and is therefore best preserved in small well-filled and sealed vials; if it has changed to a brown color and effervesces only slightly with acids, it should be rejected. When heated in contact with the air, it becomes black, evolving the odor of burning sugar, and is finally converted into red-brown ferric oxide. Water dissolves only the sugar, but the powder is completely dissolved with effervescence in dilute hydrochloric acid, and this solution gives a blue precipitate with both potassium ferricyanide and ferrocyanide, showing the presence of ferrous and of ferric salt.

Tests.—The powder, placed upon moistened red litmus-paper, should not change the red color to blue (absence of alkali). The solution in diluted hydrochloric acid should yield no precipitate or but a slight turbidity with barium chloride, indicating only traces of sulphate left behind from the mother-liquor.

If 1.15 Gm. of saccharated ferrous carbonate be dissolved in 10 Cc. of diluted sulphuric acid, and the solution diluted with water to about 100 Cc., it should require not less than 15 Cc. of tenth-normal potassium permanganate solution before the pink tint imparted to the liquid ceases immediately to disappear, corresponding to not less than 15 per cent. of ferrous carbonate (each Cc. of the volumetric solution indicating 1 per cent. of pure ferrous carbonate).—U. S. The Br. P. demands about one-third of anhydrous ferrous carbonate, and that 1 Gm. should be oxidized by at least 29 Cc. of the volumetric solution of potassium dichromate, indicating not less than 16.1 per cent. of ferrous iron or 33.3 per cent. of ferrous carbonate. If none of the ferrous salt had been oxidized, the powder would contain 20.85 per cent. (U. S., P. G.), 42.8 per cent. (Br.), of anhydrous ferrous carbonate. The German Pharmacopœia determines the total iron only.

Action and Uses.—This remedy is employed in the treatment of chlorosis, neuralgia, and other affections depending upon anæmia. It has been introduced as a substitute for the subcarbonate of iron, and is superior to the latter because of the fact that the iron is nearly all in the ferrous state. The dose is from 5 to 20 grains (0.30–1.3 Gm.), several times daily.

FERRI CHLORIDUM, *U. S.*—Ferric Chloride.

Ferrum sesquichloratum, P. G.; *Ferrum muriaticum oxydatum, Ferri perchloridum.—Sesquichloride (Perchloride) of iron*, E.; *Perchlorure de fer, Chlorure ferrique*, Fr.; *Eisenchlorid*, G.

Formula, $FeCl_3.6H_2O$ or $Fe_2Cl_6.12H_2O$. Molecular weight, 268.32 or 536.64.

It should contain not less than 20 per cent. of metallic iron in the form of chloride.—U. S.

Preparation.—Evaporate 100 Gm. of solution of ferric chloride on a water-bath until it weighs 50 Gm. Set it aside in a glass-covered vessel until it forms a crystalline mass. Break the salt into pieces and keep it in glass-stoppered bottles, protected from light.—U. S.

Instead of grams, avoirdupois ounces may be used in the directions above. During evaporation and the subsequent operation the use of iron spatulas or stirrers should be carefully avoided; only porcelain or glass should be used. On evaporating a solution of ferric chloride to the crystallizing-point, vapors containing hydrochloric acid are given off as soon as the temperature reaches a certain point, which varies with the strength of the solution; and if the heat is raised to the boiling-point, ferric chloride is

mechanically carried off. Evaporation should be done at a gentle heat, and it will be found of advantage to have a slight excess of hydrochloric acid at the beginning of the evaporation. The crystallization may be effected by keeping the capsule in a warm place until the contents solidify, but the crystals will then be very damp. When evaporation has been carried too far, a salt, $FeCl_3 + 3H_2O$, is formed which is very deliquescent.

Another procedure is to evaporate the solution to less than half its weight; on cooling the mass will now remain liquid, and is set aside loosely covered to protect it from dust and other impurities, and at the same time to admit the atmosphere, from which it will attract moisture and gradually crystallize. The crystals begin to form as small circular nodules having a radiated appearance, floating upon the liquid, and increasing in size until the entire liquid forms a solid mass, which adheres firmly to the vessel. By warming it slightly the mass is readily detached, and should at once be broken into pieces and put into dry, well-stoppered bottles.

Properties.—The official ferric chloride forms orange-colored wart-like pieces which have a crystalline texture and a slight odor of hydrochloric acid, are very deliquescent, forming a thick red-brown liquid having a density of about 1.55, and formerly known as *Oleum martis per deliquium.* The salt is readily and completely soluble in water and alcohol, also in a mixture of 1 part of ether and 3 parts of alcohol, yielding yellowish-brown solutions of an acid reaction and a strongly styptic, ferruginous taste. The crystals fuse at 35.5° C. (96° F.); at a higher temperature they are decomposed and partly volatilized. The aqueous solution shows the reactions of ferric salts and chlorides in yielding a red-brown precipitate with ammonia water and other alkalies, a blue one with potassium ferrocyanide, and a white one, insoluble in nitric acid, with silver nitrate.

Tests.—The complete solubility in the solvents mentioned is generally an indication of the absence of other metallic salts. The presence of nitric acid or of ferrous salt is detected as described above. 1 Gm. of the salt in boiling water, when precipitated by an excess of ammonia-water, should give a colorless filtrate, 20 Cc. of which, after acidulating with hydrochloric acid, should give no color or turbidity with an equal volume of hydrogen sulphide solution when standing corked at 35° C. (95° F.) for at least half an hour, either before or after making alkaline with ammonia-water (absence of other heavy metals). If to 3 drops of an aqueous solution of the salt (1 in 2) 10 Cc. of tenth-normal sodium thiosulphate solution be added and then slowly heated to boiling, no brown precipitate of ferric hydroxide should separate (absence of oxychloride). The ferric chloride is reduced to ferrous with formation of sodium tetrathionate, $2FeCl_3 + 2Na_2S_2O_3 = 2FeCl_2 + 2NaCl + Na_2S_4O_6$. Any ferric hydroxide which was held in solution by ferric chloride is precipitated after reduction of the latter takes place. If 1 Gm. of anhydrous ferric chloride be dissolved in water to 100 Cc., then 55.5 Cc. of this solution placed in a glass-stoppered flask (250 Cc.) with 3 Cc. of hydrochloric acid and 2 Gm. of potassium iodide, should, after securely fastening the stopper and heating for half an hour at 40° C. (104° F.) and cooling, require not less than 20 Cc. of tenth-normal sodium thiosulphate solution for complete decolorization (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron).—U. S.

The volumetric determination of iron by means of potassium iodide and sodium thiosulphate depends upon the well-known reaction of the former salt and ferric chloride, whereby iodine is liberated; thus, $2FeCl_3 + 2KI = I_2 + 2FeCl_2 + 2KCl$, the ferric salt being at the same time reduced to the ferrous state; 322.08 parts of anhydrous or 536.64 parts of official ferric chloride correspond to 251.80 parts of iodine, and hence each Cc. of sodium thiosulphate solution necessary to discharge the brown color of iodine will represent 0.02683 Gm. of $FeCl_3 + 6H_2O$, corresponding to 0.005550 Gm. of metallic iron. The iodine liberated is held in solution by an excess of potassium iodide.

Action and Uses.—Ferric chloride is rarely employed in internal medicine except in the form of the tincture or solution. The internal uses of the remedy will be discussed under TINCTURA FERRI CHLORIDI (which see). The drug is astringent and styptic, and solutions varying in strength from 15 to 90 per cent. have been employed in the treatment of epistaxis, hæmoptysis, and the bleeding following tooth-extraction and other minor operations. It has been suggested as an injection for the cure of varices and aneurism, but its employment in these conditions is not considered a safe procedure. The deliquesced salt has also been applied as a caustic and styptic to lupoid and scrofulous ulcers.

FERRI CITRAS, *U. S.*—Ferric Citrate.

Ferrum citricum oxydatum, P. G.—*Citrate of iron*, E.; *Citrate de sesquioxide de fer, Citrate ferrique*, Fr.; *Eisencitrat, Citronensaures Eisenoxyd, Ferricitrat*, G.

Formula, $Fe(C_6H_5O_7)$ (anhydrous). Molecular weight, 243.12.

Preparation.—Freshly prepared ferric hydroxide, obtained from 1050 Gm. of solution of ferric sulphate, is added to 300 Gm. of citric acid, and the mixture heated on a water-bath to 60° C. (140° F.) until solution is effected. After filtration the clear liquid is evaporated, at the same temperature, to the consistence of syrup and spread on plates of glass, so that, when dry, the salt may be obtained in scales.

At a higher temperature than indicated by the formula the salt is slowly reduced to a ferrous compound. When the solution is concentrated to a thick, syrupy liquid, it is spread on plates, and then dried in a dry or warm place. Failure in scaling is usually due to incomplete saturation of the citric acid with ferric hydroxide, occasionally to the presence of saline impurities retained by the carelessly washed hydroxide. The yield is from 42 to 44 per cent.

The amount of water of hydration varies considerably, and hence no definite formula can be assigned to the official scale salt; much confusion exists in the literature upon the subject, some authors assigning as low as 3.5 per cent., while others claim 18–20 per cent. of water. F. B. Power (1891) found the amount of water present in scales of ferric citrate, carefully prepared by himself, to average 31.9 per cent.; the same author also determined that all water of hydration is eliminated at 100° C. (212° F.). The variable proportion of water may be due to difference in temperature employed, subsequent exposure, etc. The U. S. P. requires the presence of at least 16 per cent. of metallic iron, which is somewhat less than the German Pharmacopœia, which requires 19 to 20 per cent. of iron. It should be kept in well-stoppered bottles, protected from light.

Properties.—If of the proper composition, the salt readily comes off the plates in the form of thin, transparent, garnet-red scales which yield a red-brown powder, are permanent in the air, inodorous, and have a faint ferruginous taste and an acid reaction. It is insoluble in alcohol, and dissolves completely but slowly in cold water, and easily in boiling water, but diminishes in solubility by age. Its solution is darkened, but not precipitated, by ammonia. When strongly heated, the salt is decomposed, emitting fumes having the odor of burnt sugar, and leaving an ash consisting of ferric oxide. On being boiled with an excess of potassium hydroxide solution, the salt or its solution yields a precipitate of ferric hydroxide, and the filtrate, on being neutralized with acetic acid and then boiled with test-solution of calcium chloride, gives a white granular precipitate of calcium citrate. With potassium ferrocyanide test-solution it affords a bluish-green color or precipitate, which is increased and rendered dark-blue by the subsequent addition of hydrochloric acid (difference from ammonio-citrate of iron). If heated with potassium hydroxide test-solution it affords a brownish-red precipitate, without evolving vapor of ammonia.

Tests.—Ferric citrate is not liable to adulteration. The presence of tartaric acid would be detected by precipitating a boiling solution of the salt (1 in 10) with excess of potassium hydroxide, acidulating the filtrate with acetic acid, cooling, and allowing to stand 24 hours, when no white crystalline precipitate should appear (absence of tartrate). The ash obtained by incinerating the salt should not have an alkaline reaction (absence of fixed alkalies). If 0.555 Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 15 Cc. of water and 2 Cc. of hydrochloric acid, with the aid of a gentle heat, and, after the addition of 1 Gm. of potassium iodide, the mixture kept for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, it should require not less than 16 Cc. of tenth-normal sodium thiosulphate solution before the color of the liquid is discharged (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron).—U. S.

The object of heating the ferric citrate with hydrochloric acid is to convert the citrate into chloride, after which the determination proceeds as explained under the latter.

Action and Uses.—Ferric citrate is one of the less astringent preparations of iron. It is best administered in solution, and is less liable to derange digestion than the astringent salts. The dose of the salt is from 3 to 10 grains (0.2–0.60 Gm.).

FERRI ET AMMONII CITRAS, *U. S., Br.*—Iron and Ammonium Citrate.

Ferrum citricum ammoniatum, Ferri ammonio-citras, Ferro-ammonium citricum.—Ammonio-ferric citrate, Ammonio-citrate of iron, Soluble citrate of iron, E.; *Citrate de fer et d'ammoniaque (de fer ammoniacal), Citrate ferrique ammoniacal,* Fr.; *Ferriammoniumcitrat, Citronensaures Eisenoxyd-Ammonium (Ammoniak),* G.

Preparation.—Iron and ammonium citrate may be prepared by adding to a solution of ferric citrate ammonia-water in slight excess, evaporating the mixture, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spreading it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place. It is deliquescent in moist air.

The process of manufacture has been dropped from the U. S. P.

In the Br. P. ferric citrate is prepared by first dissolving the ferric hydroxide obtained from 10 fluidounces of solution of ferric sulphate, in 4 ounces of citric acid dissolved in an equal weight of water and heated on a water-bath. After cooling, $5\frac{1}{2}$ fluidounces of solution of ammonia are added, the liquid is filtered and evaporated to a syrup, which is dried on glass plates at a temperature not above 37.8° C. (100° F.).

Properties and Tests.—The salt, which is sometimes sold as soluble citrate of iron, closely resembles ferric citrate in appearance and behavior, except that it has a neutral reaction, is more readily soluble in cold water, gives off the odor of ammonia when heated with an excess of potassium hydroxide solution, and does not strike a blue color on mixing its solution with potassium ferrocyanide unless it be acidulated with hydrochloric acid. Impurities, if present, may be determined in the same manner. On ignition, the salt yields about 31–32 per cent. (Br.) of ferric oxide. Being made from normal ferric citrate with the addition of ammonia, it is probably a mixture or compound of ammonio-ferric citrate with ferric oxycitrate. As in the case of ferric citrate, so also here, the Pharmacopœia requires the presence of at least 16 per cent. of metallic iron, which is determined in exactly the same manner as in the case of ferric citrate.

Action and Uses.—This salt has no advantage over ferric citrate except that it is more soluble. It should always be given in solution, and may be combined with carbonated alkalies and given in a state of effervescence by the addition of a solution of citric acid. The dose is from 2 to 5 grains (0.12–0.30 Gm.), several times daily.

FERRI ET AMMONII SULPHAS, *U. S.*—Ferric Ammonium Sulphate.

Ferrum sulfuricum oxydatum ammoniatum, Ferrum ammonio-sulphuricum, Ferri ammonio-sulphas, Alumen ammoniacale ferricum.—Ammonio-ferric sulphate, Ammonio-ferric alum, Iron alum, E.; *Sulfate de fer et d'ammoniaque, Sulfate ferrique ammoniacal, Alun de fer ammoniacal,* Fr.; *Ferriammoniumsulfat, Schwefelsaures Eisenoxyd-Ammonium, Ammoniakalischer Eisenalaun,* G.

Formula, $NH_4Fe(SO_4)_2 + 12H_2O$ or $(NH_4)_2Fe_2(SO_4)_4 + 24H_2O$. Molecular weight, 478.69 or 957.38.

It should contain in the unefflorescd condition 99.5 per cent. of pure salt, and be kept in well-stoppered bottles, protected from light.—U. S.

Preparation.—The salt may be prepared by mixing equivalent quantities of ammonium sulphate and solution of ferric sulphate while hot, and setting aside to crystallize. The crystals are washed quickly with cold water, and dried on bibulous paper in the air. The mother-liquor yields a second crop of crystals on concentration.

Properties.—This salt crystallizes like alum in regular octahedrons, which are transparent and colorless or of a pale-amethyst or violet color, particularly if crystallized from a solution containing a little free acid. They have the specific gravity 1.712, are inodorous, of an acid and strongly astringent taste, and efflorescent on exposure to air. On the application of heat, it melts, parts with its water of crystallization, and is further decomposed, leaving ultimately a light-brown or red-brown residue. The salt is insoluble in alcohol and ether; at 25° C. (77° F.) it requires 2.7 parts, and at the boiling temperature 0.8 part, of water for solution. The aqueous solution has an acid reaction and is of a brownish-yellow color, which gradually changes to red, a basic salt being afterward deposited, and the decomposition being hastened by continued boiling of the solution. This shows the chemical reactions of ferric salts, sulphuric acid, and ammonia.

Tests.—If the solution be boiled with an excess of potassium hydroxide solution, and the colorless alkaline filtrate heated with an excess of ammonium chloride, or neutralized with hydrochloric acid and again rendered alkaline by ammonia, it should not yield a white gelatinous precipitate of aluminum hydroxide. The Pharmacopœia requires an amount of ferric sulphate corresponding to at least 11.5 per cent. of metallic iron, the method of titration and the quantities used being exactly the same as in the case of FERRIC CITRATE (which see); 11.5 Cc. of tenth-normal sodium thiosulphate solution should be required, corresponding to 11.5 per cent. of metallic iron. Silver nitrate solution added to 30 Cc. of the salt (1 in 20), acidulated with 3 Cc. of nitric acid, should not produce any turbidity (absence of chlorides).

Action and Uses.—Ferric alum is employed in medicine for its astringency. It may be successfully used in the treatment of diarrhœa with anæmia, as it is not so irritating to mucous membranes as the subsulphate. A saturated solution may also be locally applied as a styptic. The internal dose is from 5 to 10 grains (0.30–0.60 Gm.), 3 times daily.

FERRI ET AMMONII TARTRAS, *U. S.*—Iron and Ammonium Tartrate.

Ferri ammonio-tartras, Ferrum tartaricum ammoniatum.—Ammonio-ferric tartrate, Ammonio-tartrate of iron, E.; *Tartrate de fer et d'ammoniaque, Tartrate ferrique ammoniacal,* Fr.; *Ferriammontartrat, Weinsaures Eisenoxyd-Ammonium,* G.

It should contain not less than 13 per cent. of metallic iron, and be kept in well-stoppered bottles, protected from light.—U. S.

Preparation.—Solution of ferric sulphate, 100 Cc.; tartaric acid, 29 Gm.; distilled water, 200 Cc.; ammonia water, water, of each a sufficient quantity. To 110 Cc. of ammonia water, previously diluted with 250 Cc. of cold water, add, while constantly stirring, the solution of ferric sulphate, previously diluted with 1300 Cc. of cold water. When the precipitate has subsided, draw off the clear supernatant liquid by means of a syphon, then mix the precipitate intimately with about 1500 Cc. of cold water, again draw off the clear liquid, and repeat the washing in the same manner until the decanted liquid gives not more than a slight cloudiness with barium chloride test-solution. Then bring the precipitate on a wet muslin strainer, allow it to drain, and express the water as completely as possible. Dissolve one-half of the tartaric acid in the distilled water, neutralize the solution exactly with ammonia water, then add the other half of the tartaric acid, and dissolve it by the application of a gentle heat. Now bring in the moist ferric hydroxide, in successive portions, stirring constantly, and continuing the heat, which should not exceed 60° C. (140° F.), until the hydroxide is dissolved. Filter the solution while hot, evaporate it in a porcelain vessel, at or below the above-mentioned temperature, to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place.—U. S., 1890.

If 5 fluidounces of solution of ferric sulphate be used, it will require 662 grains of tartaric acid, 16 fluidounces of distilled water, and 5.5 fluidounces of ammonia water.

This formula is essentially that suggested by Prof. Procter (1841). By neutralizing one-half of the tartaric acid with ammonia water, ammonium tartrate is formed, which is converted into the acid salt by the addition of reserved tartaric acid. On digesting this with ferric hydroxide a solution is obtained which, by careful evaporation and drying upon plates, yields the official salt in scales.

Properties.—Iron and ammonium tartrate is in transparent, garnet-red, inodorous scales of a sweetish and slightly ferruginous taste, and yields a rust-colored powder. The Pharmacopœia permits the salt if of a reddish-brown color. In dry air it is permanent; in a moist atmosphere it is hygroscopic, but scarcely deliquescent. When heated, it gives off water and ammonia, is then charred, with the odor of burning sugar, and finally leaves a residue of ferric oxide. The salt is not soluble in alcohol or ether, but dissolves slowly and freely in glycerin and water. The latter solution is neutral to test-paper, is darkened but not precipitated by ammonia or by cold solutions of fixed alkalies or their carbonates, and is not colored blue by potassium ferrocyanide unless acidulated. When acidulated with hydrochloric acid and mixed with potassium acetate, potassium bitartrate is precipitated, When heated with potassium hydroxide solution in excess, a red-brown precipitate of ferric hydroxide is deposited, ammonia is given off, and the colorless fil-

trate, when cooled and strongly acidulated with acetic acid, yields a white crystalline precipitate of potassium bitartrate.

Tests.—The ash obtained on incineration should not have an alkaline reaction; this test readily distinguishes this salt from the next. The amount of iron present is determined volumetrically in the same manner as in the case of FERRIC CITRATE (which see), 0.555 Gm. of the salt requiring not less than 13 Cc. of the tenth-normal volumetric solution, representing 13 per cent. of iron.

Action and Uses.—This remedy may be employed as are the other mildly astringent preparations of iron in doses of from 10 to 30 grains (0.60–2 Gm.), preferably in solution.

FERRI ET POTASSII TARTRAS, *U. S.*—Iron and Potassium Tartrate.

Ferrum tartaratum, Br.; *Ferri potassio-tartras, Ferri-Kalium tartaricum, Ferrum tartarisatum.—Potassio-ferric tartrate, Tartarated (tartarized) iron, Ferro-tartrate of potassium*, E.; *Tartrate de fer et de potasse, Tartrate ferrico-potassique, Tartre chalybé, Tartre martial*, Fr.; *Kaliumferritartrat, Weinsaures Eisenoxyd-Kali, Eisenweinstein*, G.

It should contain not less than 15 per cent. of metallic iron, and be kept in well-stoppered bottles, protected from light.—U. S.

Preparation.—Solution of ferric sulphate, 100 Cc.; potassium bitartrate, 38 Gm.; distilled water, 300 Cc.; ammonia water, water, each a sufficient quantity. Prepare ferric hydroxide exactly as in Ferri et Ammonii Tartras. Then mix the potassium bitartrate, in a porcelain vessel, with the distilled water, heat the mixture on a water-bath to a temperature not exceeding 60° C. (140° F.), and gradually add the moist ferric hydroxide, stirring constantly until it is dissolved. Filter the liquid while hot, and let the filtrate stand in a cool, dark place for 24 hours. Then stir it well with a porcelain or glass spatula, so that the precipitate which has formed in it may be thoroughly incorporated with the liquid. Now add, very cautiously, just sufficient ammonia water to dissolve the precipitate, evaporate the solution in a porcelain vessel, at or below the above-mentioned temperature, to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place.—U. S., 1890,

If 5 fluidounces of solution of ferric sulphate be used, it will require 867 grains of acid potassium tartrate, 15 fluidounces of distilled water, and 5.5 fluidounces of ammonia water.

The formula of the British Pharmacopœia is like the above, the proportions used being solution of persulphate of iron 10 fluidounces, solution of ammonia 16 fluidounces, and acid potassium tartrate 3 ounces and 146 grains. As in the preceding case, ferric hydroxide is formed first, and this is used for saturating the potassium salt. A salt of the formula $K_6Fe_2(C_4H_4O_6)_6$ is probably formed first, which would yield somewhat more than 12 per cent. (Dulk found 12.78 per cent.) of ferric oxide; the British Pharmacopœia requires about 30; Soubeiran and Capitaine obtained 30.8 per cent. of ferric oxide, and regarded the salt as having the composition $K(FeO)C_4H_4O_6$. It is likely that different basic compounds may be formed by prolonged digestion. To render the salt perfectly and readily soluble in water, the U. S., 1890, directs the addition of a little ammonia water to the filtered solution before evaporation—a course recommended for this and analogous salts by G. H. C. Klie in 1876.

Properties and Tests.—In its physical properties, as well as in its behavior to solvents, alkalies, and potassium ferrocyanide, this salt resembles iron and ammonium tartrate, from which it differs in giving off a slight odor of ammonia when heated with potassium hydroxide solution, and, when incinerated, in leaving ash which has an alkaline reaction to test-paper and effervesces on the addition of hydrochloric acid. The Pharmacopœia demands not less than 15 per cent. of metallic iron, which is determined exactly as directed under FERRI CITRAS (which see), 0.555 Gm. of the salt requiring not less than 15 Cc. of tenth-normal sodium thiosulphate solution.

Tartarus ferratus, as above stated, is made into balls, which in France are known as *boules de Mars* and *boules de Nancy*, and, dissolved in hot water, are added to baths as a substitute for natural chalybeate waters. It is given internally in carbonated water, sherry wine, or syrup.

Action and Uses.—Because of its richness in iron, freedom from astringency, and

mild taste, this is one of the best salts of iron to employ. It rarely causes constipation, and is not very liable to produce gastric irritation. It is usually given in solution in the dose of from 5 to 10 grains (0.30–0.60 Gm.).

FERRI ET QUININÆ CITRAS, *U. S., Br.*—Iron and Quinine Citrate.

Chininum ferro-citricum, P. G.; *Citrate de fer et de quinine*, Fr.; *Ferrichinincitrat, Eisenchinincitrat, Citronensaures Eisen-Chinin*, G.

It should contain not less than 11.5 per cent. of quinine and 13.5 per cent. of metallic iron.—U. S.

Preparation.—Ferric citrate, 85 Gm.; quinine, dried at 100° C. (212° F.) to a constant weight, 12 Gm.; citric acid, 3 Gm.; distilled water, a sufficient quantity to make 100 Gm. Dissolve the ferric citrate in 160 Cc. of distilled water by heating on a water-bath at a temperature not exceeding 60° C. (140° F.). To this solution add the quinine and citric acid, previously triturated with 20 Cc. of distilled water, and stir constantly until the quinine is dissolved. Lastly, evaporate the solution, on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place.—U. S., 1890.

To make 2 avoirdupois ounces of this compound dissolve 744 grains of ferric citrate in 3½ fluidounces of warm distilled water; to the solution add 105 grains of quinine dried at 100° C., and 26 grains of citric acid previously triturated with 3 fluidrachms of distilled water. When the quinine has all been dissolved evaporate as directed above.

The British Pharmacopœia directs to prepare ferric hydroxide from 9 fluidounces of solution of ferric sulphate as described under Ferri et Ammonii Tartras; the ferric hydroxide is then dissolved in 6 ounces and 60 grains of citric acid, dissolved by warming on a water-bath in an equal weight of water. In this solution is then dissolved quinine obtained by adding a slight excess of ammonia water to a solution of 2 ounces of quinine sulphate in 8 times its weight of distilled water and 3 fluidounces of diluted sulphuric acid, and washing the precipitate with 3 pints of distilled water. The mixture is then cooled, and to it are added, in small quantities at a time with brisk stirring, 3 fluidounces of solution of ammonia diluted with 4 fluidounces of distilled water. The quinine which separates on each addition of ammonia water is allowed to dissolve before the next addition. The solution is finally filtered. evaporated, and dried on glass plates at 37.8° C. (100° F.).

The British Pharmacopœia preparation corresponds closely to the next following compound in the subsequent addition of ammonium citrate, by which the physical properties of the resulting scales are changed.

The corresponding salt of the German Pharmacopœia again differs in containing, besides quinine, both ferric and ferrous salt, but no ammonia; no process is given in the last P. G., but in the preceding edition it was made by digesting powdered iron 3 parts with citric acid 6 parts and water 500 parts, adding afterward quinine 1 part, freshly precipitated by sodium hydroxide solution from 1.3 parts of quinine sulphate; the solution was then evaporated and scaled.

Properties.—The product of the first process is in transparent, inodorous scales of a yellowish-green-brown to reddish-brown color, varying according to their thickness. When heated to near redness, like other citrates it emits fumes having the odor of burnt sugar, and it finally leaves a brown ash free from alkaline reaction to test-paper. The salt, according to the U. S. P., is slowly deliquescent in damp air; it dissolves slowly in cold, more readily in hot, water, is slightly soluble in alcohol, and insoluble in ether; its solubility diminishes with age. The solution is slightly acid to test-paper, has a bitter and mildly chalybeate taste, and yields with tannin a grayish-black precipitate consisting of the mixed tannates of iron and quinine. On the addition of ammonia the liquid darkens in color, yields a white curdy precipitate of quinine, and the filtrate gives a blue precipitate with potassium ferrocyanide after the addition of hydrochloric acid. The solution of the salt on being heated with excess of potassium hydroxide solution gives a precipitate of ferric hydroxide and quinine, without evolving vapors of ammonia, and the filtrate after the addition of calcium chloride, again filtering, and then boiling, yields a white granular precipitate of calcium citrate. Another portion of the filtrate, acidulated with

acetic acid and allowed to stand for some time, should not deposit a crystalline white precipitate (absence of tartrate).

The product of the British Pharmacopœia corresponds with the behavior and tests described above, except that it is readily soluble in cold water; it is of a greenish-golden-yellow color, and in the air somewhat deliquescent.

Tests.—Dissolve 1.11 Gm. of the iron and quinine citrate in a capsule, with the aid of a gentle heat, in 20 Cc. of water. Transfer the solution, together with the rinsings of the capsule, to a separating funnel, allow the liquid to become cold, then add 5 Cc. of ammonia water, and 10 Cc. of chloroform, and shake. Allow the liquids to separate, remove the chloroform layer, and shake the residuary liquid twice more with 10 Cc. of chloroform. Allow the combined chloroformic extracts to evaporate spontaneously in a tared capsule, and dry the residue at a temperature of 100° C. (212° F.) to a constant weight. This residue should weigh not less than 0.1276 Gm. (corresponding to at least 11.5 per cent. of dried quinine), and should correspond to the reactions and tests of quinine (see QUININA). Heat the aqueous liquid, from which the quinine has been removed in the manner just described, on a water-bath, until the odor of chloroform and ammonia has disappeared, and allow it to cool. Then dilute it with water to the volume of 50 Cc., transfer 25 Cc. of the liquid to a glass-stoppered bottle (having a capacity of about 100 Cc.), add 2 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and allow the mixture to stand for half an hour at a temperature of 40° C. (104° F.). After it has been allowed to cool, it should require not less than 13.5 Cc. of tenth-normal sodium thiosulphate solution before the color of the liquid is discharged (each Cc. of the volumetric solution indicating 1 per cent of metallic iron).—U. S.

5 Gm. dissolved in 45 Cc. of water, and made alkaline with a slight excess of ammonia water, should yield a residue, on extracting repeatedly with ether and evaporating the latter, of 0.75 Gm. of quinine dried thoroughly at 120° C. (248° F.). This should dissolve almost entirely in purified ether and leave but a minute residue when burned.—Br. According to the P. G., 10 Gm. treated in a similar manner should yield at least 0.9 Gm. of quinine dried at 100° C.

The salt should contain at least 15 per cent. Br., 11.5 per cent. U. S., 9 per cent. P. G., of quinine.

The pharmacopœial method prescribed for the determination of quinine and iron is identically that proposed by F. B. Power, and possesses the great advantage of using the same weighed sample for both operations; although 12 per cent. of quinine is directed in the formula, a little allowance for shortage is very properly made, owing to the variable quantity of water present. The amount of anhydrous ferric citrate represented by 13.5 per cent. of metallic iron is 59.14 per cent.

Substitution of cinchonine for quinine in the salt may be detected by tests characteristic of these alkaloids. Quinine is soluble in 23 parts, cinchonine in 526 parts of ether. Toward polarized light the former is lævorotatory; the latter, dextrorotatory.

Action and Uses.—This preparation may be employed during convalescence from acute diseases and other conditions in which the two bases are indicated. The ordinary dose is 5 grains (0.30 Gm.), which may be increased if needed. It is best administered in pill-form.

FERRI ET QUININÆ CITRAS SOLUBILIS, *U. S.*—Soluble Iron and Quinine Citrate.

Preparation.—Ferric citrate, 85 Gm.; quinine, dried at 100° C. (212° F.) to a constant weight, 12 Gm.; citric acid, 3 Gm.; ammonia water, distilled water, each a sufficient quantity, to make 100 Gm. Dissolve the ferric citrate in 160 Cc. of distilled water, by heating on a water-bath, at a temperature not exceeding 60° C. (140° F.). To this solution add the quinine and citric acid previously triturated with 20 Cc. of distilled water, and stir constantly until the quinine is dissolved. Then add gradually, and with constant stirring, 50 Cc., or a sufficient quantity, of ammonia water, so that after the addition of each portion of the latter the precipitated quinine will be redissolved and the liquid acquire a greenish-yellow tint. Lastly, evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and

spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place.—U. S., 1890.

This preparation differs from the preceding in the addition of ammonia water prior to evaporation of the liquid, whereby the solubility of the scale compound is vastly increased; whenever iron and quinine citrate is to be dispensed in form of solution, the "soluble" should be used; whereas the official salt without ammonia is to be employed for pill-masses, tablet-form, etc., on account of its less tendency to absorb moisture on exposure to air.

Properties and Tests.—Soluble iron and quinine citrate occurs in thin transparent scales of a greenish-golden-yellow color, and is readily soluble in cold water; if a portion of the salt be heated with potassium hydroxide solution, vapor of ammonia is evolved. In all other respects it corresponds to the preceding compound, and should contain exactly the same amount of quinine and iron when assayed by the method there prescribed.

Action and Uses.—This preparation is best prescribed in solution in doses of from 5 to 10 grains (0.30–0.60 Gm.). Its uses are indicated under FERRI ET QUININÆ CITRAS (which see).

FERRI ET STRYCHNINÆ CITRAS, *U. S.*—Iron and Strychnine Citrate.

Citrate de fer et de strychnine, Fr.; *Citronensaures Eisen-Strychnin*, G.

It should contain not less than 0.9 nor more than 1 per cent. of strychnine, and not less than 16 per cent. of metallic iron; it should be kept in well-stoppered bottles protected from light.—U. S.

Preparation.—Iron and ammonium citrate, 98 Gm.; strychnine, 1 Gm.; citric acid, 1 Gm.; distilled water, 120 Cc.; to make 100 Gm. Dissolve the iron and ammonium citrate in 100 Cc. of distilled water, and the strychnine, together with the citric acid, in 20 Cc. of distilled water. Mix the two solutions, evaporate the mixture by means of a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place.—U. S., 1890.

A small quantity of this scale salt may be prepared by dissolving 490 grains of iron and ammonium citrate in 1½ fluidounces of distilled water, adding a solution of 5 grains of strychnine and 5 grains of citric acid in 1 fluidrachm of distilled water, and evaporating as directed.

This is simply a mixture of strychnine citrate with ammonio-ferric citrate, scaled in precisely the same manner as the other iron preparations.

Properties.—The salt closely resembles ammonio-citrate of iron in appearance, and has the same behavior to reagents as described above, but differs from it in the distinctly bitter taste and in the white precipitate produced by ammonia, the precipitate being soluble in boiling alcohol, from which, if the solution is sufficiently concentrated, crystals will be obtained giving the peculiar reactions of strychnine. The alkaloid will also be obtained by adding potassium hydroxide solution to the salt, agitating with chloroform, and evaporating the chloroform solution.

Tests.—Dissolve 4.44 Gm. of iron and strychnine citrate in a glass separator in 15 Cc. of water, add 5 Cc. of ammonia-water and 10 Cc. of chloroform, and shake at intervals for at least 10 minutes. Allow the liquids to separate, remove the chloroform layer, and shake the residuary liquid twice more with 10 Cc. of chloroform. Allow the combined chloroformic extracts to evaporate spontaneously in a tared capsule, and dry the residue at a temperature of 100° C. (212° F.) to a constant weight. This residue should weigh not less than 0.04 Gm., nor more than 0.0444 Gm. (corresponding to not less than 0.9, nor more than 1 per cent. of strychnine), and should respond to the reactions and tests of strychnine (see STRYCHNINA). Heat the aqueous liquid, from which the strychnine has been removed in the manner just described, on a water-bath, until the odor of chloroform and ammonia has disappeared, and allow it to cool. Then dilute it with water to the volume of 100 Cc., transfer 25 Cc. of the liquid to a glass-stoppered bottle (having the capacity of about 100 Cc.), add 2 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and allow the mixture to stand for half an hour at a temperature of 40° C. (104° F.). After it has been allowed to cool it should require not less than 32 Cc. of tenth-normal sodium thiosulphate solution before the color of the liquid is dis-

charged (each Cc. of the volumetric solution indicating 0.5 per cent. of metallic iron).—U. S.

These tests, suggested by F. B. Power, demand about 1 per cent. of strychnine, and practically 79 per cent. of anhydrous ferric citrate, corresponding to 16 per cent. of metallic iron. The limits of 0.9 and 1 per cent. are based on the variable quantity of water present. Dr. Squibb has pointed out that the solution of the salt is not permanent, but soon begins to form a deposit containing much strychnine, which is likely to lead to alarming if not dangerous effects.

Action and Uses.—This preparation may be employed in those conditions in which iron and strychnine are usually indicated, namely, in cases of nervous debility with anæmia, as in convalescence. It has the disadvantage that the dose of one ingredient cannot be increased or diminished without affecting the other agent also. The dose is from 3 to 5 grains (0.2–0.30 Gm.), best given in pill-form, as its solution is said to be unstable.

FERRI HYDROXIDUM, *U. S.*—Ferric Hydroxide.

Ferri oxidum hydratum, U. S., 1890. *Ferri peroxidum.—Hydrated oxide of iron; Moist peroxide of iron*, E.; *Sesquioxide (Peroxyde) de fer hydraté humide; Hydrate de peroxyde de fer gélatineux*, Fr.; *Feuchtes Eisenoxydhydrat*, G.

Formula of freshly prepared ferric hydroxide, $Fe(OH)_3$ or $Fe_2(OH)_6$. Molecular weight, 106.14 or 212.28.

Preparation.—Solution of ferric sulphate, 100 Cc.; ammonia-water, 138 Cc.; water, a sufficient quantity. To the ammonia-water, previously diluted with 500 Cc. of cold water, add, with constant stirring, the solution of ferric sulphate, previously diluted with 1000 Cc. of cold water. As soon as the precipitate has subsided, draw off the clear liquid by means of a siphon, then mix the precipitate intimately with about 1000 Cc. of cold water, again draw off the clear liquid after subsidence of the precipitate, and repeat this operation until a portion of the decanted liquid gives not more than a slight cloudiness with barium chloride test-solution. Finally transfer the precipitate to a wet muslin strainer, and, after it has drained, mix it with sufficient cold water to make the mixture weigh 300 Gm.

When ferric hydroxide is to be made in haste for use as an antidote, the washing may be performed more quickly, though less perfectly, by bringing the precipitate at once on a wet muslin strainer, pressing forcibly with the hands until no more liquid passes, and then adding sufficient water to make the whole weight about 300 Gm.

The official ferric hydroxide may also be prepared by adding a mixture of 3½ fluidounces of solution of ferric sulphate and 2 pints of water, with constant stirring, to 5 fluidounces of ammonia water previously diluted with 20 fluidounces of water.

The reaction is one of double decomposition; thus, $Fe_2(SO_4)_3+6NH_4OH=Fe_2(OH)_6+3(NH_4)_2SO_4$. The ammonium sulphate formed is soluble and removed by washing. The brown ferric hydroxide remaining has the formula given. It combines very easily with weak acids, and for this reason is an effectual antidote to arsenic, which forms with it an insoluble salt. It cannot be dried without losing water and being converted into oxyhydrate of the formula $Fe_2O_2(OH)_2$, which has a more decided reddish tint and combines less readily with acids, and not at all with arsenous acid. The compound of this composition was official in the British Pharmacopœia until 1898, and was obtained by heating the hydroxide not over 100° C. (212° F.). The loss of water from the official hydroxide is retarded by keeping it mixed with water in the form of a magma; but after some time it parts with half its water of hydration, forming the reddish-brown ferric oxyhydrate, $Fe_2O_3.Fe_2(OH)_6$, which has lost the power of combining with weak acids, such as arsenous or acetic acid. A similar effect may be wholly or partly obtained during the preparation of the hydroxide if the mixture be allowed to become hot. Its effectiveness as an antidote is due to two conditions—the making of the hydroxide at the *ordinary*, not at an elevated, temperature, and its *recent* preparation; the magma with water should be smooth, not granular, and should be easily soluble in acetic acid.

Action and Uses.—Ferric hydroxide is rarely employed in internal medicine. It is largely used, however, as an antidote in poisoning by arsenic (see FERRI HYDROXIDUM CUM MAGNESII OXIDO). It should always be freshly prepared and as free from ammonia-water as possible. It is thought by some, however, that traces of ammonia aid in its efficiency as an antidote. As an antidote it should be given *ad libitum*.

FERRI HYDROXIDUM CUM MAGNESII OXIDO, *U. S.*—Ferric Hydroxide with Magnesium Oxide.

Ferri Oxidum Hydratum cum Magnesia, U. S., 1890. *Antidotum Arsenici.—Arsenic antidote*, E.; *Contre-poison de l'arsenic*, Fr.; *Gegengift des Arseniks*, G.

Preparation.—Solution of ferric sulphate, 40 Cc.; magnesium oxide, 10 Gm.; water, a sufficient quantity. Mix the solution of ferric sulphate with 125 Cc. of water, and keep the liquid in a well-stoppered bottle. Rub the magnesium oxide with cold water to a smooth and thin mixture, transfer this to a bottle capable of holding about 1000 Cc., and fill it with water to about three-fourths of its capacity. When the preparation is wanted for use, shake the magnesium oxide mixture to a homogeneous, thin magma, add it gradually to the diluted ferric sulphate, and shake them until a uniform smooth mixture results.

Note.—The diluted solution of ferric sulphate and the mixture of magnesium oxide with water should always be kept on hand, ready for immediate use.—U. S.

Using wine measure, it will be found convenient to keep on hand, in separate bottles, 2 fluidounces of ferric sulphate solution, diluted with 6 fluidounces of water, and 225 grains of magnesium oxide made into a smooth mixture with 30 fluidounces of water; the amount of water to be mixed with the magnesium oxide will be found quite sufficient.

The magnesia is used in excess, more than is necessary for separating all the ferric hydroxide, and the mixture is prevented from becoming heated by the previous diffusion of the magnesia in water. Neither filtration nor straining is requisite, the compounds of the mixture being ferric and magnesium hydroxides and magnesium sulphate, none of which has any caustic or otherwise injurious effect, nor forms a soluble compound with arsenic. The mixture being made only when needed, the ferric hydroxide is in that condition in which it readily combines with arsenous acid and has not become inert for the purpose by long keeping.

Uses.—This remedy is employed exclusively as an antidote in arsenical poisoning. It should always be freshly prepared and given in large quantity. It is certain that this mixture is a more efficient antidote to arsenic than either of its ingredients would be alone.

FERRI HYPOPHOSPHIS, *U. S.*—Ferric Hypophosphite.

Ferrum hypophosphorosum.—Hypophosphite of iron, E.; *Hypophosphite de fer*, Fr.; *Ferrihypophosphit, Unterphosphorigsaures Eisenoxyd*, G.

Formula, $Fe(PH_2O_2)_3$. Molecular weight, 249.09.

It should contain not less than 98 per cent. of pure salt, and be kept in well-stoppered bottles.—U. S.

Preparation.—A solution of sodium hypophosphite which is free from carbonate is added to a solution of ferric chloride or ferric sulphate, which should not contain an excess of acid. The precipitate is well washed with distilled water and dried with a moderate heat. It is a process of double decomposition between the sodium and ferric salts. The presence of carbonate in the former would contaminate the salt with a corresponding quantity of ferric hydroxide, while an excess of acid would occasion loss by preventing the ferric hypophosphite from being precipitated. By this method a slight loss is occasioned by the partial solubility of the freshly precipitated ferric hypophosphite in water.

Moerk suggests to prepare the salt as follows: Place 30 Gm. of calcium hypophosphite into a flask with 100 Cc. of distilled water; add gradually 49.5 Gm. of ferric chloride solution, shaking well after each addition. Allow the mixture to stand 3 days with frequent agitation, then filter, and wash until all calcium has been removed. This is said to yield about 93 per cent. of a very pure salt, based upon the quantity of ferric chloride used.

Properties.—Ferric hypophosphite is a white or grayish powder, inodorous, nearly tasteless, slightly soluble in water, more so in hypophosphorous acid, but freely so in hydrochloric acid. Like other insoluble or sparingly soluble ferric salts, it dissolves in solutions of an alkali citrate, with a green color. It is readily oxidized by nitric acid and other oxidizing agents, and when heated in the dry state evolves inflammable hydrogen phosphide and leaves ferric pyrophosphate. Its formula is given above; it contains, in addition, water of hydration, the amount of which has not been determined.

Tests.—If to 0.5 Gm. of the salt 5 Cc. of acetic acid be added, no effervescence should occur (absence of carbonate), and if the mixture be subsequently heated to

boiling, the filtrate, upon cooling, should afford no turbidity with ammonium oxalate test-solution (absence of calcium). If 0.5 Gm. of the salt be boiled with 10 Cc. of sodium hydroxide test-solution, a reddish-brown precipitate is produced, and if to the filtrate from the latter slightly acidulated with hydrochloric acid magnesia mixture be added, and subsequently an excess of ammonia-water, no crystalline precipitate should be produced (absence of phosphate). If 1 Gm. of the salt be dissolved in 25 Cc. of boiling water, with sufficient hydrochloric acid, and precipitated with slight excess of ammonia-water, the filtrate should be colorless, and, after acidifying with hydrochloric acid, should not be colored or made turbid by an equal volume of fresh hydrogen sulphide solution, when kept corked at 35° C. (95° F.) for at least half an hour, either before or after adding ammonia to alkalinity (absence of heavy metals).

The volumetric assay of the salt by potassium permanganate solution is defective and has been dropped from the U. S., 1900, in which no method is now given.

See under Calcii Hypophosphis for reference to Jowett's criticism of the permanganate method of titration. Jowett tests for phosphite in ferric hypophosphite, by shaking up 0.5 Gm. of the salt with 10 Cc. of a 5 per cent. solution of sodium hydroxide, filtering, acidifying with acetic acid, and adding lead acetate solution. He was unable to devise a method of determining the amount of hypophosphite without introducing the error due to phosphite, but this could be partly remedied by noting the amount of lead phosphite precipitate in the above test. His method of assay is to oxidize 0.3 Gm. of the salt, then add 0.5 Gm. of sodium citrate, and finally excess of sodium hydroxide solution. The precipitate is washed and the iron in it determined iodometrically, and the phosphate in the filtrate by the usual methods. The salt prepared from ferrous compounds contains some ferrous hypophosphite, which would cause an error in the official method of titration, due to iron in the ferrous state.

Action and Uses.—Ferric hypophosphite has been recommended in the treatment of anæmias associated with a depressed condition of the central nervous system. As it does not possess the virtues of phosphorus, it is highly probable that this remedy is of much less value than was formerly supposed. The dose is from 5 to 10 grains (0.30–0.60 Gm.). It is usually administered in the form of a syrup.

FERRI LACTAS.—Ferrous Lactate.

Ferrum lacticum, P. G.; *Lactate of iron*, E.; *Lactate ferreux, Lactate de fer*, Fr.; *Eisenlactat, Milchsaures Eisenoxydul*, G.

Formula, $Fe(C_3H_5O_3)_2 3H_2O$. Molecular weight, 285.88.

Preparation.—This compound has been omitted from the U. S., 1900. It may be prepared by digesting iron filings with lactic acid until action ceases, filtering, and crystallizing. It may also be prepared from crystalline calcium lactate, $Ca(C_3H_5O_3)_2 + 5H_2O$, obtained in the preparation of lactic acid, by dissolving 31 parts of it in 750 or 800 parts of water, and mixing this with a solution of 28 parts of crystallized ferrous sulphate; by double decomposition ferrous lactate is formed and remains in solution, while most of the calcium sulphate is precipitated, the remainder being removed by mixing the liquid with one-tenth volume of alcohol; the filtrate is finally evaporated and crystallized. A similar process has been adopted by the French Codex.

Both these processes involve considerable evaporation, which may be avoided, according to Pagenstecher (1842), by mixing an alcoholic solution of sodium lactate with a freshly prepared solution of ferrous chloride, when nearly the whole of the ferrous lactate will crystallize out, and the alcohol used may be recovered by distilling the mother-liquor. Thus prepared, the salt is less prone to oxidation.

Properties.—Ferrous lactate forms a greenish-white or yellowish crystallized powder or crusts consisting of small needle-shaped crystals containing 19 per cent. of water of crystallization, and having a slight peculiar odor, a sweet and mild chalybeate taste, and a slightly acid reaction. The dry salt is nearly permanent in dry air, but in a damp atmosphere is gradually converted into ferric salt. It is almost insoluble in cold alcohol, but may be crystallized from boiling diluted alcohol; it dissolves slowly at 15° C. (59° F.) in 40 parts, P. G., of water, and in 12 parts of boiling water, the solutions being of a greenish-yellow color, and it is freely soluble with a green color in solutions of alkali citrates. On the application of heat it turns brown and black, and then, with frothing, emits white acid vapors having the odor of burnt sugar, and finally

leaves brownish-red ferric oxide, amounting to about 27.7 per cent. The aqueous solution yields a dark-blue precipitate with potassium ferricyanide, and a light blue one with potassium ferrocyanide; in contact with the air it speedily turns brown, forming ferric lactate, and then yields at once a dark-blue precipitate with potassium ferrocyanide. The salt, boiled for 15 minutes with an excess of nitric acid diluted with an equal bulk of water, yields on cooling white granules of mucic acid.

Two varieties of ferrous lactate occur in commerce, one in well-defined crystalline crusts, and another in the form of a crystalline powder. The first named is to be preferred for pharmaceutical purposes; it is, as a rule, more soluble and less likely to become oxidized.

Ferrous lactate should be kept in well-stoppered bottles.

Tests.—A 2 per cent. aqueous solution of the salt should not afford, with lead acetate test-solution, or after acidulation with hydrochloric acid, with hydrogen sulphide test-solution, more than a whitish opalescence (limit or absence of sulphate, chloride, citrate, tartrate, malate, etc., and of foreign metals). The aqueous solution, acidulated with nitric acid, should not afford more than a slight opalescence with barium chloride test-solution, or with silver nitrate test-solution (limit of sulphate or chloride). If 25 Cc. of the aqueous solution (1 in 50) be boiled for a few minutes with 5 Cc. of diluted sulphuric acid, then an excess of potassium or sodium hydroxide test-solution added, the filtrate, after the addition of a few drops of alkaline cupric tartrate solution, and heated to boiling, should not afford a red precipitate (absence of sugar). If a portion of the salt be triturated with strong sulphuric acid, no odor of butyric acid or gas should be evolved (absence of carbonate), and the mixture, after standing for some time, should not assume a brown color (absence of sugar, gum, or other organic impurities). If 1 Gm. of the salt, contained in a porcelain crucible, be moistened with nitric acid, and carefully ignited, it should leave a residue of ferric oxide weighing not less than 0.270 nor more than 0.278 Gm. This residue should not have an alkaline reaction to litmus-paper, nor yield anything soluble in water (absence of foreign salts).

Action and Uses.—This salt has been employed to some extent in the treatment of chlorosis. It is a mild, non-astringent chalybeate, and because of its feeble taste may be given without difficulty. The dose is stated to be from 1 to 20 grains (0.06–1.3 Gm.). It may be dissolved in hot syrup to the extent of 4 grains to the fluidounce, but should not be dissolved in water, owing to its liability to oxidation. The ordinary dose of the syrup is from 2 to 4 fluidrachms (8–16 Cc.).

FERRI OXIDUM SACCHARATUM.—Saccharated Ferric Oxide.

Ferrum oxydatum saccharatum, P. G.—*Saccharated oxide of iron, Saccharated iron*, E.; *Saccharate de fer, Saccharure d'oxyde de fer soluble*, Fr.; *Eisenzucker, Lösliches Eisenoxyd*, G.

Preparation.—To a mixture of 30 parts of solution of ferric chloride (specific gravity, 1.281) and 150 parts of water add gradually and with frequent stirring a solution of 26 parts of sodium carbonate in 150 parts of water until precipitation has been completed; the precipitate is repeatedly washed with water by decantation until all chlorides have been removed, then drained and expressed on a muslin filter. 50 parts of powdered sugar and 5 parts of solution of sodium hydroxide (specific gravity, 1.70) are added to the residue, the mixture is heated to perfect solution, and then evaporated to dryness and powdered; finally sufficient powdered sugar is added to make the weight of the finished product 100 parts.—P. G.

Properties.—A small quantity of sodium hydroxide is essential to cause solution of the ferric hydroxide by the sugar; without it, the hydroxide does not dissolve. The substance is a reddish-brown powder, having a sweet and mild chalybeate taste, soluble in 20 parts of hot water with feeble alkaline reaction. The usual reactions of iron are inhibited; no precipitate of iron is produced by phosphates, carbonates, arsenates, ferrocyanide of potassium, or tannic acid. All the iron is precipitated by ammonium sulphide as ferrous sulphide. After addition of hydrochloric acid, potassium ferrocyanide produces slowly a dark-blue precipitate. An acidified solution precipitates insoluble iron saccharate, which is decomposed by more acid, forming an iron salt.

If 1 Gm. of saccharated iron oxide be dissolved in 10 Cc. of diluted sulphuric acid, and, after disappearance of the brown color, dilute solution of potassium permanganate be added until a red tint is produced of a few moments' duration, and then 2 Gm. of

potassium iodide be added and the mixture allowed to stand in a stoppered bottle 1 hour at ordinary temperature, it should require 5–5.3 Cc. of tenth-normal sodium thiosulphate to titrate the iodine separated by oxidation, corresponding to 2.8–2.97 per cent. of metallic iron (each Cc. of the thiosulphate solution represents 0.0056 Gm. of iron).

Action and Uses.—The saccharated oxide of iron is said to be an efficient ferruginous preparation, and is believed by some to be the best antidote in arsenical poisoning. A syrup of the soluble oxide of iron may be prepared by dissolving 1 part of it in 1 part of distilled water and 1 of syrup, and given in quantities representing from 3 to 10 grains (0.2–0.60 Gm.) of the salt, although smaller doses usually produce better results.

FERRI PHOSPHAS SOLUBILIS, *U. S.*—Soluble Ferric Phosphate.

Ferri phosphas, U. S. 1880.—*Ferri et sodii citro-phosphas; Ferrum phosphoricum cum natrio citrico.—Soluble phosphate of iron, Sodio-ferric citro-phosphate*, E.; *Citro-phosphate de fer et de soude*, Fr.; *Natriumferricitrophosphat*, G.

It should contain not less than 12 per cent. of metallic iron, and be kept in well-stoppered amber bottles, away from light.—U. S.

Preparation.—Ferric citrate, 50 Gm.; sodium phosphate, uneffloresced, 55 Gm.; distilled water, 100 Cc. Dissolve the ferric citrate in the distilled water by heating on a water-bath. To this solution add the sodium phosphate, and stir constantly until it is dissolved. Evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in dark, amber-colored, well-stoppered bottles.—U. S., 1890.

To prepare a small quantity of soluble ferric phosphate, 1 avoirdupois ounce of ferric citrate should be dissolved in 2 fluidounces of hot distilled water; to the solution add 481 grains of uneffloresced sodium phosphate and proceed as stated above.

The official title of this preparation serves to distinguish it at once from other commercial varieties of ferric phosphate which are insoluble in water. The proportion of the two salts is based upon the assumption that carefully prepared ferric citrate in scales contains 10 molecules of water, and has the formula $Fe_2(C_6H_5O_7)_2 + 10H_2O$; it is important that uneffloresced sodium phosphate be used, as otherwise an excessive amount of the latter will cause the scales to become white on standing.

Properties and Tests.—Thin, bright-green, transparent scales, without odor, and having an acidulous, slightly saline taste. The salt is permanent in dry air when excluded from light, but becomes dark and discolored on exposure to light. Freely and completely soluble in water, but insoluble in alcohol. The aqueous solution of the salt has a slightly acid reaction. With potassium ferrocyanide test-solution the solution affords a blue color, but does not yield a blue precipitate unless it has been acidulated with hydrochloric acid. If 1 Gm. of the salt be boiled with 15 Cc. of potassium or sodium hydroxide test-solution, a reddish-brown precipitate is produced; and if the colorless filtrate from the latter be strongly acidulated with hydrochloric acid, then magnesia mixture added, and subsequently a slight excess of ammonia water, an abundant white crystalline precipitate is produced. During the boiling with the alkali, no odor of ammonia should be evolved.

The Pharmacopœia requires 12 per cent. of metallic iron, which is determined in a manner exactly as given under Ferri Pyrophosphas Solubilis (which see), 0.555 Gm. of the salt requiring about 12 Cc of tenth-normal sodium thiosulphate solution. This is 2 per cent. more than is required for the similar salt, Ferri Pyrophosphas Solubilis.

Composition.—The exact composition of the soluble ferric phosphate cannot be stated, and it is possible that no less than four salts are present, viz., sodium and ferric phosphates and sodium and ferric citrates; if the interchange of acid radicals were complete, the chemical formula might be written as $Fe_2(PO_4)_2 2Na_2HC_6H_5O_7 + Aq$.

Action and Uses.—This salt possesses practically the properties of the other chalybeates. It has been employed in the treatment of the various menstrual disorders and of indigestion resulting from anæmia. The dose is from 5 to 10 grains (0.30–0.60 Gm.).

True Phosphates of Iron.—*Ferri phosphas*, Br.; *Ferrum phosphoricum.—Phosphate of iron, Ferroso-ferric phosphate*, E.; *Phosphate de fer, Phosphate ferroso-ferrique*, Fr.; *Ferroferriphosphat, Phosphorsaures Eisenoxydul-Oxyd*, G. $Fe_3(PO_4)_2.FePO_4.12H_2O$.—Dissolve 3 ounces

of ferrous sulphate in 30 ounces of boiling distilled water, and 2¾ ounces of sodium phosphate in a like quantity of water. When each solution has cooled to between 37.8° and 54.4° C. (100° and 130° F.), add the latter to the former, pouring in also a solution of ¾ ounce of sodium bicarbonate in a little distilled water. Mix thoroughly. Transfer the precipitate to a calico filter, and wash it with hot distilled water till the filtrate ceases to give a precipitate with barium chloride. Finally, dry the precipitate at a temperature not exceeding 48.9° C. (120° F.).—Br. This salt is employed in doses of from 5 to 10 grains (0.30–0.60 Gm.) for the same purposes as *Ferri Phosphas Solubilis.*

The mineral *vivianite*, which forms pale-blue crystals, is mainly ferrous phosphate. On bringing together solutions of ferrous sulphate and sodium phosphate a white precipitate of ferrous phosphate is produced, which on exposure and during the washing is oxidized, and acquires a more or less blue, greenish-blue, or grayish-blue color. During the reaction a portion of the sulphuric acid is set free, and retains phosphates of iron in solution, to obtain which sodium acetate is added, which, reacting with the free sulphuric acid, forms sodium sulphate and free acetic acid, in which the phosphates of iron are insoluble. Or the free acid may be nearly neutralized with sodium carbonate or bicarbonate, as directed above. The washing of the precipitate should be continued until the filtrate fails to give a reaction for sulphuric acid.

Thus prepared, phosphate of iron is a tasteless and inodorous bluish powder, varying somewhat in shade. It is insoluble in water, but dissolves in hydrochloric acid, yielding a yellow solution in which dark-blue precipitates are produced by both potassium ferrocyanide and ferricyanide. If the acid solution is treated with sufficient tartaric acid, and then with an excess of ammonia, no precipitate is produced, but on the addition of magnesium sulphate a white precipitate of ammonio-magnesium phosphate falls. When the powder is boiled with caustic soda the filtrate, after being neutralized, yields a yellow precipitate with silver nitrate. Both precipitates indicate phosphoric acid. The chemical composition varies to some extent, and is influenced by its exposure to the atmosphere while moist, the temperature at which it is dried, etc. The above formula is that of Rammelsberg. Wittstein obtained a somewhat different result. The British Pharmacopœia regards it as containing at least 47 per cent. of ferrous phosphate ($Fe_3(PO_4)_2 + 8H_2O$); 1 Gm. dissolved in hydrochloric acid should require for complete oxidation not less than 28.2 Cc. of the volumetric solution of potassium dichromate, which indicates 47 per cent. of the ferrous salt.

The salt should yield nothing to hot distilled water (insufficient washing), and the solution in hydrochloric acid should yield only a white turbidity of sulphur with hydrogen sulphide, but not a black (copper, etc.) or a yellow (arsenic) precipitate. The same solution, digested with bright copper, should not form a dark deposit of arsenic upon the metal.

Ferri phosphas albus.—Ferrum phosphoricum oxydatum.—Ferric phosphate, White phosphate of iron, E.; *Phosphate ferrique*, Fr.; *Ferriphosphat*, G. $Fe_2(PO_4)_2 + 4H_2O$. Molecular weight, 371.1.—On mixing 4 fluidounces of solution of ferric sulphate with a solution of 1 ounce of sodium acetate, and adding solution of sodium phosphate, a white precipitate of ferric phosphate is obtained. After washing and drying at 100° C. (212° F.) it is a white or yellowish-white tasteless powder having the composition stated, is decomposed by alkalies, and dissolves readily in dilute mineral acids, in citric and tartaric acids, and in alkali citrates, the latter solutions having a green color. The freshly precipitated and washed salt, mixed with water until the mixture contains 1 or 1.2 per cent. of ferric phosphate, has been used under the name of *Lac ferri, milk of iron.*

FERRI PYROPHOSPHAS SOLUBILIS, *U. S.*—Soluble Ferric Pyrophosphate.

Ferri pyrophosphas, U. S. 1880.—*Ferri et sodii citro-pyrophosphas, Ferrum pyrophosphoricum cum sodio citrico.—Pyrophosphate of iron with sodium citrate, Sodio-ferric citro-pyrophosphate*, E.; *Citro-pyrophosphate de fer et de soude*, Fr.; *Pyrophosphorsaures Eisenoxyd mit Citronensaurem Natron*, G.

It should contain not less than 10 per cent. of metallic iron, and be kept in well-corked amber bottles, away from light.—U. S.

Preparation.—Ferric citrate, 50 Gm.; sodium pyrophosphate, uneffloresced, 50 Gm.; distilled water, 100 Cc. Dissolve the ferric citrate in the distilled water by heating on a water-bath. To this solution add the pyrophosphate, and stir constantly until it is dissolved. Evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistency of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in dark, amber-colored, well-stoppered bottles.—U. S., 1890.

As seen by the above formula, ferric citrate and sodium pyrophosphate are used in the proportion of equal weights; this change from the 1880 Pharmacopœia is based on

the recommendations of Lake and Power. In view of the insolubility in water of true ferric pyrophosphate, the addition of the word "soluble" to the official title was desirable.

On precipitating a solution of sodium pyrophosphate by ferric sulphate, a white precipitate of *ferric pyrophosphate*, $Fe_4(P_2O_7)_3$, is obtained, which, like other insoluble ferric salts, is readily soluble in alkali citrates, forming green solutions. Formerly, ammonium citrate was used for this purpose, but owing to the slow volatilization of the ammonia the salt gradually became insoluble.

Properties and Tests.—The salt is obtained in inodorous, transparent, apple-green scales, which are permanent in dry air when excluded from light, but turn dark on exposure to light. The salt has an acidulous, slightly saline, and scarcely chalybeate taste, and a slightly acid reaction, is insoluble in alcohol, but dissolves freely in water, yielding a greenish solution; this gives with potassium ferrocyanide a blue color, but no precipitate unless acidulated with hydrochloric acid. If 0.555 Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 10 Cc. of water, then 10 Cc. of hydrochloric acid, and subsequently 40 Cc. of water added, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, and mixed with a few drops of starch test-solution, it should require about 10 Cc. of tenth-normal sodium thiosulphate test-solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron).—U. S.

Like the soluble ferric phosphate, this preparation is evidently of a complex nature, and, as in all the scale compounds of iron, the amount of water of hydration is variable.

Composition.—Regarding the chemical composition of this and similar preparations, two views have been entertained. According to the one, they are double salts of ferric pyrophosphate and alkali citrate; according to the other, which has been advocated by Rother (1876), they should be regarded as mixtures of alkali-ferric pyrophosphate, $Fe_4(P_2O_7)_3 3Na_4P_2O_7$, with alkali-ferric citrate and ferric citrate. The formula given for the double pyrophosphate corresponds with that of Gladstone for sodio-ferric pyrophosphate, for which Fleitmann and Persoz (1848) gave the formula $Fe_4(P_2O_7)_3.2Na_4P_2O_7$.

Action and Uses.—This is an excellent ferruginous preparation because of its mild taste, free solubility, and large percentage of iron. It may be given either in pill or solution, in water or syrup. The dose is from 2 to 5 grains (0.12–0.30 Gm.).

FERRI SULPHAS, *U. S., Br.*—Ferrous Sulphate.

Ferrum sulfuricum, P. G.; *Ferrum vitriolatum purum, Vitriolum martis purum.*—*Sulphate of iron*, E.; *Sulfate (Protosulfate) de fer, Sulfate ferreux*, Fr.; *Ferrosulfat, Schwefelsaures Eisenoxydul*, G.

Formula of crystallized or precipitated ferrous sulphate, $FeSO_4 + 7H_2O$; molecular weight, 276.01; of exsiccated ferrous sulphate, approximately, $2FeSO_4 + 3H_2O$; molecular weight, 355.34.

It should contain not less than 99.5 per cent. of pure salt, and should not be effloresced. Keep well corked.—U. S.

Preparation.—For medicinal use, it should be prepared directly from sulphuric acid acting upon iron wire or clean iron filings in the presence of water, when hydrogen is evolved, ferrous sulphate remaining in solution: $Fe_2 + 2H_2SO_4$ yields $2H_2 + 2FeSO_4$. The salt is prone to oxidation if its chemically neutral solution is evaporated to crystallization, but in the presence of free sulphuric acid yields crystals which are far more permanent. This explains the necessity of having some free sulphuric acid in the liquid from which ferrous sulphate is crystallized. The crystals are collected upon a diaphragm, washed rapidly with a little water (according to the Fr. Cod. with a little alcohol) to remove the mother-liquor, and then dried. No process is given in the U. S. and Br. pharmacopœias for its preparation. Ferrous sulphate of the P. G. is identical in appearance with granulated ferrous sulphate (see below), and is not made by direct crystallization, but by pouring the solution into strong alcohol and washing the resulting granular product with alcohol.

Ferrous sulphate is obtained on a large scale from alum shale, and by roasting iron pyrites, exposing to the air, and exhausting the mass with water; also by passing solutions of copper sulphate over scraps of iron, whereby copper is precipitated, the iron entering into solution. It is also obtained as a by-product in various manufactures in

which sulphuric acid is used for the purpose of purifying certain products. The article thus obtained is usually impure and not fit for medicinal purposes, except for disinfecting, and in this impure state is known as *copperas*, or *green vitriol* (*Ferrum sulphuricum crudum*, P. G.; *Couperose verte, Vitriol vert*, Fr.; *Kupferwasser, Eisenvitriol, Grüner Vitriol*, G.). It usually contains copper, zinc, aluminum, and magnesium sulphates.

Properties.—Ferrous sulphate is in transparent bluish-green monoclinic prisms, or sometimes in rhombic crystals, having the specific gravity 1.9. When crystallized from neutral solutions the salt is pale-green, and in the presence of ferric salt of deeper, more emerald-green color. It is inodorous, has a styptic and somewhat saline taste, a slight acid reaction, melts by heat in its water of crystallization, leaving finally a whitish residue, and when exposed to the air effloresces and is gradually oxidized; the efflorescence takes place more rapidly above 35° C. (95° F.), and when finally heated to 115° C. (239° F.) the loss of water of crystallization amounts to 38.87 per cent. The salt is insoluble in alcohol and ether, but it dissolves at 25° C. (77° F.) in 0.9 and at 100° C. (212° F.) in 0.3 part of water.—U. S. The aqueous solution yields with barium chloride a white precipitate insoluble in hydrochloric acid, a dark-blue one with potassium ferricyanide, and a bluish-white one with potassium ferrocyanide.

Tests.—Impurities are rarely present if the salt has been prepared from iron and sulphuric acid. 1 Gm. of the salt heated to boiling in 25 Cc. of water and 1 Cc. of diluted sulphuric acid, oxidized with nitric acid, and then precipitated with a slight excess of ammonia-water, should give a colorless filtrate, which, after acidifying with hydrochloric acid, should not be colored or made turbid by an equal volume of fresh hydrogen sulphide solution, when kept corked at 35° C. (95° F.) for at least half an hour, either before or after adding ammonia-water to alkalinity (absence of heavy metals). The filtrate from another portion of the salt, oxidized and precipitated as just described, should not leave a weighable residue on evaporation and ignition (absence of salts of the alkali metals). If 1 Gm. in small fragments be agitated for 5 minutes with 10 Cc. of alcohol, the filtrate should not turn moistened blue litmus-paper red (absence of free acid). If 1.38 Gm. of the uneffloresced salt be dissolved in about 25 Cc. of diluted sulphuric acid, not less than 49.75 Cc. of tenth-normal potassium-permanganate solution should be required to impart to the liquid a permanent pink color (each Cc. of the volumetric solution indicating 2 per cent. of crystallized ferrous sulphate).—U. S.

Each molecule of potassium permanganate is capable of converting 5 molecules of ferrous salt into ferric salt; thus, $10FeSO_4.7H_2O + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 78H_2O$; hence each Cc. of tenth-normal permanganate solution used in the above test corresponds to 0.027601 Gm. of ferrous sulphate (crystals), which is equal to 2 per cent. of the weight of the sample used, for 1.3801 : 0.027601 :: 100 : 2. The Br. P. employs a volumetric solution of potassium dichromate, and 1 Gm. of ferrous sulphate should require 36 Cc. (using potassium ferricyanide as indicator), which represents 100 per cent.

Ferri Sulphas Exsiccatus, U. S., Br.; *Ferrum sulfuricum siccum*, P. G.—*Dried (exsiccated) ferrous sulphate or sulphate of iron*, E.; *Sulfate ferreux desséché*, Fr.; *Getrocknetes Ferrosulfat*, G.—Ferrous sulphate, in coarse powder, 100 Gm. Allow the salt to effloresce at a temperature of about 40° C. (104° F.), and then heat it in a porcelain dish, on a water-bath, until the product weighs from 64 to 65 Gm. Lastly, reduce the residue to a fine powder, and transfer it at once to perfectly dry, well-stoppered bottles.—U. S.

The British Pharmacopœia directs the use of a porcelain or iron dish, and the heat to be raised only to 100° C. (212° F.). At a somewhat higher temperature the yield is about 61 per cent. The German Pharmacopœia employs the same method as the U. S.

Crystallized ferrous sulphate contains 45.3 per cent. of water of crystallization, a portion of which is lost in a dry atmosphere at the ordinary temperature, the remainder, except 1 molecule, at 115° C. (239° F.). The last molecule of water is expelled only at about 280° C. (536° F.), and, if proper care be taken, without loss of sulphuric acid.

Exsiccated ferrous sulphate forms a grayish-white powder, which dissolves slowly in cold, more rapidly in hot, water, leaving only a small quantity of ferric oxysulphate. Otherwise, the behavior and tests of purity are the same as for the crystalline salt, nearly 10 parts of which are represented by 6 parts of the exsiccated salt.

Ferri Sulphas Granulatus, U. S.; *Ferri sulphas præcipitatus*, U. S. 1880.—*Precipitated or granulated ferrous sulphate or sulphate of iron*, E.; *Sulfate ferreux précipité*,

Fr.; *Præcipitirtes Ferrosulfat*, G.—Ferrous sulphate, 100 Gm.; distilled water, 100 Cc.; diluted sulphuric acid, 5 Cc.; alcohol, 25 Cc. Dissolve the ferrous sulphate in the distilled water previously heated to boiling, add the diluted sulphuric acid, and filter the solution while hot. Evaporate the solution immediately in a tared porcelain capsule, on a sand-bath, until it weighs 150 Gm., and then cool it quickly, with constant stirring. Place the product into a glass funnel stopped with a plug of absorbent cotton, and, when it has thoroughly drained, pour upon it the alcohol. When this has also drained, spread the crystallized powder on bibulous paper, dry it quickly, at the ordinary temperature, and transfer it at once to perfectly dry, well-stoppered bottles.—U. S.

Granulated ferrous sulphate may also be prepared by dissolving 8 avoirdupois ounces of the pure salt in 8 fluidounces of boiling distilled water, and adding 2½ fluidrachms of diluted sulphuric acid. After filtration the solution is evaporated to 12 avoirdupois ounces, as directed above, and the granules are washed with 2 fluidounces of alcohol.

The present official directions differ materially from those of 1880, in which the precipitation of the salt was directed with a large volume of alcohol, and also a subsequent washing with alcohol until all free acid was removed. The addition of sulphuric acid (as already stated) is to prevent the oxidation of the ferrous salt, and the washing of the granular product with alcohol removes acid and water, but not entirely. The Br. P. (1898) dropped this preparation.

Action and Uses.—Ferrous sulphate is one of the most astringent salts of iron. When taken in overdose it produces gastric pain, nausea, vomiting, and purging. Because of its astringency it is supposed to be especially adapted to the treatment of leucorrhœa, metrorrhagia, menorrhagia, and other abnormal discharges resulting from anæmia. It has also been employed with advantage in the treatment of gastro-intestinal hemorrhages, gastric ulcer, chronic gastric catarrh, and chronic diarrhœa. Externally a lotion containing from ½ to 2 per cent. of the salt in water has been recommended in chronic conjunctivitis and in leucorrhœa, but is not frequently employed. A 5 per cent. solution in water, or an ointment containing 1 or 2 parts of the salt in 30 parts of lard, may be locally applied in the treatment of erysipelas and eczema. Commercial iron sulphate is largely employed as a disinfectant, but possesses little germicidal power. The dried sulphate of iron is frequently prescribed in pill-form, as the crystallized salt is unfit for that purpose. It should be remembered that 3 grains of the dried ferrous sulphate are practically equivalent to 5 grains of the crystalline salt. The ordinary dose is from 1 to 2 grains (0.06–0.12 Gm.).

FERRUM, *U. S., Br.*—Iron.

Ferrum pulveratum, P. G.—*Mars, Fer*, Fr.; *Eisen*, G.

Symbol, Fe. Atomicity bivalent and apparently trivalent. Atomic weight, 55.5.

Metallic iron, in the form of fine, bright, and non-elastic wire, U. S.; wrought iron in the form of wire or nails free from oxide, Br.; iron in fine powder, P. G.

Origin.—Iron is the most useful and one of the most widely diffused metals in nature, being present in most rocks and soils, and generally forming one of the constituents of the ashes of plants and animals. It is rarely found in the metallic state. It is often combined with sulphur, as *iron pyrites*, more frequently oxidized, as *magnetic iron*, *spathic iron*, *hæmatite*, and other ores, and likewise in combination with mineral acids. It is found in large quantities in several States of North America, and in Great Britain, Sweden, Germany, France, and other European countries.

The manufacture of metallic iron must of necessity vary with the nature of the ore, but the principle is in all cases the same. The ore frequently requires roasting or calcination, mainly for the purpose of rendering it more porous and better adapted for the smelting process; this process is conducted in blast-furnaces, the ore being mixed with carbonaceous matter,—coke and the like,—some flux, either lime or clay, being added at the same time, whereby a more readily fusible silicate of aluminum and calcium compounds present as impurity is formed, which on cooling forms the glass-like slag. The crude iron obtained from the blast-furnace is called *pig* or *cast iron*, and contains various proportions of carbon, silicon, sulphur, phosphorus, and other impurities, from which it must be purified to adapt it for various uses in the arts. In the *refining* or *puddling* process it is fused, and by stirring brought into contact with a blast of air, by which the impurities are oxidized, or the oxidation is effected with the aid of an oxide of iron. The slag still remaining in the iron is then at a white heat pressed out under a steam-hammer,

and the iron thus purified rolled into bars. For many purposes a further purification is requisite.

Properties.—Iron is a grayish metal having the specific gravity 7.7 to 7.9. Its tenacity or strength is nearly twice as great as that of any other metal commonly used, and when heated to redness it possesses a ductility admitting of its being drawn into the thinnest wire. At a white heat it becomes pasty and may be welded, but it can be fused only by the full heat of a blast-furnace, and on congealing it expands somewhat in volume. Iron remains unchanged in dry air, but in the presence of moisture its surface becomes covered with brown-red oxide (*rust*). It enters into combination with nearly all the elements, and forms the base of two important series of salts, the *ferrous* and *ferric*. In the former the valence of iron is two, but in ferric compounds there is at present uncertainty as to the real valence of the iron. It is regarded by some as trivalent, and the formula for ferric chloride, for example, is written $Fe^{III}Cl_3$; others give a double formula to this and similar compounds, thus $Fe^{II}_2Cl_6$, in which it is thought that two iron atoms are united, each exerting a valence of four; thus, $Cl_3Fe—FeCl_3$. A further knowledge of the facts is needed before a final conclusion can be reached. From the close analogy between ferric and aluminum compounds, it seems to be justifiable to consider iron trivalent in the ferric state, as aluminum is considered trivalent in its compounds.

Ferrous salts, when anhydrous, are mostly white, and bluish-green in the hydrated state; the oxalate is yellow. When moist or in solution they are easily oxidized on exposure to the air or under the influence of oxidizing agents. Their aqueous solutions are colored brownish-black by nitric oxide, and yield black precipitates with ammonium sulphide, and white ones, changing to green, black, and brown, with alkalies and their carbonates; the precipitation, particularly with ammonia, is incomplete. Soluble phosphates precipitate white ferrous phosphate, changing to greenish-blue; potassium ferrocyanide produces a bluish-white precipitate, changing to dark-blue, and potassium ferricyanide a dark-blue one. Ferrous solutions free from ferric salt are not affected by potassium sulphocyanate or tannin. The soluble normal ferrous salts have an acid reaction to test-paper; those insoluble in water dissolve in hydrochloric acid.

Ferric salts are either normal or basic; the normal salts, when soluble, having an acid reaction, are mostly white when anhydrous, and brown-yellow when hydrated; the basic salts are of a darker brown or reddish-brown color. Those insoluble in water dissolve in hydrochloric acid. Hydrogen sulphide reduces ferric to ferrous salts, sulphur being separated; ammonium sulphide produces the same reduction, and afterward a black precipitate. Alkali and alkali carbonates added in excess separate brown ferric hydroxide, in the latter case with the evolution of carbon dioxide; the precipitation is prevented by the presence of tartaric acid and some other organic compounds. Alkali acetate, added in the cold, colors the solutions deep brown-red, the color disappearing on the addition of hydrochloric acid; on boiling, a brown precipitate of basic ferric acetate or ferric hydroxide is deposited. Solutions of ferric salts treated with metallic iron, sulphurous acid, or other deoxidizing agents, are reduced to ferrous salts. Sodium phosphate precipitates white ferric phosphate, which is insoluble in acetic acid, becomes brown by ammonia, and if excess of sodium phosphate be present dissolves in ammonia with a red-brown color. Sodium arsenate has a behavior similar to that of the phosphate. Gallotannic acid causes a blue-black color and precipitate (writing-ink). Meconic acid and sulphocyanates color the solutions blood-red, the color produced by the latter reagent being destroyed by corrosive sublimate and by strong mineral acids. Potassium ferricyanide darkens solutions of ferric salts to an olive-brown color; potassium ferrocyanide precipitates Prussian blue.

The official iron powder of the P. G. should contain at least 98 per cent. of iron, by the iodometric method, and should be free from other metals and arsenic, and contain no more than a trace of sulphur, which is tested for as hydrogen sulphide on dissolving the iron in dilute hydrochloric acid, by means of lead acetate paper held in the mouth of the test-tube.

Action and Uses.—Iron in one sense is both a medicine and a food, in that it is useful when the system is in a condition requiring iron to relieve certain pathological states, and also because it is a part of most of the food which is ingested and is utilized daily by the body in the maintenance of health. It is, however, of the greatest importance from a therapeutic point of view to remember that the quantity of iron which is taken in the food each day is exceedingly minute, and that the quantity in the entire

body is very small. For this reason the administration of large doses of iron in the majority of instances is useless and to some extent harmful. The effect of iron when taken in very large doses is to produce constipation, a sense of fulness of the head, and some disorder of the stomach. How largely the head-symptoms are dependent upon the gastric disorder, and how much upon the iron itself, is not fully determined. The drug is absorbed from the stomach and bowels. The bowels also have the ability of excreting it when it is taken into the body in excess.

The exact form in which iron is absorbed has not been determined, but the clinical fact remains that it is a most valuable remedy in the treatment of all forms of anæmia, and particularly in those forms which are characterized by a diminution in the quantity of hæmoglobin rather than by a diminution in the number of the red blood-corpuscles. In other words, it finds its chief field of usefulness in secondary rather than in primary anæmias. As a type of the latter class of anæmia, however, in which iron is valuable is that frequent disorder in young women known as "chlorosis." The usefulness of iron is greatly increased by the employment in moderate quantities of good food, tonics, and mild stimulants, and this is particularly true in the treatment of anæmia following prolonged exhausting diseases, such as typhoid fever and similar infectious maladies. It would also seem probable from clinical experience that the administration of iron is a valuable aid to a patient in combating septic infection, although how it acts under these circumstances is unknown.

All preparations of iron tend to produce constipation if administered in full dose, and for this reason it is often necessary to give laxatives simultaneously. Indeed, in many cases iron seems to be absorbed and utilized much better if administered with a laxative than if administered alone. If given to persons who do not require it, it speedily produces a condition of plethora, and causes a condition which has been known as "iron headache"; that is, pain in the head, and a sensation of fulness, particularly in brow and vertex. For some unknown reason, these disagreeable symptoms are particularly prone to occur in persons who have a gouty or rheumatic tendency. Iron also usually fails to be of much advantage in persons who are suffering from gastro-intestinal catarrh, and from febrile movements non-septic in character. Sometimes in young children the administration of iron produces irritability and catarrh of the bladder, and so results in incontinence of urine. When given in large dose, so much of the iron escapes through the feces as a sulphide that the excrement is colored black, and not infrequently the coating of the tongue is also black, probably due to the formation of a sulphide of iron as a result of decomposition-changes in the saliva. When massive doses of iron are administered, the greater portion of it escapes from the bowels in the feces; a small portion is utilized, and a moderate quantity after absorption is stored in the liver and spleen, where it is used as needed, or ultimately eliminated.

The number of medicinal preparations of iron is exceedingly great. Some of them have therapeutic properties which iron itself does not possess. For the properties of these peculiar preparations of iron, see the preparations already named.

As already pointed out, iron is commonly given in too large quantities. Indeed, in the opinion of the writer, the doses of all the iron preparations, as commonly recommended in works of reference, are too large. Because these doses are accepted as "standard doses," however, they are given in the text dealing with the various preparations of iron, instead of the smaller ones which the writer believes are preferable in most cases.

UNOFFICIAL COMPOUNDS OF IRON.

Ferralbumose.—Finely cut meat freed from fat is digested with artificial gastric juice, the liquid is filtered and freed from albumin by boiling, after which it is exactly neutralized with sodium carbonate, again filtered, and evaporated to dryness in vacuo; 10 Gm. of the dry albumose, dissolved in 90 Cc. of water, are treated with a 10 per cent. solution of ferric chloride until a precipitate ceases to form, after which the precipitate is washed, dried, and sifted. It contains 10 per cent. of iron or 14 per cent. of ferric oxide.

Ferratin.—According to Bunge, iron occurs in foods in a special form very closely combined with albumin. Schmiedeberg extracted this compound from hog's liver and called it ferratin. Böhringer & Sons have patented a process for making artificial ferratin; having the same properties as the natural substance. It is obtained by interaction between egg-albumin, ferric tartrate, and caustic soda. Purified ferratin is a reddish-brown powder, insoluble in plain and weakly acidified water, but soluble in a large proportion of tartaric acid,

and easily soluble in slightly warmed weakly alkaline water. It contains 7–10 per cent. of iron, not in the form of a salt, but apparently united with carbon. It differs from the usual iron albuminates in not turning dark when 1 drop of ammonium sulphide solution is added to a 0.3 per cent. solution in water containing ammonia. Recently a soluble sodium-ferratin has been put on the market. Ferratin is readily absorbed, and causes no digestive disturbances. It is given in chlorosis, acute anæmia, and in cases of great loss of blood, in doses of from 3 to 5 grains (0.20–0.3 Gm.), 3 times a day.

Ferri Albuminas. *Ferrum albuminatum.—Iron albuminate*, E.; *Eisenalbuminat*, G.—35 parts of dry egg-albumin are dissolved in 1000 parts of water at a temperature not above 50° C. (122° F.), and filtered; the solution is then added while stirring to 120 parts of solution of iron oxychloride (P. G.); the resulting turbid, rust-colored solution, which has an acid reaction, is exactly neutralized with 0.75 per cent. sodium hydroxide solution, whereupon the iron albuminate is precipitated (excess of alkali must be avoided, as it dissolves the latter). The precipitate is washed thoroughly by decantation with water at 50° C. (122° F.) until free from chloride (silver nitrate test), filtered, allowed to drain, and pressed to free it from mother-liquor. It is then spread out to dry at a temperature not above 30° C. (86° F.), powdered, and protected against light. Iron albuminate is soluble in dilute alkali, and such a solution is official in the P. G. as *Liquor Ferri Albuminatis.* The powder is ochre-colored, insoluble in water, and contains 13–14 per cent. of iron. A soluble iron albuminate in scales is prepared by the aid of sodium citrate. Used in anæmia and chlorosis. Dose 5 to 20 grains (0.30–1.30 Gm.).

Ferri Benzoas. *Ferrum benzoïcum.—Ferric benzoate*, E.; *Eisenbenzoat, Ferribenzoat*, G. $Fe_2(C_7H_5O_2)_3(OH)_3 + 6H_2O$.—The salt is obtained by interaction between solution of ammonium benzoate and diluted ferric chloride solution. The precipitate is washed thoroughly by decantation, filtered, and dried in the shade at a temperature not above 30° C. (86° F.). It is a brownish-red, odorless, tasteless powder, insoluble in water. It is soluble in hot acids, with deposition of benzoic acid on cooling. Caustic alkalies precipitate ferric hydroxide. Freshly prepared iron benzoate is soluble in codliver oil. It contains 17–18 per cent. of iron or 24.28–25.71 per cent. of ferric oxide.

Ferri Bromidum. *Ferrum bromatum.—Ferrous bromide*, E.; *Eisenbromid, Ferrobromid*, G.; *Bromure ferreux*, Fr. $FeBr_2$.—It is prepared by gradually adding 2 parts of bromine to 1 part of iron filings or wire and 10 parts of water, and digesting until the liquid has a greenish color, when it is filtered and evaporated to dryness in an iron dish. It forms a grayish-black mass, which on exposure to air acquires a brown color through oxidation. From its hot concentrated solution in water it may be obtained in transparent pale-green rhombic plates, of the composition $FeBr_2.6H_2O$. On being heated to redness in contact with the atmosphere, it is converted into ferric oxide and ferric bromide, the latter subliming in yellow scales. Ferrous bromide is used in the form of syrup, which see.

Ferri Caseinas. *Ferrum caseïnatum, Ferrum nucleoalbuminatum.—Iron caseïnate, Iron nucleoalbuminate.*—Diluted skimmed milk is treated with just sufficient strongly diluted acetic acid to precipitate the casein, which is washed repeatedly with warm water, then with alcohol, and finally with ether to remove fat. 1 part of casein is rubbed with 1 part of calcium carbonate and 100 parts of water, and the solution filtered. The calcium caseinate in the filtrate is precipitated with a small excess of a 1 per cent. freshly prepared solution of ferrous lactate. After washing and drying, the precipitated iron caseinate is a flesh-colored, odorless, tasteless powder, insoluble in water, soluble in weak sodium carbonate and ammonia solutions. It contains 2.5 per cent. of iron, and is digested by pancreatin and pepsin and hydrochloric acid. Recommended by Dawydow as an easily absorbable iron compound in place of iron albuminate.

Ferri Ferrocyanidum. *Ferrum cyanatum, Ferrum borussicum.—Ferric ferrocyanide, Prussian blue, Berlin blue*, E.; *Ferrocyanure ferrique, Bleu de Prusse (de Berlin)*, Fr.; *Ferrocyaneisen, Blausaures Eisen, Berliner Blau*, G. $Fe_4[Fe(CN)_6]_3$.—Obtained by adding a solution of 10 parts of potassium ferrocyanide to 20 parts of solution of ferric chloride (1.28 specific gravity) in 200 parts of water. The precipitate is washed with warm dilute hydrochloric acid by decantation, and then thoroughly with water, and dried. It requires considerable washing to free it from the potassium salt, and when dried at a temperature of about 40° C. (104° F.) or lower it retains $18H_2O$ in combination, which it gradually loses at a higher temperature. The double decomposition taking place is expressed thus: $3K_4Fe(CN)_6 + 4FeCl_3 = Fe_4[Fe(CN)_6]_3 + 12KCl$. Ferric ferrocyanide is in dark-blue masses, which exhibit upon the fresh somewhat conchoidal fracture a reddish metallic luster and yield a deep-blue powder. It is inodorous, tasteless, insoluble in water, alcohol, and dilute mineral acids, but dissolves while moist in solution of ammonium nitrate with a violet-blue color, and yields with oxalic acid, equal to one-sixth or more of its own weight, a powder which dissolves completely in water, and which has been used as *wash-blue* and *blue ink;* the residue left on evaporating the solution to dryness has been known as *Bleu suisse* or *Swiss blue.* Commercial Prussian blue should previously be purified for this purpose by treating it with dilute hydrochloric or sulphuric acid and washing with water. Concentrated mineral acids decompose it, with liberation of hydrocyanic acid; when boiled with alkalies, ferric hydroxide is separated and

alkali ferrocyanide dissolved; and when heated in contact with air, ammoniacal vapors are given off and a rust-colored residue is left containing ferric oxide and potassium cyanate, the latter resulting from potassium compounds present in the pigment. Prussian blue is hygroscopic, and contains about 28 per cent. of water. For uses in the arts Prussian blue is made by precipitating ferrous sulphate with potassium ferrocyanide, and exposing the bluish-white precipitate to the air or treating it with oxidizing agents until it has acquired the proper shade; the commoner varieties contain alumina and other impurities. The pigment was accidentally discovered by Diesbach, a manufacturer of colors in Berlin, and a notice of the discovery published in 1710; but processes for preparing it were first published by Woodward, John Brown, and Stephane F. Geoffroy (1724–25); most of the noted chemists of the eighteenth and of the early part of the nineteenth century were engaged in the investigation of its composition and of that of allied compounds. *Soluble Prussian blue* is obtained on adding a solution of a ferric salt (anhydrous ferric chloride, 1 part) to a solution of potassium ferrocyanide (3 parts) (not the reverse), keeping the latter in excess. The deep-blue precipitate will become soluble in water as soon as the greater portion of the foreign salts has been washed out; the precipitate is *potassium ferri-ferrocyanide*, $K_2Fe_2'''[Fe''(CN)_6]_2$. A similar soluble precipitate is obtained by adding a ferrous salt to a solution of red prussiate of potassium (potassium ferricyanide), but it has the composition $K_2Fe_2''[Fe(CN)_6]_2$, and is *potassium ferro-ferricyanide*. *Turnbull's blue, ferrous ferricyanide*, was discovered by Gmelin (1827), and is obtained by adding potassium ferricyanide to a solution of ferrous salt. Ferric ferrocyanidum has no chalybeate effect upon the human economy and is not used in internal medicine.

Ferri Glycerophosphas. *Ferrum glycerinophosphoricum.—Iron glycerophosphate*, E.; *Glycerinphosphorsaures Eisen*, G. $Fe_2[C_3H_5(OH)_2PO_4]_3$.—This salt is obtained by dissolving freshly precipitated ferric hydroxide in glycerophosphoric acid, evaporating the solution in a vacuum apparatus to syrupy consistence, and then spreading on plates of glass and drying at a gentle heat. It forms yellow scales, soluble in water and diluted alcohol. This salt is employed for the same purposes and in the same doses as calcium glycerophosphate (which see).

Ferri Iodidum. *Ferrum iodatum.—Ferrous iodide, Iodide of iron*, E.; *Iodure de fer*, Fr.; *Eisenjodür*, G. FeI_2.—It may be made by mixing 6 Gm. of bright iron wire with 17 Gm. of iodine and 20 Cc. of distilled water in a flask and shaking the mixture occasionally until the solution has acquired a green color and lost the smell of iodine. The solution is then filtered and evaporated rapidly in a dish of polished iron until a drop of the solution on the end of an iron wire solidifies on cooling. The liquid should now be poured into a porcelain dish, and as soon as it has solidified should be broken into fragments and kept in a well-stoppered bottle. The solution of ferrous iodide, on evaporation, is readily oxidized; hence the direction to evaporate in a polished iron dish, which, however, cannot prevent the formation of oxide, or possibly oxyiodide, of iron. The residuary salt is therefore never completely soluble in water. According to de Luca, pure anhydrous ferrous iodide is white, and in the presence of moisture greenish. By the above process, however, it is usually obtained as a steel-gray laminated mass, with a metallic luster, fusing at about 177° C. (350° F.) and evolving vapors of iodine. It is deliquescent when pure, and dissolves readily with a green color in water, also in glycerin and alcohol. Solid ferrous iodide is at best a very unsatisfactory medicinal preparation, owing to the unavoidable changes occurring under ordinary circumstances. Saccharated ferrous iodide was formerly recognized in the U. S. and German pharmacopœias. It is made by mixing a solution of 20.75 Gm. of freshly prepared ferrous iodide, made as stated above, with 40 Gm. of powdered milk-sugar and evaporating on a water-bath, with frequent stirring, until a dry mass remains, which is then transferred to a heated iron mortar, reduced to powder, and intimately mixed with 1 Gm. of reduced iron and sufficient powdered milk-sugar to make the final product weigh 100 Gm. The finished product is a yellowish or grayish-white powder, very hygroscopic, odorless, with a sweetish ferruginous taste and slight acid reaction, and is soluble in 7 parts of water at 15° C. (59° F.). It is given in doses of from 3 to 5 grains (0.20–0.30 Gm.). (See Syrupus Ferri Iodidi.)

Ferri Malas. *Ferrous malate*, E.—Impure malate of iron is recognized by several European pharmacopœias as *extractum ferri pomatum*, which is prepared by digesting the expressed juice of sour apples with 3 or 4 per cent. of iron filings until the reaction has ceased, filtering, and evaporating. It has a blackish-green color, and contains a variable quantity of iron, sometimes as much as 8 per cent. 1 part of it dissolved in 9 parts of cinnamon water, containing one-tenth its weight of alcohol, is known as *Tinctura Ferri Pomata*, P. G. (See also Tinctura Ferri Pomata, N. F.).

Ferri Oxalas. *Ferrum oxalicum oxydulatum.—Ferrous oxalate*, E.; *Ferrooxalat*, G. $FeC_2O_4.2H_2O$.—This is obtained by interaction between solutions of ammonium oxalate and ferrous sulphate as a pale-yellow to lemon-yellow, odorless, nearly tasteless, stable powder, which is difficultly soluble in cold or hot water, soluble and decomposed in hot acids. Used technically as a photographic developer and for preparing iron reduced by hydrogen.

Ferri Oxidum Magneticum. *Ferrum oxydatum magneticum.—Ferroso-ferric oxide, Black oxide of iron, Magnetic oxide of iron*, E.; *Oxyde ferroso-ferrique, Oxyde de fer noir (magnétique), Ethiops martial*, Fr.; *Magneteisen, Ferroferrioxyd, Eisenoxyd-Oxydul*, G. $Fe_3O_4 = FeO.Fe_2O_3$.

—Magnetic oxide, which is found in Sweden and Michigan as magnetic iron ore, consists of 1 molecule each of ferrous and ferric oxide. It is black or brownish-black, and is one of the best ores for manufacturing iron, Swedish iron being of superior quality. It was formerly official in the Br. P. (1867), and was prepared by adding solution of sodium hydroxide to a mixture of ferrous and ferric sulphate in proper proportion, filtering, washing, and drying at 49° C. (120° F.). Under the name of *Æthiops martialis* various pharmacopœias formerly recognized black ferroso-ferric oxide, which varied in composition according to the different methods of preparation.

Ferri Oxidum Rubrum. *Crocus martis adstringens, Colcothar, Caput mortuum.—Ferric oxide*, E.; *Colcothar, Safran de mars astringent*, Fr.; *Eisenoxyd, Rother Eisensafran, Englisch-Roth, Todtenkopf*, G. Fe_2O_3.—It is obtained by heating to redness ferric hydroxide or by igniting ferrous sulphate in contact with air, when the salt is decomposed, water and sulphuric and sulphurous acids being given off. It is brown-red, more or less gritty, inodorous, tasteless, and insoluble in diluted acids. It is no longer employed medicinally, the ferric hydroxide being used instead, but it is used extensively in the arts. It forms the main constituent of iron paint, which is sold as *English red, Berlin red* (*Minium de fer*, Fr.; *Eisenmennige*, G.), and under various other names, and usually consists of ferric oxide mixed with from 5 to 50 per cent. of alumina or other insoluble compound. When obtained as a fine powder by elutriation, it is known as *polishing rouge, terre douce de vitriol, rouge anglais, Polirroth*, and is employed for polishing metals. The mineral *hæmatite* or *red hæmatite, ferret d' Espagne, sanguine, Blutstein*, is ferric oxide, while the various *brown hæmatites* are different ferric hydroxides.

Ferri Peptonas. *Ferrum peptonatum.—Iron peptonate*, E.; *Eisenpeptonat*, G.; *Peptonate de fer*, Fr.—A mixture of 24 parts of solution of dialyzed iron (oxychloride of iron, P. G.) and 200 parts of water is added, in a thin stream and while constantly stirring, to a solution of 2 parts of dry peptone in 200 parts of water; 1.5 per cent. solution of caustic soda is added till a very weak alkaline reaction is produced, whereupon the iron peptonate is precipitated, which is washed as quickly as possible with water by decantation until silver nitrate shows the absence of chlorine; it is then drained on a wet cloth, and dissolved in 3 parts of 25 per cent. hydrochloric acid. The solution is then evaporated on a water-bath, and finally spread on plates to dry at 50°–60° C. (122°–140° F.). Iron peptonate forms shining, brown, translucent scales, containing 24–25 per cent. of iron. It is slowly soluble in cold, more quickly in warm water, the solution having a slight acid reaction, and not being clouded by boiling nor by addition of alcohol. A liquor and a syrup of iron peptonate are also employed. Iron peptonate and its solutions are recommended as superior to the inorganic salts of iron in the treatment of chlorosis and other chlorotic anæmias. The points of superiority consist in their decrease in astringency and in the absence of corrosive effect upon the teeth and mucous membranes. The dose is from 3 to 10 grains (0.20–0.60 Gm.).

Ferri Salicylas. *Ferrum salicylicum.—Ferric salicylate*, E.; *Ferrisalicylat*, G.—Obtained by mixing concentrated solutions of ferric chloride and sodium salicylate, as a brown powder, soon turning to violet, which, after washing and drying, forms an amorphous brown mass or a black-brown powder. It is occasionally given in doses of from 3 to 10 grains (0.2–0.6 Gm.), in pills, as a tonic, antiseptic, astringent, and antirheumatic.

Ferri Subcarbonas, U. S. 1870. *Crocus martis aperitivus* (*aperiens*).—*Subcarbonate of iron*, E.; *Safran de mars apéritif*, Fr.; *Eisensafran*, G.—This compound, formerly official, was prepared by mixing solutions of 8 ounces of sodium carbonate and 9 ounces of ferrous sulphate, washing, and drying without heat. At first a white precipitate of ferrous carbonate is obtained, which in contact with the air rapidly darkens, changing in color through various shades of green, blue, and olive into brown, carbon dioxide being at the same time given off. This change of color is accompanied with its conversion into ferric hydroxide, with the exception of small and variable proportions of ferrous carbonate, which escape oxidation. This preparation must therefore be regarded as identical, or nearly so, with ferric hydroxide. It is an amorphous reddish-brown powder, inodorous and almost tasteless, and closely resembling ferric hydroxide. If it has been dried at an elevated temperature, it is of a brighter red color, does not readily dissolve in warm dilute hydrochloric acid, and consists mainly of the oxyhydrate, $Fe_2O_2.(OH)_2$. Dried at ordinary temperature, it consists chiefly of the oxyhydrate, $Fe_2O_3.Fe_2(OH)_6$. It may be employed for the same purposes as the saccharated ferrous carbonate, but it is not considered as efficient as the latter remedy. The dose is 5 grains (0.30 Gm.).

Ferri Sulphidum. *Ferrum sulphuratum.—Ferrous sulphide*, E.; *Ferrosulfid, Schwefeleisen*, G.; *Sulfure de fer*, Fr. FeS.—Iron unites with sulphur in various proportions, some of the compounds, like iron pyrites, FeS_2, being found in nature. The monosulphide, which is employed for generating hydrogen sulphide, is made by mixing 3 parts of iron filings with 2 parts of sublimed sulphur, introducing the mixture in small portions into a crucible heated to bright redness and kept covered after each addition; or a rod of iron is raised nearly to a white heat and then brought into contact with sulphur; ferrous sulphide will at once form and melt, and should be permitted to drop into cold water to solidify. It is in yellowish-black or blackish masses or irregular pieces, which have a metallic luster and are permanent in dry air, but are oxidized when kept in a damp atmosphere. It dissolves readily in dilute

sulphuric or hydrochloric acid, with the evolution of hydrogen sulphide, and without residue when the sulphide is pure. As met with, it sometimes contains an excess of sulphur, but usually has an excess of iron, and the hydrogen sulphide evolved is mixed with hydrogen. The chief use of ferrous sulphide is for the generation of hydrogen sulphide, H_2S, a colorless gas having an odor like that of rotten eggs and a specific gravity of 1.19 (air = 1). Water dissolves 3 volumes of the gas; the solution is not permanent in the air, but is oxidized, water being formed and white sulphur deposited.

Ferri Tannas. *Ferrum tannicum.—Ferric tannate*, E.; *Ferritannat, Gerbsaures Eisenoxyd*, G.; *Tannate ferrique*, Fr.—Ferric tannates, free from gallate and containing but little of ferrous compound, are produced by precipitating cold solutions of ferric salts with tannin; a mixture of ferrous salt and tannin exposed to the air likewise deposits ferric tannate. Wittstein (1874) found these precipitates to contain between 8.4 and 56.25 per cent. of ferric oxide, the nature of the iron salt and the order of mixing the solutions influencing the composition of the precipitate. A compound containing about one-third its weight of ferric oxide is obtained by preparing the hydroxide from 3 fluidounces of solution of ferric sulphate, and triturating the washed and pressed precipitate with 1 troyounce of tannin and sufficient alcohol, after which it is dried on a water-bath. Tannate of iron is a black or bluish-black powder which is decomposed by mineral and the stronger organic acids. When boiled with water the ferric is reduced to ferrous salt.

Ferri Valerianas. *Ferrum valerianicum.—Ferric valerianate, Valerianate of iron*, E.; *Eisenvalerianat, Baldriansaures Eisenoxyd*, G.—Valerianate of iron is a basic salt of variable composition. It is obtained by adding to a cold solution of ferric sulphate a cold solution of sodium valerianate as long as a precipitate is produced, collecting this upon a filter, washing with a little water, and drying it at a temperature not exceeding 20° C. (68° F.). Prolonged washing and an elevated temperature will produce a more basic salt. It is a dark brick-red light amorphous powder, having a slight odor and a taste of valerianic acid, and is insoluble in cold water, but readily soluble in alcohol. The U. S. P. of 1890 required that the salt upon ignition should leave a residue of 21.42–28.57 per cent. of ferric oxide, representing 15 to 20 per cent. of metallic iron. In the doses of from 1 to 3 grains (0.05–0.20 Gm.) it has been recommended in chlorosis with hysterical attacks.

FERRUM REDUCTUM, *U. S., P. G.*—Reduced Iron.

Ferrum redactum, Br.; *Ferrum hydrogenio reductum, Ferrum ope hydrogenii paratum.—Iron reduced by hydrogen, Iron by hydrogen*, E.; *Fer réduit par l'hydrogène*, Fr.; *Reducirtes Eisen*, G.

It should contain not less than 90 per cent. of pure metallic iron.—U. S., P. G.

Preparation.—Ferric hydroxide is prepared as directed under FERRI HYDROXIDUM, and dried. It is then introduced into an iron tube and heated to dull redness in a current of hydrogen gas, which is purified of acid vapors and other products by passing it through a solution of potassium permanganate, basic lead acetate, and sulphuric acid. After hydrogen ceases to be absorbed, the reduced iron is allowed to cool in the hydrogen to prevent reoxidation, and is then preserved in dry-stoppered bottles. The reaction is $Fe_2O_3 + 6H = Fe_2 + 3H_2O$.

If the temperature is too high, the reduced iron will be more or less granular, instead of being in a finely divided state. 2 pounds of ferric hydroxide require from 5 to 8 hours for complete reduction. The metallic iron reduced by electricity from ferrous sulphate (Böttger), or from ferrous chloride (Collas), has no advantage over that prepared by means of hydrogen.

Properties.—Reduced iron is a very fine gray (grayish-black, U. S., Br.) powder, free from metallic luster, but exhibiting metallic streaks when rubbed with firm pressure in a mortar, and yielding a lustrous scale when struck on an anvil with a hammer. It is without odor or taste, and is not altered in dry air, but is gradually oxidized and becomes rust-colored in a damp atmosphere, and when touched with a lighted taper ignites and is converted into black ferroso-ferric oxide. It is strongly attracted by a magnet, and is insoluble in all simple solvents, but is easily dissolved by dilute hydrochloric or sulphuric acid, with the evolution of hydrogen, the solution showing the reactions of ferrous salts. Reduced iron of a very dark or black appearance should be looked on with suspicion, as it contains a large quantity of oxide which has escaped reduction, or carbon.

Tests.—On treating reduced iron with diluted hydrochloric acid, the undissolved residue should not weigh more then 1 per cent. (carbon).—U. S. The hydrogen should be free from noxious odor, and should not impart a black color to filter-paper moistened with solution of lead acetate and stretched over the orifice of the test-tube; the black color would be due to the presence of sulphur, resulting from the sulphate which remains

in incompletely washed ferric hydroxide. If 1 Gm. of reduced iron be shaken with 5 Cc. of water, the liquid should not change the color of litmus-paper. To 0.5 Gm. of reduced iron in a small covered beaker add 20 Cc. of diluted sulphuric acid; after a while warm on a water-bath until action ceases, then collect any residue of impure iron arsenide upon a very small filter, add the rinsings of the beaker to the filter, and wash the residue with water until free from acid reaction. Transfer the residue to the beaker by rinsing it back, add about 0.25 Gm. of potassium chlorate and 5 Cc. of hydrochloric acid, and evaporate slowly to dryness on a water-bath. Dissolve the residue in water to 50 Cc., then add 5 Cc. of this solution to 5 Cc. of a saturated solution of sulphurous acid and heat on a water-bath for 15 minutes, until all traces of sulphurous acid have been removed. The resulting solution should not respond to the modified Gutzeit's test for arsenic (given under ARSENI TRIOXIDUM). Introduce 0.555 Gm. of reduced iron into a glass-stoppered flask of about 100 Cc. capacity, add 6 Cc. of water, 2 Gm. of potassium iodide, and 2.6 Gm. of iodine, accurately weighed in a weighing-bottle. Securely stopper the 100 Cc. flask, thoroughly rotate the contents, and let stand for 1 hour. Dilute the contents with water to 100 Cc., mix well, and to 25 Cc. of this solution add tenth-normal sodium-thiosulphate solution until the last trace of brown color has disappeared. Divide the weight of iodine taken by 0.02518, and subtract from the quotient twice the number of Cc. of tenth-normal sodium thiosulphate solution used; the remainder represents the percentage of metallic iron present in the reduced iron, and this should not be less than 90 per cent.—U. S.

Note.—The percentage purity of the iodine used should be accurately determined by a previous experiment, and in place of 2.6 Gm., as directed, its equivalent in pure (100 per cent.) iodine taken.—U. S. The P. G. gives the same method of assay. In the above assay only free metallic iron is acted on by the iodine, thus $Fe + I_2 = FeI_2$. The potassium iodide acts as a solvent for the iodine, thus bringing the latter in intimate contact with the iron. From the reaction 55.5 Gm. of Fe require $2 \times 125.9 =$ 251.8 Gm. of iodine, or 0.555 Gm. of Fe taken in the determination require 2.518 Gm. of iodine, if the iron is perfectly pure. Each Cc. of tenth-normal sodium thiosulphate solution is equivalent to 0.01259 Gm. of iodine. If nCc. of thiosulphate solution is required to titrate the excess of iodine in the 25 Cc. portion of the iron solution, the actual amount of iodine entering into combination with the 0.555 Gm. of reduced iron taken would be $(2.6 - 4n \times 0.01259)$ Gm. The weight of pure metallic iron equivalent to this is $\frac{0.555}{2.518} \times (2.6 - 4n \times 0.01259)$ Gm., which is present in 0.555 Gm. taken for assay. Hence the percentage of purity is $\frac{0.555}{2.518} \times (2.6 - 4n \times 0.01259) \times \frac{100}{0.555}$. This expression, when simplified, becomes $\frac{2.6}{0.02518} - 2n$, which is the rule in the Pharmacopœia for finding the percentage. Or, since 215.8 Gm. of iodine are capable of combining with 55.5 Gm. of pure metallic iron, 0.02518 Gm. of iodine will correspond to 1 per cent. of pure iron in the 0.555 Gm. used for the assay, and the quotient obtained by dividing 2.6 by 0.02518 will express the percentage of pure iron corresponding to the 2.6 Gm. of iodine taken. If all the iodine taken could combine with the 0.555 Gm. of reduced iron there would be no necessity for further calculation, but as an unknown excess of iodine is intentionally used, the exact amount in combination must be determined. 1 Cc. of tenth-normal sodium thiosulphate solution corresponding to 0.01259 Gm. of iodine also corresponds to ½ per cent. of pure iron in the 0.555 Gm. used. As only one-quarter of the excess of iodine is titrated in the 25 Cc. of solution, the total excess of iodine is equivalent to 4 times the number of Cc. of tenth-normal sodium thiosulphate solution used, and hence the percentage of pure metallic iron corresponding to such total excess of iodine must be represented by 4 times the number of Cc. of thiosulphate solution multiplied by ¼, or, in other words, by the number of Cc. multiplied by 2. This product subtracted from the quotient obtained above leaves the actual percentage of pure iron present.

The Br. P. requires at least 75 per cent. of metallic iron, which is determined by adding 0.25 Gm. of reduced iron to a hot solution of 1 Gm. of copper sulphate in 15 Cc. of water, closing the flask immediately and shaking occasionally. After 10 minutes the liquid is rapidly filtered out of contact with air as much as possible, acidified with sulphuric acid, and titrated with volumetric potassium dichromate solution, of which 33.7 Cc. should be used before a blue precipitate ceases to form with potassium ferricyanide

(each Cc. of the volumetric solution represents 0.0056 Gm. of iron). The action of the iron on the copper sulphate is $Fe + CuSO_4 = FeSO_4 + Cu$, ferrous sulphate and copper being formed.

Action and Uses.—The medicinal properties and uses of the reduced iron are discussed under FERRUM (which see).

FERRUM PULVERATUM S. ALCOHOLISATUM S. PORPHYRISATUM, or *Pulverized iron*, may be mistaken for reduced iron. It is made in Europe on a large scale from a good quality of cast iron, and therefore contains carbon. It has the general properties of reduced iron, from which it differs in being denser, in having a distinct metallic luster, and in not igniting when touched with a lighted taper; the hydrogen evolved by it has a distinct odor, but should contain only traces of hydrogen sulphide. A solution of the iron in hydrochloric acid should not yield a dark color nor precipitate with hydrogen sulphide (absence of lead, copper, etc.), and when oxidized with nitric acid and treated with ammonia in excess the filtrate should be colorless (copper, etc.), and should not be rendered turbid by ammonium sulphide.

FICUS, *U. S., Br.*—Fig.

Caricæ, Ficus passa, Fici, Fructus caricæ.—*Feige*, G.; *Figue*, Fr.; *Higo*, Sp.

The partially dried fruit of *Ficus Carica* L. (Fam. *Moraceæ*).

Origin and Preparation.—A small soft-wooded tree, or in less favorable climates a shrub, native of southwestern Asia and cultivated in all warm-temperate or subtropical regions. The inflorescence consists of a short, enlarged, hollow axillary branch, which is lined by innumerable minute flowers. The staminate flowers are few and near the mouth. In fruit this hollow branch becomes fleshy and each of the pistillate flowers develops a small yellowish akene, commonly called the seed. The unripe fig is green and contains a milky acrid juice; but on ripening, this juice becomes saccharine and the fruit assumes a yellowish to purple color. In Italy, the early figs, which appear in the axils of the previous year's leaf-scars, are known as *grossi* or *orni*, while those produced in the axils of leaves are known as *forniti* or *cratiri*, the latter name being given to those which ripen after the fall of the leaves. The ripe figs are dried either in the sun or by artificial heat. They then have a wrinkled or shrivelled appearance and a stiff consistency, and thus packed are classed as *natural figs*. When rendered pliant by kneading and squeezing before being packed, they are called *pulled figs*.

FIG. 181.

Ficus Carica L.: *a*, section of fig; *b*, staminate flower; *c*, pistillate flower.

Description.—Irregularly short pear-shaped, about 7.5 Cm. (3 In.) long, and having an average diameter about two-thirds as great; brown or yellowish, or more or less whitened by superficial effloresced sugar; either much shrivelled or wrinkled, or with flat and even surfaces due to pressure of packing, and of a stiff or pliant texture; internally fleshy, mucilaginous, usually translucent, and containing numerous imbedded yellow, seed-like akenes; odor peculiar, fruity; taste sweet, mucilaginous, and pleasant.

Smyrna figs are large and puffy; *Greek figs* are smaller and more wrinkled.

Constituents.—Besides 15 per cent. of akenes and cellular tissue, the fruit yields 50–60 per cent. of glucose, with gum, fat, phosphates, chlorides, etc., but nothing of any special medicinal activity.

Action and Uses.—Figs have long been employed for their nutritive value, but if eaten in large quantities are apt to occasion flatulent colic and diarrhœa. In medicine they are occasionally eaten for their laxative effect in the treatment of habitual constipation. The laxative property resides in the saccharine juice of the fresh fruit, and in the dried fruit is probably due to the indigestible seeds and skin. Applied externally, roasted figs are employed as emollient poultices over gum-boils and small abscesses; and demulcent decoctions are prepared from them and employed in the treatment of catarrhal affections of the nose and throat.

FILICES.—The Ferns.

Except for decorative purposes, this very large group of flowerless plants has few important uses. Under ASPIDIUM, the anthelmintic property of a number of species has been described. This is the most important medicinal property of the group, and most of the species possessing it are at the same time poisonous, very much like Aspidium. It has been claimed that horses and cattle have been poisoned by eating the herbage of *Pteridium aquilinum* (L.) Kuhn (*Pteris a.* L.), the common *Brake* or *Bracken*, but this appears scarcely probable. Gardeners, in handling the herbage of *Davallia Mooreana* Hook. et A., frequently suffer from a cutaneous irritation somewhat resembling that caused by nettles. The poisonous agent in this case has not been determined. Although quite a large number of species are used in native or domestic practice as expectorants, diuretics, carminatives, and astringents, very few of them have been employed in scientific medicine.

Adiantum, Venus-hair or Maiden-hair, Herba capillorum veneris.—Capillaire, Fr. Cod.; *Frauenhaar, Venushaar*, G.; *Capelvenere*, It.; *Culantrillo*, Sp.—This is the frond of *A. capillus-veneris* L. or of *A. pedatum* L. (Fam. *Polypodiaceæ*). These are slender and delicate herbs, growing from slender horizontal rhizomes, the first-named widely distributed through warm-temperate and tropical regions, the second throughout most of eastern and central North America. Venus-hair is about 30 Cm. (1 Ft.) high, the cylindrical stipe blackish-brown and shining, the frond bipinnate to tripinnate below, the pinnules short-stalked, unequal, roundish wedge-shaped with oblique base, obtusely lobed, with linear marginal sori. Maiden-hair is similar, but rather larger, the stem forked at the summit, each branch slightly recurved and divided into 6 or 7 horizontal pinnate branches, the whole leafy portion somewhat horseshoe-shaped, the pinnules triangular-oblong, the inferior margin entire, the superior margin cleft and spore-bearing. The odor is faint; the taste sweetish, slightly bitter and faintly astringent. The constituents are a little tannin, an unknown bitter principle, a trace of volatile oil, with sugar, gum, etc. Adiantum is somewhat aromatic, demulcent, and stimulant. It has been used in the treatment of chronic affections of the respiratory tract, and is said to be of value for the relief of cough. It is employed in the form either of a syrup or an infusion. The so-called *Black maiden-hair* of Europe is *Asplenium Adiantum nigrum* L., and the *White maiden-hair* is *A. rutamuraria* L. *A. trigonum* Labill. is said by Maiden to be used in Tasmania as an astringent and mild emetic.

Scolopendrium Scolopendrium (L.) Karst. (*Asplenium S.* L.; *Phyllitis S.* Greene; *S. vulgare* J. E. Sm.; *S. officinarum* Swz.; *S. officinale* DC.) is *Folia Scolopendrii, F. Phyllitidis* or *F. Linguæ Cervinæ, Hart's-, Lamb's-, Adder's-*, or *Fox-tongue, Snake-, Caterpillar-*, or *Finger-fern; Hirschzunge*, G. The leaves of this peculiar fern, widely distributed through the north-temperate zone, though rare in North America, were formerly much used as a sedative expectorant, mild astringent and alterative, and contain gum, tannin, and a little volatile oil.

Cibotium, Penghawar Djambi, Paleæ or *Pili Cibotii; Farnhaar* (G.), is the chaffy hairs from the bases of the stipes of *Cibotium Djambianum* Hassk., *C. Barometz* J. Sm., and *C. glaucescens* Kunze (Fam. *Polypodiaceæ*), tree-ferns of the East Indies. They are employed generally among the natives as an application to open wounds to check hemorrhage, and this use has prevailed to some extent in scientific surgery. The article is applied either in the entire condition or after being reduced to powder. Different opinions as to whether the mode of action is identical with that of lint have been expressed. It has been assumed that coagulation is chiefly due to absorption of the blood-serum by the dry fiber, but the action seems more energetic than would be thus explained. The hairy rhizomes of these plants, growing in peculiar forms, constituted the *Agnus Scythicus* or *Tartarian Lamb* of ancient fable. *Pulu* is a similar, but finer product yielded by *C. Menziesii* Hook. and *C. glaucum* Hook. et A., of the Sandwich Islands. The similar, but thicker and stiffer material obtained from the base of *Alsophila lurida* Hook., and allied species of Java, is similarly employed under the name *Paku-kidang* or *Pakoe-kidang*. All the above products are employed to a considerable extent as a substitute for hair in stuffing mattresses and other furniture. In Mexico, a similar product, similarly employed under the name *Ocopetate* or *Cola de Mono*, is obtained from *Cibotium Schiedei* Schlecht. (or *Cyathea Mexicana* Ch. et Sch.?).

In South America, a gummy exudation is obtained by wounding the stems of several tree-ferns, and is applied as a protective covering to wounds. Upon drying, it adheres very tightly, resists the action of water, and is highly elastic, like collodion.

In the East Indies and Polynesia the rhizomes of a number of ferns are eaten as starchy foods, or the starch is extracted from them. Cumarin has been reported as occurring in several ferns, and a number have contributed dyestuffs. Although the idea of employing the wood of ferns must appear strange to most persons, yet Maiden reports that beautiful walking-sticks, rustic furniture, and lattice-work are made from the trunk-wood of several arborescent species of *Alsophila*.

FLUIDEXTRACTA.—Fluidextracts.

The term fluidextract, in its present acceptation, is applied to concentrated alcoholic or hydro-alcoholic solutions of vegetable principles, which are permanent and represent all the active virtues of the drugs from which they are made; they are officially recognized in the pharmacopœias of the United States, Great Britain, Germany, and Switzerland, differing but slightly in strength in the four countries.

Fluidextracts, or liquid extracts, as they are called in Great Britain, were first introduced about 1832. Prior to 1847 little interest appears to have been taken in this class of preparations in the United States, only 3 fluidextracts being on record as in use at that time—namely, those of senna, valerian, and rhubarb; from that time forward fluidextracts grew in favor, and the Pharmacopœia of 1850 gave working formulas for 7 concentrated solutions, of which, however, only 1 (valerian) is deserving of the title of fluidextract in the present definition of that term; 2 were oleoresins (cubebs and black pepper), and 4 concentrated syrups (rhubarb, sarsaparilla, senna, and spigelia and senna). In 1860 the number of fluidextracts officially recognized was increased to 25, in 1870 to 46, in 1880 to 79, in 1890 to 88, and in the present (1900) edition of the Pharmacopœia 85 are directed. Besides these a large number of unofficial fluidextracts are annually produced, and this class of preparations must be considered as the most important galenicals used by physicians.

Prior to 1880 the strength of fluidextracts, as prescribed by the Pharmacopœia, was 1 grain of drug to 1 minim of fluidextract; since that time the pharmacopœial strength is based upon the relation of the metric measures of weight and capacity, so that any weight of a given drug is to be converted into a fluidextract having the bulk of the same weight of water at its maximum density, or, in other words, 1 Gm. of the drug is represented by 1 Cc. of the fluidextract. The exceptions to this rule are the fluidextracts of aconite, belladonna root, cinchona, coca, colchicum seed, conium, hydrastis, hyoscyamus, guarana, ipecac, nux vomica, pilocarpus, scopola, and stramonium, all of which are directed to be standardized to definite alkaloidal strength. The present strength of official fluidextracts is about 5 per cent. weaker than formerly. British liquid extracts, with the exception of those of belladonna, cinchona, ipecac, licorice, nux vomica, male fern, opium, and pareira, are of the strength of 1 avoirdupois ounce to 1 Imperial fluidounce, which practically corresponds to our own. In Germany each Gm. of drug is represented by 1 Gm. of fluidextract, the relation being weight for weight.

All the official fluidextracts are directed to be prepared by percolation, a menstruum uniform in alcoholic strength being employed during the process of exhaustion. When, however, glycerin is used with the first portion of the menstruum, percolation is continued and finished with a liquid of the same alcoholic strength, but not mixed with glycerin. By evaporating the weak percolate to a soft extract, most of the water is also expelled, and the comparatively small portion remaining with the extract will occasion but a slight change in the menstruum of the reserved portion, which, at the same time, is the best solvent for the extractive matter; finally, the addition of fresh menstruum will not change the alcoholic strength of the liquid.

It is important that the exhaustion of the drug be conducted as carefully as possible, so that the reserved portion may represent a solution of nearly the whole active virtues of the drug; with this end in view, the rate of percolation for 1000 Gm. of drug should be adjusted to about 5 (not over 8) drops per minute, at which rate about 20 Cc. can be collected in an hour. In the hands of a careful operator, handling such quantities as are given in the pharmacopœial formulas, the official process yields very satisfactory results, and the danger arising from evaporation of the weak percolate may well be disregarded, since from 85 to 90 per cent. of the active principles are most likely contained in the reserved portion, therefore only a small proportion of the medicinal virtues of the drug will be subjected to heat.

The official directions for the preparation of fluidextracts are intended for the quantity of drug designated in the formulas, and must of necessity often be modified by manufacturers who operate upon hundreds of pounds at one time; fineness of powder, degree of packing, and rate of percolation must be adapted to the quantity of material in hand. Manufacturers in some cases resort to repeated maceration and expression instead of percolation.

Authority is given by the Pharmacopœia to employ, where it may be applicable, the

process of repercolation without change of initial menstruum. This process is followed by several manufacturers, and does away with all possibility of injury from application of heat. E. R. Squibb, who was the author of the process, defined it to be "the successive application of the same percolating menstruum to fresh portions of the substance to be percolated." His suggestion was based upon the observation that a weak solution of the constituents of a drug is a better solvent for the soluble active principles of that drug than fresh menstruum. The following example will serve to illustrate the process of repercolation: 1000 Gm. of a properly powdered drug are divided into 5 portions of 200 Gm. each; one portion is moistened, packed, macerated, and percolated to exhaustion, the first 150 Cc. of the percolate being set aside as finished product, the remainder being collected in fractions of 200 Cc., and numbered respectively 1, 2, 3, etc., in the order in which they are collected. The second portion of the drug is moistened with No. 1 weak percolate, packed and percolated to exhaustion, the different weak percolates being used in the order in which they have been collected, followed by fresh menstruum if necessary, the first 200 Cc. of the percolate from this second portion of the drug being set aside as finished product, the remainder being again collected in fractions of 200 Cc., and numbered 1, 2, 3, etc., as before. The third, fourth, and fifth portions of the drug are treated exactly like the second portion, the first 200 Cc. of the percolate in each instance being set aside as finished product. When the fifth portion of the drug has been exhausted there will be on hand five lots of finished product (150, 200, 200, 200, and 200 Cc.; total, 950 Cc.), and, besides, four or five lots of weak percolate supposed to hold in solution the soluble matter from 50 Gm.; these weak percolates, properly numbered, are set aside, to be again used in place of fresh menstruum for the next lot of the same preparation, the process henceforth being continued exactly as directed above for the second portion of the drug. This retention of 25 per cent. of the soluble matter of one portion of the drug in the weak percolates is based on numerous carefully conducted experiments, the results of which showed that when 100 Gm. of drug are exhausted by percolation, from 70 to 80 per cent. of the total soluble constituents present are contained in the first 75 Cc. of percolate. By some the process of repercolation is termed fractional percolation, and modifications of Squibb's method, stated above, have been suggested; in every instance, however, the same principle is kept in view, namely, the use of weak percolates instead of fresh menstruum.

The following directions are given in the National Formulary for application of the process of fractional percolation in the manufacture of fluidextracts: Take of the drug, in powder of the prescribed fineness, 1000 Gm., and divide it into 3 portions, of 500, 325, and 175 Gm., respectively. Moisten the first portion of the drug (500 Gm.) with the menstruum and percolate in the usual manner. Set aside the first 175 Cc. of percolate, and continue until 1500 Cc. more of percolate have passed, which must be received in several portions, so that the more concentrated will be separate from the last, weak percolate. Then moisten the second portion of the drug (325 Gm.) with the more concentrated percolates received during the preceding operation after the first 175 Cc. have passed, and percolate again in the usual manner, using the several reserved percolates, successively, as menstrua. Set aside the first 325 Cc., and continue the percolation until 650 Cc. more have passed, which should also be received in several portions. Finally, moisten the third portion of the drug (175 Gm.) with the most concentrated of the last reserved percolates, and proceed as directed for the second portion. Collect 500 Cc. of percolate, and mix with the two portions (325 and 175 Cc.) previously set aside, so as to make 1000 Cc. of fluidextract.

It stands to reason that when either repercolation or fractional percolation is employed in the manufacture of fluidextracts, the menstruum must remain uniform throughout, not only in regard to the proportion of alcohol present, but also as to the amount of glycerin or other addition made to the original liquid.

Since it is intended in the above process of fractional percolation to represent in 1000 Cc. of finished product the active constituents of 1000 Gm. of drug, the question arises whether this is always possible. Some drugs are more easily exhausted than others, and in our experience complete exhaustion of the drug has at times not been effected with the collection of the last 500 Cc. of percolate. This defect does not occur with repercolation, since only 950 Cc. of finished fluidextract are made from 1000 Gm. of drug, the remaining 50 Gm. being represented in the several lots of weak percolate set aside for another occasion.

All fluidextracts, no matter how carefully made, will begin to deposit soon after they are completed, and this precipitation will continue for a varying length of time. The menstruum dissolves certain extractive principles which it is incapable of retaining in perfect solution afterward under changes of temperature, and thus far no method is known to prevent entirely such separation, which is augmented by exposure to light, air, and heat. Fluidextracts prepared without heat are less prone to deposit than when made by the official process, and in these the amount of precipitate is often very trifling; happily, frequent examinations of precipitates in fluidextracts have disclosed the facts that they consist chiefly of inert extractive matter, and therefore do not affect the medicinal value of the preparation. All freshly made fluidextracts should be set aside in well-stoppered glass vessels, in dark and moderately cool places, for a period of 2 or 3 months, before filtering and bottling them; this plan is universally followed by large manufacturers, and explains the absence, in many cases, of appreciable deposits.

With few exceptions the fluidextracts of the Pharmacopœia are prepared by the following general formula: the quantity of menstruum for moistening the drug, the degree of pressure to be used in packing, and the quantity of percolate to be set aside as reserve being specified in each case:

1000 Gm. of the powdered drug of the prescribed degree of fineness are thoroughly moistened with a certain quantity of the initial menstruum and packed more or less firmly in a cylindrical percolator; the drug, having been properly covered with a paper diaphragm, enough menstruum is poured on to saturate completely the powder and leave a stratum above it. When liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator to prevent evaporation, macerate for 48 hours. Then allow percolation to proceed slowly, gradually adding menstruum (alcohol or alcohol and water), until the drug is exhausted. Reserve the first 700 to 900 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion and add sufficient menstruum to make the fluidextract measure 1000 Cc.

Concentration of the weak percolate is usually effected by distilling off the alcohol in a suitable apparatus on a water-bath, and finally evaporating the liquid, in a porcelain capsule, to the proper consistence, preferably with constant stirring. The Pharmacopœia does not in every case specify the temperature for evaporation, but it is best to keep it always below 50° C. (122° F.), so as to avoid changes in the extractive, as far as possible.

Of the 85 official fluidextracts, 10 are made with alcohol alone.

Arranged according to the menstruum, the official fluidextracts may be divided into 22 classes, as follows:

Alcohol: aromatic powder, capsicum, cimicifuga, cubeb, gelsemium, ginger, Indian cannabis, lupulin, savin, veratrum.

Alcohol 4 volumes, water 1 volume: belladonna root, eriodictyon, euonymus, mezereum, podophyllum, rhubarb, scopola, serpentaria, stavesacre.

Alcohol 3 volumes, water 1 volume: aconite, buchu, calamus, eucalyptus, grindelia, ipecac, leptandra, matico, nux vomica (with acetic acid), sumbul, valerian, xanthoxylum.

Alcohol 7 volumes, water 3 volumes: calumba.

Alcohol 2 volumes, water 1 volume: bitter orange-peel, colchicum seed, hyoscyamus, stramonium, viburnum opulus, viburnum prunifolium.

Alcohol 6½ volumes, water 3½ volumes: convallaria.

Alcohol 1 volume, water 1 volume (diluted alcohol): berberis, chimaphila, chirata, coca, conium (with acetic acid), cypripedium, digitalis, ergot (with acetic acid), eupatorium, gentian, guarana, krameria, lappa, phytolacca, pilocarpus, quillaja, rubus, scutellaria, senna, spigelia, stillingia, taraxacum.

Alcohol 5 volumes, water 8 volumes: frangula.

Alcohol 4 volumes, water 6 volumes: rhamnus purshiana.

Alcohol 1 volume, water 2 volumes: quassia, sarsaparilla.

Alcohol 8 volumes, glycerin 1 volume, water 1 volume, followed by a mixture of alcohol 8 volumes, water 2 volumes: cinchona.

Alcohol 6 volumes, water 3 volumes, glycerin 1 volume, followed by a mixture of alcohol 2 volumes, water 1 volume: hydrastis.

Alcohol 6 volumes, water 3 volumes, glycerin 1 volume, followed by a mixture of alcohol 6 volumes, water 4 volumes: apocynum, geranium, pareira.

Diluted alcohol 9 volumes, glycerin 1 volume, followed by diluted alcohol: granatum, quercus, rhus glabra, rose, sarsaparilla (compound fluidextract).

Alcohol 3 volumes, water 6 volumes, glycerin 1 volume, followed by a mixture of alcohol 1 volume, water 2 volumes: hamamelis.

Alcohol 2 volumes, water 5 volumes, glycerin 3 volumes: uva ursi.

Alcohol 2 volumes, water 6 volumes, glycerin 2 volumes: wild cherry.

Alcohol 6 volumes, water 3 volumes, solution of potassium hydroxide 0.3 volume: senega.

Alcohol 1 volume, glycerin 1 volume, water 2 volumes, followed by diluted alcohol: aromatic rhamnus purshiana.

Diluted acetic acid, 10 per cent. solution: lobelia, sanguinaria, squill.

Boiling water: glycyrrhiza, triticum. Finished product contains about 25 per cent. by volume of alcohol as a preservative, and in the case of glycyrrhiza also 25 per cent. of glycerin and 5 per cent. of ammonia-water.

The following fluidextracts were dropped in the revision of the 1890 Pharmacopœia: arnica root, asclepias, aspidosperma, castanea, colchicum root, cusso, dulcamara, gossypium, iris, menispermum, rumex, scoparius, stramonium seed.

The following fluidextracts have been introduced for the first time in the 1900 Pharmacopœia: berberis, euonymus, granatum, quercus, quillaja, rhamnus purshiana (aromatic), scopola, stavesacre, sumbul, stramonium leaves.

FLUIDEXTRACTUM ACONITI, *U. S.*—Fluidextract of Aconite.

Fluidextractum aconiti radicis.—Fluidextract of aconite root, E.; *Extrait liquide de racine d'aconit*, F.; *Flüssiges Akonitknollenextrakt*, G.

Preparation.—Aconite, in No. 60 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical glass percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the aconite is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, in a porcelain capsule, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of aconitine in the remainder of the liquid, add to this enough menstruum to make each 100 Cc. of the finished fluidextract contain 0.4 Gm. of aconitine.

Assay of Fluidextract of Aconite.—Fluidextract of aconite, 10 Cc.; ether, distilled water, ammonia-water, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, hematoxylin test-solution, of each a sufficient quantity. Pour 10 Cc. of fluidextract of aconite into an evaporation-dish and evaporate carefully to dryness on a water-bath at a temperature not exceeding 60° C. (140° F.). Add 5 Cc. of tenth-normal sulphuric acid and 10 Cc. of distilled water. When the extract is dissolved, filter into a separator, washing the dish and filter with about 40 Cc. of distilled water. To the contents of the separator add 25 Cc. of ether and 2 Cc. of ammonia-water, and agitate for a minute. Draw off the lower layer into a flask and filter the ether into a beaker. Return the aqueous fluid to the separator, add 15 Cc. of ether, and agitate a minute. Again draw off the lower layer into the flask and filter the ether into the beaker. Repeat the process with 2 other portions of 10 Cc. each of ether. Evaporate the ether to dryness and dissolve the residue in 3 Cc. of tenth-normal sulphuric acid. Add to the solution 5 drops of hematoxylin test-solution, and then carefully run in fiftieth-normal potassium hydroxide solution until a violet color is produced, the transition stages being as follows: first yellow, then green, finally passing into violet. Divide the number of Cc. of fiftieth-normal potassium hydroxide solution used by 5, subtract this number from 3 (the 3 Cc. of tenth-normal sulphuric acid used), multiply the remainder by 0.064, and this product by 10 (or multiply at once by 0.64), which will give the weight in grammes of aconitine in 100 Cc. of the fluidextract of aconite.—U. S.

25 avoirdupois ounces of aconite should be moistened with about 10 fluidounces of the menstruum (alcohol 3 volumes, water 1 volume), and the first 22 fluidounces of the percolate set aside as reserve.

When assaying preparations of aconite, it is important to avoid a rise of temperature above that directed, as aconitine is easily decomposed. It will also be found advantageous to add 5 Gm. of powdered pumice stone to the fluidextract before evaporation, as this will facilitate subsequent extraction of the resinous residue and filtration of the liquid.

The correct end-reaction in the assay of aconite, when hematoxylin is used as indicator, is green, the color of transition from yellow to violet, but the first appearance of violet will also answer.

EXTRACT OF ACONITE has very properly been dropped from all the pharmacopœias. The solid extract is not a very satisfactory preparation, since the alkaloid present in the percolate of the root is apt to undergo decomposition during the prolonged exposure to heat required for evaporation to a pilular substance, and the extract is often found to have an acid reaction.

If small quantities of extract of aconite are wanted, they may be readily obtained by evaporating a convenient amount of the fluidextract in a porcelain capsule on a water-bath, at a temperature not exceeding 50° C. (122° F.), to a pilular consistence.

Uses.—The action of this preparation is identical with that of ACONITUM (which see). It is frequently employed as an ingredient to liniments for the purpose of relieving superficial neuralgias, but is rarely employed in internal medicine. The internal dose is from ½ to 1 minim (0.025–0.05 Cm.).

FLUIDEXTRACTUM APOCYNI, *U. S.*—Fluidextract of Apocynum.

Fluidextract of Canadian hemp, E.; *Extrait liquide de chanvre du Canada*, Fr.; *Flüssiges Canadisch-Hanfwurzelextrakt*, G.

Preparation.—Apocynum, in No. 60 powder, 1000 Gm.; glycerin, 100 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 600 Cc. of alcohol and 300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolater; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water, made in the proportion of 600 Cc. of alcohol to 400 Cc. of water, until the apocynum is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with 10 fluidounces of the menstruum (alcohol 6 volumes, water 3 volumes, glycerin 1 volume), and the first 22 fluidounces of the percolate set aside as reserve. The final volume of the finished product is made up to 24 fluidounces by addition of a mixture of alcohol 6 volumes and water 4 volumes.

It has been found that a slightly weaker menstruum than that formerly (1890) used, extracts the drug equally well and yields a satisfactory preparation.

Uses.—The employment of this remedy is identical with that of APOCYNUM (which see). Dose, 5 minims (0.30 Gm.). As an emetic it may be given in doses of from 15 to 20 minims (1–1.3 Cc.).

FLUIDEXTRACTUM AROMATICUM, *U. S.*—Aromatic Fluidextract.

Extrait liquide des aromates, Fr.; *Flüssiges Gewürzextrakt*, G.

Preparation.—Aromatic powder, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 350 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and,

having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the aromatic powder is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the powder should be moistened with about 9 fluidounces of alcohol, and the first 21 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This preparation is of a rich red-brown color, and has the warm aromatic taste of the powder.

Uses.—This preparation is valuable for disguising the odor and taste of many remedies. It may be added in small quantities to powdered drugs in order to produce a more eligible preparation. It is rarely administered alone. The dose is from 10 to 30 minims (0.60–2 Cc.).

FLUIDEXTRACTUM AURANTII AMARI, *U. S.*—Fluidextract of Bitter Orange-peel.

Extrait liquide d'écorce d'orange amère, Fr.; *Flüssiges Pomeranzenschalenextrakt*, G.

Preparation.—Bitter orange-peel, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it moderately in a conical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the orange-peel is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of the menstruum (alcohol 2 volumes, water 1 volume), and the first 19½ fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

In preparing this fluidextract it should be remembered that the orange-peel should consist almost exclusively of the glandular epidermal layer, known in commerce as Curaçoa orange-peel. Prepared from good material, the preparation will be of a yellowish-brown color and have the agreeable odor and pleasantly bitter taste of the peel.

Uses.—Because of its aromatic properties this remedy is frequently employed with other bitter tonics. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM BELLADONNÆ RADICIS, *U. S.*—Fluidextract of Belladonna Root.

Extractum Belladonnæ Liquidum—Liquid Extract of Belladonna, Br.—*Extrait liquide de racine de belladone*, Fr.; *Flüssiges Tollkirschenwurzelextrakt*, G.

Preparation.—Belladonna root, in No. 60 powder, 1000 Gm.; alcohol, water, a sufficient quantity to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the belladonna root is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of alkaloids in the remainder of the liquid; add to this enough menstruum to make each 100 Cc. of the finished fluidextract contain 0.5 Gm. of the alkaloids from belladonna root.

Assay of Fluidextract of Belladonna Root.—Fluidextract of belladonna root, 10 Cc.; distilled water, ammonia-water, chloroform, normal sulphuric acid, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, hematoxylin or iodeosin test-solution, each a sufficient quantity. Measure 10 Cc. of fluidextract of belladonna root into a separator, add 10 Cc. of distilled water, 20 Cc. of chloroform, and 2 Cc. of ammonia-water. Shake well for several minutes, and draw off the lower chloroformic layer into a second separator. Repeat the extraction twice with 10 Cc. of chloroform, and draw each 10 Cc. of chloroform into the second separator. To the latter add 5 Cc. of normal sulphuric acid and 20 Cc. of distilled water, shaking well for several minutes. Draw off and reject the lower chloroformic layer, and filter the acid aqueous layer into a clean separator. Wash the last separator and filter with 10 Cc. of distilled water, adding this to the aqueous fluid in the separator. To the latter add 10 Cc. of chloroform and 4 Cc. of ammonia-water, and shake well for several minutes. Draw off the lower chloroformic layer into a beaker, and repeat the extraction twice with 10 Cc. of chloroform, adding the chloroform to the beaker. Allow the chloroform in the beaker to evaporate on a moderately warm water-bath until the residue is perfectly dry. Add 5 Cc. of tenth-normal sulphuric acid to the beaker, and when the residual alkaloids have all dissolved, titrate the solution with fiftieth-normal potassium hydroxide solution, using 5 drops of hematoxylin or iodeosin test-solution as indicator. Divide the number of Cc. of fiftieth-normal potassium hydroxide solution used by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid used), and multiply the remainder by 0.0287, and this product by 10 (or multiply at once by 0.287), to obtain the weight in grammes of alkaloids contained in 100 Cc. of the fluidextract of belladonna root.—U. S.

25 avoirdupois ounces of the powdered root should be moistened with about 9 fluidounces of the menstruum (alcohol 4 volumes, water 1 volume), and the first 20 fluidounces of the percolate set aside as reserve.

Liquid extract of belladonna of the Br. P. is made by repercolation, as follows: 8 ounces of the root in No. 20 powder are moistened with 6 fluidounces of a menstruum composed of 90 per cent. alcohol 7 volumes and water 1 volume, and set aside for 6 hours; the powder is then packed firmly in a percolator and 6 fluidounces more of the menstruum added; when the liquid begins to drop, the lower orifice of the percolator is closed and maceration continued for 24 hours, after which percolation is allowed to go on slowly, using more menstruum as required and collecting the percolate in small portions. A second quantity of powdered root is moistened with the first 6 fluidounces of percolate collected, and then treated exactly as in the case of the first lot of drug, using as menstruum, however, the liquid collected in portions as percolate from the first 8 ounces. Two more portions of 8 ounces of powdered root are then treated exactly as the second portion, the third portion being extracted with the liquid from the second percolator, and the fourth portion with the liquid from the third percolator. From the fourth portion of drug 12 fluidounces of strong percolate are finally collected, in which the proportion of alkaloids present is determined, and sufficient of the alcohol and water mixture given above added to produce a liquid extract containing 0.75 Gm. of total alkaloids in 100 Cc. or $\frac{3}{4}$ grain in 110 minims. The alkaloids in the strong percolate are determined by the following method:

Introduce 10 Cc. of the liquid into a separator, add 10 Cc. of chloroform, 50 Cc. of water, and a decided excess of ammonia-water; set aside; draw off the chloroformic layer. Twice repeat the agitation with chloroform and the separation. Shake the combined chloroformic solutions with 5 Cc. of diluted sulphuric acid, mixed with twice its volume of warm water; separate the chloroformic fluid and repeat the agitation with acidulated water. The mixed acid liquids are washed with 3 Cc. of chloroform, and then agitated with 10 Cc. of chloroform and an excess of ammonia-water. Separate the chloroformic solution and twice repeat the agitation with chloroform and the separation; wash the mixed chloroformic solutions with 5 Cc. of water containing 1 drop of ammonia-water; draw off the chloroformic layer into a tared dish and evaporate on a water-bath; finally dry the residue below 100° C. (212° F.) and weigh. Dissolve the residue in 10 Cc. of tenth-normal hydrochloric acid and add hundredth-normal sodium hydroxide solution until the liquid is neutral, using tincture of cochineal as indicator. Deduct the volume of sodium hydroxide solution thus required from 100 Cc., and multiply the remainder by 0.00287; the product will represent the weight of total alkaloids contained in the 10 Cc. of strong percolate used for the assay.

Since a fluidextract of belladonna leaves is occasionally employed, the above preparation should always be designated by the title of the U. S. P., given above. Care should be taken in the selection of belladonna root, which should not be woody. This fluidextract has a reddish-brown color.

The alcoholic strength of the menstruum is sufficient to exhaust the drug perfectly and yield a stable preparation, hence the addition of water is fully justified.

Uses.—This preparation is equally as efficient as the drug from which it is prepared. The dose is from 1 to 2 minims (0.05–0.10 Cc.).

FLUIDEXTRACTUM BERBERIDIS, *U. S.*—Fluidextract of Berberis.

Fluidextract of barberry, E.; *Extrait liquide de bérberide (d'épine-vinette)*, Fr.; *Flüssiges Berberitzenextrakt*, G.

Preparation.—Berberis, in No. 60 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol and pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol until the berberis is exhausted. Reserve the first 700 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of the menstruum, and the first 18 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Uses.—The properties of this preparation are fully described under BERBERIS (which see). Dose, 2 to 5 minims (0.10–0.3 Cc.).

FLUIDEXTRACTUM BUCHU, *U. S.*—Fluidextract of Buchu.

Extrait liquide de bucco, Fr.; *Flüssiges Buccoextrakt*, G.

Preparation.—Buchu, in No. 60 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol and 250 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the buchu is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of the menstruum (alcohol 3 volumes, water 1 volume), and the first 21 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The menstruum of fluidextract of buchu has again been changed to a mixture of alcohol and water, as it was in 1880, since this has been found to exhaust the drug equally well and the finished product keeps well. When made with the present menstruum, the fluidextract has about the same physical properties as that of the 1890 Pharmacopœia, as regards color, odor, and taste.

Uses.—This preparation exhibits the entire activity of buchu, but unless it is largely diluted with water is inferior to the infusion in the treatment of renal diseases. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM CALAMI, *U. S.*—Fluidextract of Calamus.

Extrait liquide d'acore vrai, Fr.; *Flüssiges Kalmusextrakt*, G.

Preparation.—Calamus, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 350 Cc. of the menstruum, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the calamus is exhausted.

Reserve the first 900 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of powdered calamus should be moistened with about 9 fluidounces of a mixture of alcohol 3 volumes, water 1 volume, and the first 22 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Made from peeled calamus, this fluidextract is of a brownish-yellow color, but if prepared from the unpeeled rhizome, which is directed to be used, it is of a considerably darker tint, the characteristic odor and taste being likewise more prominent. The reduction in alcoholic strength of the menstruum (the U. S. P. 1890 directed strong alcohol) is justified by experience, as it has been found that calamus can be completely exhausted by the present mixture of alcohol and water, the finished product keeping well. For preparing the powder the air-dry calamus should be dried over unslaked lime, but not by heat, which would expel much of the volatile oil. In view of the large intercellular passages contained in the tissue of calamus a powder passing through a No. 40 or even No. 30 sieve would seem to be sufficiently fine for ready extraction.

Extractum Calami, P. G.—*Extract of calamus*, E.; *Extrait d'acore vrai*, Fr.; *Kalmusextrakt*, G.—The German Pharmacopœia directs extract of calamus to be made by exhausting finely cut calamus with a mixture of alcohol 2 parts and water 3 parts by maceration, filtering the expressed liquid, and evaporating to the consistence of a thick extract. Extract of calamus is of a reddish-brown color, has the peculiar aromatic odor of the drug, and forms a turbid solution when mixed with water.

Uses.—The fluidextract may be used in all the cases for which calamus is appropriate. It is a convenient form of that drug. Dose, from 5 to 20 minims (0.3–1.3 Cc.).

FLUIDEXTRACTUM CALUMBÆ, *U. S.*—Fluidextract of Calumba.

Extrait liquide de colombo, Fr.; *Flüssiges Kolomboextrakt*, G.

Preparation.—Calumba, in No. 20 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 700 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the calumba is exhausted. Reserve the first 700 Cc. of the percolate; by means of a water-bath distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of the menstruum (alcohol 7 volumes, water 3 volumes) and the first 17½ fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The fluidextract is of a rich orange-brown color, and possesses a strongly bitter taste.

Solid extract of calumba is sometimes prescribed. It can be readily prepared by evaporating the fluidextract to a pilular consistence, in a porcelain capsule, on a water-bath.

Uses.—This preparation represents the bitter properties of the drug. Being one of the few which contains no tannic acid, it may be readily employed in conjunction with the various preparations of iron. The dose is from 10 minims to 1 fluidrachm (0.6–4 Cc.).

FLUIDEXTRACTUM CANNABIS INDICÆ, *U. S.*—Fluidextract of Indian Cannabis.

Extrait liquide de chanvre indien, Fr.; *Flüssiges Indisch-Hanfextrakt*, G.

Preparation.—Indian cannabis, in No. 30 powder, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 300 Cc. of alcohol and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the Indian cannabis is exhausted. Reserve the first 900 Cc. of the percolate; by means of a water-bath distil off the alcohol from the remainder and evaporate the residue, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve.

There is scarcely any necessity for this preparation, since the extract of Indian cannabis is readily soluble in alcohol. The fluidextract is of a dark-green color. If properly prepared it may be used for the extemporaneous preparation of the extract.

Uses.—This preparation is of variable strength and should always be physiologically tested before being used. When good it represents the virtues of the drug. The beginning dose is from ½ to 1 minim (0.025–0.05 Cc.), which amount may be gradually increased if necessary.

FLUIDEXTRACTUM CAPSICI, *U. S.*—Fluidextract of Capsicum.

Fluidextract of red pepper, E.; *Extrait liquide de capsique, de piment des jardins*, Fr.; *Flüssiges Spanisch-Pfefferextrakt*, G.

Preparation.—Capsicum, in No. 50 powder, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 500 Cc. of alcohol and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the capsicum is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of capsicum should be moistened with 12 fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve.

There is likewise little need for this preparation, the drug being already represented by the oleoresin and the tincture. The fluidextract is of a rich brown-red color, yields a turbid mixture with water, and has the burning taste of the drug.

Uses.—The dose is from 1 to 2 minims (0.05–0.10 Cc.).

FLUIDEXTRACTUM CHIMAPHILÆ, *U. S.*—Fluidextract of Chimaphila.

Fluidextract of pipsissewa, E.; *Extrait liquide de pyrole ombellée*, Fr.; *Flüssiges Doldenmangoldextrakt*, G.

Preparation.—Chimaphila, in No. 30 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol and pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the chimaphila is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of the menstruum, and the first 20 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Experience has shown that the addition of about 10 per cent. of glycerin improves the stability of the fluidextract; the same result might be obtained by using a mixture of alcohol 2 volumes and water 1 volume.

Uses.—The employment of this preparation is described under CHIMAPHILA. The fluidextract is thought by some to be less efficient than an infusion. The dose is from 30 to 60 minims (2–4 Cc.) several times daily.

FLUIDEXTRACTUM CHIRATÆ, *U. S.*—Fluidextract of Chirata.

Extrait liquide de chirette, Fr.; *Flüssiges Chirettaextrakt*, G.

Preparation.—Chirata, in No. 30 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the chirata is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of diluted alcohol, and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The fluidextract is reddish brown, and has the intensely bitter taste of the drug. The bitter principles of chirata being soluble in water, the present weaker menstruum is indicated for this drug. Although precipitation takes place after some time, the active principles are probably not affected thereby.

Uses.—Dose, 15 to 30 minims (1–2 Cc.).

FLUIDEXTRACTUM CIMICIFUGÆ, *U. S.*—Fluidextract of Cimicifuga.

Extractum Cimicifugæ Liquidum—Liquid Extract of Cimicifuga, Liquid Extract of Actæa racemosa, Br.—*Fluidextract of black cohosh*, E.; *Extrait liquide à grappes*, Fr.; *Flüssiges Cimicifugaextrakt*, G.

Preparation.—Cimicifuga, in No. 60 powder, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 250 Cc. of alcohol, and pack it in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the cimicifuga is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of cimicifuga should be moistened with 6 fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This has all the sensible properties of the drug from which it was made, and is a permanent preparation. That of the Br. P. is nearly identical with the foregoing, the menstruum being 90 per cent. alcohol.

Uses.—This is probably the best preparation of cimicifuga to employ, as it possesses all of the virtues of the drug. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM CINCHONÆ, *U. S.*—Fluidextract of Cinchona.

Extractum Cinchonæ Liquidum—Liquid Extract of Cinchona, Br.; *Extractum chinæ calisayæ fluidum.—Extrait liquide de quinquina jaune*, Fr.; *Flüssiges Chinaextrakt, Kalisayarindenextrakt*, G.

Preparation.—Cinchona, in No. 60 powder, 1000 Gm.; glycerin, 100 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 800 Cc. of alcohol and 100 Cc. of water. Moisten the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When

the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, and when the liquid in the percolator has disappeared from the surface gradually pour on a mixture of alcohol and water, made in the proportion of 800 Cc. of alcohol to 200 Cc. of water, and continue the percolation until the cinchona is exhausted. Reserve the first 700 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained, ascertain, by calculation, the amount of anhydrous ether-soluble alkaloids in the remainder of the liquid, and add to this sufficient of a mixture of alcohol and water, using the same proportions as before, to make each 100 Cc. of the fluidextract contain 4 Gm. of anhydrous ether-soluble alkaloids from cinchona.

Assay of Fluidextract of Cinchona.—Fluidextract of cinchona, 10 Cc.; normal sulphuric acid, ammonia-water, chloroform, ether having a specific gravity not above 0.720 at 25° C. (77° F.), each a sufficient quantity. Place 10 Cc. of fluidextract of cinchona into a flask or bottle and pour over it a mixture of 100 Cc. of ether, 25 Cc. of chloroform, and 10 Cc. of ammonia-water. Cork securely and shake vigorously for 10 minutes. Decant or pipette off 66 Cc., representing 5 Cc. of the fluidextract, into a measuring cylinder, and transfer to a separator, washing the cylinder out with 5 Cc. of ether, and adding this to the separator. Add to the latter about 10 Cc. of normal sulphuric acid, or sufficient to make the solution distinctly acid, and shake vigorously for several minutes. Draw off the lower layer into a second separator. To separator No. 1 add 5 Cc. more of normal sulphuric acid and 5 Cc. of distilled water, shake for several minutes, and when the liquids have separated draw off the lower layer into separator No. 2. Now add 5 Cc. of distilled water to separator No. 1, shake as before, and also draw off the lower aqueous layer into separator No. 2. To the contents of separator No. 2 add 25 Cc. of ether and a small piece of red litmus-paper. Then add, gradually, ammonia-water, keeping the temperature of the liquids below 25° C. (77° F.), until the reaction is alkaline. Then shake vigorously for 1 or 2 minutes, and let liquids separate for 10 minutes, at a temperature below 15° C. Draw off and discard the lower aqueous layer, and then transfer the ethereal layer into a tared beaker. Add 5 Cc. more of ether to the separator, rinse carefully, and add the rinsings to the tared beaker, and entirely evaporate the ether at a moderate heat on a water-bath. Then dry the beaker in an air-bath at 120° C. (248° F.) for 2 hours, and weigh, allowing to cool, preferably in a desiccator. Replace in the air-bath, and heat again for half an hour, cool, and weigh, repeating until the weight is constant. The weight of alkaloids so obtained multiplied by 20 gives the number of grammes of anhydrous ether-soluble alkaloids in 100 Cc. of the fluidextract.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of menstruum (alcohol 8 volumes, glycerin 1 volume, water 1 volume), and the first 20 fluidounces of percolate set aside as reserve; when 24 fluidounces of menstruum have been used, percolation is to be continued with a mixture of alcohol 8 volumes and water 2 volumes.

The Br. P. gives the following directions:

Macerate for 2 days red cinchona, in No. 60 powder, 20 ounces with water 100 ounces, glycerin 2½ fluidounces, and hydrochloric acid 5 fluidrachms; percolate, exhaust with water, evaporate below 82.2° C. (180° F.) to 20 fluidounces. After determining the alkaloidal strength of the liquid, every volume of it containing 5 Gm. of total alkaloids is first brought to 85 Cc. either by evaporation, or, if necessary, by dilution with distilled water; then a volume of 12.5 Cc. of 90 per cent. alcohol is to be added, and the final adjustment of the volume to 100 Cc. is to be made by addition of distilled water. The finished liquid extract will thus contain 5 Gm. of the total alkaloids of cinchona bark in every 100 Cc.

The assay of the liquid extract is directed to be carried out as follows: 5 Cc. of the liquid are put into a separator, together with 25 Cc. of water; 30 Cc. of benzolated amyl alcohol and 15 Cc. of solution of potassium hydroxide are then added, and the mixture thoroughly and repeatedly shaken; after complete separation of the liquids, draw off the alkaline aqueous fluid into another separator. To the contents of the second separator add 30 Cc. of benzolated amyl alcohol and agitate thoroughly; allow to separate; draw off and reject the lower layer, and add the alcoholic fluid to the contents of the first separator. Wash with a little water; add 30 Cc. of a warm mixture of 1 volume of diluted hydrochloric acid and 5 volumes of water, and agitate thoroughly; allow to separate; draw off the lower acid layer into a clean separator; agitate the alcoholic layer with a second quantity of 30 Cc.

of the mixture of acid and water; when separated, draw this off and add to the other acid liquid. To the mixture add 10 Cc. of chloroform and sufficient ammonia-water to impart a strongly alkaline reaction; shake thoroughly; allow to separate; draw off the lower chloroformic layer into a tared dish; repeat the agitation and separation with 2 successive portions of 10 Cc. of chloroform, and add the chloroformic liquids to the contents of the dish. Evaporate the chloroform slowly on a water-bath, dry the residue at a temperature of 110° C. (230° F.), and weigh.

The first formula is decidedly the better. Fluidextract of cinchona is of a rich, red-brown color, and if made from good bark contains all the alkaloids in their natural combination. Water alone will but partially exhaust cinchona bark, and during the long-continued evaporation a portion of the alkaloids will become insoluble through alteration of the tannin. On the other hand, a stronger alcohol will dissolve more cinchonic red, but secure the more thorough exhaustion of the alkaloids.

Uses.—This preparation may be employed as a tonic in doses of from ½ to 1 fluidrachm (2–4 Cc.). It is probably superior to any one of the various alkaloids contained in the bark, but because of the large doses which would be required it is rarely used in the treatment of severe malarial fevers.

FLUIDEXTRACTUM COCÆ, *U. S.*—Fluidextract of Coca.

Extractum Cocæ Liquidum—Liquid Extract of Coca, Br.; *Extractum erythroxyli fluidum*, U. S., 1880.—*Fluidextract of erythroxylon*, E.; *Extrait liquide de coca*, Fr.; *Flüssiges Cocaextrakt*, G.

Preparation.—Coca, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 450 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the coca is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of ether-soluble alkaloids in the remainder of the liquid, and add to this sufficient diluted alcohol to make each 100 Cc. of the fluidextract contain 0.5 Gm. of ether-soluble alkaloids from coca.

Assay of Fluidextract of Coca.—Fluidextract of coca, 10 Cc.; ammonia-water, ether, distilled water, normal sulphuric acid, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, hematoxylin or iodeosin test-solution, each a sufficient quantity. Measure 10 Cc. of fluidextract of coca into a separator, add 25 Cc. of ether, and then 2 Cc. of ammonia-water, shaking together for several minutes. When the fluids have separated, draw off the lower aqueous layer into a second separator, and to this second separator add 20 Cc. more of ether, and repeat the shaking for a minute. Draw off and reject the lower aqueous layer from the second separator, and add the ethereal layer to the first separator. To this separator now add 5 Cc. of normal sulphuric acid and 5 Cc. of distilled water, shaking well for a minute or two. After the liquids have separated, draw off the lower aqueous layer into a clean separator, and repeat the extraction in the first separator with 9 Cc. of distilled water and 1 Cc. of normal sulphuric acid, shaking for a minute. Add the aqueous solution to the other separator, and reject the ether. Now add to the acid liquid 20 Cc. of ether and sufficient ammonia-water to make it distinctly alkaline, and shake for a minute or two. Draw off the separated aqueous layer into another separator and the ethereal layer into a beaker. Repeat the extraction of the aqueous layer in the other separator with 10 Cc. and again with 10 Cc. of ether, and add the resulting ethereal extracts to the beaker. Now evaporate off the ether from the beaker spontaneously, and when dry add to it 5 Cc. of tenth-normal sulphuric acid, and stir until the alkaloids are all dissolved. Then add 5 drops of hematoxylin or iodeosin test-solution, and titrate the excess of acid with fiftieth-normal potassium hydroxide solution. Divide the number of Cc. of fiftieth-normal potassium-hydroxide solution used by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid used), and multiply the remainder by 0.03, and this product by 10 (or multiply at once by 0.3), to obtain the weight in grammes of ether-soluble alkaloids contained in 100 Cc. of the fluidextract of coca.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10¼ fluidounces of menstruum, and the first 19½ fluidounces of percolate set aside as reserve.

The liquid extract of coca of the Br. P. is made in a very similar manner to the above, 60 per cent. alcohol being directed as the menstruum. No requirement for definite alkaloidal content, however, is made.

Fluidextract of coca is of a deep-brown or olive-brown color, has a pleasant tea-like odor, and the bitter astringent and slightly aromatic taste of the leaves.

Uses.—This is an excellent preparation of coca, and is largely employed in doses of from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM COLCHICI SEMINIS, *U. S.*—Fluidextract of Colchicum Seed.

Extrait liquide de semence de colchique, Fr.; *Flüssiges Zeitlosensamenextrakt*, G.

Preparation.—Colchicum seed, in No. 50 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the colchicum seed is exhausted. Reserve the first 750 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of colchicine in the remainder of the liquid, and add to this enough menstruum to make each 100 Cc. of the fluidextract contain 0.5 Gm. of colchicine.

Assay of Fluidextract of Colchicum Seed.—Fluidextract of colchicum seed, 10 Cc.; ether, chloroform, alcohol, ammonia-water, normal sulphuric acid, distilled water, each a sufficient quantity. Measure into a separator 10 Cc. of fluidextract of colchicum seed, add 1 Cc. of ammonia-water, and shake out the alkaloid with 3 successive portions, 15, 15, and 10 Cc. of chloroform. Collect the chloroformic solutions in a beaker or dish, and evaporate it nearly to dryness by applying a very gentle heat. Dissolve the residue in 10 Cc. of ether, add 5 Cc. of water, stir well, and heat gently until the ether is evaporated. After cooling, filter the aqueous solution into a small separator, retaining the insoluble matter as much as possible in the beaker or dish. Redissolve the residue in a little ether, add 5 Cc. of water, and proceed as before. Wash the container, and filter with a little water, and shake the aqueous solution well for 1 minute with 15 Cc. of chloroform. Draw off the chloroform, after perfect separation, into a tared flask, and again shake out the aqueous liquid, successively, with three portions of 10 Cc. each of chloroform, collecting these solutions in the tared flask. Evaporate the chloroferm completely; dissolve the residue in a little alcohol, evaporate the latter, redissolve it in alcohol, evaporate the alcohol as before, and dry the residue at 100° C. (212° F.) until the weight, after cooling in a desiccator, remains constant. Multiply the weight of the residue by 10 to obtain the weight, in grammes, of colchicine contained in one hundred cubic centimetres of the fluidextract of colchicum seed.—U. S.

25 avoirdupois ounces of the powdered seed should be moistened with about 7½ fluidounces of menstruum (alcohol 2 volumes, water 1 volume), and the first 18 fluidounces of percolate set aside as reserve.

Uses.—The fluidextract of the root is probably more efficient than that prepared from the seed, but they may be used interchangeably. Dose, from 2 to 8 minims (0.10–0.50 Cc.).

FLUIDEXTRACTUM CONDURANGO.—Fluidextract of Condurango.

Extractum Condurango fluidum, P. G.—*Extrait liquide de condurango*, Fr.; *Flüssiges Condurangoextrakt*, G.

Preparation.—Condurango bark, in No. 25 powder, 100 parts; glycerin, $6\frac{2}{3}$ parts; alcohol, water, each a sufficient quantity to make 100 parts. Mix the glycerin with $66\frac{2}{3}$ parts of alcohol and $26\frac{2}{3}$ parts of water, and, having moistened the powder thoroughly with sufficient of the menstruum, set the mixture aside in a closed vessel for 2 or 3 hours. Transfer to a percolator, pack firmly, and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours at a temperature of 15°–20° C. (59°–68° F.). Allow percolation to proceed at the rate of 15–20 drops per minute, pouring on menstruum composed of alcohol 1 part, water 3 parts, until the drug is exhausted. Reserve the first 85 parts; evaporate the remainder of the percolate to a syrupy consistence, and add sufficient menstruum to make 15 parts. Mix the two liquids, and set aside for 2 or 3 days, then filter.—P. G.

Fluidextract of condurango is of brown color and has the specific gravity 1.038–1.040, yielding from 16–20 per cent. of extractive.

It should be borne in mind that all liquid preparations of the German Pharmacopœia are made by weight.

Uses.—This is probably the best preparation of condurango to employ. The dose is from 1 to 2 fluidrachms (4–8 Cc.).

FLUIDEXTRACTUM CONII, *U. S.*—Fluidextract of Conium.

Extractum conii fructus fluidum.—Fluidextract of hemlock fruit, of conium seed, E.; *Extrait liquide de semence (fruit) de ciguë*, Fr.; *Flüssiges Schierlingsfruchtextrakt*, G.

Preparation.—Conium, in No. 40 powder, 1000 Gm.; acetic acid, 20 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Mix the acetic acid with 980 Cc. of diluted alcohol, and, having moistened the powder with 300 Cc. of the menstruum, pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the conium is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder in a porcelain capsule, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of coniine in the remainder of the liquid, and add to this sufficient diluted alcohol to make each 100 Cc. of the fluidextract contain 0.45 Gm. of coniine.

Assay of Fluidextract of Conium.—Fluidextract of conium, 10 Cc.; ether, alcohol, ammonia-water, normal sulphuric acid, sodium carbonate test-solution, hydrochloric acid (5 per cent.), distilled water, of each a sufficient quantity. Transfer 10 Cc. of fluidextract of conium to an evaporating dish containing a little clean sand, and evaporate it to dryness by means of a water-bath. Mix the sand uniformly with the extract and transfer it to an Erlenmeyer flask of about 250 Cc. capacity, rinsing the dish with 100 Cc. of a mixture of ether 320 Cc., alcohol 25 Cc., and ammonia-water 10 Cc., added in portions, and transfer the rinsings to the flask. Insert the stopper securely and shake the flask at intervals during 1 hour. Decant 50 Cc. of the liquid (representing 5 Cc. of the fluidextract) into a beaker, and add sufficient normal sulphuric acid to produce a distinctly acid reaction. Evaporate the ether at a gentle heat by aid of a water-bath; then add 15 Cc. of absolute alcohol, and set the beaker aside in a cool place for 2 hours to allow the ammonium sulphate to deposit. Filter the liquid; wash the residue and filter with a little absolute alcohol, and add the washings to the filtrate; neutralize any excessive amount of acid with sodium carbonate test-solution, being careful to retain a slight acidity. Concentrate the liquid to 3 Cc. by the aid of a gentle heat on a water-bath, add 3 Cc. of distilled water and 2 drops of normal sulphuric acid. Add 15 Cc. of ether to remove traces of fatty matter, pour off the ether solution, and repeat the washing. Then transfer the acid liquid to a separator, introduce a small piece of red litmus-paper, and add sufficient sodium carbonate test-solution to render the liquid slightly alkaline; then shake out with sucessive portions of 15, 10, and 10 Cc. of ether. To the combined ether-solutions

in a tared beaker add, drop by drop, sufficient hydrochloric acid (5 per cent.) to insure an excess of acid, and then evaporate the ether by means of a gentle heat on a water-bath. Remove the excess of hydrochloric acid by adding to the residue 3 Cc. of alcohol and heating gently to evaporate the liquid, repeat this operation once, and dry the residue at a temperature not exceeding 60° C. (140° F.) until the weight remains constant after cooling. Multiply the weight of the residue by 0.777 and then by 20 (or at once by 15.54), to obtain the weight in grammes of coniine contained in 100 Cc. of the fluidextract of conium.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of the menstruum (diluted alcohol 49 volumes acetic acid 1 volume); after 24 fluidounces of menstruum have been used, percolation is to be continued with diluted alcohol, and the first 22 fluidounces of percolate set aside as reserve.

A fluidextract, prepared from the fully developed green fruit of conium, is preferable to that from the leaves. The acetic acid is added for the purpose of preventing evaporation of the readily volatile coniine. The fluidextract keeps well, is of a brown-green color, and has the peculiar odor of conium, which is considerably increased on the addition of potassium hydroxide.

Solid extract of conium may be readily prepared by evaporating a convenient quantity of the fluidextract to a pilular consistence, in a porcelain capsule on a water-bath, at a temperature not exceeding 50° C. (122° F.).

Uses.—The fluidextract is a convenient form and, next to the juice, the most reliable for the administration of conium. Dose, 2 to 5 minims (0.10–0.30 Cc.).

FLUIDEXTRACTUM CONVALLARIÆ, *U. S.*—Fluidextract of Convallaria.

Fluidextract of lily of the valley, E.; *Extrait liquide de muguet*, Fr.; *Flüssiges Maiblumenwurzelextrakt*, G.

Preparation.—Convallaria, in No. 60 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 650 Cc. of alcohol with 350 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the convallaria is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces should be moistened with about 10 fluidounces of the menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Experience has shown that the fluidextract, when made with a somewhat stronger alcoholic menstruum, keeps better than as formerly made with diluted alcohol.

Uses.—This preparation is the one most commonly employed. For its medicinal properties, see CONVALLARIA. The dose is from 3 to 15 minims (0.20–1 Cc.).

FLUIDEXTRACTUM CUBEBÆ, *U. S.*—Fluidextract of Cubeb.

Extrait liquide de cubèbe, Fr.; *Flüssiges Kubebenextrakt*, G.

Preparation.—Cubeb, in No. 40 powder, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 250 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the cubeb is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of powdered cubeb should be moistened with about 6 fluidounces of the menstruum, and the first 22 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This fluidextract should not be confounded with the oleoresin of the same drug,

which was formerly recognized as fluidextract; it contains the medicinally active resin, together with most of the volatile oil, is of a dark-green color, and has the odor and taste of cubeb.

Uses.—This preparation is less efficacious than the powdered drug, but it may be employed when the drug is indicated. The dose is from 15 to 40 minims (1–2.6 Cc.).

FLUIDEXTRACTUM CYPRIPEDII, *U. S.*—Fluidextract of Cypripedium.

Fluidextract of ladies' slipper, E.; *Extrait liquide de cypripède de jaune*, Fr.; *Flüssiges Gelbfrauenschuhextrakt*, G.

Preparation.—Cypripedium, in No. 60 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the cypripedium is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of menstruum, and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Experience has taught that a mixture of alcohol 2 volumes, water 1 volume, will yield better results than either alcohol or diluted alcohol.

Fluidextract of cypripedium is of a reddish-brown color, with the taste of the drug well marked.

Uses.—Dose, 5 to 15 minims (0.3–1 Cc.).

FLUIDEXTRACTUM DIGITALIS, *U. S.*—Fluidextract of Digitalis.

Extrait liquide de digitale, Fr.; *Flüssiges Digitalisextrakt*, G.

Preparation.—Digitalis, in No. 60 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the digitalis is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of digitalis should be moistened with about 10 fluidounces of diluted alcohol, and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The fluidextract is of a green-brown color, and a fair representative of digitalis; the precipitate which is formed on standing probably retains little or none of the active principles of the leaves. Diluted alcohol exhausts the drug thoroughly, the finished preparation keeping as well as when made with the stronger alcoholic menstruum of 1890.

Uses.—The fluidextract has no marked advantages over the tincture, which is commonly employed. The dose is from 1 to 2 minims (0.05–0.10 Cc.).

FLUIDEXTRACTUM ERGOTÆ, *U. S.*—Fluidextract of Ergot.

Extractum ergotæ liquidum—Liquid Extract of Ergot, Br.—*Extractum secalis cornuti fluidum*, P. G.—*Extrait liquide d'ergot de seigle*, Fr.; *Flüssiges Mutterkornextrakt*, G.

Preparation.—Ergot, recently ground and in No. 60 powder, 1000 Gm.; acetic acid, 20 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Mix the acetic acid with 980 Cc. of diluted alcohol, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the mixture to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator,

macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the ergot is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder in a porcelain capsule, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of the menstruum (diluted alcohol 49 volumes, acetic acid 1 volume), and the first 21 fluidounces of percolate set aside as reserve; when 24 fluidounces of the menstruum have been used, percolation is to be continued with diluted alcohol. The final volume of the finished product should be made up to 24 fluidounces.

The corresponding preparation of the Br. P. is equally efficient. The following is the formula: Take of ergot, crushed, 20 ounces; distilled water, 7½ pints (Imperial); alcohol (90 per cent.), 7½ fluidounces. Digest the ergot in 5 pints of the water for 12 hours; draw off the infusion and repeat the digestion with the remainder of the water; press out, strain, and evaporate the liquids by the heat of a water-bath to 14 fluidounces; when cold add the alcohol; allow to stand for an hour, then filter. The product should measure 20 fluidounces.—Br.

The P. G. directs that 100 parts of ergot shall be exhausted with a menstruum composed of 1 part of alcohol and 4 parts of water (both by weight); the first 85 parts of percolate are set aside as reserve and the weak percolate, after addition of 2.4 parts of 25 per cent. hydrochloric acid, is evaporated to a syrup, mixed with sufficient menstruum to make 15 parts, and then added to the reserve tincture.

The large quantity of fixed oil present in ergot is liable to be displaced by percolation with an alcoholic menstruum, but not with water. None of the pharmacopœias direct the removal of the oil; this may be accomplished by exhausting the ergot with ether or petroleum benzin.

Uses.—The uses of fluidextract of ergot are fully described under ERGOTA (which see). It is probably the best preparation of the drug for internal administration. The dose is from ½ to 2 fluidrachms (2–8 Cc.).

FLUIDEXTRACTUM ERIODICTYI, *U. S.*—Fluidextract of Eriodictyon.

Fluidextract of yerba santa, E.; *Extrait liquide d'eriodictyon*, Fr.; *Flüssiges Eriodictyonextrakt*, G.

Preparation.—Eriodictyon, in No. 60 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the eriodictyon is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of the menstruum (alcohol 4 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Fluidextract of yerba santa is of a deep brownish-green color, pleasantly aromatic odor, and a slightly astringent not disagreeable taste; the menstruum perfectly exhausts the drug and yields a stable preparation.

Uses.—This preparation is employed chiefly for the purpose of disguising the bitter taste of quinine. It may be given in doses of from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM EUCALYPTI, *U. S.*—Fluidextract of Eucalyptus.

Extrait liquide d'eucalyptus, Fr.; *Flüssiges Eukalyptusextrakt*, G.

Preparation.—Eucalyptus, in No. 40 powder, 1000 Gm.; alcohol, water, of each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water,

and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the eucalyptus is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of eucalyptus should be moistened with about 10 fluidounces of the menstruum (alcohol 3 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Uses.—This forms an efficient method for the administration of the drug. The dose is from 5 to 15 minims (0.3–1 Cc.).

FLUIDEXTRACTUM EUONYMI, *U. S.*—Fluidextract of Euonymus.

Fluidextract of wahoo, E.; *Extrait liquide d'écorce de fusain*, Fr.; *Flüssiges Spillbaumrindenextrakt*, G.

Preparation.—Euonymus, in No. 40 powder, 1000 Gm.; alcohol, water, of each a sufficient quantity to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of alcohol and water as before, until the euonymus is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the powdered drug should be moistened with 9 fluidounces of the menstruum (alcohol 4 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluidextract of euonymus is one of the newly introduced preparations of the Pharmacopœia. It has a brown color and a bitter taste. Since the active virtues of the drug reside in the resinous constituents, the menstruum must necessarily be strongly alcoholic, although a somewhat weaker alcohol will also exhaust the drug perfectly. The preparation is chiefly intended for the preparation of the powdered extract.

Uses.—Dose, 1 to 2 drachms (4–8 Cc.).

FLUIDEXTRACTUM EUPATORII, *U. S.*—Fluidextract of Eupatorium.

Fluidextract of boneset.—Fluidextract of thoroughwort, E.; *Extrait liquide d'eupatoire perfoliée*, Fr.; *Flüssiges Durchwachsdostenextrakt*, G.

Preparation.—Eupatorium, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the eupatorium is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of diluted alcohol, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This fluidextract is of a dark-greenish or brown-red color, and represents the virtues of the drug.

Uses.—The tonic properties of eupatorium are well represented in 1-fluidrachm (4 Cc.) doses of this preparation.

FLUIDEXTRACTUM FRANGULÆ, *U. S.*—Fluidextract of Frangula.

Extractum frangulæ fluidum, P. G.; *Extrait liquide d'écorce de bourdaine*, Fr.; *Flüssiges Faulbaumrindenextrakt*, G.

Preparation.—Frangula, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 500 Cc. of alcohol with 800 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the frangula is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of menstruum (alcohol 5 volumes, water 8 volumes), and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The P. G. directs a menstruum of 3 parts of alcohol and 7 parts of water. both by weight.

The fluidextract has a dark brown-red color and sweetish bitter taste.

Uses.—This is an active preparation of the drug. The dose is from 10 to 30 minims (0.6–2 Cc.).

FLUIDEXTRACTUM GELSEMII, *U. S.*—Fluidextract of Gelsemium.

Extrait liquide de gelsemium, Fr.; *Flüssiges Gelsemiumextrakt*, G.

Preparation.—Gelsemium, in No. 60 powder, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 300 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the gelsemium is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Alcohol is well adapted for exhausting gelsemium. The fluidextract has a deep red-brown color and the strong odor and bitter taste of the drug.

Uses.—This preparation is rarely employed at the present time. Its uses are fully described under the drug. The dose is from 1 to 3 minims (0.05–0.20 Cc.).

FLUIDEXTRACTUM GENTIANÆ, *U. S.*—Fluidextract of Gentian.

Extrait liquide de gentiane, Fr.; *Flüssiges Enzianextrakt*, G.

Preparation.—Gentian, in No. 30 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the gentian is exhausted. Reserve the first 800 Cc. of the percolate. By means of a water-bath distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of gentian should be moistened with about 9 fluidounces of

menstruum, and the first 19½ fluidounces of percolate set aside as a reserve; the final volume of the finished product should be made up to 24 fluidounces. The bitter principle of gentian is perfectly soluble in water, but a certain amount of alcohol is necessary for preventing fermentation.

Uses.—Fluidextract of gentian is employed as a stomachic and simple bitter tonic. The preparation is usually given in conjunction with other remedies having a similar action. The dose is from 10 to 30 minims (0.6–2 Cc.).

FLUIDEXTRACTUM GERANII, *U. S.*—Fluidextract of Geranium.

Extrait liquide de géranium maculé, Fr.; *Flüssiges Fleckstorchschnabelextrakt*, G.

Preparation.—Geranium, in No. 30 powder, 1000 Gm.; glycerin, 100 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 600 Cc. of alcohol and 300 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water made in the proportion of 6 volumes of alcohol and 4 volumes of water, until the geranium is exhausted. Reserve the first 750 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of the menstruum (alcohol 15 fluidounces, water 7½ fluidounces, glycerin 2½ fluidounces), and the first 17½ fluidounces of percolate set aside as reserve; after the 25 fluidounces of menstruum have been used, percolation is to be continued with a mixture of alcohol 6 volumes and water 4 volumes. The final volume of the finished product is to be made up to 24 fluidounces.

The increase of alcohol in the menstruum for fluidextract of geranium is a decided improvement, and has been found to preserve the finished product better than diluted alcohol, formerly used. The tendency to partial gelatinization has been materially lessened. The fluidextract is of dark reddish-brown color and has a strongly astringent taste.

Uses.—Because of its astringency, fluidextract of geranium may be employed with success in the treatment of serous diarrhœas. The adult dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM GLYCYRRHIZÆ, *U. S.*—Fluidextract of Glycyrrhiza.

Extractum glycyrrhizæ liquidum—Liquid Extract of Liquorice, Br.—*Fluidextract of licorice or liquorice*, E.; *Extrait liquide de réglisse*, Fr.; *Flüssiges Sussholzwurzelextrakt*, G.

Preparation.—Glycyrrhiza, in No. 20 powder, 1000 Gm.; glycerin, 250 Cc.; ammonia-water, 50 Cc.; alcohol, water, of each a sufficient quantity to make 1000 Cc. Pour 400 Cc. of boiling water upon the glycyrrhiza, contained in a suitable vessel, and allow it to stand for 1 hour. Pack the moistened powder loosely in a metallic percolator, pour boiling water upon it, and allow the percolation to proceed, supplying boiling water until the glycyrrhiza is exhausted. Evaporate the percolate at a moderate heat until it measures 450 Cc., and, when cool, add 450 Cc. of alcohol, mix well, and set it aside for 3 days. After filtering the liquid, distil it until 500 Cc. of distillate have been obtained; transfer the liquid in the still to a glass or porcelain vessel, add the glycerin, ammonia-water, and 200 Cc. of alcohol. Finally, add sufficient water to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the powdered drug should be moistened with 10 fluidounces of boiling water, macerated for 1 hour, and then percolated to exhaustion with boiling water. After evaporation of the percolate to 11¼ fluidounces, an equal volume of alcohol is added, and the mixture set aside for 3 days. The mixture is filtered and distilled until 12½ fluidounces of distillate have been obtained. To the residue, 6 fluidounces of glycerin, 1¼ fluidounces of ammonia-water, and 5 fluidounces of alcohol are added, and, finally, sufficient water to bring the volume of the finished product up to 24 fluidounces.

The Br. P. directs the exhaustion of the licorice root with 2 successive portions of cold water, using each time 50 fluidounces for 20 ounces of the drug, and allowing the mixture to macerate for 24 hours before expressing. The mixed infusions are heated to 100 C. (212 F.), strained through flannel, and evaporated until the liquid has acquired, when cold, a specific gravity of 1.200; ¼ of its volume of alcohol is now added and the mixture is set aside for 12 hours, after which it is filtered.

Fluidextract of licorice has a yellowish-brown color and should have a pure sweet taste free from acridity. It is not at all likely that in the British process the drug will be completely exhausted by treatment twice with cold water and subsequent expression.

Uses.—Fluidextract of licorice is employed almost exclusively as a vehicle for disguising the taste of bitter drugs. It increases the secretion of the salivary glands and acts also as a mild laxative. The dose is from 1 to 2 fluidrachms (4–8 Cc.).

FLUIDEXTRACTUM GRANATI, *U. S.*—Fluidextract of Granatum.

Fluidextract of pomegranate-root bark, E.; *Extrait liquide d'écorce de grenadier, Extrait liquide d'écorce de balaustier*, Fr.; *Flüssiges Granatwurzelrindenextrakt*, G.

Preparation.—Granatum, in No. 30 powder, 1000 Gm.; glycerin, 100 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Mix the glycerin with 900 Cc. of diluted alcohol, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the granatum is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the powdered drug should be moistened with about 10 fluidounces of a mixture of glycerin 2½ fluidounces and diluted alcohol 21½ fluidounces; subsequent percolation is to be continued with diluted alcohol. The first 20 fluidounces of percolate are to be set aside as reserve and the final volume of finished product brought up to 24 fluidounces.

Fluidextract of pomegranate bark is of a greenish-brown color and has a slightly astringent taste, but no decided odor. The menstruum directed is capable of exhausting the drug perfectly and the finished preparation keeps well.

Uses.—The employment of this preparation is fully described under GRANATUM (which see). The dose is from 20 to 30 minims (1.3–2 Cc.).

FLUIDEXTRACTUM GRINDELIÆ, *U. S.*—Fluidextract of Grindelia.

Extrait liquide de grindélia, Fr.; *Flüssiges Grindelienextrakt*, G.

Preparation.—Grindelia, in No. 30 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the grindelia is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of a mixture of 24 volumes of alcohol and 8 volumes of water, and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

This fluidextract is of a brown-green color. The official menstruum has been changed to a somewhat weaker alcohol, as it has been found that the latter exhausts the drug thoroughly, and that the finished product keeps as well as when made with alcohol alone. The active principles are, most likely, volatile oil and resin.

Uses.—This is an efficacious preparation of grindelia. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM GUARANÆ, *U. S.*—Fluidextract of Guarana.

Extrait liquide de guarana, Fr.; *Flüssiges Guaranaextrakt*, G.

Preparation.—Guarana, in No. 60 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 200 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the guarana is exhausted. Reserve the first 700 Cc. of the percolate. By means of a water-bath distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 6 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of alkaloids contained in the remainder of the liquid; add to this sufficient diluted alcohol to make each 100 Cc. of the finished fluidextract contain 3.5 Gm. of the alkaloids from guarana.

Assay of Fluidextract of Guarana.—Guarana, 5 Cc.; chloroform, ether, ammonia-water, normal sulphuric acid, distilled water, each a sufficient quantity. Transfer to a separator 5 Cc. of fluidextract of guarana, add 15 Cc. of chloroform and 1 Cc. of ammonia-water. Shake well and allow the liquids to separate completely. Draw off the chloroform into a beaker. Shake out the fluid remaining in the separator with two additional portions of chloroform of 10 Cc. each, evaporate the combined chloroformic solutions carefully to dryness. Dissolve the alkaloidal residue in 20 Cc. of warm distilled water. Allow it to cool, and filter the solution into a separator, rinse the flask and filter with distilled water, adding the rinsings to the separator, then add 10 Cc. of chloroform, and shake the separator for 1 minute. Draw off the chloroform into a tared flask, and repeat the extraction with 10 Cc. of chloroform, adding this to the tared flask. Distil off the chloroform, and, when dry, add 2 Cc. of ether, and evaporate this very carefully with the aid of a water-bath (to avoid decrepitation). Dry the residue to a constant weight on the water-bath. Multiply the weight by 20, which will give the weight in grammes of alkaloids contained in 100 Cc. of fluidextract of guarana.—U. S.

25 avoirdupois ounces of guarana should be moistened with about 5 fluidounces of diluted alcohol, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluidextract of guarana has been in use for a number of years, but in the endeavor to obtain it as little alcoholic as possible many of the preparations formerly used gradually formed heavy deposits. Experience has shown that the present official menstruum yields very satisfactory results. The fluidextract is of a deep red-brown color and has an astringent and bitter taste.

Uses.—This is probably the best preparation of guarana to employ. The dose is from ½ to 2 fluidrachms (2–8 Cc.).

FLUIDEXTRACTUM HAMAMELIDIS FOLIORUM, *U. S.*—Fluidextract of Hamamelis Leaves.

Extractum Hamamelidis Liquidum—Liquid Extract of Hamamelis, Br.—*Fluidextract of witch-hazel leaves*, E.; *Extrait liquide de hamamélis*, Fr.; *Flüssiges Hamamelisextrakt*, G.

Preparation.—Hamamelis, in No. 40 powder, 1000 Gm.; glycerin, 100 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 300 Cc. of alcohol and 600 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then a mixture of alcohol and water, made in the proportion of 300 Cc. of alcohol to 600 Cc. of water, until the hamamelis is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract;

dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of menstruum, composed of alcohol 7½ fluidounces, water 15 fluidounces, glycerin 2½ fluidounces, and the first 21 fluidounces of percolate set aside as reserve. Subsequent percolation is to be continued with a mixture of alcohol 3 volumes and water 6 volumes, and the final volume of finished product should be made up to 24 fluidounces.

The Br. P. directs a menstruum of 45 per cent. alcohol to be used for exhausting the leaves.

The fluidextract is of a brown color, and has the astringent and bitter taste of the leaves. The substitution of glycerin for a portion of the water yields a more permanent preparation.

Uses.—The use of this remedy is outlined under HAMAMELIDIS FOLIA (which see). The dose is from 10 to 30 minims (0.6-2 Cc.).

FLUIDEXTRACTUM HYDRASTIS, *U. S.*—Fluidextract of Hydrastis.

Extractum hydrastis liquidum—Liquid Extract of Hydrastis, Br.; *Extractum hydrastis fluidum,* P. G.—*Fluidextract of golden seal,* E.; *Extrait liquide de hydrastis,* Fr.; *Flüssiges Hydrastisextrakt,* G.; *Estratto di idraste liquido,* It.

Preparation.—Hydrastis, in No. 60 powder, 1000 Gm.; glycerin, 100 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 600 Cc. of alcohol and 300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then a mixture of alcohol and water, made in the proportion of 600 Cc. of alcohol to 300 Cc. of water, until the hydrastis is exhausted. Reserve the first 850 Cc. of the percolate. By means of a water-bath distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of hydrastine in the remainder of the liquid; add to this sufficient menstruum to make each 100 Cc. of the finished fluidextract contain 2 Gm. of hydrastine.

Assay of Fluidextract of Hydrastis.—Fluidextract of hydrastis, 10 Cc.; distilled water, potassium iodide, ammonia-water, ether, each a sufficient quantity. Measure 10 Cc. of the fluidextract into a 100 Cc. measuring flask, and add to it 85 Cc. of distilled water and 2 Gm. of potassium iodide; when this has dissolved, add sufficient water to make 100 Cc. and shake for several minutes. Then filter off 50 Cc. of the liquid into a separator. Render the liquid alkaline with ammonia, add 30 Cc. of ether, and shake at intervals during several minutes. Draw off the aqueous layer into a beaker, and then the ethereal portion into another tared beaker. Return the aqueous solution from the beaker to the separator, and shake it with 20 Cc. more of ether for a minute. Draw off and reject the aqueous layer, and then draw off the ethereal layer into the tared beaker. Allow the ether to evaporate at a gentle heat, dry the residue in the beaker to constant weight on a water-bath, and then weigh. The weight obtained, multiplied by 20, gives the weight in grammes of hydrastine contained in 100 Cc. of fluidextract of hydrastis.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of menstruum, composed of alcohol 14½ fluidounces, water 7¼ fluidounces, glycerin 2½ fluidounces, and the first 21 fluidounces of percolate set aside as reserve. Subsequent percolation is to be continued with a mixture of alcohol 2 volumes, water 1 volume.

The use of glycerin in the official menstruum is of decided advantage, and adds to the permanency of the preparation.

The liquid extract of the Br. P. is prepared with 45 per cent. alcohol. The P. G. directs the extraction of hydrastis with a mixture of 7 parts of alcohol and 3 parts of water, both by weight.

Fluidextract of hydrastis has a deep brown-yellow color and the strongly bitter taste of the root.

Uses.—The fluidextract forms a convenient method for administering the drug. The dose is from ½ to 2 fluidrachms (2–8 Cc.).

FLUIDEXTRACTUM HYOSCYAMI, *U. S.*—Fluidextract of Hyoscyamus.

Extrait liquide de jusquiame, Fr.; *Flüssiges Bilsenkrautextrakt*, G.

Preparation.—Hyoscyamus, in No. 60 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 2000 Cc. of alcohol with 1000 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the hyoscyamus is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 20 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of alkaloids in the remainder of the liquid; add to this sufficient menstruum to make each 100 Cc. of the finished fluidextract contain 0.075 Gm. of alkaloids from hyoscyamus.

Assay of Fluidextract of Hyoscyamus.—The method to be employed is identical with that given for the assay of fluidextract of belladonna root, using, however, 50 Cc. of fluidextract of hyoscyamus instead of the quantity of fluidextract of belladonna root directed, and multiplying the product obtained by titration by 2 instead of 10, to get the number of grammes of mydriatic alkaloids contained in 100 Cc. of fluidextract of hyoscyamus.—U. S.

The larger quantity of fluidextract of hyoscyamus directed for the assay is necessary because the drug contains very much less alkaloid than belladonna. The coloring-matter present is apt to interfere somewhat with observation of the line of separation between the aqueous and chloroformic liquids, and some little practice is necessary for successful work.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of menstruum (alcohol 2 volumes, water 1 volume), and the first 20 fluidounces of percolate set aside as reserve.

The fluidextract is of a deep green-brown color, has the heavy odor of the drug, and keeps well.

Uses.—The employment of this remedy is described under HYOSCYAMUS (which see). The dose is from 5 to 10 minims (0.3–0.6 Cc.).

FLUIDEXTRACTUM IPECACUANHÆ, *U. S.*—Fluidextract of Ipecac.

Extractum Ipecacuanhæ Liquidum—Liquid Extract of Ipecacuanha, Br.—*Extrait liquide d'ipécacuanha*, Fr.; *Flüssiges Ipecacuanhaextrakt*, G.

Preparation.—Ipecac, in No. 80 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the ipecac is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of alkaloids in the remainder of the liquid; to this add sufficient menstruum to make each 100 Cc. of the finished fluidextract contain 1.75 Gm. of alkaloids from ipecac.

Assay of Fluidextract of Ipecac.—Fluidextract of ipecac, 10 Cc.; normal sulphuric acid, ammonia-water, ether, tenth-normal sulphuric acid, fiftieth-normal potassium hydrox-

ide solution, hematoxylin test-solution, each a sufficient quantity. Measure 10 Cc. of fluidextract of ipecac in a graduated pipette, and transfer it to a porcelain evaporating dish. Evaporate off all the alcohol on a water-bath, and when almost cool add 5 Cc. of normal sulphuric acid, and stir until all the alkaloids have been dissolved. Filter into a separator, rinse the dish, and wash the filter successively with 10 Cc. and 5 Cc. of distilled water, and add these liquids to the separator. To the separator add 20 Cc. of ether and a small piece of red litmus-paper; render the liquid alkaline with ammonia-water, and shake for a minute. Draw off the lower aqueous layer into a beaker, and the ethereal layer into another beaker. Return the aqueous solution to the separator, and shake with 10 Cc. more of ether, adding the ethereal solution to that already in the beaker. After again returning the aqueous solution to the separator, shake again with 10 Cc. of ether, and then add the ethereal layer to that already in the beaker. Allow the combined ether-solutions to evaporate either spontaneously or with the aid of a water-bath, and then add 10 Cc. of tenth-normal sulphuric acid. Stir the liquid carefully with a glass rod to facilitate the solution of the alkaloids, and when these have all dissolved, add 5 drops of hematoxylin solution. From a graduated burette add sufficient fiftieth-normal potassium hydroxide solution to just cause the yellow color of the solution to turn purple. Divide the number of Cc. of fiftieth-normal potassium hydroxide solution used by 5, subtract the quotient from 10 (the 10 Cc. of tenth-normal sulphuric acid used), and multiply the remainder by 0.0254, and this product by 10 (or multiply at once by 0.254), which will give the weight in grammes of alkaloids contained in each 100 Cc. of the fluidextract of ipecac.—U. S.

25 avoirdupois ounces of ipecac should be moistened with about 9 fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve.

The Br. P. demands that liquid extract of ipecac shall contain 2 to 2.25 Gm. of the alkaloids of ipecacuanha in 100 Cc., and is to be prepared as follows: Moisten 1 pound of ipecacuanha, in No. 20 powder, with 6 fluidounces of 90 per cent. alcohol; pack firmly in a percolator; add more of the alcohol, and when the liquid begins to drop close the lower orifice of the percolator; set aside for 24 hours. Then percolate slowly until 13½ fluidounces have been collected; reserve this portion. Continue percolation until nothing more is extracted; drain well. Mix 700 grains of calcium hydroxide with the marc; allow them to remain in contact for 24 hours; then continue percolation until exhaustion is complete. Recover the alcohol from the last two percolates by distillation; dissolve the residual extract in the reserved portion of percolate.

Determine the proportion of alkaloids in the resulting strong liquid extract by the following analytical process: Dilute 20 Cc. with an equal bulk of water. Remove the alcohol by the aid of a water-bath; add to the warm solution an excess of solution of lead subacetate. Filter; wash the precipitate with water and add the washings to the filtrate. Remove the excess of lead from the filtrate by precipitation with diluted sulphuric acid; filter; wash the precipitate with water and add the washings to the filtrate. Transfer the filtrate to a separator; add excess of ammonia-water and agitate with 25 Cc. of chloroform. Separate and set aside the chloroformic solution. Repeat twice the agitation with chloroform and the separation. Mix the chloroformic solutions; evaporate; dry at a temperature below 80° C. (176° F.), and weigh the residue of total alkaloids.

From the weight calculate the amount of alkaloids in the bulk of strong liquid extract, and add to the latter sufficient 90 per cent. alcohol to produce a liquid containing not less than 2 and not more than 2.25 Gm. of alkaloids in 100 Cc.

Fluidextract of ipecac is a thin dark reddish-brown liquid, having a slightly acrid, bitterish taste. It keeps well.

Uses.—The fluidextract of ipecac is not largely employed except in conjunction with other remedies. It possesses the expectorant and emetic properties of the drug, and may be given for the various conditions in which the latter is recommended. The dose, as an expectorant, is from 2 to 5 minims (0.10–0.3 Cc.); as an emetic, from 10 to 30 minims (0.6–2 Cc.).

FLUIDEXTRACTUM KRAMERIÆ, *U. S.*—Fluidextract of Krameria.

Fluidextract of rhatany, E.; *Extrait liquide de ratanhia*, Fr.; *Flüssiges Ratanhiaextrakt*, G.

Preparation.—Krameria, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol and pack it firmly in a cylindrical glass percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the krameria is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of krameria should be moistened with about 10 fluidounces of diluted alcohol, and the first 17½ fluidounces of percolate set aside as reserve; the fiual volume of finished product should be made up to 24 fluidounces.

Fluidextract of krameria is of a deep brownish-red color and strongly astringent taste.

Uses.—This preparation is employed for its astringent properties. See KRAMERIA. The dose is from 20 to 60 minims (1.3–4 Cc.).

FLUIDEXTRACTUM LAPPÆ, *U. S.*—Fluidextract of Lappa.

Fluidextract of burdock, E.; *Extrait liquide de bardane*, Fr.; *Flüssiges Klettenwurzelextrakt*, G.

Preparation.—Lappa, in No. 60 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow percolation to proceed, gradually adding diluted alcohol, until the lappa is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Experience has shown that diluted alcohol perfectly exhausts burdock root, yielding a very satisfactory preparation.

Uses.—This fluidextract may be substituted for the root. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM LEPTANDRÆ, *U. S.*—Fluidextract of Leptandra.

Extrait liquide de leptandra, Fr.; *Flüssiges Leptandraextrakt*, G.

Preparation.—Leptandra, in No. 60 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it moderately in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the leptandra is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluidextract of leptandra is of a dark reddish-brown color and has a very bitter taste.

Uses.—Fluidextract of leptandra may be employed as a purgative, but because of its disagreeable taste is rarely given. The dose is from 10 minims to 1 fluidrachm (0.6–4 Cc.).

FLUIDEXTRACTUM LOBELIÆ, *U. S.*—Fluidextract of Lobelia.

Extrait liquide de lobélie enflée, Fr.; *Flüssiges Lobelienextrakt, G.*

Preparation.—Lobelia, in No. 50 powder, 1000 Gm.; acetic acid, water, of each a sufficient quantity to make 1000 Cc. Mix 275 Cc. of acetic acid with 725 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of acetic acid and water as before, until the lobelia is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder at a temperature not exceeding 50 C. (122 F.) to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the powdered drug should be moistened with 8½ fluidounces of a mixture of acetic acid 11 volumes and water 29 volumes, and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The present fluidextract of lobelia is an entirely different preparation from that of 1890, the former hydro-alcoholic menstruum having been replaced by 10 per cent. acetic acid. It may be looked upon as a concentrated vinegar, being about 10 times as strong as the vinegar of lobelia of 1880 and containing about 60 per cent. more acetic acid. Fluidextract of lobelia is of a green-brown color and has the disagreeable acrid taste of the drug.

Uses.—This preparation represents fully the active properties of lobelia. The dose, as an expectorant, is from 1 to 5 minims (0.05–0.30 Cc.); as an emetic, 10 to 20 minims (0.60–1.30 Cc.).

FLUIDEXTRACTUM LUPULINI, *U. S.*—Fluidextract of Lupulin.

Extrait liquide de lupuline, Fr.; *Flüssiges Lupulinextrakt*, G.

Preparation.—Lupulin, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Pack the lupulin firmly in a cylindrical percolator; then add sufficient alcohol to saturate the lupulin and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the lupulin is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

From the percolation of 25 avoirdupois ounces of lupulin with alcohol the first 22 fluidounces obtained should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

As pointed out by the late Alonzo Robbins in 1883, percolation of lupulin with alcohol proceeds more satisfactorily if the drug be not moistened before packing, as the moistened powder is apt to form a tough mass difficult to percolate, on account of the large proportion of resinous matter present. The fluidextract is of a deep red-brown color and has the characteristic odor and taste of lupulin.

Uses.—Fluidextract of lupulin is employed as an antispasmodic and nervous sedative in doses of from ½ to 2 fluidrachms (2–8 Cc.).

FLUIDEXTRACTUM MATICO, *U. S.*—Fluidextract of Matico.

Extrait liquide de matico, Fr.; *Flüssiges Maticoblätterextrakt*, G.

Preparation.—Matico, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the matico is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluidextract of matico is a greenish-black liquid, having the characteristic aromatic odor of the leaves and a bitterish taste.

Uses.—The fluidextract represents the activity of the drug, and is the best form for internal administration. The dose is from 10 minims to 1 fluidrachm (0.6–4 Cc.).

FLUIDEXTRACTUM MEZEREI, *U. S.*—Fluidextract of Mezereum.

Extrait liquide de mézéréon (de garou), Fr.; *Flüssiges Seidelbastextrakt*, G.

Preparation.—Mezereum, in No. 30 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 800 Cc. of alcohol and 200 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the mezereum is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of mezereum should be moistened with about 10 fluidounces of a mixture of alcohol 4 volumes and water 1 volume, and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Experience has shown that the addition of about one-fifth water to the former purely alcoholic menstruum yields an equally satisfactory preparation, and hence this change has been made. The fluidextract of mezereum is of green color and very acrid taste. It is rarely employed except as an addition to external remedies.

Solid extract of mezereum may be readily prepared by evaporation of the fluidextract in a porcelain capsule on a water-bath to the consistence of a soft residue, a pilular extract being impossible. The French Codex recognizes an ethereal extract of mezereum under the name *Extrait éthéré de garou*, which is made by first exhausting mezereum with alcohol, recovering the latter, treating the soft residue with ether, and evaporating the ethereal solution to a soft extract, the final yield being about 6 or 7 per cent.

Uses.—Fluidextract of mezereum may be locally employed as a counterirritant. Internally, it is rarely given. The internal dose is from 5 to 10 minims (0.3–0.6 Cc.).

FLUIDEXTRACTUM NUCIS VOMICÆ, *U. S.*—Fluidextract of Nux Vomica.

Extractum Nucis Vomicæ Liquidum—Liquid Extract of Nux Vomica, Br.—*Extrait liquide de noix vomique*, Fr.; *Flüssiges Brechnuszextrakt, Flüssiges Strychnossamenextrakt*, G.

Preparation.—Nux vomica, in No. 60 powder, 1000 Gm.; acetic acid, 50 Cc.; alcohol, water, of each a sufficient quantity. Mix alcohol and water in the proportion

of 750 Cc. of alcohol and 250 Cc. of water. Moisten the powder with 1000 Cc. of the mixture, to which the acetic acid has previously been added, and let it digest, in a well-covered vessel in a warm place, during 48 hours. Then pack it in a cylindrical glass percolator, gradually pour menstruum upon it, and allow the percolation to proceed slowly until the nux vomica is practically exhausted. Reserve the first 900 Cc. of the percolate, distil off the alcohol from the remainder by means of a water-bath, and evaporate the residue, at a temperature not exceeding 50° C. (122 F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 20 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of strychnine in the remainder of the liquid, add to this sufficient menstruum to make each 100 Cc. of the finished fluidextract contain 1 Gm. of strychnine.

Assay of Fluidextract of Nux Vomica.—Fluidextract of nux vomica, 20 Cc.; ammonia-water, ether, chloroform, distilled water, normal sulphuric acid, 3 per cent. sulphuric acid solution, 10 per cent. sodium hydroxide solution, nitric acid (specific gravity, 1.40), tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, iodeosin solution, of each a sufficient quantity. Transfer 20 Cc. of fluidextract of nux vomica to a porcelain dish, evaporate it to dryness by means of a water-bath, and dissolve the residue, while warm, in a mixture of 16 Cc. of ether, 5 Cc. of chloroform, and 4 Cc. of ammonia-water, and transfer the solution to a separator, rinsing the dish with a little chloroform, which is to be added to the separator, and shake the separator carefully for a few minutes. When the liquids have separated, draw off the aqueous layer into another separator, washing the chloroform-ether liquid and separator with a little water, and adding this to the second separator. Then shake the aqueous liquid with two successive portions of 15 and 10 Cc., respectively, of chloroform, and add these to the first separator. If a small portion of the liquid left in the second separator still shows, after acidifying, a reaction with mercuric potassium iodide test-solution, repeat the shaking out with 10 Cc. more of chloroform. Now shake the combined liquids in the first separator with three successive portions, respectively, of 15, 10, and 10 Cc. of normal sulphuric acid, and collect the combined acid solutions in another separator. To this acid solution add a small piece of red litmus-paper and sufficient ammonia-water to render it alkaline, then shake out successively with three portions, respectively, of 25, 10, and 10 Cc. of chloroform, and collect the chloroform solutions in a beaker. Evaporate the chloroform with the aid of a water-bath, dissolve the alkaloidal residue in 15 Cc. of 3 per cent. sulphuric acid by the aid of a water-bath, and allow the liquid to cool. To this solution add 3 Cc. of a cooled mixture of equal volumes of nitric acid (specific gravity, 1.40) and distilled water, and, after rotating the liquid a few times, set it aside for exactly 10 minutes, stirring it gently three times during this interval. Transfer the resulting red liquid to a separator containing 25 Cc. of an aqueous 10 per cent. sodium hydroxide solution, wash the beaker three times with very small amounts of distilled water, and add the washings to the separator. If the liquid is not quite turbid, add 2 Cc. more of the sodium hydroxide solution. Now add 20 Cc. of chloroform to the separator, and shake it well by a rotating motion for a few minutes, allow the liquids to separate, and draw off the chloroform through a small filter, wetted with chloroform, into a beaker. Repeat this twice, using 10 Cc. of chloroform each time, and draw off both portions into the beaker, using the same filter. Finally, wash the filter and funnel with 5 Cc. of chloroform, and then evaporate all the chloroform by means of a water-bath, very carefully, to avoid decrepitation. To the alkaloidal residue add 10 Cc. of tenth-normal sulphuric acid, 5 drops of iodeosin test-solution, about 80 Cc. of water, and 20 Cc. of ether. When all the alkaloid is dissolved, titrate the excess of acid with fiftieth-normal potassium hydroxide solution until the aqueous liquid just turns pink. Divide the number of Cc. of fiftieth-normal potassium hydroxide solution used by 5, subtract the quotient from 10 (the 10 Cc. of tenth-normal sulphuric acid used), multiply the remainder by 0.0332, and this product by 5 (or multiply at once by 0.165), which will give the weight in grammes of strychnine contained in 100 Cc. of the fluidextract of nux vomica.—U. S.

25 avoirdupois ounces of the powdered drug should be moistened with a mixture of 16 fluidounces of alcohol, 8 fluidounces of water, and 1¼ fluidounces of acetic acid in a warm place for 48 hours, transferred to a percolator, and afterward percolated with a mixture of alcohol 3 volumes and water 1 volume, 20 fluidounces being set aside as reserve.

Since fluidextract of nux vomica is but little used and of exactly one-fifth the strength of the powdered extract, small quantities of it may be prepared, as wanted, by dissolving 5 Gm. of the extract in sufficient menstruum (alcohol 3 volumes, water 1 volume) to produce 25 Cc. of solution.

The British liquid extract of nux vomica is 50 per cent. stronger than that of the U. S. P. It is made by exhausting the drug in No. 20 powder with 70 per cent. alcohol as follows: After macerating 500 Gm. of the powder with 250 Cc. of menstruum for 6 hours, pack it firmly in a percolator, saturate with menstruum, and allow to macerate for 24 hours; continue slow percolation until 375 Cc. have been collected and set this aside as strong percolate. Continue the percolation until about 1875 Cc. of menstruum have been employed, or until the drug is exhausted. Concentrate the weak percolate to 31 Cc., add 93 Cc. of 90 per cent. alcohol, and add this mixture to the reserved portion. After 24 hours' rest, filter the liquid. Evaporate 10 Cc. of the filtered liquid to a thick syrupy consistence and dissolve in 20 Cc. of water, heating if necessary; transfer the solution to a separator and add 5 Gm. of sodium carbonate dissolved in 25 Cc. of water, and also 10 Cc. of chloroform Shake well, draw off the chloroformic solution, and repeat the treatment twice with the same quantity of chloroform. Treat the united chloroformic liquids with 3 successive portions of 2 Cc. of diluted sulphuric acid mixed with 8 Cc. of water. Mix the acid liquids and dilute with 175 Cc. of water, transfer to a flask, add 25 Cc. of 5 per cent. potassium ferrocyanide solution, shake the mixture well for ½ hour, and allow to stand for 6 hours. The resulting precipitate is transferred to a small filter, the last portions being rinsed out with water containing $\frac{1}{40}$ of its volume of diluted sulphuric acid, and washed until free from bitterness. Having rinsed the precipitate into a separator, 5 Cc. of ammonia-water are added, the mixture well shaken, and then shaken out with 2 successive portions of 15 Cc. of chloroform. The united chloroformic liquids are evaporated in a tared dish and the residue dried for 1 hour on a water-bath. From the weight of the dried residue the amount of strychnine in the strong liquid extract is calculated, and to the latter sufficient 70 per cent. alcohol is added to produce a liquid extract containing 1.5 Gm. of strychnine in 100 Cc.

Uses.—Fluidextract of nux vomica is rarely administered, the tincture being preferred. The dose is from 1 to 5 minims (0.05–0.30 Cc.).

FLUIDEXTRACTUM PAREIRÆ, *U. S.*—Fluidextract of Pareira.

Extractum pareiræ liquidum, Br.—*Liquid extract of pareira*, E.; *Extrait liquide de pareira brava*, Fr.; *Flüssiges Pareiraextrakt*, G.

Preparation.—Pareira, in No. 40 powder, 1000 Gm.; glycerin, 100 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 600 Cc. of alcohol and 300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water, made in the proportion of 600 Cc. of alcohol to 400 Cc. of water, until the pareira is exhausted. Reserve the first 850 Cc. of the percolate. By means of a water-bath distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of menstruum composed of alcohol 6 fluidounces, water 3 fluidounces, glycerin 1 fluidounce, and the first 21 fluidounces of percolate set aside as reserve. Subsequent percolation should be continued with a mixture of alcohol 6 volumes, water 4 volumes, and the final volume of finished product made up to 24 fluidounces.

The liquid extract of pareira of the Br. P. is prepared by exhausting the root in No. 40 powder, with boiling distilled water, first by maceration and then by percolation, collecting about 10 times as much infusion as weight of drug. After determining the percentage of extractive in the percolate, the latter is evaporated until the residual liquid contains one-third its weight of extractive, and is then mixed with sufficient 90 per cent. alcohol to produce from 3 volumes of the evaporated liquid 4 volumes of liquid extract. If necessary the mixture is filtered.

Fluidextract of pareira is of a brown color, and possesses the peculiar bitter taste of the root in a marked degree. The change in the official menstruum, by increasing the

proportion of water from 18 to 30 per cent., has been found advisable, since the drug is exhausted thoroughly and the finished product keeps well.

The British preparation is practically a concentrated infusion preserved by one-fourth its volume of alcohol.

Uses.—The fluidextract may be given for the various conditions in which pareira brava is recommended. The dose is from 1 to 2 fluidrachms (4–8 Cc.).

FLUIDEXTRACTUM PHYTOLACCÆ, *U. S.*—Fluidextract of Phytolacca.

Fluidextract of poke root, E.; *Extrait liquide du racine de phytolaque*, Fr.; *Flüssiges Kermesbeerenwurzelextrakt*, G.

Preparation.—Phytolacca root, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 400 Cc. of the mixture, and pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the phytolacca root is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder in a porcelain capsule, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of diluted alcohol, and the first 19½ fluidounces of percolate set aside as reserve. The final volume of finished product should be made up to 24 fluidounces.

Experience has shown that diluted alcohol exhausts poke root as well as the stronger menstruum (alcohol 2 volumes, water 1 volume) formerly used, and as the finished product keeps well, the change seems desirable.

Uses.—Fluidextract of poke may be employed as the most eligible preparation. As an alterative the dose is from 2 to 5 minims (0.10–0.3 Cc.); as an emetic, from 10 to 30 minims (0.6–2 Cc.).

FLUIDEXTRACTUM PILOCARPI, *U. S.*—Fluidextract of Pilocarpus.

Extractum jaborandi liquidum—Liquid extract of jaborandi, Br.; *Fluidextract of jaborandi*, E.; *Extrait liquide de jaborandi*, Fr.; *Flüssiges Jaborandiextrakt*, G.

Preparation.—Pilocarpus, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the pilocarpus is exhausted. Reserve the first 750 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of alkaloids in the remainder of the liquid; add to this sufficient menstruum to make each 100 Cc. of fluidextract contain 0.4 Gm. of the alkaloids from pilocarpus.

Assay of Fluidextract of Pilocarpus.—Fluidextract of pilocarpus, 10 Cc.; chloroform, ammonia-water, normal sulphuric acid, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, cochineal or iodeosin test-solution, of each a sufficient quantity. Transfer 10 Cc. of fluidextract of pilocarpus to a porcelain dish containing a little clean sand, and evaporate it to dryness by means of a water-bath. Mix the sand uniformly with the extract and transfer the mixture to an Erlenmeyer flask of about 200 Cc. capacity, rinsing the dish with 25 Cc. of chloroform and transferring the rinsings to the flask. Add to the latter 2.5 Cc. of ammonia-water, cork the flask securely, and shake it well at intervals during 1 hour. Filter the contents of the flask into a separator, rinsing the flask, and filter with a little chloroform, and adding the rinsings to the separator. Then shake out the chloroform solution with 15 Cc. of normal sulphuric acid, drawing off the acid aqueous solution into another sepa-

rator. Repeat the shaking out with a mixture of 5 Cc. of normal sulphuric acid and 5 Cc. of distilled water, collecting the acid solutions in the second separator. Again repeat the shaking out with 10 Cc. of distilled water, and add the aqueous liquid to the second separator. Introduce into the second separator a small piece of red litmus-paper, add enough ammonia-water to render the liquid alkaline, and extract the liquid with 20 Cc. of chloroform, drawing off the chloroformic solution into a beaker. Repeat the shaking out with 2 portions of 15 and 10 Cc. each of chloroform, and add the chloroformic solutions to the beaker. Evaporate the chloroform by means of a water-bath, and dissolve the alkaloidal residue in 5 Cc. of tenth-normal sulphuric acid. Add 5 drops of cochineal or iodeosin test-solution, and titrate the excess of acid with fiftieth-normal potassium hydroxide solution. Divide the number of Cc. of fiftieth-normal potassium hydroxide solution used by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid used), and multiply the remainder by 0.02, and this product by 10 (or multiply at once by 0.2), to obtain the weight in grammes of alkaloids contained in 100 Cc. of the fluidextract of pilocarpus.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of menstruum, and the first 17½ fluidounces of percolate set aside as reserve.

Fluidextract of jaborandi is of a greenish-red-brown color.

The liquid extract of the Br. P. is practically identical with the above, being made by percolation with 45 per cent. alcohol, but no definite alkaloid content is demanded.

Uses.—This is the best preparation of the leaves to employ. It is, however, inferior to the alkaloid. The dose is from 10 to 30 minims (0.6–2 Cc.).

FLUIDEXTRACTUM PODOPHYLLI.—Fluidextract of Podophyllum.

Fluidextract of May-apple or of mandrake, E.; *Extrait liquide de podophylle*, Fr.; *Flüssiges Podophyllumextrakt*, G.

Preparation.—Podophyllum, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the podophyllum is exhausted. Reserve the first 850 Cc. of the percolate; by means of a water-bath distil off the alcohol from the remainder; dissolve the residue in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of menstruum (alcohol 4 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The fluidextract is of a dark brown-red color. It may be conveniently used for the extemporaneous preparation of the solid extract of podophyllum.

Uses.—The fluidextract possesses all of the medicinal properties of the root, but it is rarely employed. The dose is from 5 to 20 minims (0.3–1.3 Cc.).

FLUIDEXTRACTUM PRUNI VIRGINIANÆ, *U. S.*—Fluidextract of Wild Cherry.

Extrait liquide d'écorce de cerisier de Virginie, Fr.; *Flüssiges Wildkirschenrindenextrakt*, G.

Preparation.—Wild cherry, in No. 30 powder, 1000 Gm.: glycerin, alcohol, and water, each a sufficient quantity to make 1000 Cc. Mix 200 Cc. of glycerin and 200 Cc. of alcohol with 600 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical glass percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water, made in the proportion of 200 Cc. of alcohol to 800 Cc. of water, and allow the percolation to proceed very slowly until the fluidextract measures 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 8 fluidounces of menstruum (glycerin 5 fluidounces, alcohol 5 fluidounces, water 15 fluidounces), and, finally, continue percolation with a mixture of alcohol 1 volume and water 4 volumes until 24 fluidounces of fluidextract have been obtained.

This is one of those troublesome fluidextracts the formula of which has been changed since its introduction in each subsequent edition of the Pharmacopœia. The one suggested by Prof. Procter in 1859, in which the bark was exhausted by alcohol, and after the evaporation of the menstruum the decomposition of amygdalin was effected by emulsion of almonds, was an efficient and elegant preparation, but objected to on account of troublesome manipulation. The present official menstruum is a decided improvement on that directed by the 1890 Pharmacopœia, and the resulting preparation mixes clear with aqueous and weakly alcoholic liquids, which was impossible with the former fluidextract on account of the strong alcohol used.

Fluidextract of wild cherry is of a deep brownish-red color, and when recently made has the odor of bitter-almond oil in a marked degree, and possesses also the astringent and pleasantly bitter taste of the bark. The odor slowly diminishes upon standing.

Uses.—The fluidextract is the most active preparation of wild cherry bark. Because of its concentration it is more easily administered than the other preparations. It is frequently prescribed in cough mixtures in doses of from 15 to 60 minims (1–4 Cc.).

FLUIDEXTRACTUM QUASSIÆ.—Fluidextract of Quassia.

Extrait liquide de quassie, Fr.; *Flüssiges Quassiaextrakt*, G.

Preparation.—Quassia, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 300 Cc. of alcohol with 600 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the quassia is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of menstruum, alcohol 1 volume, water 2 volumes, and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The bitter principle of quassia is perfectly soluble in water, and the fluidextract made with the official menstruum will probably keep as well as that made with diluted alcohol, as directed in 1880. We have had no experience with the present menstruum. The fluidextract has a brown-yellow color and a persistently bitter taste.

Uses.—For the effects and uses of this preparation, see QUASSIA. The dose is from 15 to 30 minims (1–2 Cc.).

FLUIDEXTRACTUM QUERCUS, *U. S.*—Fluidextract of Quercus.

Fluidextract of white-oak bark, E.; *Extrait liquide d'écorce du chêne*, Fr.; *Flüssiges Eichenrindenextrakt*, G.

Preparation.—Quercus, in No. 40 powder, 1000 Cc.; glycerin, 100 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Mix the glycerin with 900 Cc. of diluted alcohol, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the quercus is exhausted. Reserve the first 700 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of powdered white-oak bark should be moistened with about 10 fluidounces of a menstruum composed of glycerin 2½ fluidounces and diluted alcohol 22½ fluidounces; subsequent percolation is to be continued with diluted alcohol. The first 19½ fluidounces of percolate are to be set aside as reserve, and the final volume of finished product brought up to 24 fluidounces.

Fluidextract of quercus is one of the newly introduced preparations of the Pharmacopœia. It has a reddish-brown color, a very astringent taste, but little or no odor. A fluidextract of red-oak bark is marketed by manufacturers, but is not officially recognized.

Uses.—This preparation is useful in diarrhœa and other conditions in which it is desired to administer quercus internally. Dose, 15 to 60 minims (1–4 Cc.). See QUERCUS.

FLUIDEXTRACTUM QUILLAJÆ, *U. S.*—Fluidextract of Quillaja.

Fluidextract of soap-bark, E.; *Extrait liquide d'écorce de quillaya*, Fr.; *Flüssiges Seifenrindenextrakt*, G.

Preparation.—Quillaja, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, gradually adding diluted alcohol, until the quillaja is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the powdered drug should be moistened with about 10 fluidounces of diluted alcohol, and the first 20 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The value of fluidextract of soap-bark in pharmacy is questionable, since its use in medicine is very limited on account of its toxic properties. The fluidextract is of a brownish color, has a slight odor, and a disagreeable acrid taste. It froths considerably when shaken alone or diluted with water.

Uses.—This fluidextract fully represents the properties of the drug. See QUILLAJA.

FLUIDEXTRACTUM RHAMNI PURSHIANÆ, *U. S.*—Fluidextract of Rhamnus Purshiana.

Extractum cascaræ sagradæ liquidum, Br.; *Liquid extract of cascara sagrada*, E.; *Extrait liquide de cascara sagrada*, Fr.; *Flüssiges Cascara Sagradaextrakt*, G.

Preparation.—Rhamnus purshiana, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 400 Cc. of alcohol with 600 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the rhamnus purshiana is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of menstruum, composed of alcohol 4 volumes and water 6 volumes, and the first 20 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The Br. P. directs that 20 ounces of cascara sagrada in No. 20 powder shall be moistened with three-fourths of its weight of cold distilled water and set aside for 6 hours; then place it loosely in a percolator and percolate with more distilled water until the powder is exhausted; evaporate the percolate to 12 fluidounces; add 4 fluidounces of 90 per cent. alcohol, previously mixed with sufficient distilled water to make up the volume of the mixed liquids to 20 fluidounces.

The reduction of the alcoholic strength of the official menstruum is in accord with the experience that cold water alone will extract all the virtues of rhamnus purshiana.

In our experience an equally efficient fluidextract can be prepared with a mixture of 1 volume of alcohol and 3 volumes of water. Percolation with cold water, as directed in the British formula, is not desirable in this country, especially in warm weather, as fermentation is apt to set in.

Fluidextract of rhamnus purshiana is of a very dark, reddish-brown color and has an intensely bitter taste; hence it has been almost entirely superseded by the next following preparation.

Uses.—For the effects and uses of this preparation, see RHAMNUS PURSHIANA. The dose is from 15 to 60 minims (1–4 Cc.).

FLUIDEXTRACTUM RHAMNI PURSHIANÆ AROMATICUM, *U. S.*—Aromatic Fluidextract of Rhamnus Purshiana.

Aromatic fluidextract of cascara sagrada, Tasteless fluidextract of cascara sagrada, E.; *Extrait liquide aromatique de cascara sagrada*, Fr.; *Bitterloses flüssiges Cascara-Sagrada-extrakt*, G.

Preparation.—Rhamnus purshiana, in No. 40 powder, 1000 Gm.; glycyrrhiza, in No. 30 powder, 100 Gm.; magnesium oxide, 125 Gm.; glycerin, 250 Cc.; compound spirit of orange, 10 Cc.; alcohol, diluted alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the rhamnus purshiana, glycyrrhiza, and magnesium oxide thoroughly, and, having added 2000 Cc. of water, allow the mixture to macerate for 12 hours, and then dry it at a gentle heat with the aid of a water-bath. Mix the glycerin with 500 Cc. of alcohol and 250 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the powder is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, add the compound spirit of orange and enough diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of powdered rhamnus purshiana should be mixed with 2½ avoirdupois ounces of powdered licorice root and 3 avoirdupois ounces of magnesium oxide, and then well moistened with 48 fluidounces of water and allowed to macerate for 12 hours. After drying the mixture with a gentle heat, it is moistened with 10 fluidounces of the menstruum composed of 6 fluidounces each of glycerin and water and 12 fluidounces of alcohol, percolation being finally completed with diluted alcohol. The first 20 fluidounces of percolate are to be set aside as reserve, and the final product made up to 24 fluidounces.

Aromatic fluidextract of cascara sagrada is one of the new preparations of the Pharmacopœia, although it has been in use for a number of years, and is much preferred on account of its more pleasant taste. Not only does the treatment with magnesia destroy the intensely bitter taste of the cascara bark, but the addition of licorice and compound spirit of orange adds to the palatableness of the preparation. It has been stated that maceration with water and subsequent drying before moistening with menstruum are not essential for the complete destruction of the bitter taste, but in our experience this modification of the process is not satisfactory. Slaked lime has also been suggested in place of magnesia, but has been found less efficient and yields an inferior preparation. The finished fluidextract is a heavy liquid of deep reddish-brown color, almost black when undiluted, and has a pleasant sweetish taste.

Uses.—The action and dose of this drug are the same as of the preceding. Its pleasant taste enhances its value. Dose, 15 to 60 minims (1–4 Cc.).

FLUIDEXTRACTUM RHEI, *U. S.*—Fluidextract of Rhubarb.

Extrait liquide de rhubarbe, Fr.; *Flüssiges Rhabarberextrakt*, G.

Preparation.—Rhubarb, in No. 30 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and

leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the rhubarb is exhausted. Reserve the first 750 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 70° C. (158° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of menstruum (alcohol 8 volumes, water 2 volumes), and the first 18½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

This fluidextract has undergone considerable modifications. The root, exhausted by an alcoholic menstruum, and the liquid, after the evaporation of the alcohol, preserved by sugar, resulted in a fluidextract which was very thick and deposited considerably. A fluidextract prepared with cold water and preserved by sugar, as recommended by George Bille (1872), is free from the last-mentioned objection, but, it was claimed, though fairly active, not to contain *all* the purgative principles of rhubarb. The use of glycerin with an alcoholic menstruum proved a failure with the fluidextract, as it did with the tincture, the liquids, although clear for a time, precipitating more copiously afterward. The present menstruum yields a fluidextract which precipitates only very slightly, and is almost identical with that proposed by A. Robbins in 1883; a fluidextract thus prepared retained its fluidity for nearly four years. None of these different fluidextracts will yield clear mixtures with aqueous liquids unless an alkali be added. Fluidextract of rhubarb is of a blackish red-brown color, and has the odor and taste of the drug.

Uses.—For the effects and uses of this preparation, see RHEUM. The dose is from 15 to 30 minims (1–2 Cc.).

FLUIDEXTRACTUM RHOIS GLABRÆ, *U. S.*—Fluidextract of Rhus Glabra.

Fluidextract of sumach berries, E.; *Extrait liquide de fruit de sumac*, Fr.; *Flüssiges Sumachbeerenextrakt*, G.

Preparation.—Rhus glabra, in No. 40 powder, 1000 Gm.; glycerin, 100 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Mix the glycerin with 900 Cc. of diluted alcohol, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the rhus glabra is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of a menstruum composed of diluted alcohol 22½ fluidounces and glycerin 2½ fluidounces; subsequent percolation is to be continued with diluted alcohol. The first 19½ fluidounces of percolate should be set aside as a reserve, and the final volume of finished product made up to 24 fluidounces.

The fluidextract is of a deep-red color, and has a pleasant acidulous and astringent taste.

Uses.—For the effects and uses of this preparation, see RHUS GLABRA. The dose is from 15 to 30 minims (1–2 Cc.).

FLUIDEXTRACTUM ROSÆ, *U. S.*—Fluidextract of Rose.

Fluidextract of red rose, E.; *Extrait liquide de rose rouge*, Fr.; *Flüssiges Essigrosenextrakt*, G.

Preparation.—Red rose, in No. 20 powder, 1000 Gm.; glycerin, 100 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Mix the glycerin with 900 Cc. of diluted alcohol, and, having moistened the powder with 400 Cc. of the mixture, pack

it firmly in a cylindrical glass percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the red rose is exhausted. Reserve the first 750 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of a menstruum composed of dilute alcohol 21½ fluidounces and glycerin 2½ fluidounces; subsequent percolation is to be continued with diluted alcohol. The first 18½ fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

This fluidextract is of a deep-red color, of an agreeable odor of rose, and of a pleasant mildly astringent taste.

Uses.—For the uses of this preparation, see ROSA GALLICA. Dose, 1 to 2 drachms (4–8 Cc.).

FLUIDEXTRACTUM RUBI, *U. S.*—Fluidextract of Rubus.

Fluidextract of blackberry-bark, E.; *Extrait liquide d'écorce de ronce*, Fr.; *Flüssiges Brombeerrindenextrakt*, G.

Preparation.—Rubus, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol and pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the rubus is exhausted. Reserve the first 800 Cc. of the percolate; by means of a water-bath distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of diluted alcohol. The first 19½ fluidounces of percolate should be set aside as a reserve, and the final volume of finished product made up to 24 fluidounces.

As the menstruum directed by the 1890 Pharmacopœia did not produce an entirely satisfactory preparation, it was thought that on account of the astringent principle present in the drug an increase in the proportion of glycerin might prove advantageous, but experience has shown that a fluidextract made with diluted alcohol alone keeps better than when made with any other menstruum. Fluidextract of rubus is of a deep-brown color, and has a decidedly astringent taste.

Uses.—For the effects and uses of this preparation, see RUBUS. The dose is from ½ to 2 fluidrachms (2–8 Cc.).

FLUIDEXTRACTUM SABINÆ, *U. S.*—Fluidextract of Savine.

Extrait liquide de sabine, Fr.; *Flüssiges Sadebaumextrakt*, G.

Preparation.—Savine, in No. 40 powder, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 250 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the savine is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 6 fluidounces of menstruum, and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluidextract of savine is a brown-green liquid containing the volatile oil, resin, and

tannin of the drug, and is not only well adapted for making Ceratum Sabinæ, but it offers likewise a convenient way for administering savine.

EXTRACTUM SABINÆ is made with 60 per cent. alcohol (Fr. Codex), the tincture being evaporated to the proper consistence; it has a greenish-brown color. The yield is 19 or 20 per cent.

Uses.—Fluidextract of savine is rarely employed internally. It may be applied externally in the form of a cerate or ointment. The internal dose is from 5 to 10 minims (0.3–0.6 Cc.).

FLUIDEXTRACTUM SANGUINARIÆ, *U. S.*—Fluidextract of Sanguinaria.

Fluidextract of blood-root, E.; *Extrait liquide de sanguinaire*, Fr.; *Flüssiges Blutwurzelextrakt*, G.

Preparation.—Sanguinaria, in No. 30 powder, 1000 Gm.; acetic acid, water, of each a sufficient quantity to make 1000 Cc. Mix 275 Cc. of acetic acid with 725 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, allow it to macerate, in a well-covered vessel, during 48 hours. Then pack it firmly in a cylindrical percolator, gradually pour menstruum upon it, using the same proportions of acetic acid and water as before, and allow the percolation to proceed slowly until the sanguinaria is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the powdered root should be moistened with 7½ fluidounces of a mixture of acetic acid 11 volumes and water 29 volumes, and allowed to macerate for 48 hours before percolation. The first 21 fluidounces of percolate are set aside as reserve, and the final volume of fluidextract made up to 24 fluidounces.

The menstruum for this fluidextract has been greatly changed in the present formula, and the finished product now represents a concentrated vinegar of sanguinaria ten times as strong as that of 1880, and containing about 60 per cent. more acetic acid. Although the acetous menstruum will extract all the active principles of the drug, precipitation will take place as heretofore, and it is questionable whether the preparation will keep better, or even as well, as that of 1890. Fluidextract of sanguinaria is of a very deep-red color and has an acetous odor and a sour, somewhat acrid taste.

Uses.—Dose, 3 to 5 minims (0.20–0.30 Cc.). See SANGUINARIA.

FLUIDEXTRACTUM SARSAPARILLÆ, *U. S.*—Fluidextract of Sarsaparilla.

Extractum sarsæ liquidum, Br.—*Liquid extract of sarsaparilla*, E.; *Extrait liquide de salsepareille*, Fr.; *Flüssiges Sarsaparillaextrakt*, G.

Preparation.—Sarsaparilla, in No. 30 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 300 Cc. of alcohol with 600 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the sarsaparilla is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of menstruum (alcohol 1 volume, water 2 volumes), and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Liquid extract of sarsaparilla of the Br. P. is made with 20 per cent. alcohol in the following manner: 20 ounces of the root, in No. 40 powder, are divided into 3 portions. One portion is moistened with 4 fluidounces of the alcohol, packed in a percolator, set aside for 24 hours, and then percolated with more of the alcohol, until 4 fluidounces of liquid have been obtained. The second portion of drug is moistened with the first percolate, packed in a percolator, set aside for 24 hours, and then percolated with a men-

struum obtained by further percolation of the first portion; 4 fluidounces of percolate are collected and used to moisten the third portion of the drug. The mixture is packed in a percolator, set aside for 24 hours, and then percolated with a menstruum obtained by successive percolation through the first and second portions of drug. From the third portion of drug 18 fluidounces of percolate are collected, which are then mixed with 2 fluidounces of glycerin, making a total of 20 fluidounces.

The relative strength of the two fluidextracts is practically the same. The first process appears to be well adapted for exhausting the root and preserving the fluidextract, which contains about one-third its measure of alcohol. The second formula directs repercolation and employs a menstruum containing about two-thirds as much alcohol as that of the U. S. P., the final addition of glycerin being made for the purpose of preventing deposit upon standing.

Uses.—Fluidextract of sarsaparilla is employed for the same purposes as the drug from which it is prepared. Its principal use, however, is as a vehicle for other remedies. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM SARSAPARILLÆ COMPOSITUM, *U. S.*—Compound Fluidextract of Sarsaparilla.

Extrait liquide de salsepareille composé, Fr.; *Zusammengesetztes flüssiges Sarsaparillaextrakt*, G.

Preparation.—Sarsaparilla, in No. 30 powder, 750 Gm.; glycyrrhiza, in No. 30 powder, 120 Gm.; sassafras bark, in No. 30 powder, 100 Gm.; mezereum, in No. 30 powder, 30 Gm.; glycerin, 100 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Mix the glycerin with 900 Cc. of diluted alcohol, and, having moistened the mixed powders with 400 Cc. of the mixture, pack them firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol and water, until the powder is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the mixed ground drugs should be moistened with about 10 fluidounces of a menstruum composed of diluted alcohol 22½ fluidounces and glycerin 2½ fluidounces, subsequent percolation being continued with diluted alcohol. The first 20 fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

The present official menstruum contains about 50 per cent. more alcohol than that of 1890, and has proved more satisfactory. The preparation deposits but slightly. The frequent use which is made of the above combination of drugs probably renders such a fluidextract desirable, though it seems to be unnecessary, since the introduction of concentrated preparations of licorice-root and mezereum affords the opportunity of giving these and sarsaparilla in any proportion that may be desired.

Uses.—This preparation has been used as a substitute for the compound decoction of sarsaparilla. It is probably equally efficient, and because of its concentration is administered with much less difficulty. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM SCILLÆ, *U. S.*—Fluidextract of Squill.

Extrait liquide de scille, Fr.; *Flüssiges Meerzwiebelextrakt*, G.

Preparation.—Squill, in No. 20 powder, 1000 Gm.; acetic acid, water, each a sufficient quantity to make 1000 Cc. Mix 275 Cc. of acetic acid with 725 Cc. of water, and, having added 800 Cc. of the mixture to the powder, allow it to macerate, in a well-covered glass or porcelain vessel, during 48 hours, then transfer it to a conical glass percolator, and allow the percolation to proceed slowly, adding menstruum gradually, using the same proportions of acetic acid and water as before, until the fluidextract measures 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with 20 fluidounces of a mixture of 11 volumes of acetic acid and 29 volumes of water, and allowed to macerate

for 48 hours, after which the mass is percolated with the same menstruum until 24 fluidounces have been obtained.

The menstruum for fluidextract of squill has been radically changed, the present preparation representing an acetous fluidextract of ten times the strength of the official vinegar of squill, and containing about 60 per cent. more acetic acid. Squill will absorb much of the watery menstruum and swell considerably, hence uniform percolation will be found difficult, as the particles of drug are apt to cake together.

Fluidextract of squill is a yellowish, somewhat syrupy liquid of decided acetous odor and a bitter and very sour taste.

Uses.—This preparation may be employed whenever squills is indicated. The dose is from 2 to 3 minims (0.10–0.20 Cc.). See SCILLA.

FLUIDEXTRACTUM SCOPOLÆ, *U. S.*—Fluidextract of Scopola.

Extrait liquide de racine de scopola, Fr.; *Flüssiges Skopolawurzelextrakt*, G.

Preparation.—Scopola, in No. 40 powder, 1000 Gm.; alcohol, water, of each a sufficient quantity to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the scopola is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° Cc. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid by the process given below; from the results thus obtained ascertain, by calculation, the amount of mydriatic alkaloids in the remainder of the liquid, and add to this sufficient menstruum to make each 100 Cc. of the finished fluidextract contain 0.5 Gm. of the mydriatic alkaloids from scopola root.

Assay of Fluidextract of Scopola.—The method to be employed is identical with that given under FLUIDEXTRACT OF BELLADONNA ROOT.—U. S.

25 avoirdupois ounces of the powdered root should be moistened with about 9 fluidounces of the menstruum (alcohol 4 volumes, water 1 volume), and the first 22 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This is one of the new fluidextracts introduced into the Pharmacopœia of 1900. It resembles fluidextract of belladonna root in every particular, having also the same composition. Fluidextract of scopola may be used for the preparation of the solid extract by evaporating a convenient quantity to a pilular consistence, at a low temperature on a water-bath.

Uses.—The action of this preparation is closely allied to that of BELLADONNA (which see). The dose is from 1 to 5 minims (0.05–0.30 Cc.).

FLUIDEXTRACTUM SCUTELLARIÆ, *U. S.*—Fluidextract of Scutellaria.

Fluidextract of skull-cap, E.; *Extrait liquide de scutellaire*, Fr.; *Flüssiges Helmkrautextrakt*, G.

Preparation.—Scutellaria, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 350 Cc. of the menstruum, and pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum until the scutellaria is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 9 fluidounces of

menstruum, and the first 20 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The fluidextract will have a green-brown color.

Uses.—This preparation is rarely employed. It represents all the medicinal properties of the drug. The dose is from ½ to 2 fluidrachms (2–8 Cc.).

FLUIDEXTRACTUM SENEGÆ, *U. S.*—Fluidextract of Senega.

Extrait liquide de polygale de Virginie, Fr.; *Flüssiges Senegaextrakt*, G.

Preparation.—Senega, in No. 40 powder, 1000 Gm.; solution of potassium hydroxide, 30 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the solution of potassium hydroxide with 600 Cc. of alcohol and 300 Cc. of water, and, having moistened the powder with 450 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then a mixture of alcohol and water, made in the proportion of 600 Cc. of alcohol to 300 Cc. of water, until the senega is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10½ fluidounces of a menstruum composed of alcohol 16 fluidounces, water 8 fluidounces, and solution of potassium hydroxide 6 fluidrachms, subsequent percolation to be continued with a mixture of alcohol 2 volumes, water 1 volume. The first 21 fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

Water is a better solvent for senegin than a strongly alcoholic menstruum, but it has also the disadvantage of dissolving a considerable proportion of various pectin compounds, which are apt after some time to convert the liquid into a gelatinous mass.

The present formula for fluidextract of senega differs slightly from that of the last Pharmacopœia, inasmuch as the ammonia-water has been replaced in the menstruum by a smaller quantity of potassium hydroxide solution, the object being, however, the same, namely, to prevent gelatinization in the finished product. The fluidextract is of a dark-brown color, and possesses the characteristic odor and acrid taste of the root.

Extractum Senegæ.—*Extract of senega*, E.; *Extrait de polygale, Extrait de sénéca*, Fr.; *Senegaextrakt*, G.—The French Codex orders alcohol of specific gravity 0.914, which yields from 16 to 20 per cent. of extract. It may be prepared extemporaneously by evaporating the fluidextract to the proper consistence.

Uses.—Fluidextract of senega may be used for all the conditions in which senega is recommended. The dose is from 2 to 10 minims (0.10–0.6 Cc.).

FLUIDEXTRACTUM SENNÆ, *U. S.*—Fluidextract of Senna.

Extrait liquide de séné, Fr.; *Flüssiges Sennaextrakt*, G.

Preparation.—Senna, in No. 40 powder, 1000 Gm.; alcohol, diluted alcohol, each a sufficient quantity to make 1000 Cc. Moisten the senna with 350 Cc. of alcohol, pack it firmly in a percolator, and percolate it with alcohol until it is practically exhausted by this menstruum. The alcoholic percolate thus obtained is rejected, and the alcohol may be recovered therefrom by distillation. Then take out the moist powder and dry it, and moisten with 400 Cc. of diluted alcohol; pack it firmly in a cylindrical percolator and add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the senna is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

After exhausting 25 avoirdupois ounces of senna with alcohol, the powder, having been dried, should be moistened with about 10 fluidounces of diluted alcohol, and the

first 20 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The present fluidextract of senna is quite different from that of the 1890 Pharmacopœia, inasmuch as the drug is first treated with alcohol for the purpose of removing odorous resinous matter, which causes griping. Diluted alcohol has been found to extract all the active virtues of senna and to preserve the finished product well. The fluidextract has a dark-brown color and characteristic taste.

Uses.—Because of the severe griping which it produces, this preparation is rarely employed except in conjunction with other remedies. In cases of obstinate constipation it may be given with equal portions of fluidextract of cascara sagrada. It is also administered with the saline purgatives, but when so given carminatives should be added to prevent or diminish the griping. The dose is from ½ to 2 fluidrachms (2–8 Cc.).

FLUIDEXTRACTUM SERPENTARIÆ, *U. S.*—Fluidextract of Serpentaria.

Extrait liquide de serpentaire, Fr.; *Flüssiges Schlangenwurzelextrakt*, G.

Preparation.—Serpentaria, in No. 50 powder, 1000 Gm.; alcohol, water, each a sufficient quantity so make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the serpentaria is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C.(122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces should be moistened with about 7½ fluidounces of menstruum (alcohol 4 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve. The final volume of finished product should be made up to 24 fluidounces.

The virtues of serpentaria are well exhausted and properly preserved by this process. The fluidextract has a red-brown color and the peculiar odor and bitter taste of the drug.

Uses.—Fluidextract of serpentaria fully represents the virtues of the drug (which see). It is given internally in doses of from 15 to 30 minims (1–2 Cc.). As a local application it is said to be of value in ivy-poisoning.

FLUIDEXTRACTUM SPIGELIÆ, *U. S.*—Fluidextract of Spigelia.

Extrait liquide de spigélie, Fr.; *Flüssiges Spigelienextrakt*, G.

Preparation.—Spigelia, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 300 Cc. of diluted alcohol and pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the spigelia is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of menstruum and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Originally, the fluidextract was saccharine, and in 1870 the sugar was replaced by glycerin. It was found, however, that it will keep unaltered in the form of a concentrated tincture, as by the present formula. It is a dark-brown liquid.

FLUIDEXTRACTUM SPIGELIÆ ET SENNÆ.—*Fluidextract of spigelia and senna*, E.; *Extrait liquide de spigélie et séné*, Fr.; *Flüssiges Spigelien- und Sennaextrakt*, G.—After 1860 this preparation was made by mixing fluidextract of spigelia 10 fluidounces with fluidextract of senna 6 fluidounces and oils of caraway and of anise each 20 minims. A more elegant and satisfactory preparation, however, is obtained, according

to Alonzo Robbins (1883), by preparing it from the drugs, as originally suggested by Procter (1848), omitting the alkali; the proportions are spigelia 60 Gm., senna 30 Gm., anise and caraway each 5 Gm.; the menstruum is diluted alcohol, and the yield is 100 Cc.

Uses.—The action of spigelia is well represented by the fluidextract; the latter may be employed for all conditions in which the former is recommended. The dose is from ½ to 2 fluidrachms (2–8 Cc.).

FLUIDEXTRACTUM STAPHISAGRIÆ, *U. S.*—Fluidextract of Staphisagria.

Fluidextract of stavesacre seed, E.; *Extrait liquide des semences de staphisaigre*, Fr.; *Flüssiges Stephanskörnerextrakt*, G.

Preparation.—Staphisagria, in No. 40 powder, 1000 Gm.; alcohol, water, of each a sufficient quantity to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow percolation to proceed slowly, gradually adding menstruum, using the same proportions of alcohol and water as before, until the staphisagria is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50 C. (122 F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the powdered seed should be moistened with 10 fluidounces of a mixture of alcohol 4 volumes and water 1 volume, and the first 20 fluidounces of percolate set aside as reserve; the final volume of the fluidextract should measure 24 fluidounces.

Stavesacre seed contains from 20 to 30 per cent. of fixed oil, and if strong alcohol were used for extraction the oil would partly separate and become very troublesome. By the addition of water it is hoped to overcome this difficulty, as the oil is less liable to be taken up. The fluidextract has a decided green color, but no particular odor or taste except that of the alcoholic menstruum.

Uses.—This, in combination with ether and alcohol, is used to destroy lice. It is not given internally.

FLUIDEXTRACTUM STILLINGIÆ, *U. S.*—Fluidextract of Stillingia.

Extrait liquide de stillingie, Fr.; *Flüssiges Stillingiaextrakt*, G.

Preparation.—Stillingia, in No. 40 powder, 1000 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 300 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add sufficient diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the stillingia is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of menstruum, and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluidextract of stillingia will sometimes become gelatinous on standing, which difficulty may be overcome by the addition of sugar (about 10 or 12 per cent. of the weight of drug used); a somewhat stronger alcoholic menstruum (alcohol 3 volumes, water 1 volume) also seems to improve the preparation materially. It is of a dark red-brown color and has the bitterish, pungent taste of the root.

Uses.—The alterative properties of this preparation are equivalent to those of the drug (which see). The dose is from 15 to 30 minims (1–2 Cc.).

FLUIDEXTRACTUM STRAMONII, *U. S.*—Fluidextract of Stramonium.

Fluidextract of stramonium seed, U. S., 1890; *Extrait liquide des feuilles de stramoine*, Fr.; *Flüssiges Stechapfelblätterextrakt*, G.

Preparation.—Stramonium, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the stramonium is exhausted. Reserve the first 800 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay 10 Cc. of this liquid as directed below; from the results thus obtained ascertain, by calculation, the amount of mydriatic alkaloids in the remainder of the liquid, and add to this sufficient menstruum to make each 100 Cc. of the finished fluidextract contain 0.35 Gm. of the mydriatic alkaloids from stramonium.

Assay of Fluidextract of Stramonium.—The method to be employed is identical with that given under FLUIDEXTRACT OF BELLADONNA ROOT.—U. S.

25 avoirdupois ounces of the powdered drug should be moistened with about 10 fluidounces of the menstruum (alcohol 2 volumes, water 1 volume), and the first 20 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Fluidextract of stramonium is of a deep green-brown color, and has the characteristic heavy odor of the drug. It should be borne in mind that stramonium seed are no longer recognized in the U. S. P., and that the present official fluidextract is made from the leaves of stramonium.

Uses.—Fluidextract of stramonium may be employed for all the conditions in which the drug is recommended. The dose is from 1 to 2 minims (0.05–0.10 Cc.).

FLUIDEXTRACTUM SUMBUL, *U. S.*—Fluidextract of Sumbul.

Fluidextract of muskroot, E.; *Extrait liquide de sumbul*, Fr.; *Flüssiges Sumbulwurzel-oder Moschuswurzelextrakt*, G.

Preparation.—Sumbul, in No. 30 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it moderately in a cylindrical percolator, then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the sumbul is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.

25 avoirdupois ounces of the powdered drug should be moistened with about 7½ fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluidextract of sumbul is one of the new preparations officially recognized in the Pharmacopœia. It is of a yellowish-brown color and has the peculiar musk-like odor of the root. Since the virtues of sumbul reside chiefly in the oil and an acid present, the menstruum directed appears desirable for complete exhaustion of the drug.

Uses.—The antispasmodic properties of the root are well represented by the fluidextract. The dose is from 15 to 45 minims (1–3 Cc.).

FLUIDEXTRACTUM TARAXACI, *U. S.*—Fluidextract of Taraxacum.

Extractum taraxaci liquidum—Liquid extract of taraxacum, Br.; *Fluidextract of dandelion*, E.; *Extrait liquide de pissenlit*, Fr.; *Flüssiges Löwenzahnextrakt*, G.

Preparation.—Taraxacum, in No. 30 powder, 1000 Gm.; solution of sodium hydroxide, 50 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 300 Cc. of diluted alcohol and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow percolation to proceed slowly, gradually adding diluted alcohol, until the taraxacum is exhausted. Reserve the first 800 Cc. of the percolate; distil off the alcohol from the remainder by means of a water-bath and evaporate the residue to a soft extract; dissolve this in the reserved portion, add the solution of sodium hydroxide, and enough diluted alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the powdered drug should be moistened with about 7½ fluidounces of diluted alcohol, and the first 20 fluidounces of percolate set aside as reserve; after evaporation of the second percolate to a soft extract and solution in the reserve portion, 1¼ fluidounces of sodium hydroxide solution should be added, and the final volume of fluidextract made up to 24 fluidounces by addition of diluted alcohol.

The Br. P. directs that 20 ounces of taraxacum root, in No. 20 powder, be macerated for 48 hours in a closed vessel with 40 fluidounces of 60 per cent. alcohol. 10 fluidounces of liquid are then expressed and set aside, the residue being mixed with 40 fluidounces of water and again allowed to macerate for 48 hours. After expression, the aqueous liquid is evaporated to 10 fluidounces and mixed with the hydroalcoholic liquid previously expressed. If necessary sufficient water is added to bring the volume up to 20 fluidounces.

Fluidextract of taraxacum is of a reddish-brown color, and if made from true dandelion root has a bitterish-sweet taste. More decided bitterness would point to the probable adulteration with chicory. The addition of sodium hydroxide solution to the percolate, as directed in the present formula, is for the purpose of avoiding effervescence should the fluidextract be dispensed together with carbonates or bicarbonates, as taraxacum yields a slightly acid percolate with diluted alcohol.

Uses.—When prepared from the fresh root, the properties of the fluidextract equal those of the drug. The dose is from ½ to 1 fluidrachm (2–8 Cc.).

FLUIDEXTRACTUM TRITICI, *U. S.*—Fluidextract of Triticum.

Fluidextract of couch-grass, E.; *Extrait liquide de chiendent*, Fr.; *Flüssiges Quecken-extrakt*, G.

Preparation.—Triticum, finely cut, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Pack the triticum in a cylindrical tinned copper or tinned iron percolator, pour boiling water upon it and allow percolation to proceed, supplying boiling water as required, until the triticum is exhausted. Evaporate the percolate to 750 Cc., and, having added to it 250 Cc. of alcohol, mix well and set it aside for 48 hours. Then filter the liquid, and add to the filtrate sufficient of a mixture composed of 3 volumes of water and 1 volume of alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of finely cut couch-grass should be exhausted by percolation with boiling water, and the infusion evaporated to 18 fluidounces; after addition of 6 fluidounces of alcohol the mixture is set aside for 48 hours, filtered, and to the filtrate sufficient of a menstruum, composed of alcohol 1 volume and water 3 volumes, added to bring the final volume of the finished product up to 24 fluidounces.

The manipulation for preparing this fluidextract will be successful only if suitable provision be made to let the liquid pass from the percolator in drops, the drug being too coarse and unyielding to permit its packing like most of the other powders. We consider digestion preferable to percolation, since the drug is thus easily exhausted, and by shortening the process fermentation of the strongly saccharine liquid is prevented. For the reason stated the liquid should be rapidly concentrated. The fluidextract is of a brown color and has a sweet taste.

A solid extract of triticum was formerly official in the P. G. under the name *Extractum Graminis*, and is still recognized in the French Codex as *Extrait de Chiendent*. The latter preparation is directed to be made by exhausting the drug with cold distilled water by maceration, using two successive portions, mixing the expressed liquids, allowing the mixture to subside, decanting, and evaporating the clear liquid to the consistence of a soft extract.

Uses.—This is the best preparation of the drug to employ, as it is thought to represent more thoroughly than any other preparation the medicinal properties of the plant. The dose is from 2 to 4 fluidrachms (8–16 Cc.).

FLUIDEXTRACTUM UVÆ URSI, *U. S.*—Fluidextract of Uva Ursi.

Extrait liquide de busserole, Fr.; *Flüssiges Bärentraubenblätterextrakt*, G.

Preparation.—Uva ursi, in No. 30 powder, 1000 Gm.; glycerin, 300 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 200 Cc. of alcohol and 500 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water, made in the proportion of 200 Cc. of alcohol to 500 Cc. of water, until the uva ursi is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient of the mixture of alcohol and water to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 10 fluidounces of a mixture composed of alcohol 4¾ fluidounces, water 12 fluidounces, and glycerin 7¼ fluidounces, subsequent percolation to be continued with a menstruum of alcohol 2 volumes, water 5 volumes; the first 22 fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

The large quantity of glycerin directed appears to us unnecessary; in fact, glycerin may be omitted entirely, since experience has shown that diluted alcohol completely exhausts the drug and yields a fluidextract which keeps well. We should prefer the latter menstruum for this preparation. The fluidextract is of a dark-brown color and possesses a bitter, astringent taste.

Uses.—The uses of fluidextract of uva ursi are fully described under the drug (which see). It may be administered in capsules, but is probably more efficient when administered largely diluted with water. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM VALERIANÆ, *U. S.*—Fluidextract of Valerian.

Extrait liquide de valériane, Fr.; *Flüssiges Baldrianextrakt*, G.

Preparation.—Valerian, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the valerian is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The present menstruum has been found to yield excellent results. The fluidextract is of a deep red-brown color, and has the characteristic odor and taste of valerian. Little loss of oil will occur if proper care is observed in the percolation and evaporation.

EXTRACTUM VALERIANÆ has been dismissed from most pharmacopœias. The French Codex directs it to be made with alcohol of specific gravity 1.914; the yield is 19 or 20 per cent. It may be readily prepared by concentrating the fluidextract at a moderate heat on a water-bath.

Uses.—Fluidextract of valerian is a very efficient preparation, and may be employed for the various conditions in which the drug is recommended. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM VERATRI, *U. S.*—Fluidextract of Veratrum.

Extractum veratri viridis fluidum, U. S. 1890—*Fluidextract of American veratrum*, E.; *Extrait liquide de vératre américain*, Fr.; *Flüssiges Grüngermerextrakt*, G.

Preparation.—Veratrum, in No. 60 powder, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 300 Cc. of alcohol and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the veratrum viride is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50°C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of menstruum, and the first 22 fluidounces set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The resins and alkaloids are readily taken up and held in solution by the menstruum directed, and the fluidextract is therefore ten times as strong as the tincture of the same drug.

Uses.—The fluidextract is employed less frequently than the tincture; it is, however, a very efficient preparation. The dose is from 1 to 2 minims (0.05–0.10 Cc.).

FLUIDEXTRACTUM VIBURNI OPULI, *U. S.*—Fluidextract of Viburnum Opulus.

Fluidextract of cramp-bark, E.; *Flüssiges Schneeballrindenextrakt*, G.

Preparation.—Viburnum opulus, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it moderately in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the viburnum is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of menstruum, and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluidextract of cramp-bark has a reddish-brown color, slight odor, and somewhat astringent taste.

Uses.—This preparation may be administered whenever viburnum opulus is indicated. The dose is from 15 to 60 minims (1–4 Cc.).

FLUIDEXTRACTUM VIBURNI PRUNIFOLII, *U. S.*—Fluidextract of Viburnum Prunifolium.

Fluidextract of blackhaw-bark, E.; *Extrait liquide de viburne*, Fr.; *Flüssiges Viburnumextrakt*, G.

Preparation.—Viburnum, in No. 40 powder, 1000 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 300 Cc. of menstruum, pack it moderately in a

cylindrical percolator; then add sufficient of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the viburnum is exhausted. Reserve the first 850 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient menstruum to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 7½ fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The fluidextract is of a deep brown-red color and possesses the astringent and bitter taste of the bark.

Uses.—It is thought to represent the medicinal properties of the drug. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

FLUIDEXTRACTUM XANTHOXYLI, *U. S.*—Fluidextract of Xanthoxylum.

Fluidextract of prickly ash, E.; *Extrait liquide d'écorce de clavalier*, Fr.; *Flüssiges Zahnwehrindenextrakt*, G.

Preparation.—Xanthoxylum, in No. 40 powder, 1000 Gm.; alcohol, water, of each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 250 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the xanthoxylum is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 6 fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluidextract of prickly ash is of a reddish-brown color, and possesses the acrid taste of the bark.

Uses.—It is probable that this preparation contains all the active constituents of xanthoxylum. Its dose is stated to be from ½ to 1 fluidounce (2–4 Cc.).

FLUIDEXTRACTUM ZINGIBERIS, *U. S.*—Fluidextract of Ginger.

Extrait liquide de gingembre, Fr.; *Flüssiges Ingwerextrakt*, G.

Preparation.—Ginger, in No. 50 powder, 1000 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 250 Cc. of alcohol and pack it firmly in a cylindrical percolator; then add sufficient alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the ginger is exhausted. Reserve the first 900 Cc. of the percolate and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add sufficient alcohol to make the fluidextract measure 1000 Cc.—U. S.

25 avoirdupois ounces of the drug should be moistened with about 6 fluidounces of menstruum (alcohol), and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Ginger is readily exhausted by alcohol; the brownish-red fluidextract is 5 times stronger than the tincture of ginger, and has the same sensible properties, but in a higher degree. It is used in preparing Syrupus Zingiberis.

Uses.—This preparation is less convenient than the oleoresin, but it represents the medicinal properties of the drug. The dose is from 5 to 20 minims (0.3–1.3 Cc.).

FŒNICULUM, *U. S.*—Fennel.

Fœniculi fructus, Br.; *Fructus fœniculi*, P. G.; *Semen fœniculi.—Fennel-fruit, Fennel-seed*, E.; *Fenchel*, G.; *Fenouil*, Fr.; *Hinojo*, Sp.; *Funcho*, Port.; *Finocchio*, It.

The dried, nearly ripe fruit of *Fœniculum vulgare* Miller (*Anethum F.* L.; *Meum F.* Spreng.: *F. Capillaceum* Gilib.; *F. dulce* DC.; *F. Fœniculum* (L.) Karst.; *F. officinale* All.—Fam. *Umbelliferæ*).

Fennel is official in all pharmacopœias, which differ widely as to the botanical name employed and as to the varieties admitted. *F. Fœniculum* (L.) Karst. is the correct name.

Origin.—From a tall, coarse herb, annual to perennial according to the climate, native of southwestern Asia and southern Europe. It is frequently seen wild in the United States. It has a somewhat branched, light-green, glaucous, furrowed stem, very large leaves with coarsely sheathing petioles and decompound blades, the divisions narrowly linear and elongated. The large compound umbels of yellow flowers terminate the stem and branches and are entirely non-involucrate. All parts of the plant have an agreeable odor and an aromatic, sweetish taste. The cultivated forms of the plant vary so greatly that there is considerable diversity of opinion among botanists as to their being distinct species. The fruit is obtained from cultivated plants, mostly in Germany, Russia, and France, though the plant is cultivated in almost all parts of the world except where very cold, and various other countries than those named contribute more or less to commerce. Saxon fennel, the largest variety, is usually preferred.

Fig. 182.

a *b*

Fœniculum: *a*, fruit (× 3); *b*, transverse section (× 8).

Description.—Of 2 separate or united carpels, each 0.6 to 1 Cm. (¼ to ⅖ In.) long, about one-third as broad and one-sixth as thick, oblong or a little narrowed at the summit, more or less curved, bearing 5 very prominent and stout light-colored ribs upon the back, otherwise smooth, yellowish- or brownish-green; pericarp containing an oil-tube between each two ribs and 2 upon the flat side; odor pleasantly aromatic; taste sweet and pleasantly aromatic.

German, French, and Indian fennels are all about of the dimensions given above; Russian and Japanese, only about half as large. Bitter fennel, from wild plants, and mostly French, is one of the smallest. The Japanese is reported to have a distinctive odor closely approaching that of anise, than which it is but little larger. The Indian fennel plant is classed as a distinct species, *F. panmorium* DC. Roman fennel is a very large and sweet, greenish variety, referred to *F. dulce*, regarded by some as a distinct species.

Exhausted fennel, which yields a yellowish instead of a dark-brown infusion, is largely ground with the genuine, and it is reported that it is often tinged with chrome-yellow and thus sold entire. Moistening with alcohol and rubbing will detach this color.

Constituents.—The important constituent of fennel is its volatile oil, the amount of which ranges from 2 to 5 per cent., and which has a peculiar sweet taste, usually more or less camphoraceous. With this are about 12 per cent. of fixed oil, sugar, and ordinary plant-constituents. Umney found the Saxon, Russian, and Galician fruits to yield about 4.5 per cent., the French and Japanese, a little more than 2 per cent. of this oil. The ash is usually from 8 to 10 per cent., occasionally as much as 12 per cent.

Action and Uses.—Fennel is diaphoretic, aromatic, and carminative. It is sometimes employed for the purpose of expelling flatus, and a hot infusion, 3 drachms (12 Gm.) to a pint (480 Cc.) of water, is occasionally given to increase the lacteal secretion, to produce free sweating, and to establish the menstrual flow. Fennel may also be combined with purgatives for the purpose of decreasing their griping effect. The dose of the bruised or powdered fruit is from 10 to 30 grains (0.6–2 Gm.).

Allied Product.—*Fennel root* is somewhat employed in Europe. It is 15 to 25 Cm. (6 to 10 In.) long, above nearly 25 Mm. (1 In.) thick, several-headed, cylindrical, little branched, but beset with numerous thin and wrinkled radicles. The root is externally light-brown, annulate, and longitudinally wrinkled, internally white; the bark thick, fleshy, with several circles of brown resin-cells, and the meditullium yellowish and radially striate. It has an aromatic odor and a sweet fennel-like taste, and contains a little volatile oil and considerable sugar and starch.

FŒNUM GRÆCUM.—Fenugreek.

Semen fœnugræci, P. G.; *Bockshornsamen*, G.; *Fenugrec, Sencgrain*, Fr.; *Alholva*, Sp. The dried ripe seeds of *Trigonella Fœnum-græcum* L. (Fam. *Leguminosæ*).

Origin.—From a small herb, native of southwestern Asia, and extensively cultivated in tropical and subtropical Asia and Africa, and somewhat naturalized there and in southern Europe. The seeds of other species of the genus have a similar composition and properties.

Fig. 183.

Fenugreek (×3).

Description.—About 3 Mm. ($\frac{1}{8}$ In.) long and broad, and 2 Mm. ($\frac{1}{12}$ In.) thick, obliquely rhomboidal, each surface bearing a deep groove running diagonally nearly across; brownish-yellow, smooth, somewhat shining; hard and heavy; odor strong, peculiar, not agreeable; taste mucilaginous, bitterish, bean-like and peculiar. Structure exalbuminous, the embryo yellowish, the caulicle large, strongly bent against the edges of the cotyledons; a peculiar horn-like tissue, probably the tegmen, though regarded by some as perisperm, surrounds the embryo.

Powdered Fenugreek is very apt to be adulterated with starchy matters.

Constituents.—As a nutrient, the seed is essentially albuminous, about one-fourth of its weight being of such composition. There is about 6 per cent. of fixed oil. The integuments contain a little tannin and a large amount (about 28 per cent.) of gum. The specific constituents are *trigonelline*, 0.13 per cent., with about 0.05 per cent. of choline, a small amount of an amaroid, and a peculiar hydrocarbon, imparting the odor. Trigonelline ($C_7H_7NO_2$) is isomeric with pyridine-betaine. The odorous principle is derived from a *manno-galactane*, very similar to that of lucerne, which, on hydrolysis, yields mannose and galactose. The manno-galactane can be removed by macerating in excess of solution of lead acetate, removing the excess by oxalic acid, and precipitating from the aqueous filtrate by alcohol.

Action and Uses.—Fenugreek possesses emollient properties, but is no longer employed in internal medicine. It is used in the preparation of emollient poultices, demulcent lotions, and ointments. The oil is sometimes applied in the treatment of burns.

FRANCISCEA.—Brunfelsia; Manaca.

Manacán, Geratacáca, Camgámba, Mercurio Vegetal, Braz.

The dried root of *Brunfelsia Hopeana* Benth. (*Franciscea uniflora* Pohl.—Fam. *Solanaceæ*).

The stem is similarly used, but is held to be very inferior to the root. The flowers are said to be used by the natives as an application to indolent ulcers.

Origin and Description.—The Manaca plant is a large shrub, growing in lowlands along streams in Brazil and bearing a handsome purplish, infundibular-bell-shaped flower. The root occurs in short pieces about 6 to 25 Mm. ($\frac{1}{4}$ to 1 In.) thick, externally dark-brown or rust-brown, and often thinly scaly. The bark is thin and adheres tightly to the hard, tough, reddish-yellow wood. The stem contains a thin pith, the root none. Manaca is inodorous and has a disagreeably bitter taste.

Constituents.—We are uncertain as to the constituents of this drug, since the identity of the materials which have been examined was not fixed, three different Manacas being in use. It is probable, however, that the "Red Manaca," the composition of which is here considered, is that under discussion.

Red Manaca contains fat, resin, 11.25 per cent. of starch, the alkaloid *manacine*, and a fluorescent compound. This latter is probably identical with gelsemic acid, is readily soluble in alcohol and chloroform, less so in water and ether, is not a glucoside but reduces Fehling's Solution. Its aqueous solution is acid, and is yellow by transmitted light, blue by reflected light, the fluorescence being increased by ammonia. It resembles a similar constituent of *Fabiana*. *Manacine* is amorphous, slightly bitter, weakly basic, soluble in water, alcohol, and methyl alcohol, and easily decomposed in solution. It is precipitated by alkaloidal reagents, but not by alkalies. The alkaloid *francisceine* is probably the same as that just described. Brandl (1895) split it into *manaceine* and a fluorescent resinous substance identical with æsculetin. Some investigators have failed to find an alkaloid.

Action and Uses.—Manaca probably acts as a depressant to the motor centers of the spinal cord. When given in full dose, it occasions respiratory difficulty, profuse sweating, depression, nausea and vomiting, an increased urinary flow, and free purgation. In overdose it is an acrid depressing poison. In medicinal dose it has been employed in the treatment of chronic muscular rheumatism, and has been recommended as a substitute for mercury in the treatment of syphilis. The fluid extract may be given in doses of from 10 to 40 minims (0.6–2.6 Cc.), 3 times daily.

FRANGULA, *U. S.*—Frangula.

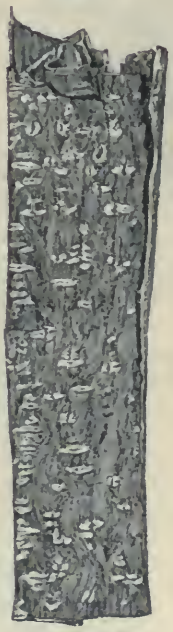
Rhamni frangulæ cortex, Br.; *Cortex frangulæ*, P. G.—*Cortex Alni Nigræ*, Russ.—*Buckthorn, Alder buckthorn*, E.; *Faulbaumrinde*, G.; *Écorce de Bourdaine* (*Bourgene*), Fr.; *Corteccia de Frangula*, It.; *Amiero Negro*, Port.

The dried bark of *Rhamnus Frangula* L. (*Frangula vulgaris* Reichb.; *F. Alnus* Mill.—Fam. *Rhamnaceæ*), collected at least one year before being used.

Frangula is official in nearly all pharmacopœias. From the last edition of the Br. P. it has been dropped in favor of *R. Purshiana*.

Origin.—From a rather slender large shrub growing throughout Europe, western Asia, and northern Africa. Introduced by Michaux to his ancient Botanical Garden at New Durham, N. J., it has escaped and is naturalized in a few places near New York City. For medicinal purposes, the bark is collected in the spring, from the younger trunks and large branches. Large quantities also result as a bye-product from the peeling of the wood for the making of gunpowder carbon. The sharply purgative properties of the fresh bark are ameliorated by the peasants by keeping it a year before using, as our definition requires.

Fig. 184.



Frangula.

Description.—In quills of variable length, rarely exceeding 2.5 Cm. (1 In.) in diameter, and frequently flattened or crushed, the bark 1 Mm. ($\frac{1}{25}$ In.) or less in thickness; externally from dark-gray to purple-black, usually with transversely elongated, rarely circular white spots and occasionally with ashy patches of lichen-growth, irregularly wrinkled and often warty-roughened; internally nearly smooth, minutely striate, dark-yellow to brown; fracture short and deep-purple in the outer, fibrous and yellow in the inner layer; odor distinct, peculiar; taste somewhat aromatic, sweetish and bitter; tingeing the saliva yellow when chewed.

When moistened with lime water, it acquires a red color. With cold water it yields a yellow, and with hot water a brown, infusion, which is colored dark-brown, but not precipitated, by ferric chloride.

The powder exhibits an absence of stone-cells, which distinguishes it from Cascara Sagrada. The official bark is to be distinguished from that recently collected by its relative weakness and less disagreeableness of odor and taste, and by the dark color of the inner surface. When first collected, this is light-yellow, but very quickly turns to a medium or deep yellow, afterward becoming darker gradually. At the end of a year most of the quills should show a brown inner surface, this becoming blackish-brown after long keeping. Dieterich believes that the same effect as that of aging (the destruction of the irritating and nauseating ferment) can be secured by heating, since he maintained the bark in a temperature of 37.7° C. (100° F.) for 48 hours without decreasing the amount of the glucosides.

Constituents.—The most important constituent is *frangulin* or *rhamnoxanthin* ($C_{21}H_{21}O_9$), which occurs in odorless and tasteless, silky-lustrous, lemon-yellow crystals; by sublimation it forms yellow needles. It is soluble in hot fixed oils, benzin, turpentine, 160 parts of warm 80 per cent. alcohol, and with a bright-purple color in alkalies; it is insoluble in water, and nearly insoluble in cold alcohol and ether. It dyes cotton, wool, or silk. Boiled with dilute acids it yields *rhamnose* ($C_6H_{12}O_5$) or *rhamnodulcite* ($C_{21}H_{20}O_9$) (Schwabe), and *emodin* ($C_{15}H_{10}O_5$). The bark also contains yellow resinous matter, tannin, an amorphous bitter principle, and an odorous volatile principle. The ash amounts to 5 or 6 per cent. When fresh, the bark contains a nauseating hydrolytic ferment, which is destroyed by heat or long keeping. Kubly's *avornin* is impure fran-

gulin, and his *frangulic acid* is *pseudofrangulin* (Aweng), which hydrolyzes to *pseudoemodin*, both being somewhat aperient.

Pharmaceutical Preparations.—Elixir of Frangula, N. F.; Fluidextract of Frangula, U. S. P.

Action and Uses.—Frangula in the fresh state is exceedingly acrid, and when taken internally produces gastro-intestinal pain, with nausea and vomiting and excessive purgation. In the dried state it loses its acridity considerably, and is then said to resemble senna and rhubarb in its action. It is employed quite extensively in Great Britain and Germany in the treatment of habitual constipation, but is rarely used in the United States for this purpose. It may be administered in the dose of 20 minims (1.3 Cc.) of the fluid extract twice daily. A decoction (1 ounce to the pint) may be given in the dose of 4 drachms (16 Cc.), in the treatment of dropsy, and may also be locally applied as a cure for itch.

FRAXINUS.—Ash.

Esche, G.; *Frêne*, Fr.; *Fresco*, Sp.

The dried bark of several species of *Fraxinus* L. (Fam. *Oleaceæ*), especially of *F. Americana* L. (*F. acuminata* Lam.; *F. alba* Marsh.; *F. epiptera* Mx.; *F. Caroliniana* Wang.), the *White* or *American ash* or *Cane ash*, and *F. excelsior* L., the *European ash*.

The European species is often cultivated as a shade-tree in the United States. The American white ash grows almost throughout eastern and central North America. It attains a height of 18 to 24 M. (60 to 80 Ft.), has a durable, tough wood, 7 to 9 ovate-oblong, acuminate leaflets, and a terete fruit extended above into a spatulate-linear wing. The bark, which has been employed, is collected from the trunk and the root, the latter being preferred.

Description.—Ash bark is 3 to 6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ In.) in thickness, usually freed from the corky layer, whitish or yellowish, sometimes brownish, frequently with ridges of a warty cork adhering, and upon the inner surface yellowish and smooth; it breaks with a very fibrous fracture, and has a slight aromatic odor and a bitter and somewhat acrid taste.

European ash bark occurs in quills which are gray or greenish-gray externally, with numerous small gray or brownish-white warts, the inner surface yellowish or yellowish-brown and nearly smooth; fracture smooth, fibrous in the inner layer; odor slight; taste bitter and astringent.

Constituents.—European ash bark contains the bitter glucoside *fraxin* ($C_{16}H_{18}O_{10}$), the bitter substance *fraxetin* ($C_{10}H_8O_5$), tannin, quercitrin, mannit, a little volatile oil, gum, malic acid free and combined with calcium. The American contains tannin, resin, and a little volatile oil, and perhaps an alkaloid.

Action and Uses.—Ash bark has been employed as a bitter tonic and astringent, and is said to be valuable as an antiperiodic. Infusions of the leaves are said to be diuretic, diaphoretic, and purgative. They have been employed in the treatment of gout and rheumatism. The bark has been used in the treatment of intermittent fevers, but at present is rarely employed. An infusion of the leaves, 1 ounce to the pint (30 Gm. to 480 Cc.), may be given during the 24 hours.

Allied Species.—Southward, especially in Mexico, the bark and leaves of *F. nigra* Marsh. (*F. sambucifolia* Lam.), the *Black*, *Swamp*, *Water*, *Hoop*, or *Basket ash*, are similarly employed. In Mexico, also, the bark and leaves of *F. lanceolata* Borck. (*F. viridis* Mx.), the *Green* or *Blue ash*, are employed as a bitter tonic, and the root as a diuretic. The fruits of the different species of ash are regarded as somewhat more active than the bark and leaves.

Oleaceæ.—This family, to which *Fraxinus* belongs, comprises some 20 genera and about 350 species. Besides the Olive, its most important product, and Manna, it is notable for some highly ornamental plants, including the Jasmines, the Lilacs, and the Fringe-tree. Besides the species of ash above considered, the following medicinal species are worthy of note:

Chionanthus is the bark of the root of *C. Virginica* L., the *Fringe-tree*, *White fringe*, *Gray beard* or *Old man's beard*, *Shavings-tree*, or *Flowering ash*, of the southeastern United States. It has also been called *Poison ash*, apparently without reason. The bark is intensely bitter, and contributes its bitterness to both alcohol and water. The bitter principle has not been studied. The drug has many uses among the eclectics and homœopaths, especially as a depurant in hepatic and syphilitic disorders. It may be used in doses of from 15 to 30 grains (1–2 Gm.).

Ligustrum is the bark and leaves of the European *L. vulgare* L., the well-known privet, so largely used for hedges. The drug contains the crystalline tasteless glucoside *syringin*, so

called because first found in Syringa; also a bitter resin. *Syringopikrin*, another constituent of Syringa, is said also to occur in this drug. Ligustrum has been used as an abdominal astringent, especially in ulcerated conditions of the stomach and intestines. Its fruits are poisonous.

Syringa is the leaves of *S. vulgaris* L., the common garden Lilac, native of Europe. Its composition appears almost identical with that of Ligustrum, and its uses are similar.

The roots of several species of *Jasminum* L. have had various ill-defined uses in medicine. One of them, at one time known as "Gelseminum," led to a serious confusion concerning the name *Gelsemium*.

The genus *Linociera* yields a number of edible tropical fruits.

FUCUS VESICULOSUS.—Bladder-wrack.

Quercus marina, Sea-wrack, Lady-wrack, Kelp-ware, Black-tang, Cut-weed, Sea-oak, E.; *Varech vésiculeux*, Fr. Cod.; *Blasentang, Höckertang, Seetang, Seereiche, Meereiche*, G.; *Encina de mar, Fuco avejigado*, Sp.

The entire dried plant, *Fucus vesiculosus* L. (Fam. *Fucaceæ*), a coarse, light-yellow or brownish-green sea-weed, growing in the greatest abundance on submerged rocks along the northern coasts of both the Atlantic and Pacific. It is collected and dried upon the beach, care being taken to turn it frequently, to avoid the development of a putrid odor. The thallus sometimes reaches a length of 3 or 4 feet, but the drug is almost always in shorter pieces.

FIG. 185.

Fucus vesiculosus: fruiting branch (Nat.).

Description.—The size and form of thallus and air-vesicles are shown in Fig. 182. It forms a much-wrinkled mass, blackish or with more or less of a whitish efflorescence or incrustation. It has a marine odor and a mucilaginous and saline taste. Occasionally, from some unexplained cause, it is very astringent.

Constituents.—Fucus contains a very little volatile oil, to which its odor is but partly due. There is considerable mucilaginous matter, the nature of which has not been investigated, associated with a peculiar cellulose. The bitterness is probably due to a specific constituent. Its important constituents are inorganic, being iodine and bromine compounds of sodium and potassium, contained in the ash, which is from 2.5 to 4 per cent. Its charcoal, which is similarly used, is called *Æthiops vegetabilis*.

Action and Uses.—Bladder-wrack is not largely employed in medicine at the present time. It probably depends for its activity upon the iodine and bromine present. The bruised plant, and also the mucus found in the vesicles, have been locally applied to enlarged glands. Internally a decoction (4 drachms to the pint) (16 Gm.–480 Cc.) is said to have been useful in the treatment of obesity, and a charcoal prepared from the plant has been given in the treatment of goiter.

The decoction may be given in doses of 2 fluid-ounces (60 Cc.), 3 times daily. An alcoholic extract may be given in doses of 10 grains (0.60 Gm.) daily, and gradually increased.

Allied Species.—FUCUS NODOSUS L. (*Fucodium nodosum* Agardh) is about 1.2 to 1.8 M. (4 to 6 Ft.) long, and has a narrower frond or thallus without midrib, and with single vesicles, which are ovate or oblong, and usually large.

FUCUS SERRATUS L. has a veined and serrate frond, without vesicles.

FUCUS SILIQUOSUS L. (*Cystoseira s.* Agardh; *Halidrys s.* Lyngbye).—The frond is very narrow, 0.6 to 1.2 M. (2 to 4 Ft.) long, with short branches, articulated vesicles of a pod-

like appearance, and lanceolate flattened tubercular fruitification. This and the preceding species are permitted by the French Codex to be employed in the place of *F. vesiculosus.*

Fucus natans L. (*Sargassum bacciferum* Agardh) is the *Gulf-weed* of the Atlantic Ocean, and is often found in immense masses floating in the sea. The frond is terete, and has linear and serrate branches and globular aculeate and stipitate vesicles of the size of a pea.

The fronds of various species of *Laminaria* are similarly used.

FUNGI.

This great division of flowerless plants, distinguished by the absence of chlorophyll from their tissues, is, with the exception of Ergota, of slight importance in medicine. If, as in accordance with some classifications, the bacteria be included, the fungi become of great economic importance. The useful and injurious relations of bacteria to man, through their direct effects upon his body, or indirectly through their effects upon those vegetable and animal substances which contribute to its support and comfort, cannot be considered in this article. Although these relations are frequently medicinal or toxicological, their history must be sought in works upon pathology, or under special titles (see Antitoxin).

The medicinal relations of the Fungi have for the most part been considered under the titles Agaricus, Taka-diastase, Ergota, and Cerevisiæ. It may be added that *Lycoperdon Bovista* L. (*L. giganteum* Batsch ; *Bovista g.* Nees), the *Giant puff-ball, Vesse-loup* (Fr.), *Bovist* (G.), was formerly known as "Fungus Chirurgorum," and was used for arresting hemorrhages (see Agaricus). *Elaphomyces granulatus* Fries (*Lycoperdon cervinum* L.), the *Hart's truffle*, or *Puff-ball, Truffe de cerf* (Fr.), *Hirschbrunst* (G.), a brown, warty species, about as large as a walnut and purplish-brown internally, was used for its supposed stimulant properties.

Lycoperdon, Puff-ball, Tuckahoe or *Indian bread,* is the fungus *Lycoperdon solidum* Gronovius (*Pachyma Cocos* Fries). The botanical names assigned to it have little value, since its life-history is so poorly known that it has not yet been classified. It is found attached to the roots of coniferous trees in the southern United States. It is said to grow in China also, and to be there known as *Fuh-ling.* It is irregularly globular or oval, 30 Cm. (1 Ft.) or less in diameter, and sometimes weighs several pounds. The outer surface is ashy-black and rugose, the inner tissue whitish and firm, though somewhat spongy and usually somewhat mealy, and of an irregular fracture. It is odorless and nearly tasteless, and is said, when cooked, to have been an important article of food among the aborigines. It consists chiefly of cellulose and pectose, in exceedingly variable ratio, with a little gum and glucose and a very little albuminoid.

The principal object of the present article is the consideration of the following poisonous fungi, which are often mistaken for edible species :

Of the larger Fungi, the edible species vastly outnumber the poisonous ones, but comparatively few of them are used—very few of them generally so. Most of those used are more or less resembled by poisonous species, and the similarity is in some cases so great that accidental poisoning is common. Although each such case of similarity should be studied as to the individual distinctions, yet the formulation of general rules for the rejection of all poisonous species has been always regarded, and with the best of reason, as of paramount importance. The most important of these general rules is that no one should collect any fungus for food purposes unless he shall have previously become thoroughly familiar with its identification. The following general rules have been formulated by Farlow : (1) Avoid Fungi when in the button-stage, and after the flesh has begun to decay, even if slightly ; (2) avoid those with a swollen base which is surrounded by a sac-like envelope, especially if the gills are white ; (3) avoid those having a milky juice unless such juice be reddish ; (4) avoid those with a spider-web or flocculent ring hanging to the upper part of the stalk ; (5) avoid those in which the pileus is thin in proportion to the gills and in which the gills are nearly all of equal length, particularly if the pileus be brightly colored ; (6) avoid those having a tubular or hollow stem, and of which the flesh changes color when cut or in which the mouths are reddish (other tubular-stemmed forms should be treated with caution).

The phraseology employed in the above rules is explained in the following individual account of the more important edible and poisonous species. The most largely consumed fungus is undoubtedly *Agaricus campestris* L., the common mushroom. Its life-history is in a general way typical of most of the other species here considered. The edible body is known as the *thallus,* and represents a stage of development distinct from that of the *mycelium,* the filamentous underground growth from which the thallus develops. The thallus makes its appearance as a globular mass, the "button-stage" referred to above, borne upon a short stem, as yet not visible. In this condition its distinctive characters are not apparent, and a poisonous species may easily be mistaken for it. The stem now elongates, and from it separates the lower edge of the ball or button. This edge is then elevated and carried outward until the ball becomes converted into an umbrella-shaped crown, the *pileus.* The

upper surface of the latter is now brownish-white, somewhat roughish, and a thickish, soft but somewhat tough skin can easily be peeled off from it. The pileus is quite thick, and its edge especially presents a thick aspect. The inferior surface is occupied by blade-like gills or *lamellæ*, which are pinkish or pinkish-brown, do not quite reach to the stem, and are of different lengths. The stem is solid, but its center is occupied by a sort of pithy substance. When still young, a thin membrane projects shortly from the stem at the point where the edge of the pileus separated from it, but this nearly or quite disappears afterward. Although younger mushrooms are preferred by most persons, the stage above described is that in which it can be collected without much fear of a mistake. It has no acid or biting taste in the raw condition. Later, the pileus enlarges, often to a breadth of 6 inches or more; the lamellæ become brown, then black, being loaded with ripe spores; and finally the whole softens and breaks down. In these later stages, decomposition may render even wholesome species dangerous, from ptomaine-poisoning. The poisonous fungi most resembling the mushroom

FIG. 186.

Amanita phalloides (Nat.) (after Atkinson).

are the *Amanitas*. These possess an organ not found upon the mushroom, but common to many other fungi, the *volva*. This is originally a covering to the unopened pileus. With the growth of the latter, the volva becomes ruptured, but commonly persists as a cup or tube surrounding the base of the stem, its margin entire, toothed, or even divided up into a ragged circle of scales; or, part or all of the volva may persist in the form of scales upon the top of the pileus. Although one species of *Amanita*, and various other fungi possessing a volva, are edible, yet the safest plan for those not familiar with them is to avoid all species possessing this organ. The Amanitas may also be distinguished from the mushrooms by their white lamellæ or gills and the relatively thin edge of the pileus. The poisonous Amanitas are not very liable to be mistaken for the mushroom, since the top of the pileus is usually colored, from yellow through shades of orange to red, or occasionally olive-brown. *A. phalloides* is, however, frequently white, in which case its other characters must be depended upon for recognition. This species is commonly called *Death-cup*, and is the most fatally poisonous of all Fungi. Its volva is partly a ragged-edged, basal cup, partly in scales upon the top of the

pileus, one or the other position predominating in different cases. It has a well-developed, partly drooping, white veil. *A. muscaria* (L.) Pers. (*Agaricus muscarius* L.), the *Fungus muscarius*, *Fly-agaric*, *Fly-fungus*, *Flybane* or *Bug-agaric*, *Agaric mouche* (Fr.), *Fliegenschwann* (G.), most commonly found growing in pine forests, is similar. Its upper surface is usually more brightly colored, the volva mostly in the form of scales upon the top of the pileus. Other poisonous European species of this genus are *A. panterina* and *A. verna*, the latter regarded by some as a variety of *A. phalloides*. The constituents of these Amanitas are considered below. Although the mushroom is thus pretty readily distinguished from the poisonous Amanitas, the same is not true of a fungus which is very largely consumed in southern Europe, namely, the *Amanita Cæsarea* ("Cæsar's mushroom"). So closely related to the above poisonous species, it shares their general appearance, and it is in seeking for this that most of the fatal mistakes are made. It is for this reason that most of the persons poisoned in the United States are foreigners, who have brought their knowledge of edible and poisonous species with them to this country. *P. Cæsaria* does, however, grow with some freedom

FIG. 187.

Amanita muscaria (Nat.) (after Atkinson).

Common mushroom (Nat.) (after Atkinson).

in the southern United States. Its stem, veil, and lamellæ are yellow, and it has a white volva in the form of a cup.

The Lepiotæ, or *Parasol fungi*, are edible and closely related to the Amanitas. They are hollow-stemmed and have no volva. One, with green spores, is somewhat poisonous. That most eaten is *L. procera*, with a brown pileus. *L. naucinoides* is white and more closely resembles *A. phalloides*.

A great many of the puff-balls (*Calvatia*) are eaten when in their early condition of a solid ball of cheesy texture, especially the large one *C. Bovista*. There is nothing of a poisonous character likely to be mistaken for them, except perhaps some of the *Stinking fungi*, too quickly known by their offensive odor. The same statement will apply to the subterranean truffle, collected in Europe, as well as the largely eaten *Morchellas* and *Gyromitras*. The latter, as well as the puff-balls, are apt to develop poisonous properties when old, even before decomposition sets in, so that they should be eaten only before the development of the spores. In many cases, the poisonous constituent is *helvellic acid*. Partial boiling, followed by rejection of this water and washing, is a safe procedure. The common puff-ball, when cooked, is said to have been an article of diet among the North American Indians. The smoke from the burning plant has been employed in the country for the purpose of stupefying bees in order that their honey may be collected without difficulty. It was formerly thought to contain a narcotic principle, but it has been determined that the stupefying effect of the smoke is due to the presence of carbon dioxide. If inhaled in large amount, it causes anæsthesia, and excessive quantities cause death by respiratory failure. A 25 per cent. tincture has been recommended in 1 drachm (4 Cc.) doses in the treatment of nervous affections, but the drug is of little importance in internal medicine.

Of the numerous other edible species, few are very generally consumed, and space for their further consideration is wanting. Some of them are resembled by poisonous species,

but the latter commonly have either an acrid, peppery, or biting taste when raw, or a vile odor.

Poisonous Constituents.—Kobert classifies the poisonous principles in Fungi into: (1) the acids—*e. g.*, helvellic acid; (2) alkaloids or alkaloid-like substances, as muscarine and neurine; (3) albuminoid or albuminoid-like compounds, as the enzymes, and phallin and other toxalbumins. From a pharmacopathological standpoint, they may be (excepting Ergot), divided into: (1) those acting purely upon the nerves, as muscarine and fungus-atropine; (2) those that produce local irritation, as various species of *Lactarius* and *Russula;* (3) those acting primarily upon the blood, as helvellic acid and phallin. The most important constituents are *muscarine,* especially in *Amanita muscaria,* and *phallin,* especially in *A. phalloides.* Muscarine ($C_5H_{15}NO_3$) is an alkaloid which is colorless, inodorous, crystalline, very deliquescent, insoluble in ether, sparingly soluble in chloroform, strongly basic, and yielding deliquescent salts which are precipitated by mercuric chloride, auric chloride, and potassio-mercuric iodide. Phallin is much less known, in all ways, than muscarine. It appears to be an albuminoid substance, related to serpent-venom and to the poisonous constituents of ABRUS, but differing from them in its greater activity when absorbed through the stomach. It is coagulated by heat, and is soluble in a solution of common salt. "Amanitine" is now known to be identical with choline. Kobert believes that *A. muscaria* contains another alkaloid antagonistic to muscarine, which he has called *pilzatropine.*

The action of *Amanita muscaria* depends principally upon its alkaloid muscarine. It prolongs the diastolic period of the heart, and large quantities may produce diastolic arrest. Upon the vasomotor system and the respiratory center it acts as a decided depressant, and its action upon the abdominal contents is also quite marked; peristaltic action at first being held in abeyance, and secondarily being greatly increased. Muscarine has been employed as a remedy for epilepsy, but is probably of little value. A 1 per cent. solution of an alcoholic extract has also been recommended in doses of from 5 to 15 minims (0.30–1 Cc.) in the treatment of the night-sweats of phthisis, and is said by those who have employed it most to be of some value. When poisonous doses have been taken, the symptoms usually make their appearance several hours after ingestion, and consist of respiratory and circulatory depression, nausea and vomiting, lacrymation, ptyalism, and at times great muscular depression. The body becomes covered with a cold, clammy sweat, the pulse becomes rapid and thready, and the patient passes into collapse. The condition should be met by the prompt administration by the hypodermic needle of large doses of atropine, which is the physiological antagonist, by the application of external heat, and by the early use of the stomach-tube or emetics. Purgatives such as castor oil should be freely given as early as possible.

The symptoms produced by the accidental ingestion of *Amanita phalloides* are usually delayed for the greater part of twenty-four hours, and consist of great respiratory and circulatory depression followed by collapse. The body becomes covered with a cold, clammy sweat, severe headache is present, and an active delirium sometimes occurs. Suppression of urine, albuminuria, hæmoglobinuria, or jaundice may occur. The temperature is frequently increased and the pulse is running and thready. After death the internal viscera are found to be in a state of fatty degeneration. The treatment consists in the administration of stimulants as indicated, and the emptying of the alimentary canal by means of emetics and purges. Atropine is to be freely used as an antidote.

G.

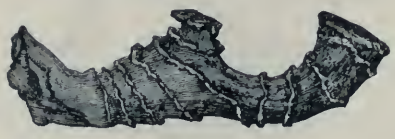
GALANGA.—Galangal.

Chinese ginger, E.; *Rhizoma (Radix) galangæ (minoris)*, P. G.; *Galgant*, G.; *Galanga*, Fr., Sp.

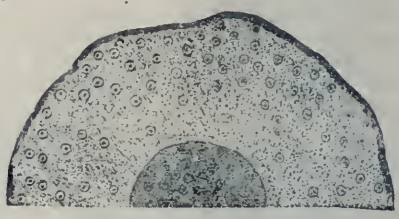
The dried rhizome of *Alpinia officinarum* Hance (Fam. *Zingiberaceæ*).

Origin.—From a perennial flag-like herb, bearing terminal racemes of white, red-veined flowers, native and somewhat cultivated in southeastern China.

FIG. 188.



Galanga.



Galanga: transverse section (× 3).

Description.—In sections, mostly short-branched, about 5 to 7 Cm. (2 to 3 In.) long and 0.5 to 2 Cm. ($\frac{1}{5}$ to $\frac{4}{5}$ In.) thick, terete, the joints somewhat thickened toward their summits; externally bright- or reddish-rust-brown, lightly wrinkled, slenderly annulate with the leaf-vestiges; internally pinkish or grayish-brown, quickly turning rust-brown after exposure; fracture tough, somewhat fibrous; transverse section exhibiting a dark endoderm at about one-third of the radial distance from the center, the oil-cells and wood-bundles scattered, the latter more numerous within the endodermis; odor and taste agreeably aromatic and pungent, ginger-like.

Constituents.—Galangal contains about 0.5 per cent. of pale- or brownish-yellow volatile oil, with a camphoraceous odor due to a large proportion of cineol, a soft acrid and pungent resin, gum, bassorin, 23 per cent. of starch, fixed oil, and 3 yellow crystalline principles, kaempferid, galangin, and alpinin ($C_{17}H_{12}O_6$). Kaempferid or "campheride" ($C_{16}H_{12}O_6$) is almost insoluble in water and alcohol, and with nitric acid forms anisic acid, oxalic acid, and other products. *Galangin* ($C_{15}H_{10}O_5$) is soluble in 68 parts of 90 per cent. alcohol and in 34 parts of absolute alcohol, and, oxidized by nitric acid, yields benzoic and oxalic acids. *Galangol* is an active pungent principle separated by Thresh.

The powder, except in color, which is rust-brown, quite closely resembles that of ginger. More fibers occur in it, and its starch-grains, much like those of ginger, average not more than half their size.

Action and Uses.—Galangal may be employed as a stimulant aromatic and carminative, promoting digestion and relieving flatulence. The drug may be given in doses of from 20 to 30 grains (1.3–2 Gm.); or a tincture (1 in 10) may be given in doses of 1 fluidrachm (4 Cc.).

Allied Drugs.—*Alpinia Galanga* Willd. (*Maranta G.* L.), the *Greater galangal*, *Radix galangæ majoris*, is rarely seen in our commerce. It resembles the preceding, but is longer and thicker, externally brown-red, internally buff-colored, and is weaker in odor and taste. Eight other species of the genus are recorded in literature as yielding aromatic products in the form either of rhizomes or seeds, several of the former being used as ginger-substitutes, of the latter as "Alpinia-" or "Galanga-cardamons."

GALBANUM, *Br., P. G.*—Galbanum.

Gummi-resina galbanum, *Galban*, *Mutterharz*, G.; *Galbanum*, Fr.; *Galbano*, Sp.

The gum-resin obtained from *Ferula galbaniflua* Boissier et Buhse (Fam. *Umbelliferæ*), and probably from other allied plants.

Origin.—Other species which have been named as sources of Galbanum are *F. rubricaulis* Boiss., *F. Schair* Borscz., *F. erubescans* Boiss., and *F. gummosa* Boiss., but it is uncertain which of these names are synonymous with that of our definition. The Galbanum plants are large, stout perennials, similar to those described under ASAFŒTIDA, and they are natives of the same general region. Little is known of the method of collecting Galbanum, but the appearance of the mass appears to indicate that it is from artificial incisions, made much after the method employed in gathering Asafetida, since sliced fragments of the root are often present. The Galbanum of the British and German pharmacopœial descriptions is that usually known as *Levant Galbanum*, and this is the one commonly understood.

Description.—Occurring in tears of variable form, these distinct or more or less agglutinated or imbedded in a brownish matrix, usually with some slices or other fragments of tissue intermixed; mass opaque or usually somewhat translucent, tears mostly less than 6 Mm. (¼ In.) in diameter, occasionally several times larger, the external color varying from a peculiar bluish-green when very fresh, to brownish or brown, or when long kept of a dark reddish-brown; rendered soft and sticky by the heat of the hand, when cold becoming dry and brittle, the fracture slightly conchoidal or, usually, granular, mostly light-yellow or yellowish-brown; odor balsamic, peculiar, and characteristic, not unpleasant; taste bitter, acrid, and disagreeable. At least 50 per cent. of Galbanum should dissolve in alcohol, and the ash should not exceed 10 per cent., not more than 8 per cent. being yielded if perfectly pure.

Moistened with alcohol, a fine purple color will be produced on the addition of a little strong hydrochloric or nitric acid. Hydrochloric acid remaining in contact with galbanum for about an hour acquires a red color, and on the gradual addition of alcohol and warming the mixture to 60° C. (140° F.) becomes transiently dark violet-colored (difference from Ammoniac, which is not colored). Water in contact with galbanum which has been heated to redness, shows a blue fluorescence on the addition of a minute quantity of ammonia water.

Lump galbanum consists sometimes of soft or harder brown masses, in which some tears are distinctly observed.

Galbanum is far less subject to adulteration than Asafetida, though earthy matters (in *Drossy Galbanum*) and vegetable tissues are often added. The latter is chiefly derived from the Galbanum plant, but foreign tissues are also included.

Constituents.—The gum-resin yields from 10 to 20 per cent. of colorless volatile oil, which becomes yellow and thick on exposure, 50 to 67 per cent. of resin, 15 to 20 per cent. of gum, and various impurities. The resin is yellowish-brown, very soft, and soluble in ether, alcohol, and alkalies. It contains 0.25 per cent. of free umbelliferon ($C_9H_6O_3$), and 20 per cent. of umbelliferon combined with galbano-resino-tannol, which amounts to 50 per cent. On destructive distillation and subsequent separation of the products it yields a colorless oil ($C_{10}H_{16}$), a clear blue oil, $(C_{10}H_{16}O)_n$, identical with the blue portion of Matricaria, fatty acids, and acicular crystals of umbelliferon. Fused with potassa, it yields resorcin and fatty acids, and boiled with nitric acid it forms *tri-nitro-resorcin* or *styphnic acid* ($C_6H_3N_3O_8$).

Oil of galbanum, which is a commercial article, has partly the odor of the drug, is of a light-yellow to brownish-yellow color, and has a specific gravity of 0.910 to 0.940. It contains d-pinene and cadinene, with other constituents.

Action and Uses.—When locally applied, galbanum acts as a counterirritant and rubefacient, and if the skin is exposed produces ulceration. Internally it acts as a stimulant expectorant and antispasmodic. In the form of a plaster it may be locally employed in the treatment of indolent ulcers and swellings for the purpose of promoting respectively suppuration or resolution. Internally it is said to be of value in the treatment of chronic bronchial affections; chronic catarrhal conditions of the intestines, and in amenorrhœa resulting from an atonic condition of the uterine mucous membrane. The internal dose is from 10 to 20 grains (0.60 to 1.3 Gm.), either in pill or emulsion, 3 times daily.

Other Galbanums.—The Galbanum described above is that commercially known as *Levant Galbanum*. Another variety is occasionally seen which is distinguished as *Persian Galbanum*. While this bears a general resemblance to the former, it differs in its peculiar shining surface and in its odor, which is characterized as turpentine-like rather than balsamic. It is usually of a darker and more reddish-brown than the Levant variety. Persian Galbanum occasionally occurs as a thick liquid, but this has the same characteristic odor as the solid form. Persian Galbanum contains less volatile oil (usually from 3 to 5 per cent. in the lump form), nearly 70 per cent. of resin, and 17 per cent. of gum. Its volatile oil is said to rotate to the right instead of to the left, as does that of the Levant variety.

GALLA, *U. S., Br.*—Nutgall.

Gallæ, P. G.; *Galla halepense, G. turcica, G. levantica, G. tinctoria, G. quercina.*—*Galls, Aleppo* or *Syrian galls*, E.; *Galläpfel, Gallen*, G.; *Galle de chêne, Noix de galle*, Fr. Cod.; *Agallas de Levante*, Sp.; *Galhas, Noz de galha*, Port.; *Noci di Galla, Galla di Lavante*, It.

An excrescence on *Quercus lusitanica* Lam. (*Q. infectoria* Olivier—Fam. *Cupuliferæ*), caused by the punctures and deposited ova of *Cynips* (*Diplolepsis*, Latreille) *Gallæ tinctoriæ* Olivier (Class *Insecta*, Order *Hymenoptera*).

Galls are official in all pharmacopœias, several of which require that the tannin-content be 60 to 70 per cent.

Origin.—*Quercus lusitanica*, the *Dyers' oak*, is a polymorphous shrub or small tree, inhabiting the eastern basin of the Mediterranean, from Greece to Persia. The tender bark of the young branches is punctured by the female of the hymenopterous insect named above, and one or more eggs are deposited in the wound. The irritation produced by this operation causes the formation of an excrescence enclosing the larva, which undergoes therein its transformations. The term *gall* is generally used to designate such excrescences formed upon any part of a plant in consequence of the puncture of an insect. If collected before the escape of the insect from them, effected by boring a hole to the exterior, the galls have the appearance described below. Otherwise they become slightly larger and lighter in weight, and assume a pale or whitish-yellow color, being then relatively deficient in tannin. Aleppo or Turkish galls are regarded as the best. Large quantities are also exported from Persia and some from Greece.

Fig. 189.

Entire. Section.

Nutgall.

Description.—Nearly spherical, about 2.5 Cm. (1 In.) or less in diameter, with a short stipe, the surface smooth except for a number of short, thick tubercles toward the summit; externally deep greenish- or bluish-gray or blackish; heavy and hard, but readily broken with a hammer, exhibiting a more or less dense granular fracture, sometimes with a waxy luster; internally, yellowish or pale brownish-gray, with a central nucleus or a cavity containing the more or less perfectly developed insect. The cellular tissue of the nucleus is mostly filled with small starch-granules and surrounded by a layer of thick-walled cells forming a shell, on the outside of which is the cellular tissue containing the tannin. This tissue has often a radiated appearance near the shell, and contains toward the surface small scattered bundles of vascular tissue. Nutgalls are nearly inodorous and have a very astringent taste. Light, spongy, and whitish-colored nutgalls should be rejected.

Nutgalls are distinguished in commerce according to their color, the *blue* or *black galls* of Syria (Aleppo) being preferred. *Smyrna galls* are usually of a grayish olive-green, more spongy in texture, and intermixed with *white galls;* the last-named are the least valuable.

Constituents.—The principal constituent of nutgalls is *tannin* or *gallotannic acid*, of which they contain about 60 per cent. Bowman (1869) assayed selected galls, finding 80 per cent., and in white galls only 30.7 per cent. 2 or 3 per cent. of gallic acid is likewise found, together with sugar, resinous and albuminous matter, and starch.

Pharmaceutical Preparations.—Ointment of Nutgall; Tincture of Nutgall, U. S. P.

Action and Uses.—Nutgall was formerly quite extensively employed for its powerfully astringent effect, but gallic and tannic acids have practically replaced it.

Other Varieties of Galls.—The number of galls produced upon different plants and by different insects is very great. They very frequently contain tannin, and a number of them are used like the official.

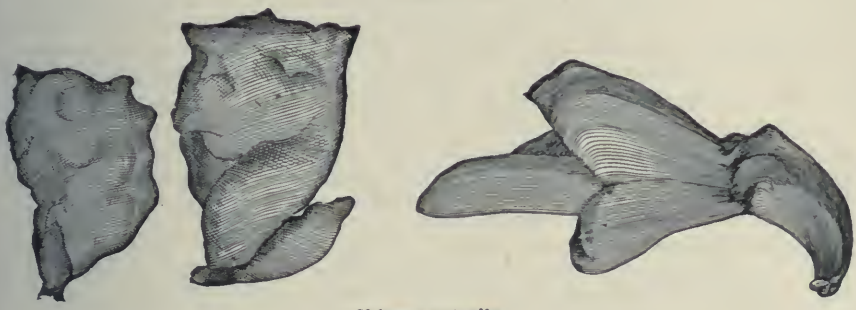
Bassorin Galls, from the same general region as the official, are imported in the form of fine powder, pressed into cakes, for dyeing purposes. They contain about 36 per cent. of tannin.

Sorian Galls are of the size of a pea, blackish, and internally not radiate. The galls which are produced upon the European oaks by different species of Cynips are of a lighter color and more spongy texture, but have an astringent taste and contain tannin.

Chinese and *Japanese Galls*, although known from a much earlier period, were not a regular article of commerce until Periera (1844) directed attention to them again. They are

produced upon the leaves or leaf-stalks of *Rhus semialata* Murray, by an insect provisionally named *Aphis Chinensis* Bell, and usually contain between 70 and 80 per cent. of tannin. They are of a very irregular shape, mostly thin, as if stalked, toward the base, much inflated above, irregularly lobed, and with few or many protuberances; they are of a reddish-brown color, but densely covered with a yellowish-gray down, consist of a thin, fragile shell, and contain in the interior numerous small dead insects. The Japanese nutgalls agree in all essential characteristics with this description, but are usually more slender and have a larger number of sharper lobes and protuberances; their origin has been referred to *Rhus japonica* Siebold. C. Hartwich (1881) found their pubescence quite dense and light-brown, and the tissue to contain unaltered starch-granules; while Chinese galls have the pubescence less dense and greenish-brown. *American Nutgalls*, as obtained from various species of *Quercus*, are light and spongy, and generally not very rich in tannin. The galls from *Quercus virens* Aiton, produced in Texas, are more analogous to Aleppo galls, but not tuberculate; they contain

FIG. 190.



Chinese nutgalls.

about 40 per cent. of tannin. The so-called *California oak-balls* are derived from *Quercus lobata* Engelmann, are about 5 Cm. (2 In.) in diameter, orange-brown and somewhat glossy externally, soft and spongy within, and appear to contain much tannin.

Tamarisk Galls are collected from *Tamarix orientalis* Forst., which grows in southern and southwestern Asia. They are $\frac{3}{12}$ Mm. ($\frac{1}{8}$–$\frac{1}{2}$ In.) thick, subglobular, knotty, and are said to contain from 40 to 50 per cent. of tannin. Similar galls are obtained in Algeria and Morocco from *T. Africana* Poir. The brown-red, fibrous, bitter, and astringent bark of *T. gallica* L., and the leaves of the same plant, are used in southern Europe.

Myrobalans.—Similar to Galls as to their general properties and uses are the dried fruits of *Buceras Bellirica* (Gærtn.) Lyons (*Myrobalanus B.* Gærtn.; *Terminalia B.* Gærtn.), the *Round* or *Belleric myrobalans*, and of *B. Chebula* (Retz.) Lyons (*Terminalia C.* Retz.; *Myrobalanus C.* Gærtn.; *Bucida comintana* Blanco), the *Long*, *Indian*, or *Black myrobalans*, *Ink-nuts*, *Hare-nuts* (Fam. *Combretaceæ*), of the East Indies. These fruits are the product of good-sized trees. Of the first-named, there are two varieties, so called, though they are more likely distinct species. The smaller one is nearly globular, with a suddenly contracted base, a little more than a half inch in diameter, brown or gray-brown, 3-ridged, finely woolly or velvety. The pulp is the astringent part. The pentagonal stone contains an oily seed. The larger form is oval-ovoid and more than an inch in length. The amount of tannin ranges from 5 to 15 per cent. or more. The kernel is edible, but there are some ill-defined claims that it is sometimes poisonous. The Long, or Chebula kind is an inch to an inch and a half long, oval or obovoid, with 5 or 6 shallow furrows separating as many indistinct faces. They are also collected unripe, when they dry black and shrivelled and only about half as large. They contain from about 30 to 45 per cent. of tannin. The tannin in all the varieties is mostly gallotannic acid.

Of *B. Arjuna* (Bedd.) Rusby (*Terminalia A.* Bedd.), the bark is used in India as an astringent. The kernel of *B. Catappa* (L.) Lyons (*Terminalia Catappa* L.; *Buceras Bucida* Crantz; *Bucida Buceras* Sieber) yields a seed which is used as a substitute for sweet almonds.

Phyllanthus Emblica L. (*Emblica officinalis* Gærtn.—Fam. *Euphorbiaceæ*), an East Indian tree, yields *emblic myrobalans*, which are drupaceous, subglobular, 6-grooved, and 3-celled, each cell containing 2 small brown-red glossy seeds.

Under the name *Vallonea*, *Valonia*, or *Acorn cups*, the involucre of the fruit of various species of *Quercus*, especially of *Q. Vallonea* Klotsch, of the Levant, are used for tanning purposes.

GAMBIR, *U. S.*—Gambir.

Catechu, Br., P. G., U. S., 1890; *Catechu pallidum, Terra japonica, Pale Catechu, Gambier*, E.; *Gambir, Gambir-Catechu*, G.; *Gambir cubique*, Fr.

An extract prepared from the leaves and twigs of *Ourouparia Gambier* (Hunter) Baill. (*Nauclea G.* Hunter; *Uncaria G.* Roxb.—Fam. *Rubiaceæ*).

Several pharmacopœias, including our own, recognize this to the exclusion of that from *Acacia Catechu*, while others authorize the use of either. The Russian requires that it contain not less than 60 per cent. of tannin substances.

Origin and Preparation.—The Gambir plant is a stout woody vine of the East Indian islands, climbing high over shrubbery and trees by means of stout hooks, formed from old peduncles. It has long been cultivated in the Singapore region, and was some years ago extensively distributed to British tropical botanical gardens, for purposes of propagation and the encouragement of its cultivation. This was regarded by the British government as one of the most important plant-distributions which they had ever made. The young, leafy shoots are boiled in water for 6 hours, being continually stirred and bruised, and the decoction evaporated, by farther boiling, to the proper consistency, then allowed to cool under constant stirring of a peculiar character. After about 25 minutes, the Gambir suddenly contracts and thickens, probably by the sudden crystallization of the catechuic acid. It is allowed to harden in various forms, the best and purest being usually that formed into thin cakes, flakes, or small cubes. It is nearly all exported from Singapore in wooden cases.

Description.—In small cubes or cakes, or in large irregular masses; externally dull grayish-brown, usually with darker-brown streaks, somewhat lighter internally; brittle to friable, slightly porous, exhibiting numerous fine acicular crystals under the microscope; of a bitterish, astringent, finally sweetish taste; partly soluble in cold water, yielding with hot water a turbid solution and with hot alcohol a clear dark-brown solution, leaving undissolved only the impurities, which should not exceed 15 per cent., and which, examined under the microscope, should be found to consist largely of parenchymatic tissue and to contain numerous epidermal hairs (distinction from Catechu, which shows woody fibers and large-pitted vessels); upon incineration it should yield not over 6 per cent. (usually not more than 5 per cent.) of ash, chiefly earthy salts.

Constituents.—Gambir yields the same substances as CATECHU, but usually less catechutannic acid and more catechin. Twelve samples (Lehmann) yielded 25–38 per cent. of tannin and 20–29 per cent. of catechin.

Action and Uses.—The uses of pale catechu are mentioned under CATECHU (which see).

Other Species.—It is said that a part of the Gambir product comes from *O. acida* (Roxb.) Lyons (*Uncaria a.* Roxb.), of the same region, and there appears no good reason why it should not be extracted from other of the 30 species of the genus.

Akakia, of India, is a catechu-like extract obtained from the fruit of *Acacia Arabica* W., there known as *Bablah* or *Web-web*, and containing about 22 per cent. of tannin. The bark of this species is also used under the name *Babul*.

GAULTHERIA.—Gaultheria.

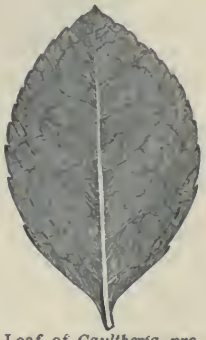
Folia Gaultheriæ.—Wintergreen, Partridge-berry, Box-berry, Checker-berry, Spice-berry, Chicken-berry, E.; *Canadischer Thee, Bergthee*, G.; *Feuilles de gaulthérie (de palommier), Thé du Canada, Thé de Terre-neuve*, Fr.

The dried leaves of *Gaultheria procumbens* L. (*Brossæa p.* O. Kuntze; *G. humulis* Salisb.; *G. repens* Raf.—Fam. *Ericaceæ*).

Origin.—This plant is very common throughout eastern North America, and is represented in the Northwest by an almost identical but rather larger species, *G. Shallon* Pursh. In partly open woodlands it often becomes very abundant, carpeting large patches to the almost total exclusion of other growth. It is a pretty little evergreen, a few inches in height, spreading by prostrate or partly subterranean creeping stems. The leaves grow in a little terminal rosette, and the white, wax-like, bell-shaped flowers are recurved and concealed underneath them. The scarlet, berry-like, inferior fruit, about as large as a black currant, is persistent and remains unchanged for nearly a year. This

fruit is gathered and eaten under the name *Checker-berry*, and is found frequently in the markets. The entire plant is commonly torn up and gathered by the use of a garden rake. After drying, most of the leaves are readily shaken off, and the remainder may be distilled along with another portion of the plants. Gaultheria should be gathered in the autumn, since during the growing season the new, thin, and inferior leaves occur with the others.

Fig. 191.



Leaf of *Gaultheria procumbens* (Nat.).

Description.—Short-petioled, about 4 Cm. (1½ In.) long and from two-thirds to nearly equally as broad, roundish-oval to obovate, finely toothed, the elongated teeth appressed to the thickish margin; thick and coriaceous, mucronate, smooth and somewhat shining, paler underneath; odor and taste agreeably and peculiarly aromatic; astringent.

Constituents.—The important constituent is from 0.5 to 1 per cent. of volatile oil (see Oleum Gaultheriæ). With this occur tannic acid, *arbutin*, *ursone*, and *ericolin* (see Ericaceæ), but no andromedotoxin.

Action and Uses.—The properties of this drug depend entirely upon its volatile oil (see Oleum Gaultheriæ).

Other Species.—The genus *Gaultheria*, L., contains about a hundred species, many of them in the Andes. The greater number are very little, if at all aromatic, though *G. fragrantissima* Wall., of India, and *G. punctata* L., *G. leucacarpa*, and *G. nummularioides*, *G. Shallon* D. Don (*G. repens* Bl.), of Java, are strongly so; and a Mexican species is said to yield far more oil than *G. procumbens*.

Chiogenes hispidula (L.) T. et G. (*Vaccinium h.* L.; *C. serpyllifolia* Salisb.; *C. Japonica* Gray), the *White tea-berry*, *W. wintergreen*, or *W. cranberry*, *Ivory plum*, *Creeping snow-berry*, *Running birch*, *Mountain partridge-berry*, a creeping evergreen, growing in patches in eastern and northern North America, is rich in methyl salicylate or oil of wintergreen, and is used similarly to Gaultheria. For other sources of this oil, see Methylis Salicylas.

GELATINUM, *U. S.*, *Br.*—Gelatin.

Gelatina alba, P. G.; *Gélatine*, Fr.; *Weisser Leim*, *Gelatine*, G.; *Gelatina*, Sp.

The air-dried product of the hydrolysis of certain animal tissues, as skin, ligaments, and bones, after treatment with boiling water.—U. S.

Preparation.—Bones, hoofs, horns, animal skins, etc., previously cleansed by washing in cold water or treatment with dilute alkali solution, are placed upon a sieve or perforated diaphragm in a boiler, and boiled with water until the collagen is rendered soluble and the solution stiffens to a jelly on cooling. While hot the solution is skimmed to remove fat and extraneous matter, and strained and clarified to remove impurities. The purified saturated solution is allowed to cool, the jelly cut into cakes, and these placed on nettings to dry. When made from carefully selected material (usually fresh bones) it constitutes the *gelatin* of commerce, while the impure and inferior grades produce products known as *colla*, *colla animalis*, *glutinum*; *glue*, E.; *colle*, *colle forte*, Fr.; *Leim*, G.

A pure gelatin may be prepared from the best qualities of commercial gelatin by soaking the gelatin for several days in successive quantities of cold water, whereby saline and soluble constituents are removed. The gelatin is then dissolved in hot water and filtered direct into alcohol; the resulting precipitate is separated, redissolved in water, and again precipitated in alcohol.

Properties.—Gelatin occurs commercially in the form of thin rectangular pieces bearing impressions of the netting upon which it has been dried, or in smooth sheets which are either thin and transparent, or thicker, more or less porous, and opaque. It also occurs cut into shreds or in the form of a coarse powder.

"An amorphous, more or less transparent, solid, usually shredded or in thin sheets; colorless or with a slight yellowish tint, inodorous, and having a slight, peculiar, almost insipid taste. Unalterable in the air when dry, but putrifying rapidly when moist or in solution. When heated, gelatin is decomposed, leaving a slight mineral residue, which should not exceed 2 per cent. of the original weight. Gelatin is insoluble in cold water, but when immersed it swells and softens, gradually absorbing from 5 to 10 times its

weight of water. It is soluble in boiling water, acetic acid, and glycerin; insoluble in alcohol, ether, chloroform, benzene, carbon disulphide, and fixed and volatile oils. When dissolved in boiling water (1 in 50), it should solidify upon cooling, and form a transparent jelly. An aqueous solution of gelatin (1 in 5000) is at once rendered turbid on the addition of tannic acid test-solution, the precipitate being insoluble in the presence of an excess of the reagent. Gelatin is precipitated from its aqueous solution by mercuric chloride test-solution in excess; it is not precipitated by a solution of alum, by ferric chloride test-solution, or by lead acetate test-solution. If potassium dichromate test-solution be added to a solution of gelatin in hot water, the jelly which forms on cooling becomes insoluble in warm water after exposure to light."—U. S.

When its solution in water is boiled for a long time, or more rapidly by superheating the solution to 140°C. (284° F.), the gelatin loses the property of gelatinizing on cooling, being altered to *gelatose* or *paragelatose* (terms applied by Dastre and Floresco, *P. J. Tr.*, 1895), or *gelatones* (gelatin-peptones). Boiled with solutions of fixed alkali hydroxide or with sulphuric acid, ammonia, *glycocoll*, $C_2H_5NO_2$, and *leucin*, $C_6H_{13}NO_2$, are obtained among other products.

The aqueous solutions of gelatin are viscid, indiffusible, strongly lævorotatory (the value of $[a]_D$ is —130° at 30° C., Hoppe-Seyler), and are not precipitated by dilute solutions of alum, ferric chloride, or lead acetate (distinction from chondrin), but yield precipitates with tannin, chlorine-water, bromine-water, corrosive sublimate, platinic chloride, picric acid, phosphomolybdic acid, and phosphotungstic acid. Gelatin is completely precipitable by saturating its aqueous solution with ammonium sulphate, magnesium sulphate, or zinc sulphate.

If a solution of gelatin be mixed with formaldehyde, the gelatin is rendered hard and insoluble after evaporation and drying the residue. By dry distillation gelatin yields ammonia and a highly offensive oil, bone oil (Dippel's animal oil), containing various pyridine bases and empyreumatic products.

Good gelatin should be colorless and odorless, form neutral solutions in water, contain not over 2 per cent. of ash, and when 1 part is dissolved in 100 parts of hot water the solution on cooling should set to a jelly. Some of the commercial gelatins frequently show an acidity of 0.2 per cent., due to the use of acids in bleaching the gelatin solution.

Gelatin consists principally of *glutin*, and contains about 50 per cent. of carbon, 18 per cent. of nitrogen, 6.5 per cent. of hydrogen, 25 per cent. of oxygen, and 0.5 per cent. of sulphur. The variation in the hardening and binding qualities of gelatin is attributable to variations in the accompanying amounts of chondrin and gelatones.

Pharmaceutical Uses.—Gelatin is extensively used for preparing ordinary court-plaster, for gelatin-coating pills, and in the manufacture of disks, lozenges, and suppositories, as well as for making the well-known hard and soft gelatin capsules. The latter are made by dipping polished moulds made of either metal, bone, or wood, of the desired size and shape and attached to a suitable disk by means of a handle, into a melted gelatin mass kept at a temperature of about 40° C. (104° F.). Before dipping, the moulds are rubbed with a soft oiled cloth to prevent adhesion of the gelatin, and after taking them from the melted mass they are rotated for a few minutes so as to insure a uniform film. After 30 minutes the gelatin mass will have become sufficiently firm to allow the capsules to be stripped from the moulds and laid aside to dry. The composition of the gelatin mass may vary with different manufacturers. Some recommend for hard capsules a mixture of 1 part of white gelatin and 3 parts of water, to be melted on a water-bath at a temperature of 65° C. (149° F.), and for soft capsules a mixture of 1 part each of white gelatin and water and 2 parts of glycerin. Other authorities propose for hard capsules a mixture of: gelatin, 30 parts; acacia and sugar, of each, 5 parts; and water, 25 parts. For soft capsules a mixture of: gelatin, 50 parts; acacia and sugar, of each, 15 parts; glycerin, 12½ parts; and water, 80 parts. The French pharmacopœia directs for elastic capsules a mixture of: white gelatin, 25 parts; sugar, 8 parts; glycerin, 10 parts; and water, 45 parts.

Gelatin has been successfully employed for the purpose of detannating wines, and offers many advantages over other agents recommended for the same object. It may be used in form of a No. 40 powder and in proportion of ½ ounce to 1 gallon of wine. The mixture should be kept in a cool place, and occasionally shaken during 48 hours, and then filtered.

Action and Uses.—Gelatin has been used in medicine quite largely during the last few years as a means of checking hemorrhage which cannot be controlled by pressure or a ligature, as it acts both locally and generally as an aid to coagulation of the blood. For the purpose of controlling oozing capillary hemorrhage it may be applied locally to the bleeding area in 10 per cent. solution. When used to check internal hemorrhages it is commonly given hypodermically in normal salt solution (0.9 per cent.) in the strength of about 1 to 2 per cent., but care must be taken that the solution is sterilized, so as to prevent local infection or even tetanus. Care must also be exercised that it does not enter a vein and cause an embolus. Gelatin when taken by way of the stomach also increases the coagulability of the blood, and administered in this way or given by the hypodermic needle has been used to favor coagulation in cases of aneurism.

GELATINUM GLYCERINATUM, *U. S.*—Glycerinated Gelatin.

Gelatina glycerinata, Gelatum glycerini, Glycerin jelly, E.; *Gelée glycerinée,* Fr.; *Glycerinleim,* G.

Preparation.—Gelatin, 100 Gm.; glycerin, 100 Gm,; water, a sufficient quantity. To the gelatin add sufficient water, which has been previously boiled and cooled, to cover it; allow it to stand 1 hour; pour off the water and allow the gelatin to drain for a few minutes; then transfer it to a tared dish, add the glycerin, and heat it on a water-bath until the gelatin is dissolved. Strain the solution while hot, and continue the heat on the water-bath until the product weighs 200 Gm. When cold, cut the mass into pieces, and preserve them in suitable containers.—U. S.

The supplement to the German Pharmacopœia (1895) directed 25 parts of white gelatin to be macerated with 25 parts of water for ½ hour, after which 50 parts of glycerin are added and perfect solution effected by heating on a water-bath. A still softer preparation was directed to be made by using only 15 parts of gelatin with 25 parts of water and 50 parts of glycerin.

Glycerinated gelatin, when prepared by the official formula, forms a firm mass when cold, is almost colorless in thin layers, and has no odor. It is admirably adapted as a vehicle for rectal and vaginal suppositories, as well as nasal and urethral bougies, being diluted with varying proportions of water and glycerin to suit the various combinations with solid extracts, chemicals, and vegetable powders. For general purposes the addition of 25 parts each of water and glycerin to 50 parts of glycerinated gelatin, previously melted, will prove satisfactory, yielding a mass which, when cold, is flexible, yet sufficiently firm, and melting readily at the temperature of the body. (See also SUPPOSITORIA.)

Action and Uses.—Glycerinated gelatin possesses no medicinal value, except as a vehicle for other drugs, as described above.

GELSEMIUM, *U. S.*—Gelsemium.

Gelsemii radix, Gelsemium root, Br.—*Yellow jessamine or jasmine, Carolina or American Yellow jessamine, Yellow or Evening trumpet flower,* E.; *Gelsemie, Giftjasmin,* G.; *Jasmin sauvage,* Fr.; *Gelsemio,* Sp.

The dried rhizome and roots of *Gelsemium sempervirens* (L.) Ait. f. (*Bignonia s.* L.; *Lisianthus s.* Mill.; *Anonymos s.* Walt.; *G. nitidum* Mx.; *G. lucidum* Poir.—Fam. *Loganiaceæ*).

This plant should not be confused with the tree Jasmine (*Jasminum* L.—Fam. *Oleaceæ*), which has also been known under the name *Gelseminum,* and which has but 2 stamens, while Gelsemium has 5.

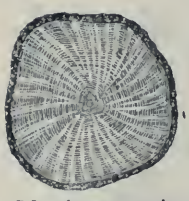
Gelsemium is official in the more important pharmacopœias.

Origin.—The Carolina Jessamine is a high-climbing woody twiner of moist woodlands of the Atlantic and Gulf region from Virginia to Central America. It bears handsome, opposite, evergreen, shining, lanceolate, entire leaves, and large, fragrant, solitary or cymose, axillary flowers, the corolla bright-yellow, funnel-shaped, shortly and broadly 5-lobed, the lobes emarginate. It is altogether one of the most beautiful and pleasing of our native plants. The drug is commonly collected just after the plant comes into flower. It is often adulterated with the aërial portion of the stem.

Description.—Rhizome cylindrical, short-flexuous, elongated or cut in sections of variable length, mostly from 0.5 to 1.5 Cm. ($\frac{1}{5}$ to $\frac{3}{5}$ In.) and occasionally 3 Cm. (a little more than an inch) in diameter, the roots much thinner, a few elongated, unbranched, coarsely hair-like, tough rootlets usually attached; externally of a light yellowish-brown, commonly with some purple or purplish-brown longitudinal streaks or patches; heavy, hard, and tough; internally yellowish-white; fracture of the rhizome splintery, the roots breaking with half the fracture transverse, the other oblique or short-splintery; bark thin, closely adhering, that of the rhizome with fine, silky bast-fibers, the wood porous, with numerous fine medullary rays; odor peculiar; taste slightly aromatic, bitter.

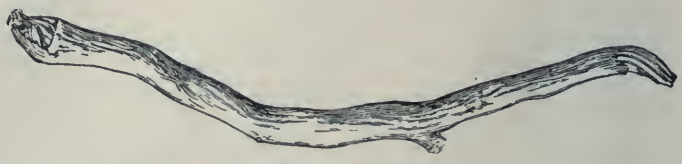
Adulteration with the aërial stems can be detected by the thinness and dark-purplish color of the latter. Sayre has pointed out that their corky layer is only about 3 to 6 cells thick, while that of the rhizome is 14 to 16, and that the latter has the bast-fibers in an interrupted ring or scattered, whereas in the aërial stem they are in thick bundles close to the cambium. He also states that the aërial stem is destitute of alkaloid. Dohme states that the similar roots of Jasminum are sometimes intermixed, and that they can be distinguished by the absence of indurated pith-cells, which occur in Gelsemium, by the abundance of starch-grains in the pith and in the medullary ray-cells, and by the bast-fibers around the sieve-tubes.

Fig. 192.



Gelsemium sempervirens Ait.: transverse section of root.

Fig. 193.



Gelsemium root (⅔ Nat.).

Fig. 194.

Gelsemium rhizome (⅔ Nat.).

Constituents.—The rhizome and roots contain 0.5 per cent. of volatile oil, 4 per cent. of two resins, one dry and acrid, the other fatty, 0.2 to 0.5 per cent. of alkaloid, 0.3 to 0.4 per cent. of gelsemic (gelseminic) acid, starch, gum, and pectin. *Gelsemic acid* ($C_{13}H_{11}O_5$, Coblentz), a colorless, odorless, and nearly tasteless crystalline body, differs from æsculin ($C_{15}H_{16}O_9$), and though an active reducing agent for copper and other metallic salts, is not a glucoside. Schmidt (1898) has shown it to be identical with beta-methyl-æsculetin [$C_9H_5(CH_3)O_4$], found in scopola root and other plants, and suggests that the name gelsemic acid be dropped. It is soluble in 1490 parts of water, 415 parts of absolute ether, 135 parts of chloroform, and readily in hot alcohol, glacial acetic acid, or alkalies, with the latter of which it produces a blue fluorescence. *Gelsemine* ($C_{12}H_{14}NO_2$, the "crystalline gelseminine" of Germany) is a colorless, odorless, intensely bitter, crystalline alkaloid, sparingly soluble in water, freely in acids, and in chloroform and ether. It is accompanied by *gelseminine* (Thompson, Cushny), an amorphous alkaloid whose hydrochloride is more readily soluble in water than that of gelsemine. The stem of the plant contains no alkaloid nor gelsemic acid.

Pharmaceutical Preparations.—Fluidextract of Gelsemium; Tincture of Gelsemium, U. S. P.

Action and Uses.—When given internally gelsemium acts as a powerful depressant to the respiratory, circulatory, and nervous systems. It acts as a depressant to the heart muscle and vagus nerves and under its influence there is a diminution in the pulse-force and blood-pressure. It primarily depresses the sensory side of the spinal cord; but later, if given in large amount, depresses the motor side. The drug has no effect upon

the spinal nerves, but the motor cranial nerves are paralyzed by large doses. In moderate amounts it causes the respiration to become slow and feeble, and in lethal quantities paralyzes the respiratory center. When the alkaloid gelsemine is locally employed in the eye, it produces mydriasis, probably by depressing the peripheral ends of the oculomotor nerves.

Gelsemium was formerly employed as a circulatory sedative in controlling the early stages of acute sthenic inflammations, but at present is rarely employed for this purpose. It has been recommended in the treatment of tetanus, chorea, malarial and typhoid infections, and in delirium tremens, but is probably of no benefit in these conditions, and in typhoid states is distinctly harmful. It has been found useful in the treatment of headache and migraine; and in asthma, whooping-cough and nervous cough, spasmodic dysmenorrhœa, torticollis and other conditions depending upon localized muscular spasm. A solution of the alkaloid gelsemine (8 grains—0.5 Gm.) (water 1 ounce—30 Gm.) has been employed as a mydriatic, and is said to be equal in potency but much more transient in its effects than atropine.

Poisonous doses of gelsemium produce a sensation of languor, relaxation, and muscular weakness, which may be followed by paralysis if the dose is sufficiently large. The face becomes anxious, the temperature subnormal, the skin cold and clammy, and the pulse rapid and feeble. Dropping of the upper eyelid and lower jaw, internal squint, double vision, and dilatation of the pupil are prominent symptoms. The respiration becomes slow and feeble, shallow and irregular, and death occurs from centric respiratory failure, the heart stopping almost simultaneously. Consciousness is usually preserved until late in the poisoning, but may be lost soon after the ingestion of a fatal dose. The treatment of gelsemium poisoning consists in the prompt evacuation of the stomach if the patient's condition permits, and in the early administration of ammonia, strychnine, atropine, and digitalis. The dose of fluid extract of gelsemium is from 2 to 5 minims (0.10–0.3 Cc.); and of the tincture, from 5 to 15 minims (0.3–1 Cc.). Gelsemine hydrochloride may be employed in doses of $\frac{1}{200}$ grain (0.0003 Gm.).

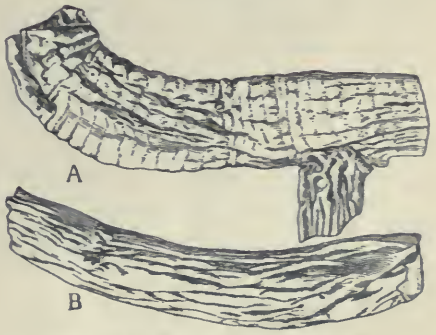
GENTIANA, *U. S.*—Gentian.

Gentianæ radix, Br.; *Radix gentianæ*, P. A., P. G.; *Radix gentianæ rubræ vel luteæ (vel majoris).—Gentian-root, Bitter-root, Fel-root*, E.; *Racine de gentiane (de gentiane jaune)*, Fr.; *Enzianwurzel, Bitterwurzel, Rother (Gelber) Enzian*, G.; *Genciana*, Sp.; *Argencana*, Port.; *Genziana*, It.

The dried rhizome and roots of *Gentiana lutea* L. (Fam. *Gentianaceæ*).

Official in all pharmacopœias, a number of which admit in addition, or have previously admitted, the species *G. Pannonica* Scop. (*G. punctata* Jacq.), *G. purpurea* L., *G. punctata* L. (*Pneumonanthe p.* Schmidt; *Dasystophana p.* Borckh.; *G. campanulata* Jacq.). These roots are all shorter and thinner than that of *G. lutea*, and that of *G. Pannonica* is scarcely annulate.

FIG. 195.



Gentian: A, rhizome and, B, root (¾ Nat.).

Origin.—A tall, stout, hollow-stemmed perennial herb of open or partly open grassy places on the mountains of southern and central Europe (for generic characters see GENTIANACEÆ). Its large flowers are bright-yellow and spotted, and occur in axillary clusters. The underground portion is frequently a yard in length, and may have several long branches. It is commonly collected in flower. To prevent its extermination, the Austrian government imposed a heavy fine for collecting a root not at least 2 Cm. (nearly an inch) in diameter at the top, this ordinarily requiring a 3 years' growth and insuring its previous propagation by seed. The United States supply comes chiefly from France.

Description.—In cylindraceous, usually slightly flattened, curved or crooked pieces of indefinite length, and from 0.5 to 3.5 Cm. (¼ to nearly 1½ In.) thick, or in longitudinal

slices of the same; externally yellowish brown to dark brown, strongly and crookedly longitudinally wrinkled, and marked with lighter-colored circular root-scars, the rhizome finely or heavily annulate; somewhat tough and flexible when damp, rather brittle when dry, the fracture short but uneven, the bark thick, reddish-brown, separated by a dark-brown line from the yellowish or reddish-yellow inner portion; free from starch; odor strong, characteristic; taste very bitter, slightly sweetish.

The yellowish-brown powder contains no starch, calcium oxalate crystals, nor tannin.

Constituents.—Gentian-root contains fatty and resinous matter, much gum, pectin, 12 to 15 per cent. of glucose, gentiopicrin, gentisin, and a yellow coloring-matter identical with quercitrin or one of its products, and crystallizing in stellate clusters of yellow needles.

Gentiopicrin ($C_{20}H_{30}O_{12}$) occurs in neutral, colorless or pale-yellow, bitter needles, readily soluble in water, less so in dilute alcohol and hot absolute alcohol, and insoluble in ether or cold alcohol. It is a glucoside to which the odor and bitterness of the drug are mostly due, and with dilute acids it splits into glucose and *gentiogenin*, a yellowish-brown, amorphous, neutral, bitter powder soluble in alcohol. The fresh root yields 0.1 per cent. of gentiopicrin.

Gentisin (gentianin or "gentisic acid," $C_{14}H_{10}O_5$) occurs in yellow, tasteless prisms, nearly insoluble in water and ether, sparingly soluble in alcohol, and with alkalies forming yellow, crystalline, soluble compounds. Fused with potassa, it yields phloroglucin ($C_6H_3(OH)_3$), acetic acid, and oxysalicylic or gentisinic acid ($C_7H_6O_4$). Boiled with hydriodic acid, it yields *gentisein* ($C_{13}H_8O_5$), which crystallizes in fine straw-colored needles. Gentisin is methyl-gentisein.

From the fresh root, but not when dried, is obtained a fermentable, crystalline sugar, *gentianose* ($C_{16}H_{66}O_{31}$), which does not reduce Fehling's Solution. The dark-green color produced in gentian preparations by ferric chloride has been charged to the presence of tannin, but Maisch and Van Itallie found no tannin, and attribute the reaction to gentisin. Ville regards gentisin as probably a gentiotannic acid. Patch found the resinous matter associated with a principle not yet isolated, which gives a greenish-black color with ferric chloride, and precipitates tartar emetic, cinchonidine sulphate, and gelatin. Owing to the large amount of sugar, the roots are used in the Alps, Jura, and Vosges Mountains for the manufacture of an alcoholic beverage.

Pharmaceutical Preparations.—Compound Tincture of Gentian, Extract of Gentian, U. S. P.; Elixir of Gentian, Elixir of Gentian with Tincture of Chloride of Iron, Ferrated Elixir of Gentian, N. F.; Fluidextract of Gentian, U. S. P.; Stronger Compound Infusion of Gentian, N. F.

Action and Uses.—Gentian may be classed as one of the best of the simple bitters, exciting the flow of the gastric juice, promoting the appetite, and aiding digestion. It has proved useful in many forms of dyspepsia, and is a good remedy for overcoming the loss of appetite following acute infectious diseases. It may be employed for its tonic effect in the treatment of mild malarial infections, and in the subacute gastric and intestinal catarrh of children. The dose of the powdered drug is from 10 to 30 grains (0.60–2), usually administered in the form of a fluidextract or tincture.

Gentianaceæ (*the Gentian Family*).—Genera about 60, species about 1000, all herbs, with the exception of a few soft-shrubby tropical species, and almost invariably smooth. None is poisonous. With the exception of a few species of *Coutoubea*, used as anthelmintics, all of the hundred or more species which have been employed medicinally are used for their bitter and stomachic, and indirectly somewhat laxative properties, much like *Gentiana*, with which the constituents also agree in a general way, so far as known. The laxative properties are typified by Menyanthes. A few of the members are wanting in these bitter properties, and several of these are somewhat used locally as potherbs. Owing to this uniformity in properties, and the great availability of plants so widely distributed, their recognition is so important that the following botanical characters of the family are introduced: leaves opposite, entire, estipulate, usually nerved or ribbed; inflorescence solitary or cymose, the cymes either panicled, or solitary and axillary or terminal; flowers regular or somewhat oblique, 4- to 5-merous; corolla gamopetalous; stamens of the same number as and alternate with the corolla-lobes, and borne upon the corolla; disk none or inconspicuous; ovary superior, 1-celled or rarely falsely 2-celled, the anatropous or amphitropous ovules numerous, on parietal placentæ; fruit a dehiscent capsule, occasionally indehiscent and rarely fleshy; embryo small, in copious albumen.

The most important medicinal genus is *Gentiana*, L., distinguished by the following characters: leaves and flowers almost invariably sessile, the latter axillary or terminal, erect or

rarely pendulous, variously colored and showy; calyx tubular; corolla contorted or imbricated, from campanulate to salver-form, or rarely nearly rotate, the lobes, with rare exceptions, spreading; stamens affixed to the tube of the corolla, the anthers or the connective pointed; ovary 1-celled, the placentæ not intruded, sometimes laterally extended; style short, with 2 spreading or recurved stigmas; capsule 2-valved, the placentæ very thin. This genus comprises upward of 300 species, widely distributed through temperate regions, including high mountains in the tropics, and some extending into the Antarctic Zone. They possess, almost without exception, the bitter taste of the official drug, and such as have been examined appear to contain the same constituents and to be available for the same uses. More than 30 species are named by Dragendorff as being so used. In collecting the official *Gentiana*, several other species growing with it, are added, especially the 3 named above in connection with our definition.

Several American species have been more or less employed medicinally, under the name *Blue gentian-root*, but, owing to their much greater cost, without corresponding superiority, they are now very little used. These roots were official in the U. S. P. of 1870 under the title *Gentiana Catesbæi*. Maisch referred the drug to *G. Andrewsii* Griseb. (*G. alba* Muhl.), the *Closed*, *Barrel*, or *Bottle gentian*; *G. Saponaria* L. (*G. Catesbæi* Walt.), the *Soapwort*, *Rough* or *Marsh gentian*, or *Harvest bells*; and *G. fimbriata* Vahl. In all probability this list should have included also *G. Elliottii* Chapm. (*G. Catesbæi* Ell.; *G. scaberrima* Kusn.), or *Elliott's gentian*. Blue gentian consists of a number of nearly simple roots about 7.5 Cm. (3 In.) or more in length, branching from an annulated head about 1.3 Cm. (½ In.) long and a fourth as thick. They are of a pale-orange or yellowish-brown without, deeply short-wrinkled, brittle, the fracture short or somewhat spongy, pale-yellow within, the bark thick, the ligneous cord quite thin.

G. Buergiri Miq. is the Japanese *Rew-tang-soh*; *G. Kurroo* Royle (*Pneumonanthe Kurroo* Don) is the East Indian *Karu*, *Nilkant*, or *Kanal-phul*; *G. decumbens* L. (*G. dahurica* Fisch.; *G. Olivieri* Gris.; *G. Pneumonanthe* Smel.; *G. adscendens* Pall.) is the *Gufas* of Turkestan or *Gul-i-Gafit* of India. *G. Tannitami* Azara (*G. thyrsoidea* Hook.) is used in Peru as a cinchona-substitute.

Frasera, *American colombo* (*Radix Colombo Americanæ*), *Indian lettuce*, *Pyramid flower*, *Meadow pride* (E.), *Racine de colombo de Mariette* or *d'Amerique* (Fr.), *Amerikanischer Colombowurzel* (G.), is the root of *Frasera Carolinensis* Walt. (*F. Walteri* Mx.), a handsome pyramidal-branching plant of the eastern and central United States, occasionally growing in Canada. The commercial drug closely resembles Gentian in everything except the color, the external surface being yellowish or pale-orange, the color within pale-yellow, a dark-brown cambium-zone separating the bark, which is rather thick and exhibits 2 differently colored layers, from the meditullium, which exhibits scarcely any radiate structure. The drug formerly occurred in transverse disks, like Calumba, but entirely lacking in the radiate structure which characterizes that drug. It is now almost always seen in longitudinal slices, the thick bark curved so as to present rounded edges. It closely resembles Gentian in odor and taste. The constituents are practically identical with those of Gentian, as are the uses.

Centaurea.—Next in importance to the Gentians are the *Erythræas*, several species of which have been quite largely employed as simple bitters. The principal one is *E. Centaurium* (L.) Pers. (*Gentiana C.* L.), the *European* or *Smaller centaury*, *Bloodwort*, *Christ's ladder*, or *Mountain flax* (E.), *Tausendguldenkraut*, *Rother Aurin* (G.), *Petite Centaurèe* (Fr.), *Centaura menor* (Sp.), the drug sold as *Herba Centaurii minoris*. The plant is 25 to 40 Cm. (about a foot) high, much branched, the branches erect, most of the leaves in a basal rosette, those of the stem oblong, blunt, sessile, 2.5 to 5 Cm. (1 to 2 In.) long; flowers rose-purple, in compound cymes, sessile or nearly so, 12 to 15 Mm. (about ½ In.) long, the 4 or 5 calyx-lobes narrow, keeled; corolla-lobes about half the length of their tube and about as long as the calyx-lobes, obtuse; anthers elongated and spirally twisted in age; style filiform, the 2 stigmas oval.

E. stricta Schiede and *E. tetramera* Schiede are used in Mexico under the name *Canchalagua*, the former being also called *Cachalohuai*, the latter *Tlanchalagua*. *E. chilensis* Pers. (*Chironia C.* Willd.; *Gentiana Peruviana* Griseb.) is called *Canchalagua* in Chile. *E. Roxburghii* Don is the Indian *Chota chirata*. The drug known in India as *Kanturium* and in China as *Lung-tau* is probably also an *Erythræa*.

A number of species of the genus *Sabbatia*, Adans., are similarly used and even employed as substitutes for quinine in malaria. The most important of these is *S. Elliottii* Steud. (*S. paniculata* Ell.; *Swertia difformis* L.), the *Quinine flower* or *Quinine herb*, *American* or *Larger centaury*, of the southeastern United States. The stem is 25 to 50 Cm. (10 to 20 In.) high, terete and diffusely branched; leaves sessile, 6 to 12 Mm. (¼ to ½ In.) long, obovate or oblanceolate, and the upper ones linear; calyx-lobes almost filiform and about one-fourth the length of the rose-colored corolla. The plant is inodorous, and has a persistent, purely bitter taste. *S. angularis* (L.) Pursh. (*Chironia a.* L.), of dry hills in the eastern United States, similarly employed, is also known as *American centaury* or *American red centaury*, *Bitter clover*, *Rose pink*, or *Square-stemmed sabbatia*. It reaches a height of 2 or 3 feet, has the quadrangular stem narrowly winged, the leaves ovate and acute, the flowers rose-pink with a greenish

center, 2.5 to 4 Cm. (1 to 1½ In.) broad, the corolla-segments obovate and about twice the length of the corolla.

Other drugs of this family which are worthy of mention are *Exacum Wightianum* Arn. (*Lisianthus Ceylanicus* Spr.; *Exacum C.* Roxb.; *Gentiana trinervis* L.), the *Ginihiringa* of Ceylon; *Slebogtia orientalis* Gris., the *Chhota kirayat*, *Mamijwa*, or *Velluruga*, of India; *Canscora decussata* R. et Sch., largely used in India as a Gentian-substitute and having many native names; *Pleurogyne rotata* Gris. (*Gentiana r.* Froel.; *Swertia r.* L.; *Lomatogonium sulcatum* Reichb.), the Japanese *To-yuk*. Many other species of *Swertia* are similarly employed.

GERANIUM, *U. S.*—Geranium.

Spotted or Wild cranesbill or storksbill, Alum-root, Cranesbill-root, E.; *Racine de geranium maculé, Bec-de-grue tacheté, Pied-de-corneille.* Fr.; *Fleckstorchschnabel*, G.; *Geranio*, Sp.

The dried rhizome of *Geranium maculatum* L. (Fam. *Geraniaceæ*).

Geranium is not elsewhere official.

Fig. 196.

Geranium maculatum: rhizome (Nat.) and transverse section of rhizome and root.

Origin.—A perennial herb, very common and abundant in woodlands throughout eastern and central North America, flowering in late spring and early summer. It is softly hairy, 1 to 2 feet in height, loosely branched above, has very long-petioled radical leaves, those of the stem having successively shorter petioles, the blades rounded, cordate, palmately 5- to 7-lobed, the divisions inversely wedge-shaped, coarsely toothed above, spotted or blotched in late summer. The flowers are of a light violet-purple, 2.5 to 4 Cm. (1 to 1½ In.) broad, slenderly pedicelled, borne in loose umbels, the buds nodding, symmetrically 5-merous with 10 stamens, the 1-seeded pistils adherent for most of their length to a slender carpophore, from which they separate at maturity, except at the top. The drug is commonly collected in late summer or autumn; but the proper time is just previous to the blooming of the plant.

Description.—Of horizontal growth, 5 to 10 Cm. (2 to 4 In.) long and 0.5 to 1.5 Cm. (⅕ to ⅗ In.) thick, more or less crooked, cylindraceous but somewhat vertically flattened, brown; roughly and shortly wrinkled and strongly, rather sharply tuberculate; fracture short, purple, the bark thin, a few short and broad yellowish wood-wedges scattered near the dark cambium; inodorous; taste strongly astringent.

Constituents.—Geranium contains tannin, gallic acid, resin, pectin, sugar, a crystalline principle soluble in alcohol and ether, and geranium-red, a phlobaphene formed from the tannin. Trimble and Peacock, studying the yield of tannin in the different months, found it most abundant in April, and especially before the plant bloomed. From 11.72 per cent. of the absolutely dried drug in January, it increased to 27.85 per cent. in April, and from then steadily dropped till in October there was only 9.72 per cent. It belongs to the gallotannic series, yielding pyrogallol on heating. By the action of heat and hydrochloric acid it is easily decomposed into glucose, gallic acid, and geranium-red. There is no gallic acid in the fresh plant.

Pharmaceutical Preparation.—Fluidextract of Geranium, U. S. P.

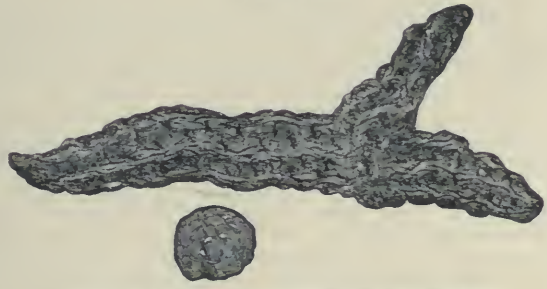
Action and Uses.—Geranium is an astringent, and may be employed in all conditions in which a remedy of this class is serviceable. It is especially useful in infants and in persons who have a delicate stomach, because of its non-irritating properties. Geranium is particularly valuable in serous diarrhœas. It may be tried in the treatment of internal hemorrhages, but is probably of little service unless it comes directly in contact with the bleeding point. A decoction made with 1 ounce (30 Gm.) of the root and 1½ pints (720 Cc.) of water boiled to 1 pint (480 Cc.) may be used as a mouth-wash in aphthous stomatitis, and as a gargle in relaxed conditions of the throat. It may also be used as an astringent injection in the vagina and rectum. The drug has been recommended in prolapsus ani and uteri, but in these conditions it is of little value.

The dose of the powdered rhizome is from 20 to 40 grains (1.3–2.6 Gm.); of the decoction, from 1 to 2 fluidounces (30–60 Cc.); and of the fluidextract, from ½ to 1 fluidrachm (2–4 Cc.).

Allied Drugs.—A number of rhizomes having properties and uses practically identical with those of Geranium may be profitably considered at this point, even though some are not related to it. Not including the closely related Pelargoniums, cultivated in the house and garden under the name of Geranium, the true Geraniums are about 160 in number. Many of them are known to the writer to have rhizomes astringent like our official one and capable of replacing it, and a score or more of species are recorded as being so used, either the rhizomes or herbage, in various parts of the world. *G. Wallichianum* Sweet is said to be used in India as a substitute for alkanna in dyeing. *G. Robertianum* L., the *Herb Robert, Herbe a Robert* (Fr.), *Ruprechtskraut* (G.), is a weak, hairy plant, with pinnatifid leaves, and rose-purple flowers, of Europe and North America. It has a strong, rather unpleasant odor, a bitterish, saline, and astringent taste, and contains tannin and an amaroid. It has been used as a mild astringent and tonic. *Erodium Cicutarium* (L.) L. Her. (*Geranium C.* L.), the *Storksbill, Pin-clover, Pingrass*, or *Alfilaria*, of southern Europe and the Levant, and a pernicious weed of southern South America and western North America, somewhat resembles the last and has a carroty odor when bruised. It has a similar use, as has the *E. moschatum* Ait., with a musky odor. The closely related *Monsonia ovata* Cav., or *Cape geranium*, is used in South Africa precisely as we use Geranium.

Tormentilla, or *Tormentil* (*Septfoil*, E.; *Tormentille*, Fr.; *Tormentillwurzel, Ruhrwurzel, Blutwurzel*, G.), the rhizome of *Potentilla Tormentilla* Neck. (*Tormentilla erecta* L.; *T. officinalis* Curt.; *Potentilla o.* Gray.—Fam. *Rosaceæ*), native of northern Europe and Asia, is very extensively used like our Geranium, and has been official in various pharmacopœias. It is 2.5 to 5 Cm. (1 to 2 In.) long, as thick as the finger or smaller, tapering to one end, usually with 1 to 3 short branches near the larger end, ridged with several strong longitudinal wrinkles, and between them bearing numerous blunt indentations; internally light brownish-red, the fracture short and somewhat resinous, showing a thin bark, 1 or 2 circles of small, yellowish wood-wedges, broad medullary rays, and a large pith. It has a peculiar faint odor and a strongly astringent taste. It contains 18 to 30 per cent. of tannin, 18 per cent. of tormentil-red, a product of the tannin, and yielding with potassium hydroxide protocatechuic acid and phloroglucin. There is also some resin, and ellagic and kinovic acids have been reported. Many others of the 150 species of *Potentilla* have been similarly employed.

Fig. 197.



Tormentilla: rhizome and transverse section (Nat.).

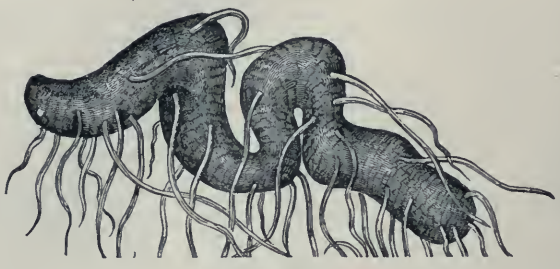
A number of other Potentillas are used partly for their bitter constituents, and will be considered under Rosaceæ. Tormentil possesses aromatic, bitter, and astringent properties, and may be employed for the same purposes as Geranium.

Bistorta, or *Bistort* (*Snakewort, English serpentary, Sweetdock*, E.; *Wiesenknöterich, Natterwurz*, G.; *Bistorte, Couleuvrine*, Fr.), the rhizome of *Polygonum Bistorta* L. (*Bistorta officinalis* Raf.; *B. major* Gray.—Fam. *Polygonaceæ*), has a record very similar to that of the last described. Before the present varied and abundant sources of starch were possessed, it was resorted to for that substance. It is very abundant in swampy meadows in northern Europe and Asia, and is represented in North America by the very similar *P. viviparum* L. (*Bistorta v.* Gray). It is sometimes several inches in length, about ½ inch thick, somewhat flattened vertically, sigmoid-curved (see Fig. 198), more or less annulate and bearing few slender roots, otherwise smooth, dark-purplish or blackish-brown; fracture nearly smooth, reddish or purple, showing a moderately thick bark, numerous small wood-bundles in one circle and a large pith; nearly inodorous and strongly astringent. It contains about 20 per cent. of tannin and a large amount of starch. (Other species of the genus, though containing tannin, are used also for other constituents, and will be considered under Polygonaceæ.)

The North American genus *Heuchera*, L. (Fam. *Saxifragaceæ*), with some 24 species, is noted for its highly astringent rhizomes; and that of *H. Americana* L. (*Split-rock* or *Cliff-weed*), of eastern and central North America, has been very extensively used under the name *Alum-root*. It is a perennial herb, bearing a large radical rosette of orbicular-heart-shaped, slightly lobed, and crenately toothed hairy leaves and very slender glandular hairy scapes

about 60 Cm. (2 Ft.) high, bearing loose panicles of small flowers with short, white, narrow petals and exserted stamens and styles. The rhizome is about 15 Cm. (6 In.) long and about 12 Mm. (½ In.) thick, with several short cylindrical heads terminating with a concave scar, tapering, and somewhat branched below, and beset with some thin roots. In its fresh state it is fleshy; when dry, irregularly shrivelled, tuberculate, the brittle fibers usually broken off. It is externally of a purplish-brown color, has a thin bark, and a thick, fleshy meditullium of a pale-reddish or brownish tint, and breaks with a short somewhat spongy or granular, not fibrous fracture, often showing internal cavities. It is inodorous, and has a strongly astringent, slightly bitterish taste. The roots agree with the rhizome in color and taste, but have a thick bark and a thin, spongy center. Heuchera has not been fully analyzed. It contains from 10 to 20 per cent. of tannin, according to the season, the most in winter.

Fig. 198.



Bistorta (Nat.).

H. villosa Mx., of the southeastern United States, has also been considerably so employed. Bistort has been employed in the treatment of serous diarrhœas and other conditions in which the vegetable astringents are usually recommended.

Statice.—This name applies to drugs derived from a number of species of the genera *Statice*, L., and *Limonium*, Adans. (Fam. *Plumbaginaceæ*), which, rich in tannin, are much used as astringents and styptics. *Limonium Carolinianum* (Walt.) Britton (*Statice C.* Walt.; *S. Limonium* Gray) is the *American marsh rosemary, Canker-root, Meadow-root, Sea lavender, Marsh-root, Thrift, Ink-root*, growing in salt marshes of the Atlantic and Gulf coasts and formerly confused with the European statices and limoniums. The paniculately much-branched scape, with its numerous small, lavender or purplish-blue flowers, rises from a tuft or rosette of spatulate-oblong or oblanceolate, 1-ribbed, bristly pointed leaves. The root is several-headed, 30 to 60 Cm. (1 to 2 Ft.) long, and 2.5 Cm. (1 In.) or more thick at the crown. It is closely annulate above, its stout branches longitudinally wrinkled. It is deep-brownish-purple without, somewhat paler within, tough and compact, with a short fracture, a rather thick bark and a meditullium with narrow pale-yellow wood-wedges. It is nearly odorless, strongly astringent, and slightly bitter. It contains from 12 to 18 per cent. of tannin, reacting greenish-black with ferric salts, a trace of volatile oil, a little caoutchouc-like matter, and gum, and is rich in inorganic salts of sodium and magnesium.

In Brazil, *L. Brasiliensis* (Boiss.) Lyons (*Statice B.* Boiss.) is similarly and very largely employed under the names *Baycuru, Biacuru*, and *Guaycuru*, as is *L. Limonium* (L.) Lyons (*Statice L.* L.; *L. vulgare* Mill.), the *European sea lavender*, etc., *Marsh-beet, Red behen*, E. (*Strandnelke*, G., *Romarin des marais, Lavandetriste*, Fr.), in Europe. Biacuru contains 1.3 per cent. of acrid, pungent resin (Symes), and Dalpe claims to have obtained a small portion of the alkaloid *baycurine*, though the statement does not appear to have been verified. Other names promiscuously applied to the different species are *Cliff rose, Sea cushion*, and *Cushion pink*. The genus Limonium contains about 120 species, and a large number of them appear to be indiscriminately employed for the same purposes. The same is true of a number of the 20 species of *Statice*, L., known by the same common names, especially *S. Armeria* L. (*Armeria vulgaris* Willd.), which grows almost throughout the north-temperate zone. Statice has been recommended as an astringent, hæmostatic, and discutient. In the form of an infusion or decoction, 1 ounce to the pint (30 Gm.–480 Cc.), it has been employed in the treatment of diarrhœa, dysentery, uterine and pulmonary hemorrhages. As a gargle, it may be tried for sore throat, especially where there is much relaxation of the mucous membrane.

GILLENIA.—Gillenia.

Indian physic, Indian hippo, False or North American ipecac, Bowman's root, E.; *Gillenie,* G.; *Gillénie,* Fr.

The dried rhizome and roots of *Porteranthus trifoliatus* (L.) Britton (*Spiræa t.* L.; *Gillenia t.* Moench) and of *P. stipulatus* (Muhl.) Britton (*Spiræa s.* Muhl.; *Gillenia stipulacea* Nutt. —Fam. *Rosaceæ*).

Fig. 199. Fig. 200.

P. stipulacea. *P. trifoliata.*
Gillenia roots (Nat.).

Origin.—Perennial herbs, *P. trifoliatus* confined almost exclusively to the region east of the Alleghenies, from New York southward, *P. stipulatus* extending more to the westward of that range. They grow to a height of 2 or 3 feet, the stems branched and often somewhat tufted. The leaves are alternate, stipulate, nearly sessile, trifoliolate, the leaflets ovate-lanceolate, acuminate, doubly serrate or incised. The white or rosy flowers are in loose corymbs, pedicelled, 5-merous, the calyx tubular, constricted at the throat, the limb 5-cleft. The petals are long, lance-linear, unequal, the stamens 10–15, very short, the carpels 5, coherent at the base, each becoming a 2- to 4-seeded follicle. The stipules of the first-named are small and narrowly linear, those of the second large, ovate-lanceolate, and incised.

Description.—The rhizome of *P. stipulatus*, the one usually sold, is short, nearly horizontal, about 25 Mm. (1 In.) thick, very knotty from the numerous branches and remnants of stems. The larger roots are about 9 Mm. (⅜ In.) thick near the base, tortuous, irregularly branched, the smaller undulated, and knotty or annulated from the semicircular constrictions and transverse fissures of the bark on one side and the depressions on the opposite side. The rhizome and roots of *G. trifoliata* are smaller and less knotty, the roots often smooth or indistinctly annulated, and with few or no transverse fissures. Both have a reddish- or grayish-brown color externally, and are hard and woody, breaking with some difficulty except through the brittle bark. The bark of the rhizome is thin, the wood about eight times thicker, of a whitish color, with several annual rings enclosing a thin pith and traversed by fine medullary rays. The bark of the root is of uneven thickness, in its outer layer brownish-red, the inner layer reddish-white, with numerous minute red resin-dots. The odor is very slight; the taste of the bark is bitter, not unpleasant, exciting the flow of saliva; the wood is tasteless.

The more tortuous roots might easily pass as an adulterant of ipecac, for which they have been used, and which they resemble in properties. They are, however, much tougher and more flexible, the bark only about half as thick relatively to the radius, and the large red resin-dots are distinctive.

Constituents.—The various analyses made of Gillenia have established the presence of starch, tannin, gum, albumin, fat, resin, etc. The bitter principle, *gillenin*, has been obtained, in an impure condition, by W. B. Stanhope (1856) in the form of a whitish powder having a slight odor and a very bitter taste, neutral to test-paper, soluble in water, alcohol, ether, and dilute acids, and colored blood-red by nitric acid. Its watery solution is stated to be precipitated by lead subacetate, tartar emetic, and potassium hydroxide, but not by tannin; ½ grain caused much nausea. It was prepared by washing the alcoholic extract with water, treating the residue with very dilute sulphuric acid, adding magnesia, evaporating, and exhausting the dry mass with alcohol.

P. stipulatus yields 2 glucosides—*gillein*, in white feathery crystals, soluble in water, alcohol, and dilute acids, and *gilléenin*, yellowish, amorphous, faintly tasting at first, afterward very bitter, soluble in water, and very slightly in alcohol and ether.

Action and Uses.—Gillenia is said to resemble ipecac in its mode of action. In large doses it acts as an emetic, and at times also produces purgation. In small doses it is said to be a tonic, and it has been employed to some extent as a mild emetic.

The dose of the powdered root is from 20 to 30 grains (1.3–2 Gm.) as an emetic, and from 2 to 5 grains (0.12–0.30 Gm.) as a tonic.

GLANDULÆ SUPRARENALES SICCÆ, *U. S.*—Desiccated Suprarenal Glands.

Glandes surrénales desséchées, Fr.; *Getrockenete Nebennieren*, G.

The cleaned, dried, and powdered suprarenal glands of the sheep (*Ovis aries*) or ox (*Bos taurus*), freed from fat.—U. S.

The suprarenal capsule is situated over either kidney, and consists of an external cortex of peculiarly arranged cells derived from the mesoblast, and an internal medulla composed of cells derived originally from the sympathetic ganglia. The cortex is apparently without medicinal value, the important physiological properties residing in the medulla.

Preparation.—After removal of the external fat and connective tissue the glands are dried as rapidly as possible in a current of warm air at a moderate temperature, and, when sufficiently dry, are reduced to coarse powder and the remaining fat removed by treatment with petroleum benzin. It is important that all moisture be removed, by exposure in a desiccator if necessary, in order to avoid subsequent putrefaction, after which the residue may be reduced to fine powder, and should be preserved in closely stoppered bottles.

Properties.—A light, yellowish-brown, amorphous powder having a slight, characteristic odor; partially soluble in water. 1 part of desiccated suprarenal glands represents approximately 6 parts of fresh glands, free from fat. Upon incineration it should not yield more than 7 per cent. of ash. If 0.5 Gm. of desiccated suprarenal glands be macerated with 25 Cc. of water for 15 minutes and filtered, the filtrate should give an emerald-green color upon the addition of a few drops of ferric chloride test-solution. The green color disappears quite rapidly.—U. S.

Although the Pharmacopœia states that 1 part of the dried glands represents 6 parts of fresh glands, we have been informed by a large manufacturer that the average yield is 1 part of dried from 5 parts of fresh glands after removal of all fat. The green color developed in the test with ferric chloride solution slowly changes to a brown red or, when viewed through a greater thickness of liquid, to a port-wine color.

Action and Uses.—Dried suprarenal gland has a comparatively limited sphere of usefulness in medicine, having been supplanted almost entirely by adrenalin, or other isolated active principles, which lend themselves to local applications for the arrest of hemorrhage much better than does the dried gland itself. Further than this, it has been found that the administration of the dried gland by the mouth is rarely followed by advantageous results, probably because it is decomposed by the gastric and other digestive juices. Given in this way, it certainly does not produce the effect upon arterial pressure which is caused by the subcutaneous or intravenous injection of adrenalin. The use of the dried gland may be resorted to in certain cases of Addison's disease with the hope that it will hold the disease in abeyance, as it acts as a specific remedy in a very small percentage of these cases. The dose of the dried gland is 3 to 5 grains (0.20–0.30 Gm.), best given in capsule (see ADRENALIN).

GLANDULÆ THYROIDEÆ SICCÆ, *U. S.*—Desiccated Thyroid Glands.

Thyroideum siccum—Dry thyroid, Br.; *Getrockenete Schilddrüsen*, G.

The cleaned, dried, and powdered thyroid glands of the sheep (*Ovis aries*), freed from fat.—U. S.

The thyroid gland is a very vascular organ, situated in front of, and on either side of, the trachea or upper windpipe. It consists of two lobes connected at their upper extremities by a bridge of pale-colored tissue. When freed from all external fat and connective tissue the lobes are broadly almond-shaped, and consist of a firm, succulent mass of tissue with dark-red color.

Preparation.—The British Pharmacopœia gives the following directions: Remove the external fat and connective tissue from thyroid glands taken from sheep immediately after killing. Cut the glands across, and reject any which contain cysts, are hypertrophied, or otherwise abnormal. Mince finely the healthy glands, and dry at a temperature of 32.2° to 37.8° C. (90°–100° F.); powder the dried product; remove all fat from it by treatment with petroleum spirit; and again dry the residue.

It is important that dried thyroid glands be kept in well-stoppered bottles, to avoid absorption of moisture and subsequent deterioration.

Properties.—A yellowish, amorphous powder, having a slight, peculiar odor, and containing the active ingredient of the thyroid tissue; partially soluble in water. 1 part of desiccated thyroid glands represents approximately 5 parts of the fresh glands. Upon incineration it should not yield more than 6 per cent. of ash. If 1 Gm. of desiccated thyroid glands be mixed with an equal weight of pure sodium hydroxide and carefully fused in a silver dish, and oxidized by adding potassium nitrate while fusing, until a white mass remains, and if the fused mass be dissolved in a small quantity of water, the solution treated with 2 Gm. of sodium nitrite, acidified with concentrated nitric acid, and then shaken with 5 Cc. of chloroform, a decided pink to violet coloration should be imparted to the latter (presence of iodine compounds). A cold extract of desiccated thyroid glands treated with 2 Gm. of sodium nitrite and acidified with strong nitric acid should not give the iodine test on shaking with chloroform.—U. S.

The statements of manufacturers differ as to the yield of dried thyroid glands from the fresh, some claiming that after removal of all fat 1 part of the dried glands represents 6 or 7 parts of the fresh glands. The official test for the presence of iodine may be modified with advantage as follows: Mix 1 Gm. of the desiccated thyroid glands with a mixture of sodium carbonate 1 Gm. and potassium nitrate 3 Gm. Fuse in a dish or crucible, allow to cool, dissolve in sufficient distilled water, and transfer to a separator. Add diluted sulphuric acid until the liquid is just acid to litmus-paper, then add 1 drop of fuming nitric acid (or 0.1 Gm. of sodium nitrate), 1 or 2 drops of concentrated sulphuric acid, and also about 3 Cc. of chloroform. Shake the mixture well, allow the liquids to separate, when the chloroform should have a violet tint, due to the iodine extracted from the mass.

The Br. P. describes dry thyroid as a dull-brown powder, with a very faint, meat-like odor and taste, and free from any trace of putrescence.

Action and Uses.—Thyroid gland is one of the most valuable medicinal substances which we possess, and exercises an influence over the processes of nutrition and metabolism which at present is not understood. Indeed, we may be said to be in complete ignorance of the manner in which it exercises its extraordinary influence when administered to man. Given to a healthy individual in moderate amounts, it produces little effect, save that of a circulatory sedative or depressant, and if its use be persisted in it may cause considerable loss of flesh. Its chief value is in the treatment of myxedema, cretinism, and some cases of excessive obesity which are probably closely related to myxedema. Given to cretins, who suffer from absence or atrophy of the thyroid gland, it produces extraordinary changes in their nutrition, and, in a great majority of instances, changes the patient from a condition of dwarfism and idiocy to nearly normal development, and to at least some approximation of ordinary mental power. There is perhaps no more remarkable result of the administration of a properly selected remedy than is seen in the treatment of this malady. A change which is similar in character also occurs in patients suffering from myxedema when thyroid gland is given to them. A normal growth of hair occurs where previously but little remained of the original growth. The broad, spade-like hands return to their natural condition; the mental apathy and stupor is supplanted by ordinary intellectual processes, and the myxedematous condition of the subcutaneous tissues, with its accompanying pallor, is relieved, so that the patient is restored to his natural appearance to so great a degree that but little trace of his ailment remains. Although thyroid gland has been used by many practitioners for the reduction of obesity, it has been by no means constant in its good effects, and when used in sufficiently large doses to cause a distinct loss of weight, it not rarely produces ill-health, and changes the skin from an appearance of health to a sallow hue. Loss of weight under its influence is also not rarely accompanied by marked wrinkling of the skin.

The dose of dried thyroid gland is 1 grain (0.06 Gm.), given in capsule, 3 times a day, which may be gradually increased to 10 or 15 grains (0.6–1 Gm.) a day, but a larger quantity than this should rarely be employed. During the administration of full doses of thyroid gland the patient should remain in bed because of the circulatory depression which sometimes follows its use, and in some cases it is wise to protect the circulation from this depression by the use of moderate doses of strychnine. As the drug not only causes a loss of fat, but also of nitrogenous tissue, patients receiving it in full doses should also partake of a liberal proteid diet. Thyroid gland has been given with asserted success in some cases of primary dementia, and even in acute mania. Its use in exophthalmic goitre is not rational.

GLUCOSUM.—Glucose.

Saccharum amylaceum, Saccharum uveum.—Grape-sugar, Starch-sugar, Dextrose, E.; *Stärkezucker, Traubenzucker, Kartoffelzucker, Glukose, Glykose,* G.

Formula, $C_6H_{12}O_6$. Molecular weight, 178.74.

Chemically the term glucose embraces a number of carbohydrates of the formula $C_6H_{12}O_6$, occurring naturally in plants, or obtained by the action of acids upon starch or cellulose and those organic compounds forming the large class of glucosides, and characterized by a strong reducing action upon Fehling's Solution. Commercially the term glucose is applied to the saccharine product obtained by the inversion of starch, and more particularly to the liquid syrupy form, while to the solidified product the term grape-sugar is applied.

Preparation.—Commercially, glucose is made by boiling 100 parts of starch, 400 parts of water, and ½ to 1¼ parts of sulphuric acid until starch can no longer be detected by means of solution of iodine. The transformation is hastened by heating under pressure in an autoclave. When grape-sugar is to be produced, the inversion of the starch is carried further, so as also to transform most or all of the dextrin to dextrose. Upon completion of the inversion the free acid is neutralized with chalk, and the liquid clarified and decolorized, if necessary, by treating it with clay and animal charcoal, filtering, and concentrating the filtrate in a vacuum-pan to 28°–30° Baumé, at which density much calcium sulphate usually separates and is removed by filtration. The filtrate is further concentrated to 40°–44° Baumé for the liquid *glucose* (*sirop cristal*, Fr.), or crystallized for the solid form, *grape-sugar* (*glucose masse*, Fr.). Liquid glucose (commercially known as glucose, mixing glucose, corn syrup, jelly glucose, confectioners' crystal glucose) is a colorless to light-yellowish, sweetish syrup, of a density 1.40 to 1.43, and contains from 34 to 43 per cent. of dextrose, 0 to 19 per cent. of maltose, 30 to 45 per cent. of dextrin, 14 to 23 per cent. of water, 0.5 to 1.5 per cent. of ash, and a variable percentage of unfermentable carbohydrates, from which Schmitt and Coblenzl separated *gallisin*, $C_{12}H_{24}O_{10}$. Calcium sulphite, added as a preservative, is found in nearly all commercial glucose, and is the cause of the decolorizing action of the latter on solutions containing free iodine.

Grape-sugar is usually in the form of white or whitish to yellowish or even brownish granular masses or powder. It is obtained in crystalline form by the process of A. Behr (1882), by the addition of crystals of dextrose to highly concentrated glucose syrup and allowing to crystallize. Grape-sugar consists of 64 to 99.5 per cent. of dextrose, 0 to 22 per cent. of dextrin, and 0.15 to 0.85 per cent. of ash. The solutions of glucose and grape-sugar usually have a faint acid reaction. Grape-sugar is soluble in a little more than 1 part of water, the fresh solution exhibiting strong birotation, a property which is prevented by the addition of a few drops of ammonia.

Pure dextrose may be obtained in the form of anhydrous crystals by crystallization from alcohol, and as hydrated crystals, $C_6H_{12}O_6 + H_2O$, from less concentrated aqueous solutions. It is a white crystalline powder, of a sweetish taste, but less sweet than cane-sugar or an equal weight of levulose, and is soluble in 1⅓ times its weight of cold water and in about 50 parts of cold or 4.5 parts of boiling alcohol; it is insoluble in chloroform and ether. Some of the commercial "corn-sugar" is practically pure dextrose. Dextrose melts at 146° C. (294.8° F.); at 170° C. (338° F.) it suffers decomposition to glucosan, $C_6H_{10}O_5$, and at still higher temperatures it yields caramel. The hydrated variety loses its water of crystallization below 100° C. (212° F.). Dextrose is strongly dextrorotatory, $[a]_d = 52.7$, from which fact it takes its name. Nascent hydrogen converts it into *sorbite* or sorbitol, $C_6H_8(OH)_6$, an alcohol of which glucose is the aldehyde. Nitric acid oxidizes it to saccharic, tartaric, racemic, and oxalic acids. *Saccharic* acid, $H_2C_6H_8O_8$, is amorphous, deliquescent, freely soluble in water and alcohol, and yields mostly crystallizable salts. Dextrose is directly fermentable. Its solution heated with alkali hydroxide acquires a dark color (distinction from cane-sugar). With organic acids it combines to form oily or amorphous products sparingly soluble in water, but soluble in alcohol and ether. It acts as a strong reducing agent in alkaline solutions. Its aqueous solution is not precipitated by neutral or basic solution of lead acetate, but is precipitated by an ammoniacal solution of lead acetate. It gives the general reactions noted below under *Sugar Tests.*

Pharmaceutical Preparation.—Syrup of Glucose, Br.

Levulose also known as fruit-sugar, an isomer of dextrose, frequently accompanies grape-sugar in fruits, and with dextrose is the principal saccharine matter of honey. In some plants it is associated with cane-sugar. Unlike dextrose, it is not formed by the action of acids upon glucosides, but is produced with dextrose by the inversion of cane-sugar. It is obtained from inulin by treatment with dilute acids. It may be prepared by cooling 10 parts of invert sugar dissolved in 100 parts of water to 0° C. (32° F.) and adding under constant stirring 6 parts of powdered slaked lime. The difficultly soluble *calcium levulosate*, $CaO.C_6H_{12}O_6.H_2O$, soluble in about 325 parts of water, is precipitated, removed by filtration, and washed with ice-cold water to wash out the soluble dextrose compound. The washed precipitate is suspended in water and the calcium removed by precipitation with a current of carbon dioxide. The filtrate is concentrated in vacuum to recover the levulose.

Levulose is usually in the form of a colorless uncrystallizable syrup, but may be obtained in the form of fine silky needles, readily soluble in water and dilute alcohol, soluble in absolute alcohol. It has about the sweetness of cane-sugar. It is strongly lævorotatory, $[\alpha]_d = -98.8°$ at 15° C. (59° F.), the rotation being strongly affected by change in temperature, decreasing by 0.6385 degree for each increase of 1 degree C. It is directly fermentable in aqueous solution, and like dextrose has a powerful reducing action in alkaline solution upon salts of copper, silver, and gold.

Dextrose, levulose, and glucose are distinguished from cane-sugar, or detected in solutions by the following tests; tannin and similar compounds which are likely to interfere are previously removed, either by solvents or precipitants:

Sugar Tests.—*Moore's Test.*—A solution of cane-sugar, heated with 3 or 4 per cent. of potassa for a minute or two, remains colorless; glucose and milk-sugar are colored brown.

Trommer's Test.—A solution of cane-sugar, mixed with a little copper sulphate and an excess of potassa or soda, retains its blue color on boiling, but turns bright-red in the presence of glucose or milk-sugar, red cuprous oxide being deposited. Glucose and most allied sugars effect the same reduction, though more slowly, in the cold.

Fehling's test is a modification of the preceding, and may be used for the quantitative determination of glucose. The test-liquid is prepared by dissolving 34.64 Gm. of crystallized copper sulphate in water, adding 200 Gm. of Rochelle Salt, and 600 or 700 Gm. of sodium hydroxide solution specific gravity 1.20, and diluting the whole to 1 liter (Schorlemmer). 10 Cc. of this solution are reduced by 0.5 Gm. of grape-sugar. Boedecker introduced Rochelle Salt in place of potassium tartrate, which was used by Fehling. The test is usually made with a solution containing about 1 per cent. of glucose; weaker solutions reduce a somewhat smaller amount of the test-liquid.

Since Fehling's Solution is reduced also by dextrin and by milk-sugar, *Barfoed's Solution* (crystallized cupric acetate, 13.3 Gm.; glacial acetic acid, 2 Gm.; distilled water, 200 Cc.), which is not affected by these two substances, is to be preferred for detecting glucose.

Pettenkofer's Test.—Bile in the presence of sugar (of other carbohydrates and of proteids) acquires a blood-red color with concentrated sulphuric or phosphoric acid.

Boettger's Test.—A little bismuth subnitrate boiled with solution of glucose, rendered alkaline by sodium carbonate, acquires a gray or black color; pure cane-sugar produces no alteration.

O. Schmidt's Test.—Lead acetate, added to a saccharine liquid, is precipitated white by excess of ammonia; on heating the mixture it remains unchanged if cane-sugar or milk-sugar is present, but turns orange-red with glucose.

Sachsse's Test.—18 Gm. of mercuric iodide, 25 Gm. of potassium iodide, and 80 Gm. of caustic potassa are dissolved in distilled water sufficient to make 1 liter. 40 Cc. of this solution heated to boiling are decomposed by 1.1342 Gm. of glucose, so that a drop of liquid is not rendered black by ammonium sulphhydrate.

Maumené's Test.—On heating a solution of glucose with a few drops of solution of silver nitrate the liquid acquires a brown color.

Tollen's Test.—An ammoniacal solution of silver nitrate containing caustic soda is reduced by glucose, with the production of a metallic mirror.

Gawalowski's Test.—A solution of sugar heated with neutral ammonium molybdate to 100° C. (212° F.) becomes blue in the presence of glucose.

Action and Uses.—Glucose is quite readily digested, and because of this fact is said to be nearly equal in value to cane-sugar as a food. As it lacks sweetness, however, it is never employed as a sweetening agent. Glucose is reputed to have diuretic properties, and in doses of 6 fluidounces (180 Cc.) daily has been recommended in the treatment of dropsical effusions. It should not be employed where renal changes are marked.

GLYCERINUM, *U. S., Br., P. G.*—Glycerin; Glycerol.

Glycerine, Glycerol, E.; *Glycérine,* Fr.; *Glycerin, Glyceryloxyhydrat, Oelsüss, Scheele'shes Süss,* G.

Formula, $C_3H_5(OH)_3$ or $CH_2OH.CHOH.CH_2OH$. Molecular weight, 91.37.

A liquid sweet soluble principle obtained from fats and fixed oils, and containing not less than 95 per cent. of absolute glycerin, the trihydric alcohol, $C_3H_5(OH)_3$.

Glycerin was discovered by Scheele (1779) in the preparation of lead plaster from olive oil and litharge, and called the *sweet principle of oils.* It occurs as a constituent (4–7 per cent.) of fixed oils and fats, being in combination with the fatty acids as compound ethers or glycerides. It is formed in small quantities, about 3 per cent. of the glucose present, during the fermentation of saccharine liquids, and has been prepared synthetically from tribromo- and trichloropropane.

Preparation.—Glycerin is obtained commercially by the decomposition of animal and vegetable fats and oils by saponification with caustic alkalies as a by-product in the manufacture of soap; by decomposition of the fats in an autoclave by means of steam and a small proportion of lime (Milly), or zinc oxide (Michaud Frères); by saponification with superheated steam at a temperature of 310°–315° C. (590°–599° F.) (Wilson); by decomposing the fats by means of water at a high temperature and pressure (R. A. Tilghman, 1854); and to some extent by decomposing the fats with sulphuric acid and steam in an autoclave.

The best results in the manufacture of glycerin are those obtained by what is known as "aqueous saponification." This process consists in mixing the fats with certain proportions of water in large copper digesters provided with stirrers, and then treating the mixture with superheated steam at a pressure of 8 or 10 atmospheres (120–150 pounds); the temperature is maintained at about 200° C. (392° F.), and the mixture kept in constant motion. This treatment decomposes the fat into glycerin and free fatty acids; the glycerin dissolves in the water and the non-volatile acids float on the surface of the aqueous solution and may be removed mechanically, while the volatile acids are allowed to escape with steam through a small orifice in the top of the digester. The dilute solution of glycerin is transferred to evaporating tanks and concentrated until it reaches a density of 28° Baumè, after which the crude dark amber-colored glycerin is introduced into specially constructed stills, into which steam enters at a temperature of about 250° C. (482° F.), and carries the glycerin in the form of vapor over into a series of condensers so arranged that the first condenser, being least cooled, will contain the heaviest glycerin, the distillate becoming gradually weaker, until in the last condenser almost pure water is collected. Coloring-matter is removed by treatment with animal or vegetable charcoal, and the distillation is repeated two or three times until the required degree of purity has been obtained.

The reaction for a fat like stearin is illustrated by the equation: $C_3H_5(C_{15}H_{35}O_2)_3$ (stearin) + 3(H.OH) (water) = $C_3H_5(OH)_3$ (glycerin) + $3HC_{15}H_{35}O_2$ (stearic acid).

Synthetic or artificial glycerin has been prepared from tribromopropane, $C_3H_5Br_3$, and also trichloropropane, $C_3H_5Cl_3$; the former compound is treated with silver acetate, and the resulting glyceryl acetate or triacetin is decomposed by potassium hydroxide, yielding glycerin and potassium acetate; thus, $C_3H_5Br_3 + 3AgC_2H_3O_2 = C_3H_5(C_2H_3O_2)_3 + 3AgBr$, and $C_3H_5(C_2H_3O_2)_3 + 3KOH = C_3H_5(OH)_3 + 3KC_2H_3O_2$. When trichloropropane is heated with water to 180° C. (356° F.) it also yields glycerin.

In subjecting soap-liquors to dialysis the glycerin passes quite freely with the salts through parchment-paper, but not through "gutta-percha paper," which has been (1882) recommended for the purification of such impure glycerin. The process of purification of glycerin by distillation was patented by Wilson and Payne in 1854.

The world's production of glycerin amounts to over 40,000 tons annually, of which amount about five-eighths is produced in the manufacture of stearic acid and the remainder from soap-liquors. Glycerin was first manufactured in the United States by Robert Shoemaker, at Philadelphia, in 1846. The production in the United States is now estimated at 6000 tons, and the importations at about a like amount per annum.

Properties.—Absolute glycerin is a colorless, odorless, viscid, very hygroscopic, optically inactive, crystallizable liquid, having a sweet and warm (due to absorption of water) taste, and a density of 1.2665 (Allen) at 15° C. (59° F.). It congeals to a crystalline mass at —8° C. (17.4° F.) if shaken, forming hard and very deliquescent crystals. It boils at 290° C. (554° F.), the boiling-point being rapidly lowered through

the presence of water, and may be distilled under reduced pressure without decomposition.

Commercial and pharmacopœial glycerin contain water. The pharmacopœias require glycerin to have a density of 1.230–1.235, P. G., not less than 1.246 at 25° C. (77° F.), U. S., 1.260, Br., which, according to the following by A. B. Lyons, based on the data obtained by W. Lenz (1880), corresponds to 86–97 per cent. of absolute glycerin:

100 per ct.,	1.26596	sp. gr.	91 per ct.,	1.24217	sp. gr.	82 per ct.,	1.21766	sp. gr.	45 per ct.,	1.11618	sp. gr.
99 "	1.26335	"	90 "	1.23945	"	81 "	1.21493	"	40 "	1.10253	"
98 "	1.26072	"	89 "	1.23673	"	80 "	1.21221	"	35 "	1.08908	"
97 "	1.25809	"	88 "	1.23400	"	75 "	1.19857	"	30 "	1.07564	"
96 "	1.25547	"	87 "	1.23128	"	70 "	1.18487	"	25 "	1.06236	"
95 "	1.25285	"	86 "	1.22855	"	65 "	1.17113	"	20 "	1.04930	"
94 "	1.25021	"	85 "	1.22583	"	60 "	1.15737	"	15 "	1.03652	"
93 "	1.24756	"	84 "	1.22310	"	55 "	1.14362	"	10 "	1.02409	"
92 "	1.24487	"	83 "	1.22038	"	50 "	1.12990	"	5 "	1.01189	"

Pharmacopœial glycerin is a clear, colorless, odorless, neutral liquid, of a thick, syrupy consistence, oily to the touch, very sweet and slightly warm to the taste, and miscible in all proportions with water or alcohol. It is soluble in a mixture of 3 parts of alcohol and 1 part of ether, or in a mixture of equal weights of chloroform and alcohol (useful in separating from gum, sugar, and gelatin). It is insoluble in ether, benzin, benzene, carbon disulphide, chloroform, and fixed or volatile oils. It dissolves bromine, iodine, sulphur .iodide, salicin, santonin, sugar, gum, pepsin, tannic acid, deliquescent salts, increases the solubility of many organic compounds which are soluble in water or alcohol, and prevents the precipitation of some salts by alkalies and other reagents. Exposed to the air, it slowly absorbs moisture, which under favorable conditions may amount to twice (W. Willmott) the bulk of the glycerin. It is slowly volatilized from an aqueous solution, at or above 100° C. (212° F.), with the vapor of water. Heated by itself to a high temperature it yields acrid fumes containing *acrolein*, boils at or above 165° C. (329° F.), and is ultimately decomposed and dissipated. With water under pressure it may be distilled without decomposition at 170°–260° C. (338°–500° F.). It may be cooled to −35° C. (−31° F.) without freezing; even with 28 per cent. of water it will bear a temperature of −31° C. (−23.8° F.) for a time without congealing. At −40° C. (−40° F.) glycerin becomes a gummy mass.

Chemically, glycerin is a triatomic alcohol and known as propenyl alcohol; hence chemists often designate it *glycerol*, in analogy with other alcohols. It forms with acids three series of ethers, in which 1, 2, or 3 atoms of hydrogen are replaced by the corresponding number of univalent acidulous radicals. The so-called neutral fats are compound ethers or ethereal salts, like *tripalmitin*, $C_3H_5(C_{16}H_{31}O_2)_3$. A similar compound is *glyceryl trinitrate*, also known as *nitroglycerin* or *glonoin*, $C_3H_5(NO_3)_3$ (which see).

When 1 part of glycerin is heated with 2 parts of acid potassium sulphate, 2 molecules of water are split off and the glycerin is converted into *acrolein* or *allyl aldehyde*; thus, $C_3H_5(OH)_3 - 2H_2O = C_3H_4O$; the same effect is produced when glycerin is heated with an excess of phosphoric anhydride, or even rapidly heated by itself to a temperature of about 290° C. (554° F.). Acrolein is a light, very refractive, and volatile oily liquid, the vapors of which are extremely irritating to the eyes.

Glycerin dissolved in water and kept, with yeast, at a temperature of about 25° C. (77° F.), is converted into *propionic acid*, and with chalk and old cheese at 40° C. (104° F.) it yields *alcohol* and *butyric acid*. When slightly diluted with water and heated to just above 100° C. (212° F.) in the presence of oxalic acid, the latter will be decomposed into *carbon dioxide* and *formic acid*. $C_2H_2O_4$ yields $CO_2 + CH_2O_2$; the formic acid may be afterward obtained by *repeatedly* diluting with water and distilling. Glycerin unites with the alkalies and alkaline earths to form compounds soluble in water, the former also in alcohol; the latter are not precipitated by carbonic acid. It unites also with sulphuric and other acids. If a fused bead of borax on a loop of platinum wire be moistened with glycerin and then held in a colorless flame, the latter will be transiently tinted deep-green.—U. S. This behavior was observed by Iles (1877), and recommended as a test for borates or for glycerin, but Klein (1878) showed that the reaction with borax takes place not only with glycerin, but also with other polyhydric alcohols; and the conditions for these reactions have been elaborately investigated by Dunstan (1883), proving that sodium pyroborate is decomposed, with the formation of sodium metaborate and a boric ether, or, if water be present, free boric acid, the alcohol being regenerated.

Tests.—Glycerin is now rarely adulterated, but since much is prepared for uses in the arts, where purity is not necessary, impure glycerin may at all times be met with in the market. Water, mucilage, dextrin, glucose, and perhaps cane-sugar syrup, would be used as adulterants. The first is detected by the specific gravity of the sample, the others by the brown color produced on mixing the sample with twice its bulk of concentrated sulphuric acid. Since cane-sugar syrup which has been exposed to the light for some time contains appreciable quantities of glucose, glycerin adulterated with either kind of sugar will become brown on being heated with solution of potassium or sodium hydroxide, and will yield a red precipitate when heated to boiling with a drop of solution of copper sulphate and an excess of potassa. The impurities may consist of saline matters should the glycerin have not been distilled, of odorous compounds if insufficiently purified by distillation, or arsenic from the use of impure sulphuric acid made from pyrites. The odor becomes apparent on warming the glycerin or rubbing it well upon the hand. Most of these compounds reduce silver nitrate and produce a more or less deep color when glycerin is diluted with a little distilled water and, after the addition of a few drops of silver nitrate solution, heated to boiling. The same reagent will detect chlorides by the white precipitate produced. Diluted glycerin should not be colored or rendered turbid on being tested with hydrogen sulphide or ammonium sulphide (metallic salts), ammonium oxalate (calcium), or barium chloride (sulphuric or oxalic acid). The presence of butyric acid is readily determined by warming a mixture of glycerin with one-fourth its measure each of alcohol and sulphuric acid, when butyric ether, recognized by its odor of pineapple, will be given off. The most important tests for practical purposes are those with sulphuric acid and silver nitrate. Goddefroy (1874) recommended the heating of glycerin in an open crucible to boiling, and then igniting it, when it should burn without diffusing the least smell or leaving the least residue. From these reactions the following tests have been formulated: "5 Cc. of glycerin, heated to boiling in an open porcelain or platinum dish, and then gently ignited, should burn and vaporize, so as to not leave more than a dark stain, which on stronger heating should disappear entirely (absence of mineral impurities). If 5 Cc. of glycerin be mixed with 50 Cc. of water and 10 drops of hydrochloric acid in a small flask, and heated for half an hour on a water-bath to boiling, then 10 Cc. of the hot liquid, mixed with 2 Cc. of sodium hydroxide test-solution and 1 Cc. of alkaline cupric tartrate volumetric solution, should show no yellowish-red cloudiness or precipitate within 6 hours (absence of sugars). If 5 Cc. of glycerin be mixed with an equal volume of concentrated sulphuric acid in a test-tube, the liquid should acquire a color not darker than yellow on standing for 1 hour (absence of readily carbonizable impurities). If 5 Cc. of glycerin be mixed with the same volume of a mixture of equal parts of alcohol and diluted sulphuric acid and gently heated, a fruity odor should not be recognizable (absence of butyric acid). No color, cloudiness, or precipitate should appear when separate portions of its aqueous solution (1 in 10) are treated with barium chloride test-solution (sulphuric acid); calcium chloride test-solution (oxalic acid); ammonium oxalate test-solution (calcium salts); silver nitrate test-solution (chlorides); or silver ammonium nitrate test-solution (acrolein); in the last-mentioned case the test-tube, loosely stoppered to protect it from impurities, should be allowed to stand at least 5 minutes. 5 Cc. of an aqueous solution (1 in 10) should not respond to the modified Gutzeit's test for arsenic (see Arseni Trioxidum). The aqueous solution (1 in 20), when acidified with hydrochloric acid, and warmed to about 50° C. (122° F.), should not be colored or rendered turbid by the addition of an equal volume of freshly prepared hydrogen sulphide test-solution after standing, well stoppered, in a warm place, 35° C. (95° F.), for at least ½ hour, nor should the further addition of ammonia-water to this solution cause a coloration or turbidity therein (absence of heavy metals.)."—U. S. If a mixture of 1 Gm. of glycerin and 1 Cc. of ammonia be heated to 60° C. (140° F.) and at once treated with 3 drops of solution of silver nitrate, no discoloration or brown precipitate should result within 5 minutes. 1 Cc. of glycerin heated with 1 Cc. of sodium hydroxide solution should not become discolored, nor develop an odor of ammonia or glue. 1 Cc. of glycerin mixed with 3 Cc. of stannous chloride solution should not become colored within one hour (absence of arsenic).—P. G. 2 Cc. diluted with 5 Cc. of a mixture of 1 part of hydrochloric acid and 7 parts of water, 1 Gm. of pure zinc being added, and the whole placed in a long test-tube, the mouth of which is covered by a piece of filter-paper moistened with a drop or two of test-solution of mercuric chloride and dried, should not afford a yellow stain on the paper even after 15 minutes (limit of arsenic).—Br.

Pharmaceutical Uses.—Glycerin forms the base of the official *glycerita* (*glycerina*), and glycerin suppositories, and is a constituent of a number of official fluidextracts, tinctures, and syrups; also of Mucilago Tragacanthæ, U. S. It is used for preserving pill-masses and certain extracts in a plastic condition, and for preventing fermentation and other changes in aqueous liquids containing organic matter in solution.

Action and Uses.—Glycerin is a mild laxative, and may be employed either by the mouth or rectum in the treatment of simple constipation. A glycerin enema containing from 2 to 4 fluidrachms (8–16 Cc.) of the drug diluted with an equal amount of water, or the official suppository, may be used. It should be remembered, however, that the continued use of this remedy may cause rectal irritation. If given in large amounts, it produces dryness of the mucous membranes, loss of muscular strength, considerable mental depression, and collapse. If injected directly into the circulation, it may also produce convulsions because of its hygroscopic action upon the blood. Glycerin is rarely administered internally except in the treatment of constipation. It may be employed as a demulcent, and as a vehicle for many disagreeable remedies. The remedy has also been recommended as a substitute for codliver oil, but it is inferior to the latter in the treatment of pulmonary tuberculosis. It is both affirmed and denied that glycerin may be used as a substitute for sugar in dieting diabetic patients, and as saccharin is much better, glycerin receives little consideration. Diluted with 4 parts of water and applied to the nostrils, it is sometimes useful in the early stages of acute coryza. Equal parts of glycerin and water flavored with a small quantity of lemon juice form an excellent remedy for removing sordes in enteric fever, and for preventing dryness of the mouth in advanced tuberculosis. An excellent preparation prepared by heating 1 part of potato starch with 15 parts of glycerin may be employed locally in the treatment of eczema, psoriasis, herpes, lichen, and chapped skin. Its local application is also said to prevent bedsores, and when applied upon a tampon it is a most valuable remedy for the relief of pelvic inflammation and congestion of the uterine cervix. This remedy is also employed in the external auditory canal for the purpose of softening impacted cerumen. The dose by the mouth as a laxative is from 1 to 2 fluidrachms (4–8 Cc.), and when given by the rectum from 1 fluidrachm to a tablespoonful (4–16 Cc.).

Derivative Products.—DICHLORHYDRIN. *a*-Dichlorhydrin. Formula, $C_3H_6Cl_2O$. Molecular weight, 127.97.—Dichlorhydrin is prepared by heating anhydrous glycerin with 2½ parts of sulphur monochloride, the following reaction taking place: $C_3H_8O_3 + 4SCl = C_3H_6Cl_2O + 2HCl + 3S$. It is a colorless, odorless, viscid liquid, soluble in 10 volumes of water, boils at 176° C. (348.8° F.), and has a specific gravity of 1.364 at 15° C. (59° F.). Dichlorhydrin is a good solvent of resins. Amber is soluble in 10 parts, and copal in apparently all proportions of dichlorhydrin. It is an excellent solvent of nitrated cellulose, and may find extensive use in the arts. It destroys India-rubber and cork stoppers.

EPICHLORHYDRIN. Formula, C_3H_5ClO. Molecular weight, 91.79.—Prepared by heating 2 parts of dichlorhydrin and 1 part of powdered sodium hydroxide to not over 130° C. (226° F.). It is a colorless limpid liquid having a chloroform-like odor, specific gravity 1.191 at 15° C. (59° F.), boils at 117° C. (242.6° F.), and possesses the general solvent properties of dichlorhydrin. By the action of potassium hydroxide upon epichlorhydrin various ethers of glycerol are produced. (Zunino, *J. C. S.*, 1900, A. 1, p. 535.)

GLYCERITA.—Glycerites—GLYCERINA.—Glycerins.

Glycerata, Glycerolata.—Glycerols, E.; *Glycérés, Glycérats, Glycérolés*, Fr.; *Glycerite, Glycerolate*, G.

This class of preparations, first proposed in 1854 by Cap and Garot, has met with much favor here and abroad. They are easily prepared, and keep indefinitely if protected against absorption of moisture from the air. The name glycerites, as applied to these solutions, seems preferable to the British term glycerins.

GLYCERITUM ACIDI TANNICI, *U. S.*—Glycerite of Tannic Acid.

Glycerinum acidi tannici, Br.; *Glycerin of tannic acid* (*of tannin*), E.; *Glycéré de tannin, Glycérine tannique*, Fr.; *Tannin-Glycerit*, G.

Preparation.—Tannic acid, 20 Gm.; glycerin, 80 Gm.; to make 100 Gm. Triturate the tannic acid with the glycerin to a smooth paste, transfer this to a tared porcelain capsule, avoiding contact with metallic utensils, and apply the heat of a water-bath until the acid is completely dissolved.—U. S.

(480 grains of tannic acid may be dissolved in 27 fluidrachms of glycerin.)

Take of tannic acid, 1 ounce; glycerin, sufficient to produce 5 fluidounces. Rub them together until solution is effected.—Br.

Action and Uses.—Because of its greater solubility glycerite of tannic acid is largely employed for its local effect. It may be used both internally and externally for the various conditions in which ACIDUM TANNICUM (which see) is employed. The internal dose is from 10 to 30 minims (0.6–2 Cc.), well diluted.

GLYCERITUM ALUMINIS.—Glycerite of Alum.

Glycerinum Aluminis, Br.—*Glycerin of alum*, E.; *Glycéré d'alun*, Fr.; *Alaun-Glycerit*, G.

Preparation.—Take of alum, in powder, 1 ounce; distilled water, 3 fluidrachms; glycerin, sufficient to produce 6 fluidounces. Triturate until solution is effected, warming slightly if necessary; set aside; pour off the clear liquid from any deposited matter that may be present.—Br.

Action and Uses.—This preparation possesses the same properties and uses as ALUMEN (which see). It is employed externally and only for its astringent effect.

GLYCERITUM AMYLI, *U. S.*—Glycerite of Starch.

Glycerinum amyli, Br.; *Unguentum glycerini*, P. G.—*Glycerin of starch, Glycamyl, Plasma*, E.; *Glycéré d'amidon, Glycérat simple (d'amidon)*, Fr.; *Glycerinsalbe*, G.

Preparation.—Starch, 10 Gm.; water, 10 Cc.; glycerin, 80 Gm. Triturate the starch with the water until a homogeneous mixture is produced. Then gradually add this to the glycerin, contained in a porcelain dish, and heated to about 140° C. (284° F.). Continue the heat, with constant stirring, keeping it below 144° C. (291.2° F.), until a translucent jelly is formed. Transfer the product to suitable vessels, provided with well-fitting covers.—U. S.

Starch, 1 ounce; glycerin, 6½ fluidounces; distilled water, 1½ fluidounces. Stir and heat.—Br.

Wheat starch, 10 parts; water, 15 parts; glycerin, 90 parts. Mix the starch and water, add the glycerin, and heat the mixture on a boiling water-bath until a translucent jelly results.—P. G.

Starch, 1 part; glycerin, 14 parts. Heat carefully.—Fr. Cod.

This preparation was introduced into British pharmacy by G. F. Schacht in 1858, and soon after became known in the United States. To obtain a uniform jelly-like mass, the starch should be first rubbed into a fine powder free from lumps, then intimately mixed with the glycerin and water, which may be done in the porcelain capsule, thus avoiding the unavoidable loss when done in a mortar; and finally the mixture is heated until all starch-granules are ruptured and the liquid is thickened to a translucent mass free from white spots. Prepared in this manner, the glycerite must be preserved in well-stoppered bottles, for in contact with the air it attracts moisture and gradually becomes soft. This tendency is entirely removed, according to W. Willmott (1879), by substituting for one-third of the glycerin an equal measure of water.

Action and Uses.—Glycerite of starch is an emollient. It may be locally applied for its soothing effect in cases of burns, erythematous and erysipelatous inflammations. Its local application will also remove excessive quantities of iodine which have been accidentally applied to the skin.

GLYCERITUM BORACIS.—Glycerite of Borax.

Glycerinum boracis, Br.—*Glycerin of borax*, E.; *Glycéré de borax*, Fr.; *Borax-Glycerit*, G.

Preparation.—Take of borax, in powder, 1 ounce; glycerin, 6 fluidounces. Triturate the borax with the glycerin until solution is effected.—Br.

From the investigations of W. R. Dunstan, it appears that this preparation will contain some free boric acid.

Action and Uses.—Because of its agreeable taste this preparation is suitable for the employment of borax in the treatment of thrush, aphthous stomatitis, and other inflammatory conditions of the mouth. It may also be used locally in the treatment of erysipelas and pityriasis.

GLYCERITUM BOROGLYCERINI, *U. S.*—Glycerite of Boroglycerin.

Glycerinum acidi borici, Br.—*Glycerin of boric acid, Glycerite of glyceryl borate, Solution of boroglyceride*, E.; *Glycéré (Soluté) de boroglyceride*, Fr.; *Boroglycerid-lösung*, G.

Preparation.—Boric acid, in powder, 310 Gm.; glycerin, a sufficient quantity to make 1000 Gm. Heat 460 Gm. of glycerin in a tared porcelain capsule to a temperature not exceeding 150° C. (302° F.), and add the boric acid in portions, constantly stirring. When all is added and dissolved, continue the heat at the same temperature, frequently stirring and breaking up the film which forms on the surface. When the mixture has been reduced to the weight of 500 Gm., add to it 500 Gm. of glycerin, mix thoroughly, and transfer it to suitable vessels.—U. S.

1 pint of this solution, containing 50 per cent. by weight of boroglycerin, weighs about 23 avoirdupois ounces (22.7544), and hence may be prepared by heating 4600 grains of glycerin with 3100 grains of boric acid at the above-mentioned temperature until the mixture weighs 5000 grains, and then adding an equal weight of glycerin. (10,000 grains = 22.85 avoirdupois ounces.) When glycerin and boric acid are heated together for some time, chemical union takes place, with the elimination of aqueous vapor, and, according to Dr. James, the reaction may be illustrated as follows: $C_3H_5(OH)_3$ (glycerin) + H_3BO_3 (boric acid) = $C_3H_5BO_3$ (boroglycerin) + $3H_2O$ (water). Care must be observed not to exceed the prescribed temperature, lest the product become discolored (yellowish or even darker). Attention was first called to boroglyceride and its remarkable preservative properties by F. S. Barff in 1881. The preparation of the Br. P. is practically identical with the preceding in strength, and is made in the same manner. 6 ounces of boric acid and 9 ounces of glycerin are heated together until reduced in weight to 10 ounces, when 10 ounces more of glycerin are added.

Action and Uses.—This preparation is used locally in medicine as a dipletant in congestion of the cervix uteri, being placed on a cotton tampon.

GLYCERITUM FERRI QUININÆ ET STRYCHNINÆ PHOSPHATUM, *U. S.*—Glycerite of the Phosphates of Iron, Quinine, and Strychnine.

Glycéré des phosphates de fer, de quinine et de strychnine, Fr.; *Eisen-, Chinin-, und Strychninphosphat-Glycerit*, G.

Preparation.—Soluble ferric phosphate, 80 Gm.; quinine, 104 Gm.; strychnine, 0.8 Gm.; phosphoric acid, 200 Cc.; glycerin, 500 Cc.; water, a sufficient quantity to make 1000 Cc. Heat the soluble ferric phosphate with 200 Cc. of water, in a porcelain dish, at a temperature not exceeding 70° C. (158° F.), until it is dissolved. Then add the phosphoric acid with the quinine and strychnine and sufficient water to make the product measure 500 Cc., and stir until solution is effected. Mix the solution with the glycerin, and filter if necessary.—U. S.

To prepare 1 pint of this glycerite, dissolve 572 grains of soluble ferric phosphate in 3 fluidounces of water with the aid of heat; then add to the solution 3 fluidounces and 80 minims of phosphoric acid together with 746 grains of quinine alkaloid, 6 grains of strychnine, and sufficient water to make the product measure 8 fluidounces. To this solution add 8 fluidounces of glycerin and mix thoroughly.

Glycerite of the phosphates of iron, quinine, and strychnine is one of the new preparations of the Pharmacopœia, and was introduced for the purpose of extemporaneously making the well-known syrup of the same name, and thereby avoiding the annoying discoloration which invariably occurs when saccharine solutions are allowed to stand in the presence of acids for some time. It is a pale amber-colored fluorescent liquid, which darkens but very slightly even when kept on hand in diffused light for a long time, and has a very acid bitter taste. It contains 0.08 Gm. of iron phosphate in each cubic centimeter, together with 0.104 Gm. of quinine and 0.0008 Gm. of strychnine, both present as phosphates, or in each teaspoonful $4\frac{1}{2}$ grains of iron phosphate, $6\frac{1}{5}$ grains of quinine, and about $\frac{1}{22}$ grain of strychnine. When mixed with simple syrup in the proportion of 1 volume of glycerite and 3 volumes of syrup, it corresponds with the official Syrupus Ferri Quininæ et Strychninæ Phosphatum (which see).

Action and Uses.—The chief employment of this preparation is in the manufacture of the syrup. It may be administered for the same conditions in which the syrup is employed. (See Syrupus Ferri, Quininæ et Strychninæ Phosphatum.) The dose is from 15 to 60 minims (1–4 Cc.).

GLYCERITUM HYDRASTIS, *U. S.*—Glycerite of Hydrastis.

Glycéré d'hydrastis du Canada, Fr.; *Gelbwurzel-Glycerit*, G.

Preparation.—Hydrastis, in No. 60 powder, 1000 Gm.; glycerin, 500 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Moisten the hydrastis with 350 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow percolation to proceed slowly, gradually adding alcohol, until the hydrastis is practically exhausted. Remove nearly all of the alcohol by distillation or evaporation, pour the thick concentrated liquid into 500 Cc. of ice-cold water, and set it aside in a cold place for 24 hours. Then filter, pass enough cold water through the filter to make the filtrate measure 500 Cc., add the glycerin, and mix thoroughly.—U. S.

25 avoirdupois ounces of hydrastis should be moistened with about 9 fluidounces of alcohol, and percolated to exhaustion with the same menstruum; after nearly all the alcohol has been evaporated, the thick liquid is poured into 12 fluidounces of ice-cold water and set aside for 24 hours. The mixture is then filtered and sufficent water passed through the filter to bring the volume up to 12 fluidounces, and lastly 12 fluidounces of glycerin are added and the whole thoroughly mixed.

Glycerite of hydrastis is chiefly intended to furnish a fluid preparation of hydrastis which shall be miscible with water in all proportions without precipitation. Each Cc. represents 1 Gm. of hydrastis, or a fluidounce, about 463 grains.

Action and Uses.—The properties of the preparation are considered under HYDRASTIS (which see).

GLYCERITUM PEPSINI.—Glycerite of Pepsin.

Glycerinum pepsini, Br.—*Glycerin of pepsin*, E.; *Glycéré de pepsine*, Fr.; *Pepsin-Glycerit*, G.

Preparation.—Take of pepsin, 800 grains; hydrochloric acid, 110 minims; glycerin, 12 fluidounces; distilled water, a sufficient quantity. Mix the hydrochloric acid, the glycerin, and 6 fluidounces of distilled water; then add the pepsin; after 1 week pour off the clear liquid, or filter; add sufficient distilled water to produce 1 pint (20 fluidounces).—Br.

The glycerite of pepsin of the National Formulary is very similar to the above preparation, but slightly stronger in digestive power. It is made as follows: Mix pepsin (U. S. P.) 85 Gm. with water 450 Cc. and hydrochloric acid 10 Cc., and agitate until solution has been effected. Then incorporate purified talcum 15 Gm. with the liquid, filter, returning the first portions of the filtrate until it runs through clear, and pass sufficient water through the filter to make the filtrate measure 500 Cc. To this add glycerin 500 Cc. and mix.

Both preparations contain 5 grains of pepsin in each fluidrachm, but the pepsin of the U. S. P. is 20 per cent. stronger than that of the British Pharmacopœia.

Pepsin solutions are filtered with some difficulty. Paper-pulp will be found preferable to purified talcum.

Action and Uses.—Glycerite of pepsin may be employed for the same purposes as PEPSINUM (which see). Because of the laxative properties of glycerin the administration of this remedy may be advantageous in cases of indigestion if constipation exists.

GLYCERITUM PHENOLIS, *U. S.*—Glycerite of Phenol.

Glyceritum acidi carbolici, U. S., 1890; *Glycerinum acidi carbolici*, Br.; *Glycerite of carbolic acid*, *Glycerin of phenol*, E.; *Glycéré d'acide phénique*, *Glycérine phéniquée*, Fr.; *Phenol- (Phenyl-) Glycerit*, G.

Preparation.—Liquefied phenol, 20 Gm.; glycerin, 80 Cc.; to make 100 Cc. Add the liquefied phenol to the glycerin and stir until thoroughly mixed.—U. S.

(5 fluidrachms of liquefied phenol may be mixed with 17 fluidrachms of glycerin.)

Take of phenol, 1 ounce; glycerin, sufficient to produce 5 fluidounces. Triturate the phenol with the glycerin until solution is effected.—Br.

Action and Uses.—Glycerite of carbolic acid forms a safe and agreeable method for the administration of PHENOL (which see) in that it renders the acid miscible in all proportions with water. The internal dose is from 5 to 10 minims (0.30–0.60 Cc.), well diluted.

GLYCERITUM PLUMBI SUBACETATIS.—Glycerite of Lead Subacetate.

Glycerinum plumbi subacetatis, Br.—*Glycerin of lead subacetate*, E.; *Glycéré de sousacétate de plomb*, Fr.; *Bleiglycerit*, G.

Preparation.—Take of lead acetate, 5 ounces; lead oxide, in powder, 3½ ounces; glycerin, 20 fluidounces; distilled water, 12 fluidounces. Mix together and boil for 15 minutes; then filter and evaporate at a temperature not exceeding 105.5° C. (222° F.) until the product weighs 32¾ ounces, and has a specific gravity of 1.48.—Br.

Action and Uses.—This preparation is employed for the same purposes as Goulard's Extract, and by some is considered a better remedy, as the glycerin present prevents the formation of dry crusts upon the skin.

GLYCERITUM TRAGACANTHÆ.—Glycerite of Tragacanth.

Glycerinum tragacanthæ, Br.—*Glycerin of tragacanth*, E.; *Glycéré de gomme adragante*, Fr.; *Traganth-Glycerit*, G.

Preparation.—Take of tragacanth, in powder, ½ ounce; glycerin, 1½ fluidounces; distilled water, ½ fluidounce. Mix the tragacanth with the glycerin in a mortar, add the water, and triturate until a homogeneous paste is produced.—Br.

Action and Uses.—Glycerite of tragacanth is only employed in medicine as an excipient in the preparation of pill-masses.

GLYCYRRHIZA, *U. S.*—Glycyrrhiza.

Glycyrrhizæ radix, Br.; *Radix liquiritiæ*, P. G.; *Liquorice- or Licorice-root*, E.; *Süssholz*, G.; *Réglisse, Bois de réglisse, Bois doux, Racine douce*, Fr.; *Orozuz Regaliz, Palo dulce*, Sp.; *Radice di Liquirizia* (or *Regalizia*), It.; *Raiz de Alcacuz*, Port.

The dried rhizome and root of *Glycyrrhiza glabra* L. (*G. officinalis* Lepech.; *Liquiritia o.* Moench; *G. vulgaris* Gueld), which yields the *Spanish*, *French*, or *Sicilian Liquorice*, or of *G. glandulifera* Wald. et Kitt. (*G. glabra glandulifera* Regel et Herder), yielding the *Russian Liquorice* (Fam. *Leguminosæ*).

Fig. 201.

Glycyrrhiza (Nat.): A, Russian, small root; B, Spanish, medium-sized root.

Licorice is official in all pharmacopœias, which differ as to the variety or varieties recognized, as to the botanical name employed, and as to the drug being peeled or unpeeled. The Br. P. requires that it be peeled. Several require that it be unpeeled, and one or two name *G. echinata* as the source.

Origin.—The licorice plants are shrubs, natives of southeastern Europe and southwestern Asia, as far as Persia, the *G. glabra* ranging more especially to the westward, the *G. glandulifera* more to the eastward. The plants are graceful, with light, spreading pinnate foliage, presenting an almost feathery appearance from a little distance, and bearing racemes of papilionaceous small, yellowish-white or purplish flowers, and a short pod somewhat resembling a partly grown pea-pod in form, glandular, hairy in the one species, smooth in the other. The

Fig. 202.

Spanish (rhizome).

Fig. 203.

Russian (root).

underground system, as in so many Leguminosæ, is double, the one part consisting of a vertical or tap-root, often with several branches, penetrating to a depth of 3 or 4 feet, the other

of horizontal rhizomes running near the surface of the ground. With the latter, horizontal roots, sometimes exist. Various indications point to the function of this plant of fixing atmospheric nitrogen, as do so many other members of the family. It prefers the rich, fine soil of bottom-lands in river valleys, where there is an abundance of moisture during the growing period, but where the ground bakes hard during the hot late summer months. Although this dry heat is very favorable for the formation of the sweet constituents, it renders collection difficult until after the early autumn rains, when the harvest commences.

Not only can the plant not endure severe freezing, but cool weather interferes with the formation of its useful juice and also renders it woody. It has been found that a climate particularly favorable to the production of the orange is favorable to that of licorice.

Owing to the depth to which the root penetrates and its ready propagation from detached pieces, the plant is a most persistent weed in cultivated grounds and exceedingly difficult of extirpation. It is very healthy and robust, and little subject to disease, at the same time successfully occupying the ground to the exclusion of other plants. For this reason the continuation of the natural supply may be considered as assured, though it is liable, of course, to suffer severe reduction from over-collection. The supply of natural root has suffered violent fluctuations, owing to the exhaustion of supplies in the districts previously worked, alternating with over-production from newly opened districts. This fact, coupled with the operations of speculators, has resulted in equally great fluctuations in quality, the new districts yielding full-grown root of good quality, the older ones that which has not been allowed to develop properly. The same ground yields a crop every 3 or 4 years. It may be said that the 4-year-old growth is the best. That of the third year and earlier is deficient in sweet substance, but immediately after the fourth year the texture begins to take on a tough, coarse, and woody character. It is desirable, furthermore, to collect the roots of those plants which have never borne fruit, since that process exhausts the sweet substance of the sap.

Cultivation.—Russian Licorice has been comparatively little cultivated, owing to the extensive areas of wild land which it occupies. Up to the year 1890, the cultivation of Spanish Licorice was small or moderate in comparison with the wild collection. Owing, however, to the depletion of the natural supplies of root of good quality, this cultivation has grown rapidly during the past decade in southern and south-central Europe, where the climate is favorable. Cultivation on a small scale, the roots mostly sold and consumed in their fresh and succulent state, has existed in England for a very long time.

The cultivation of licorice is easy, sure, and profitable, and, if properly conducted, conducive to the betterment of the soil, and it is an industry which might be pursued with great advantage in our Southern States.

Propagation is effected by means of cuttings, resulting as waste from the harvesting process. These are planted about 4 inches underneath the surface, in rows about 4 feet apart. During the first 2 years the growth is very slight, and the intervening space is utilized for the production of potatoes, cabbages, and similar crops. The soil being heavily fertilized for the production of licorice, these crops are usually very luxuriant. After the second year the growing licorice plants cover the entire soil to the exclusion of other growth. Harvesting occurs in the autumn of the fourth year. The soil is carefully removed from the space between the rows to a depth of 2 or 3 feet, as required, thus exposing the roots and rhizomes at the side, the whole being then removed bodily. The earth from the next space is then removed and thrown into the trench thus formed, and these operations repeated continuously. The roots are carefully stored in cellars and the trimmings are used for replanting.

Numerous commercial varieties, depending upon the different producing sections, are recognized by dealers, but their differentiation in description is almost impossible. Calabrian Licorice is generally preferred. By far the larger part of the Italian and Sicilian crop is now manufactured there and exported in the form of the extract. Spain formerly yielded most of the American supply, but that of first grade was long since depleted to the point of scarcity. The annual import of licorice root into the United States is probably not far from 100,000,000 pounds.

Description.—*Spanish Licorice.*—In long, cylindrical pieces, from 5 to 15 Mm. ($\frac{1}{5}$ to $\frac{3}{5}$ In.) thick, longitudinally wrinkled, externally grayish-brown to dark-brown, warty; internally tawny yellow; pliable, tough; fracture coarsely fibrous; bark rather thick; wood porous, but dense, in narrow wedges: medullary rays linear; taste sweet, very slightly acrid.

The underground stem, which is often present, has a similar appearance, but contains a thin pith.

Russian Licorice occurs in large, usually crooked pieces, often several feet in length and 5 Cm. (2 In.) in thickness, deprived of the outer bark, pale-yellow without, internally of a lighter yellow than the Spanish, and softer and of lower specific gravity, its cellular elements larger, its taste less sweet, and the wood frequently cleft. Any blackened, knotty, bitter portions should be removed before using.

The powder is identified by (1) the character and location of starch-grains and crystals; (2) the very numerous bast-fibers of peculiar appearance and the almost identical wood-fibers; (3) the peculiar sieve-tissue. The starch-grains are irregularly spheroidal, mostly solitary, and range from 1.5 or 2 to 20 mikrons in diameter. They are contained in medullary-ray and parenchyma-cells, and are often associated in the same cell with the monoclinic prismatic crystals of calcium oxalate, sometimes also with oil-globules. The bast- and wood-fibers are yellow, thick-walled, and doubly pointed. Part of the sieve-tubes have their cavities nearly or quite obliterated by cell-wall thickening. That of the Russian variety is of distinctly lighter color and less sweet, is wanting in cork-cells which are present in the other; its fibers are much less numerous and its parenchyma-cells are larger. Adulteration with the stem is indicated by the presence of pith-cells. The use of inferior grades is best indicated by color and taste, requiring experience. Most other adulterants are at once indicated by their different starch-grains.

Statements concerning the relative quality and taste of Spanish and Russian licorice are contradictory. This probably results partly from the comparison of a superior lot of one variety with an inferior lot of the other, partly from the method of preparation. The fact seems to be that the bitterness and acridity of licorice are practically confined to the bark. The bark being ground in with Spanish Licorice, a certain degree of this element must always be expected in it. The Russian Licorice, on the other hand, is freed from this defect through the removal of its bark, except as to its presence in the black knotty hollow spots, which should be carefully excised before grinding.

Constituents.—Licorice root contains 0.03 per cent. of volatile oil, 6 to 8 per cent. of glycyrrhizin, 2 to 4 per cent. of asparagin, 0.8 per cent. of fat, resin soluble in ether, sugar, gum, a trace of tannin, yellow coloring-matter, and *glycyrmarin*, a bitter principle occurring mostly in the bark. *Glycyrrhizin* (which see) is the acid ammonium salt of *glycyrrhizic acid* ($C_{44}H_{62}NO_{18}NH_4$). This acid is a brown gelatinous mass with a bittersweet taste, soluble in hot water, with which it swells to form a yellowish transparent jelly, slightly soluble in absolute alcohol, more so in 90 per cent. alcohol, and insoluble in ether. On boiling with dilute acids it splits into *para-saccharic acid* ($C_6H_{10}O_8$), which reduces Fehling's Solution, and *glycyrrhetin* ($C_{32}H_{47}NO_4$), which is a white, tasteless powder soluble in alcohol, and insoluble in water, ether, or alkalies.

Pharmaceutical Preparations.—Aromatic Elixir of Glycyrrhiza, Elixir of Glycyrrhiza, N. F.; Compound Powder of Glycyrrhiza, Fluidextract of Glycyrrhiza, Pure Extract of Glycyrrhiza, U. S. P.; Solution of Extract of Glycyrrhiza, Syrup of Glycyrrhiza, N. F.

Action and Uses.—Licorice is an excellent demulcent and slight laxative; and an infusion, made by boiling 1 ounce (30 Gm.) of the bruised root deprived of its cortical layer with 1 pint (480 Cc.) of water for a few minutes, may be employed in the treatment of sore throat and in catarrhal conditions of the genito-urinary and intestinal tracts. Licorice is also employed for the purpose of disguising the taste of acrid or bitter drugs, such as mezereon or quinine. In the form of the compound licorice powder it is employed as a laxative, the properties of which, however, are mainly due to the senna.

Other Species and Allied Products.—The genus *Glycyrrhiza*, L., contains about 12 species, 10 of them in the section of licorice, and all of these having roots more or less sweet, but most of them not sufficiently so to be of use. There are contradictory statements concerning the quality of *G. echinata* L., due perhaps to its having been confused with *G. glandulifera*. Statements are made that some superior Italian root is yielded by that species, but Flückiger states that it is worthless. The latter statement is probably the correct one. *G. lepidota* Pursh (*American Licorice*) is a species of the northwestern United States, and has there been somewhat used. The rhizome is said to resemble that of Spanish Licorice, though it is smaller. It yields 6.39 per cent. of glycyrrhizin, which, however, when ammoniated, leaves a somewhat bitter after-taste. The leaves and root of *Abrus precatorius* (see Abrus) contain glycyrrhizin, and the latter is used in India as a substitute for licorice root.

GLYCYRRHIZINUM AMMONIATUM, *U. S.*—Ammoniated Glycyrrhizin.

Glycyrrhizinum ammoniacale, Glycyrrhizine ammoniacale, Fr.; *Ammoniak-Glycyrrhizin*, G.

Preparation.—Glycyrrhiza, in No. 20 powder, 500 Gm.; water, ammonia water, sulphuric acid, of each a sufficient quantity. Mix 475 Cc. of water with 25 Cc. of ammonia water, and, having moistened the powder with the mixture, macerate for 24 hours. Then pack it moderately in a conical glass percolator, and gradually pour water upon it until 500 Cc. of percolate are obtained. Add sulphuric acid slowly to the percolate, with constant stirring, so long as a precipitate is produced. Collect this on a strainer, wash it with cold water until the washings no longer have an acid reaction, redissolve it in water with the aid of ammonia water, filter if necessary, and again add sulphuric acid so long as a precipitate is produced. Collect this, wash it, dissolve it in sufficient ammonia water previously diluted with an equal volume of water, and spread the clear solution upon plates of glass, so that when dry the product may be obtained in scales.—U. S.

This is Roussin's process, as modified by Appenzeller (1876), who noticed that a considerably larger quantity, somewhat darker in color, is obtained by exhausting the root with diluted ammonia water, and that the scales have a more pleasant taste if licorice root deprived of the brown corky layer be used. Commercial extract of licorice yields a still darker and less pleasant product. The cold percolate, if not too strongly alkaline, when heated to boiling deposits most of the albumen; this and other impurities are removed by again dissolving the precipitated glycyrrhizic acid in ammonia and reprecipitating it by an acid before its ammoniacal solution is finally evaporated and scaled. The yield is about 10 per cent.

Properties.—Ammoniated glycyrrhizin is in transparent dark-brown or brownish-red scales, inodorous, of a very sweet taste, and readily soluble in water and in diluted alcohol. The aqueous solution, when heated with potassium or sodium hydroxide, evolves vapor of ammonia. On supersaturating the aqueous solution with an acid, a substance (glycyrrhizin) is precipitated which, when dissolved in hot water, forms a jelly on cooling. This substance, when washed with diluted alcohol and dried, appears as an amorphous yellow powder of a strong, bitter-sweet taste and an acid reaction. On ignition glycyrrhizin should leave not more than a trace of ash.—U. S. The scales consist mainly of ammonium glycyrrhizate, $(NH_4)C_{44}H_{62}NO_{18}$ (Habermann), with a variable quantity of glycyramarin. They are insoluble in ether, sparingly soluble in strong alcohol, become darker colored at 100° C. (212° F.), and at a higher heat melt, being decomposed at the same time. Glycyrrhizic acid is tribasic; the taste of its alkali salts is very sweet, and in the pure state free from the characteristic after-taste of licorice; their solutions in water foam strongly on agitation and produce voluminous precipitates with most salts of the heavy metals.

Action and Uses.—Ammoniated glycyrrhizin may be used as a substitute for other preparations of licorice. It should not be prescribed in either strongly acid or alkaline mixtures. The dose is from 5 to 15 grains (0.30–1 Gm.).

GNETACEÆ.

A small family of 3 genera and about 40 species, of great interest to botanists, since it connects the Gymnosperms with the Angiosperms. Its medicinal relations have not been developed, though powerful alkaloids, as well as much tannin, exist in its members. Several species of *Gnetum*, L., yield edible fruits and gums. The physiologically active substances pertain chiefly to the genus *Ephedra*, L., which comprises some 25 species, mostly in the north-temperate zone, a few extending into the elevated and temperate regions of South America. The important medicinal species is *E. antisyphilitica* C. A. Meyer, the *Mountain rush*, *Joint fir*, *Shrubby horsetail*, *Teamster's tea*, *Mormon tea*, *Brigham weed*, *Canutillo*, *Tepopote*, of the desert regions of the southwestern United States and Mexico. The plant is a low, diœcious, practically leafless shrub, 2 or 3 feet high. The erect, opposite, rather slender branches are densely fascicled, after the manner of broom-tops, terete but ribbed and channelled, and mostly terminating in hard and sharp points. They are of a yellowish-green color, and, at least the younger parts, minutely resinous. The leaves are reduced to whitish scarious sheaths, mostly 2-cleft, varying greatly in length, from short-triangular to linear-subulate and persisting for years. The staminate aments are about a fourth of an inch long, their bracts opposite and imbricated, and their flowers consisting of about 8 monadelphous stamens, the anthers nearly sessile upon the stamen-column. The fertile aments are solitary,

nearly sessile, bracted with 4 pairs of thick, broadly ovate scales, those of each pair connate at the base. Each produces 1 or 2 smooth, oblong-ovate, and triangulate fruits. The plant has an astringent and bitter taste. Several other species closely resemble and are frequently used for it. The only known constituent upon which its activity can be supposed to depend is a glucosidal tannin, yielding a reddish powder which Loew has named *ephedrin*. Ephedra has been recommended as a remedy in the treatment of gonorrhœa, but has never met with general favor by the profession. A fluid extract may be given in doses of 1 or 2 fluidrachms (4–8 Cc.).

E. vulgaris Rich. is a Japanese species, containing the powerful alkaloid *ephedrine* ($C_{10}H_{15}NO$), which paralyzes the heart and respiration. Locally applied, it is a fairly good mydriatic, dilatation occurring, without effect upon accommodation, in about an hour and lasting about as long as that produced by atropine. *E. monostachya* L. (*E. monosperma* Gmel.; *E. polygonoides* Pall.) is a widely distributed species of Europe and Asia, largely employed by the peasantry as an antisyphilitic, diaphoretic, and antirheumatic. Grache, who has seen it so used in Poland, states that it is very inferior to the salicylates in rheumatism. It bears various local names, such as *Dschorisdsna*, *Katyr koiruch*, *Tschergak*, etc. Its alkaloid has been called *pseudo-ephedrine* ($C_{13}H_{19}NO$), though this name has been applied to a secondary alkaloid of *E. vulgaris*, from which this is said to be distinct. It melts at 112° C. (233.6° F.), is soluble in water and alcohol, in 11 parts of chloroform and 100 of ether, and yields benzoic acid when oxidized by potassium permanganate. It is at first tasteless, afterward producing a burning and benumbing effect. It is not mydriatic.

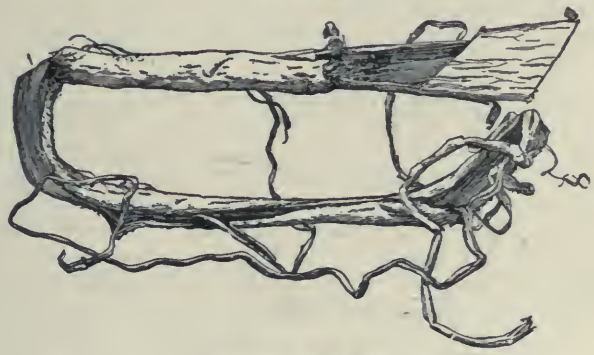
GOSSYPII CORTEX, *U. S.*—Cottonroot Bark.

Baumwoll-Wurzelrinde, G.; *Ecorce de la racine de cottonnier*, Fr.; *Corteza de la raiz d'algodon*, Sp.

The dried bark of the root of *Gossypium herbaceum* L., or of other cultivated species of *Gossypium* (Fam. *Malvaceæ*).

Origin.—(For an account of the cotton plant, see GOSSYPIUM PURIFICATUM.) Information concerning the comparative composition and properties of the barks of the

FIG. 204.



Cottonroot bark (Nat.).

different species is greatly needed; also concerning those of the barks collected at different seasons and under different conditions. Our ideas of its use appear to have been derived from the negroes of our Southern States, who doubtless brought the knowledge with them from Africa, so that it is likely that the species occurring there is that originally so used. It seems highly probable that the bark from perennial tropical plants would show a superiority over that growing as an annual farther north. It is not unlikely, moreover, that the destruction of this plant by frost, even though the latter does not reach the root, may affect the composition and properties of the drug.

Description.—In elongated, thin, flexible bands or quilled pieces, somewhat fuzzy from partly detached bast-fibers and with a few coarse rootlets adhering; outer surface yellow to yellowish brown, with slight longitudinal ridges or meshes, small black circular dots or transverse lines, and dull, brownish-orange patches from the abrasion of the thin cork, or the entire corky layer wanting; inner surface whitish, slightly silky-lustrous and finely long-striate; bast-fibers long, tough, and the bast-layer separable into thin laminæ; inodorous and of a slightly resinous, pungent and acrid, and faintly astringent taste.

The powder shows large and thin-walled, very irregular parenchymatic cells, containing abundant starch-grains, mostly solitary and spheroidal, 5 to 10 mikrons broad, many with solitary rosettes of calcium oxalate from two to three times as large as the starch-grains, occasionally accompanied by solitary prismatic crystals, numerous large resin-cells, and very numerous, very long, slender, flexible, yellowish bast-fibers with only moderately thick walls.

The bark of the stem, which has been offered to us as a substitute, is paler, usually greenish or grayish, thinner, and whitish internally.

Constituents.—Cottonroot bark yields starch, glucose, gum, fixed oil, a little tannin, and 8 per cent. of a peculiar acid resin which is colorless and soluble in water, but on exposure absorbs oxygen and becomes red and insoluble. It is also soluble in 14 parts of alcohol, 15 of chloroform, 23 of ether, 122 of benzene, and in alkalies, and is deposited by the fluid extract on standing. The aqueous solution of the alcoholic extract is stated to contain a principle which gives a purplish-black precipitate with ferric chloride.

Action and Uses.—Cottonroot bark has long been employed by the negroes of the South as an abortifacient. It has been recommended as an excellent emmenagogue, and is said to be especially useful in the treatment of subinvolution and in suppression of the menses resulting from exposure to cold. It may be employed as an oxytocic during labor, and is said to be a much safer remedy than ergot, as it does not cause tetanic contractions of the uterus to so marked a degree. In the control of hemorrhage cottonroot bark is inferior to ergot, but is said to be more efficacious than the latter remedy in the treatment of uterine fibroids. The fresh is probably more reliable than the dried bark, but if gathered late in the autumn before frost and properly dried, it still possesses some of its medicinal properties.

The dose of the fluidextract is from ½ to 1 fluidrachm (2–4 Cc.). A decoction (4 ounces to 1 pint) may be administered in doses of 2 fluidounces (60 Cc.) every half hour, as an oxytocic.

Allied Products.—The flowers of the cotton plant contain the glucoside *gossypetin* ($C_{16}H_{12}O_8$), soluble in alkalies with an orange-red color, becoming green on oxidation. It contains no methoxyl groups, and on fusion with alkali yields phloroglucinol and protocatechuic acid. It is similar to thujetin.

GOSSYPIUM PURIFICATUM, *U. S.*—Purified Cotton.

Gossypium, Br.; *G. depuratum*, P. G.; *Bombyx, Lana* (*Lanugo s. Pili*) *gossypii.*—*Absorbent cotton*, E.; *Gereinigte Baumwolle*, G.; *Cotton absorbant, C. Hydrophile*, Fr.; *Algodon*, Sp.; *Cotone Absorbente, C. Idrofilo*, It.

The hairs of the seed of *Gossypium herbaceum* L. and of other species of Gossypium, freed from adhering impurities and deprived of fatty matter.

Origin.—The cotton plants are herbs, shrubs, or small trees with 3- to 5-lobed leaves and showy axillary flowers, having a 3-leaved involucre, a cup-shaped calyx, 5 petals, numerous stamens, and producing a 3- to 5-celled capsule, the "cotton-boll," which opens by as many valves; the numerous seeds are densely covered with long woolly hairs. It is these hairs which constitute cotton.

Fig. 205.

Cotton fibers.

The genus comprises from 9 to 12 species, the number uncertain because of the numerous forms of cultivation, which may be species, hybrids, or merely cultivation-varieties. The best authorities reduce the forms of cultivation to the origin of the following species: *G. Barbadense* L. (*G. vitifolium* Lam.; *G. Peruvianum* Cav.; *G. punctatum* Schum. et Thou.; *G. acuminatum* Roxb.; *G. religiosum* Parlatore), the *Sea Island* or *Long-staple cotton*, having all the seed-hairs long and the leaf-lobes lanceolate or lance-oblong; *G. herbaceum* L., the *Upland, Common*, or *Short-staple cotton;* and *G. arboreum* L. (*G. sanguineum* Hook.), the *Tree-cotton*, the two last having short, thick hairs intermixed with the long ones upon the seed, *G. herbaceum* with ovate, *G. arboreum* with narrowly lanceolate leaf-lobes. *G. Barbadense* is regarded as a native of the New World, the others of Asia and Africa. *G. religiosum* L. is very likely distinct. Its hairs are yellow and yield the *Nanking* or

Egyptian cotton. Besides these, 6 uncultivated species are known in the Old World. Cultivation occurs in all tropical countries where there is sufficient rain and in all warm-temperate countries where the season is sufficiently long for the maturity of the seeds. Any of these products may be utilized for absorbent cotton, though the longer the staple, the better the properties for medicinal purposes. In its natural condition cotton is so thoroughly impregnated with fat that it is not fit for use as an absorbent, and the removal of this fat is a work of some difficulty. Hence the occurrence in the market of much so-called absorbent cotton which has been very imperfectly, or even slightly purified, and the necessity of careful examination.

Preparation.—Official purified cotton, commercially known as "absorbent cotton," is prepared by first boiling carefully carded cotton in a weak alkaline solution, for the purpose of removing fatty matter, after which it is rinsed in water and immersed in a weak solution of chlorinated lime. It is subsequently washed in water slightly acidulated with hydrochloric acid, and again well rinsed in water. If the cotton still retains fat, the treatment with alkali is repeated until the final product is found completely absorbent. For the more thorough removal of water after washing the cotton recourse is had to centrifugal machines, by means of which the material is rapidly dried.

Description.—Consisting of soft, narrow-filiform, thin-walled, simple cells, which are about 12 to 38 Mm. (½ to 1½ In.) long, and appear under the microscope as flattened hollow and twisted bands, which are slightly thickened at the edges, finely and spirally striate, and nearly cylindrical at the apex; odorless and tasteless, insoluble in ordinary solvents, but soluble in ammoniacal solution of oxide of copper, and is colored blue by solution of zinc chloride and iodine, but not by solution of iodine. It consists of nearly pure cellulose, and yields with nitric acid an explosive nitro-compound (see PYROXYLIN), which is used in preparing collodion.

Cotton should be perfectly free from all visible impurities, and, on combustion, should not leave more than 0.8 per cent. of ash.

When purified cotton, previously compressed in the hand, is thrown on the surface of cold water, it should readily absorb the latter and sink, and the water should not acquire either an acid or an alkaline reaction (evidence of proper purification).

Pharmaceutical Preparations.—PYROXYLIN, U. S. P.; STYPTIC COTTON, N. F.

Uses.—Absorbent cotton is largely employed as a dressing in the treatment of superficial abrasions, burns, blisters, and erysipelas. It may also be used to protect inflamed joints in rheumatic fever. In surgery it is largely employed for padding splints, and when sterilized is employed as a substitute for sponges and largely as a dressing for wounds. Cotton tampons have also been used for the purpose of correcting uterine displacement, but carded wool forms a more satisfactory material.

Allied Substances.—Innumerable fibers have been used for textile purposes, but none has been found exactly to replace cotton. A number of so-called "Tree-cottons" are known in the tropics, mostly related to cotton (*Ochroma*, *Bombax*, *Eriodendron*, etc.), and bear more or less of a resemblance to it. It has been proposed to use the fiber of *Boehmeria nivea* Gaud., the Asiatic *Ramie*, as a substitute, but the suggestion has not been favorably received.

GRAMINEÆ.—The Grass Family.

This vast family, of more than 300 genera and not less than 4000 species, is probably the most important in the vegetable kingdom, from an economic standpoint. In their proper alphabetical sequence are treated TRITICUM, ZEA, AMYLUM (many starches being derived from this family), SACCHARUM, ALCOHOL and other alcoholic liquids, MALTUM, DIASTASE, HORDEUM, and FARINÆ AVENÆ and TRITICI. Besides the minor drugs discussed below and the numerous highly important cereal grains, a number of important volatile oils are yielded by the genus ANDROPOGON (see OLEUM CITRONELLÆ); numerous fibers are obtained from the bamboos and other grasses; the Bamboos themselves contribute most important building- and utensil-materials, as well as boats, weapons, etc., in tropical regions; great quantities of paper are made from straw and other grass-fibers, and our most important forage-plants pertain to this family.

Medicinal Grasses of Minor Importance.—A great many members of this family are

used locally, in nearly all countries, as diuretics. Cumarin is contained in various species of *Savastana*, Schrank (*Hierochloa* Gmel.), as well as in *Anthoxanthum* L., both of which are variously known as *Sweet-scented grass*, *Holy grass* (because scattered in front of churches and religious processions), *Vanilla grass*, etc. In Brazil, *Elionurus candidus* Hack. is used locally and internally in catarrhal complaints, *E. rostratus* Nees as an aphrodisiac and general stimulant. Several species of *Andropogon* are more or less bitter, and are used as simple bitters, diuretics, and tonics. *Melinis minutiflora* Beauv. contains a peppery-tasting resin, and is used as an intestinal astringent and stimulant.

Poisonous Grasses.—Poisonous products, in the proper sense, are almost unknown in the Grass family, though many species of *Stipa*, L., as well as *Hordeum jubatum* L., *Heteropogon contortus* R. et Sch. (*Spear grass*, etc.), and other grasses, produce long, stiff awns which are mechanically fatal to sheep and other animals by piercing the abdominal organs.

Lolium, *Darnel* or *Bearded darnel*, *Cheat*, *Ivary*, *Bragge* or *Dragge*, *Drake*, *Drank*, *Drunk*, *Droke*, or *Dravic neele*, or *Lover's steps* (E.), *Lolch* or *Taumelkorn* (G.), *Ivraie* (Fr.), the seed of *Lolium temulentum* L. (*L. arvense* Withering), is a notable exception, being distinctly narcotic or delirifacient. The plant is a native of temperate regions of Europe and Asia, and is sparingly naturalized in the United States. It infests grain-fields, and has thus been responsible for numerous cases of poisoning, through its presence in flour. In some of the reports of such cases, Cockle has probably been mistaken for this seed, but many others are authenticated. The plant is annual, growing nearly as high as the grain, the leaves 10 to 25 Cm. (4 to 10 In.) long, 2 to 6 Mm. ($\frac{1}{12}$ to $\frac{1}{4}$ In.) wide, rough on the upper surface, smooth underneath, the spikes about 10 to 30 Cm. (4 to 12 In.) long, bearing single spikelets alternating in notches of the rachis, with the back of the scale toward the latter. The spikelets are 4- to 8-flowered, the lowermost scale empty in each of the lateral spikelets, the lower two empty in the terminal. The palets bear a double keel. The grain is oblong-ovoid, nearly 6 Mm. ($\frac{1}{4}$ In.) long, enclosed in the palets, grooved on the inner face, pale-brown, internally white, odorless and of a farinaceous, afterward bitterish taste. The starch-grains are reported as being about one-third as large as those of wheat starch and circular, with a moderately white margin and a bright, strongly translucent surface without markings. Besides the ordinary constituents of the cereals, Antze, in 1891, reported this seed as containing the volatile alkaloid *loliine*, forming crystalline salts, and crystalline *temulentic acid*, which melts at 234° C. (453.2° F.). Hofmeister subsequently stated that he was unable to verify this statement, but reported the alkaloid *temuline* ($C_7H_{12}N_2O$), which acts as a nerve poison. He did not believe that the intestinal action of Darnel could be due to this base, but regarded it as probably due to the fat-acid which was freed during digestion. The *Natyuna* of Paraguay may be the same or a related species of Lolium. The drug is a powerful irritant, depressant, and narcotic poison, causing severe gastro-enteritis, vomiting, purging, dyspnœa, headache, vertigo, muscular tremors, and profound sleep. The drug is said to have been employed as an adulterant to malt, and it is stated that the liquor brewed from this produces a peculiar intoxication. Lolium is rarely employed in medicine, but may be locally applied as an ingredient in poultices for the relief of rheumatic and neuralgic conditions.

The seeds of *Paspalum scrobiculatum* L. (*P. Commersonii* Lam.), the *Koda*, *Kodrava*, *Aruga*, etc., of the East Indies, is reputed similarly poisonous.

The great importance of cereals as foods renders the following table (from Stewart's *Feeding Animals*) of their composition interesting and important (for wheat, see FARINA TRITICI; for oats, FARINA AVENÆ; for barley, HORDEUM):

	Total nutrients.				Digestible nutrients.		
	Albuminoids.	Carbohydrates.	Fat.	Ash.	Albuminoids.	Carbohydrates.	Fat.
Rye	11	69.2	2	2	9.9	65.4	1.6
Rye bran	14.5	53.5	3.5	4.5	12.2	46.2	3.6
Indian corn	10	68.0	7	2.1	8.4	60.6	4.8
Millet	14.5	62.1	3	3	9.5	45	2.6
Wheat middlings	13.9	63.5	3.3	3	10.8	54	2.9
Rice	7.7	75.2	0.4		6.9	72.7	0.3
Buckwheat	9	58.7	1.5		6.8	47	1.2
Buckwheat bran	17.1	46.4	4.4	.	13.5	44	3.9

In the feeding of armies and other large bodies of men, as well as of animals, and in stock-raising, the *nutritive ratio* and the *feeding-value* of foods and fodders are carefully esti-

mated and tabulated for purposes of comparison and reference. Making due allowance for digestibility and other conditions affecting health, feeders are enabled by these tables to select that food or fodder which, in the then state of the market, affords the desired nutrient combination at the lowest price. These tables are based upon the well-known fact that the hydrocarbons, carbohydrates, and albuminoid constituents bear pretty definite ratios to one another as to their nutrient value, the following figures being generally accepted. Assuming that the carbohydrates and the fats act in the same general way in nourishing the system, but that the latter are 2.4 times as efficient as the former, the sum of the values of these two is obtained by multiplying the amount of fat by 2.4 and adding the product to the carbohydrates. This sum is then divided by the amount of albuminoids present. It is apparent that the quotient thus obtained will represent the number of carbonaceous units for each albuminoid unit present in the food. Thus, taking the composition of corn, its digestible fat amounts to 4.8, which multiplied by 2.4 gives us 11.52. Adding this to 60.6 carbohydrates we get 72.12 as the total number of carbonaceous units; dividing this by 8.4, the percentage of albuminoids, we get about 8.58, and we say that the nutritive ratio of corn is 1 to 8.58, or, as commonly written, 1 : 8.58, or, it is frequently expressed by saying that the nutritive ratio is 8.58.

The feeding-value is obtained by a somewhat similar process. Assuming the market value of the digestible albuminoids in a given food as being 4½ cents per pound (Wolff's German tables) and the digestible fat the same, the digestible carbohydrates are reckoned at 0.9 cent per pound. These figures would make the feeding-value of corn : 4.8 lbs. of fat by 4½ cents, 21.6 cents; 60.6 lbs. carbohydrates by 0.9 cent, 54.54 cents; 8.4 lbs. albuminoids, 37.8 cents: or a total value of about $1.14 per hundredweight. Figuring out in the same way the value of any other food, we get its relative feeding-value as compared with corn. Any change in the market price of corn may then be applied *pro rata* to the other, and their relative cheapness or dearness in any state of the market almost instantly computed.

Besides the better known grains, there are many grasses whose seeds are used locally, by aborigines, for food purposes, as is the wild rice of our northwestern territory. It is altogether probable that if such a thing were possible as that all our cultivated grains of the present day might be lost to us, we should be able pretty well to replace them by improving, through cultivation, species not now used, or the uses of which are not generally known.

Cyperaceæ, the Sedge Family.—This family, of some 60 or 70 genera and about 2500 species, though closely related to the grasses, is of comparatively slight economic importance. The plants are distinguished from the true grasses by their solid stems, leaf-sheaths which are not connate around the stems, and the presence of but a single scale subtending each flower. They are mostly coarse, harsh, and indigestible, thus not adapted for food-purposes. The rhizomes of several are utilized as starchy foods. Quite a number possess volatile oils and aromatic properties, while others are rich in tannin and are used as astringents. Among the latter may be named *Scirpus lacustris* L., *S. dubius* Roxb. (*Allikee*), *S. grossus* L., the *Kasiru* or *Kachara* of India; *S. capsularis* Lour., the *Tang-sin-ts'au; Eriophorum latifolium* Hoppe (*Herba linagrostis*) and *Eleocharis tuberosa* Schult., the *Wu-yu, Puh-tsi*, or *Ma-tih-fen* of China. Among the more important aromatics and carminatives are *Cyperus sanguineo-fuscus* Nees, the *Cure-pire* of Paraguay; *C. elegans* Rottb., of Mexico; *C. pertenuis* Roxb., the Indian *Nagar-motha* or *Koriak; C. tegetum* Roxb.; *Kyllingia monocephala* Rottb. (used in Paraguay as a substitute for Calamus); *K. aphylla* Kunth; *Mariscus patulus* Schrad.; and *Carex arenaria* L., the rhizome of which is used as a substitute for Sarsaparilla. *Scirpus capillaris* is used in Spanish America under the name *Espartillo*, as a pectoral. *Adrue* or *Guinea rush* is the rhizome of *Cyperus articulatus* L., which, besides being used as a carminative, has a high repute in the East Indies for anti-emetic properties.

GRANATUM, *U. S.*—Pomegranate.

Granati cortex, Br.; *Cortex granati*, P. A., P. G.—*Bark of pomegranate*, E.; *Granatrinde*, G.; *Grenadier*, Fr. Cod.; *Ecorce de balaustier* or *de Grenadier*, Fr.; *Corteza de granado*, Sp.; *Corteccio de Melogranato, or Melograno*, It.; *Casca de Romeira or de Romanzeira*, Port.

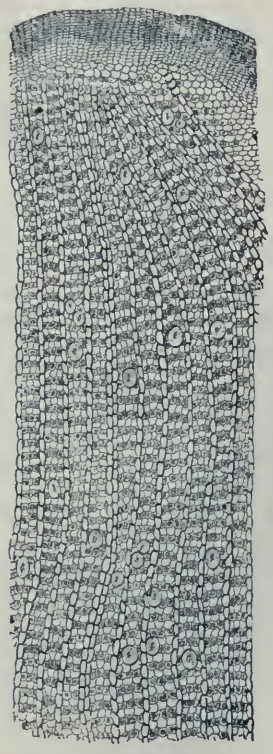
The dried bark of the stem and root of *Punica Granatum* L. (*Granatum Punicum* St. Leg.—Fam. *Punicaceæ*).

Granatum is official in most pharmacopœias, which differ as to the use of the root-bark or stem-bark, or both. The Swiss requires that it be used within a year after collection. Some require that it be collected from uncultivated plants.

Origin.—The pomegranate is indigenous to southwestern Asia from northern India to Palestine. It has been cultivated from remote antiquity, and is now met with in all subtropical countries. It is a very handsome shrub or small tree about 6 Mm. (20 Ft.) high, with lanceolate or oblong, pointed, entire and shining leaves, lovely

crimson, or rarely whitish flowers, and producing a depressed globose fruit of the size of an orange, irregularly divided by a transverse dissepiment into two unequal parts, the lower and smaller of which is about 3-celled and the upper 5- to 9-celled. The numerous seeds are oblong, irregularly angular from pressure, each invested with a fleshy pink-colored translucent coating. This pulp and the abundantly exuding juice are acid, sweet, and very refreshing in the ripe fruit, astringent and disagreeable in the unripe. There is conclusive evidence that the root-bark is several times richer in alkaloid than the stem-bark, and that deterioration is rapid when the bark is kept. There is also some evidence indicating that the bark of the white-flowered variety is richer.

Fig. 206.



Punica Granatum: root-bark, transverse section (× 40).

Description.—In quills several inches in length, and 0.5 to 2 Cm. ($\frac{1}{5}$ to $\frac{4}{5}$ In.) in diameter, or in broken pieces of the same, the bark 1 to 3 Mm. ($\frac{1}{25}$ to $\frac{1}{8}$ In.) thick; outer surface consisting of broad, shallow, rough, commonly short and reticulated, yellow fissures, alternating with less roughened, gray or slightly purplish-gray bands having sharp, lightly elevated margins, and usually more or less marked with small blackish spots of lichen; root-bark, especially the thicker pieces, browner, less fissured, more or less scaly-roughened and marked with conchoidal depressions; inner surface finely striate, with some longitudinally elongated, blister-like elevations, and varying in color from pale-greenish-yellow to cinnamon brown; fracture short, granular, greenish yellow, and showing a somewhat laminated structure; taste astringent, very slightly bitter.

Granatum is said to be adulterated with box-wood bark and barberry bark, but it is impossible to mistake either for it, as they are very bitter. The appearance of barberry bark bears not the slightest resemblance to it, and that of box-wood is nearly white on the inner surface.

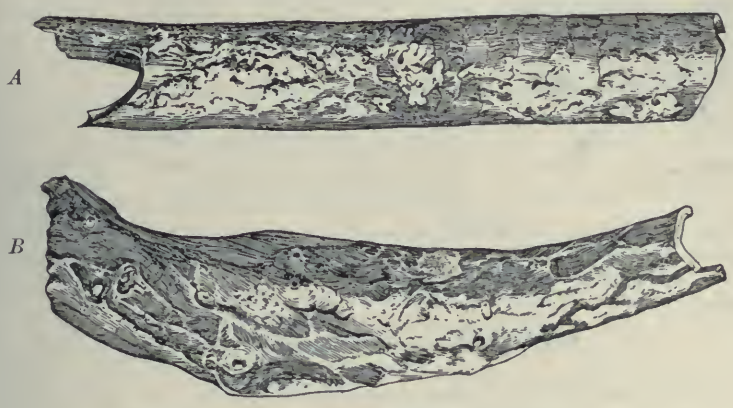
The powder is of a gray brown, usually with a greenish tint if of the stem-bark. Its characteristic element under the microscope is its rosettes of calcium oxalate, contained in regular rows of square cells, alternating with rows of empty cells. There is an abundance of starch, the grains either simple or compound, the larger reaching a diameter of 15 to 20 mikrons. Stone-cells occur sparingly.

Constituents.—The bark contains from 20 to 22 per cent. of tannin, gallic acid, mannit (formerly called punicin or granatin), yellow coloring-matter, and from about 1 to 3 per cent. of four alkaloids which probably exist as tannates in the drug. It yields from 10 to 17 per cent. of ash. The tannin is a mixture of gallotannic acid and *punicotannic* or *granatotannic acid* ($C_{20}H_{16}O_{13}$), which latter is insoluble in alcohol or ether, reduces silver and alkaline copper solutions, precipitates gelatin, tartar emetic, and iron salts, the latter black, and when boiled with dilute acids splits into sugar and *ellagic acid* ($C_{14}H_8O_9$). *Pelletierine* (*punicine*, $C_8H_{15}NO$) is a colorless, volatile liquid alkaloid, having the specific gravity 0.988 and boiling at 195° C. (383° F.), which dissolves in 20 parts of water and is miscible in all proportions with alcohol, ether, and chloroform, and rapidly resinifies by absorption of oxygen. It is dextrorotatory and forms crystalline salts.

Isopelletierine has the same composition and properties as pelletierine, but it is optically inactive, and its sulphate is deliquescent. *Methyl-pelletierine* ($C_9H_{17}NO$) is a volatile liquid alkaloid with very hygroscopic salts, and soluble in 25 parts of water, and in alcohol, ether, and chloroform. *Pseudopelletierine* (*granatonine*, $C_9H_{15}NO.2HO_2$) crystallizes in slightly volatile odorous prisms, which are optically inactive and soluble in water, alcohol, chloroform, and 9 parts of ether. Pelletierine predominates in the stem-bark, and methyl-pelletierine in the root-bark (Flückiger, 1891). The fresh drug is the more potent, for, as the bark becomes older, the alkaloids first become soluble with difficulty, then undergo decomposition. De Vrij, however, found bark active after keeping 11 years. Stoeder (1890), who examined the fresh bark in Java, obtained 3.75 per

cent. of alkaloidal hydrochloride from the white-flowered variety, 2.43 per cent. from the red-flowered, and 1.71 per cent. from the black-flowered. In 1894 he obtained

Fig. 207.



Granatum (Nat.): *A*, stem-bark; *B*, root-bark.

1.29 to 1.86 per cent. from Java root-bark, the greatest amount being from the white-flowered plant.

Valuation of Pomegranate Bark.—Inasmuch as the medicinal virtues of pomegranate bark reside wholly in the alkaloids present, which at times undergo decomposition with age, it is desirable to determine the value of the drug by assay, as follows: 20 Gm. of the coarsely powdered bark are put into a flask together with a mixture of 20 Cc. of chloroform, 80 Cc. of ether, and 20 Cc. of 10 per cent. ammonia-water, tightly corked, and allowed to macerate for 6 or 8 hours with frequent and active agitation. Decant exactly 50 Cc. of the ethereal liquid, representing 10 Gm. of the bark, and having passed the same through a small pledget of cotton if necessary, evaporate in a beaker to about 20 Cc., add 10 Cc. of tenth-normal sulphuric acid, mix well, and evaporate the remainder of the ether-chloroform mixture. The residuary aqueous fluid is passed through a small paper filter, the beaker and filter being washed with two successive portions of 3 Cc. each of water. After addition of a few drops of tincture of cochineal as indicator, the excess of acid is titrated with tenth-normal alkali solution, when the number of Cc. of acid found to have been neutralized by the alkaloids, multiplied by 0.01475 and then by 10, will express the percentage of total alkaloids in the drug. The factor 0.01475 represents the average of the equivalent of the 4 alkaloids. Good pomegranate bark should contain not less than 1 per cent. of total alkaloids when assayed by the above method.

Pharmaceutical Preparations.—Decoction of Pomegranate Bark, Br.; Fluid-extract of Granatum (Pomegranate Bark), U. S. P.

Action and Uses.—Because of its astringent properties a decoction prepared from the rind of the fruit of pomegranate was formerly used in treating relaxed conditions of the mucous membrane of the throat, in serous diarrhœas, and colliquative sweats. If given in large quantities, it may cause visual disturbances, excessive vomiting and purging, and weakness of the lower extremities, which may be followed by paralysis. The bark of the root is a very efficient tænifuge, and is said to be more active when fresh. A decoction prepared by macerating 2 ounces (60 Gm.) of the bark in 2 pints (960 Cc.) of water for 24 hours, and then slowly boiling to 1 pint (480 Cc.), may be given in doses of 1 ounce (30 Cc.) at intervals of 1 hour until all taken. The patient should not be fed for 12 hours prior to the administration of the drug, and if the purging does not occur shortly after its ingestion, castor oil or magnesium sulphate should be given. The active principle, pelletierine, is most efficient when administered in the form of the tannate in doses of from 3 to 5 grains (0.2–0.30 Gm.). Pelletierine is usually employed in the form of the sulphate or tannate, put up in syrupy solution. The sulphate is prepared by Parke, Davis & Co., and the latter by Tanret, a French manufacturer. The dose of these preparations is the contents of one bottle.

Allied Drugs.—*Granati Fructus Cortex; Cortex grenatorum* (*s. malicorii*), *Pericarpium granati.*—*Pomegranate-rind*, E.; *Granatenschalen*, G.; *Cuir de Pomme de grenadier*, Fr.—*Pomegranate-rind* forms irregularly curved fragments, which are about 2 Mm. ($\frac{1}{12}$ In. thick), externally somewhat finely tubercular and rough, of a brownish color with a yellowish or reddish tint, internally of a lighter color, marked with meshes indicating the depressions caused by the seeds. Some of the pieces are crowned by the thick tubular, 6- to 9-toothed persistent calyx, often enclosing the remains of the style and numerous stamens. They break with a short granular fracture, are nearly devoid of odor, and possess a strongly astringent taste. Examined by Reuss, pomegranate-rind was found to contain about 25 per cent. of tannin, 21 per cent. of extractive, and 34 per cent. of gummy matter. Bowman (1869) obtained 23.8 per cent. of tannin, which gives with ferric salts a blue-black precipitate. Flückiger obtained 5.9 per cent. of ash, calculated for the rind dried at 100° C. (212° F.); also some sugar.

Fig. 208.

Fruit of *Punica Granatum* and longitudinal section.

GRINDELIA, *U. S.*—Grindelia.

California Gum-plant, E.; *Grindelie*, G.; *Grindelia*, Fr.

The dried leaves and flowering tops of *Grindelia robusta* Nuttall, or of *Grindelia squarrosa* (Pursh) Dunal (*Donia s.* Pursh.—Fam. *Compositæ*).

Grindelia is not elsewhere official.

Origin.—These plants are natives of the southern Rocky Mountain region and thence westward and extend into Mexico. *G. squarrosa* is common and abundant, *G. robusta* local and scarce and seldom seen in market. The latter was first used, the former being subsequently introduced as possessing distinct properties. Later, it appeared that they acted alike and they were incorporated under one title. Many physicians still insist upon having that which they first learned to use, and this being scarce, they are commonly supplied with the other, falsely labelled. The drug should be collected during the early period of full bloom.

Fig. 209.

Grindelia: *a*, *G. robusta*; *b*, *G. squarrosa* (Nat.).

Description.—Leaves about 5 Cm. (2 In.) or less long, varying from broadly spatulate or obovate to lanceolate, sessile or clasping, obtuse, more or less coarsely and sharply serrate, often spinosely toothed or even laciniate-pinnatifid, pale yellowish-green or yellow, very smooth, finely dotted, resinous, thick and brittle; heads many-flowered, the involucres of many series of imbricated scales with acute, spreading or recurved tips. The heads of *G. squarrosa* are mostly longer than broad, contracted-campanulate or conical-urceolate; those of *G. robusta* are broader than long, depressed-urceolate. Ray-florets deep-yellow, ligulate, pistillate; disk-florets yellow, tubular, perfect; pappus of 2 or 3 mostly unequal awns, about as long as the disk-florets; odor balsamic, slightly narcotic; taste resinous and gummy, pungently aromatic, somewhat bitter.

Constituents.—The chemistry of Grindelia is as yet unsettled. Both species contain fixed oil, volatile oil, resin, crystalline robustic acid (?), *grindelin* (which Schneegans believes to be a mixture of saponin and another saponin-like glucoside), and possibly a small quantity of a bitter crystalline alkaloid, *grindeline*, which is soluble in water, alcohol, and ether. *G. robusta* contains 2 per cent. of grindelin, and 1.5 per cent. of tannin, while *G. squarrosa* yields only 0.82 per cent. of grindelin and no tannin (Clark).

Pharmaceutical Preparations.—Elixir of Grindelia, N. F.; Fluidextract of Grindelia, U. S. P.

Action and Uses.—Grindelia is a mild stomachic, cardiac tonic, and expectorant. By its stimulating effect upon the vagus nerve and vasomotor center it slows the action of the heart and increases blood-pressure, but is never employed in medicine for this purpose. In large doses it depresses the nervous system, the peripheral sensory nerves being first affected and later the sensory side of the cord, the motor nerves, and motor side of the cord. The drug is excreted by the lungs and kidneys, and occasionally produces some irritation of these organs. It is a useful remedy in the treatment of asthma, whooping-cough, and chronic bronchitis, and is said to be of value in chronic vesical catarrh. As a local application, 1 part of the fluid extract in 10 parts of water, it may be used in treating burns, blisters, herpes zoster, and the dermatitis of "rhus poisoning." The internal dose is from 20 to 60 minims (1.3–4 Cc.). The dried leaves previously impregnated with potassium nitrate may be burned and the fumes inhaled for the relief of asthmatic seizures.

Allied Drugs.—Several other species of *Grindelia*, of the western United States, Mexico, and the Andes, closely resemble the official, and some are used similarly, and even substituted for them. *G. hirsutula* Hook. et Arn. is pubescent or tomentose, the stem often reddish or purplish, the leaves varying between spatulate, oblong, and lanceolate, the upper ones clasping. It is met with along the coast northward to Puget Sound. *G. glutinosa* Dunal has been introduced near the coast of California. It is glabrous, has the leaves rounded at the apex, the involucral scales with short tips, and the pappus of 5 to 8 rigid awns, with thin serrulate edges. It is the *Calancapatle de Pueblo* of Mexico.

Hysterionica Baylahuen owes its medicinal qualities to the resin and volatile oil it contains, the former acting chiefly on the bowels and the urinary passages, and the latter, like the terebinthinates and their products, upon the lungs. It is said to possess an advantage over these medicines in that it does not disorder the stomach and bowels. It has been found useful in chronic diarrhœa, and especially of the tuberculous variety, and in chronic cystitis. The tincture, by its stimulant and protective action, has served (like tincture of benzoin) as a dressing for wounds and ulcers. An infusion of the leaves and twigs (1 : 150) has been advised, and also a tincture (100 : 500) in the dose of 15–25 drops (Baille, *Bull. de Thérap.*, cxvi. 160).

GUAIACI LIGNUM, *Br.*—Guaiacum Wood.

Lignum guajaci, P. G.; *Lignum sanctum* (*vel benedictum, vel vitæ*).—*Lignum vitæ*, E.; *Gayac*, Fr. Cod.; *Guajakholz, Pockholz, Franzosenholz*, G.; *Bois de gayac*, Fr.; *Guayaco, Palo santo*, Sp.; *Legno Santo*, It., Port.

The heart-wood of *Guaiacum officinale*, L. (*G. bijugum* Stokes) or of *G. sanctum* L. (*G. multijugum* Stokes.—Fam. *Zygophyllaceæ*).

Guaiacum wood is official in most pharmacopœias.

Origin.—From small trees of the West Indies and northern South America, the second, and perhaps the other also, extending into southern Florida. They have pinnate leaves, the former of 2 or 3, the latter of 4 or 5 parts of leaflets, and bear an abundance of showy blue flowers. In both, the dark heart-wood is surrounded by a zone of yellowish sap-wood, which is worthless for medicinal purposes, but which is said to be sometimes cut up and stained for mixing with the heart-wood.

Description.—Dark-brown, becoming olive-green upon exposure, capable of a high polish, composed of rings of alternate darker and somewhat lighter tints, resembling annual rings; medullary rays very fine, the vessels scattered, the pith indistinct; very heavy (specific gravity 1.3), hard, tough, splitting irregularly, owing to the much interwoven wood-bundles; occurring commonly in the form of raspings or shavings, which should be free or nearly so from the white sap-wood and should sink in water; odor slight, resinous, aromatic, especially on rubbing or warming; taste somewhat acrid. The shavings acquire a dark blue-green color on being moistened with nitric acid or other oxidizing agent.

Constituents.—The wood contains from 20 to 25 per cent. of resin, considered below, which is the most important constituent, and yields about 3 to 4 per cent. of aqueous extract. Fremy and Urbain (1881) found in the wood, besides 21 per cent. of cellulose, also 36 per cent. of *vasculose*, which is not soluble in ammoniacal copper solution, even after treatment with sulphuric acid. There is no volatile oil.

Action and Uses.—Guaiac wood is prescribed only in decoction (U. S. P. 1870), simple or compound, of which the latter is more efficient. When employed, it is usually in conjunction with other drugs. (For action and uses, see RESINA GUAIACI.)

Allied Species.—*Guaiacum angustifolium* Englemann (*Porliera angustifolia* Gray) is a small tree of southern Texas and Mexico, with a hard, heavy, and irregularly splitting wood of a yellowish-brown color, and used like the preceding.

GUAIACOL, *U. S.*—Guaiacol.

Gaïacol, Fr. Cod.; *Ortho-di-oxybenzene-methyl-ester, Methyl-orthodioxybenzene, Methyl-pyrocatechin, Catechol-monomethylether*, E.; *Guajakol, Brenzcatechinmonomethyl-ester*, G.

Formula, $C_7H_8O_2$ or $C_6H_4(OH)OCH_3$. Molecular weight, 123.13.

One of the chief constituents of creosote, the product from beechwood-tar, obtained by collecting and purifying the fraction of creosote boiling between 200° and 205° C. (392° and 401° F.); or prepared synthetically from either pyrocatechin by methylating, or from ortho-anisidin by diazotizing and boiling. Guaiacol should be preserved in amber-colored bottles, protected from light.—U. S.

Preparation.—Crude guaiacol is obtained by fractional distillation of beechwood-tar creosote, that portion passing over between 200° and 205° C. (392° and 401° F.) being collected; this is treated with ammonia to remove acid compounds, and then again fractionated. The lower boiling fraction is dissolved in ether and treated with a concentrated alcoholic solution of potassium hydroxide, which causes separation of potassium-guaiacol, the latter being insoluble in ether. After thorough washing with ether the salt is crystallized from alcohol, and decomposed by treatment with dilute sulphuric acid; the guaiacol thus set free is again rectified.

Synthetic guaiacol may be obtained by heating in a tightly closed vessel a mixture of equal molecules of pyrocatechin, potassium hydroxide, and potassium methylsulphate, to a temperature of 170° to 180° C. (338°–356° F.), when the following reaction occurs: $C_6H_4(OH)_2 + KOH + KCH_3SO_4 = C_6H_4OHOCH_3 + K_2SO_4 + H_2O$. The resulting guaiacol is removed by solution in alcohol or petroleum ether and purified by recrystallization. It may also be produced by heating a solution of sodium, pyrocatechin, and methyl iodide in methyl alcohol, treating the residue with sodium hydroxide solution, filtering, decomposing with hydrochloric acid, distilling the liberated guaiacol, and finally crystallizing at a low temperature.

A German patent calls for diazotizing ortho-anisidin with nitrous acid, decomposing the newly formed diazo-anisol with sulphuric acid, distilling the liberated guaiacol in a current of steam, and subsequently redistilling and crystallizing.

Properties.—Guaiacol occurs as a colorless, slightly refractive liquid of a strongly aromatic odor, or in the form of colorless crystals. Its specific gravity is 1.140 at 25° C. (77° F.), U. S.; 1.143 at 15° C. (59° F.), Fr. Cod.; 1.117 (Fischer); 1.116–1.133, Swiss P. It boils at 205° C. (401° F.), U. S., Fr. Cod.; 200°–203° C. (392°–397.4° F., Swiss P., and the crystals melt at 28.5° C. (83.5° F.), U. S., Fr. Cod. It is soluble in 60–70 parts of water at 15° C. (59° F.), 60 parts at 20° C. (68° F.) Fr. Cod., 53 parts at 25° C. (77° F.) U. S., and in all proportions in alcohol and ether. It is soluble in acetic acid and in 1 part of glycerin of 1.262 specific gravity, U. S., 7 parts of glycerin of 1.242 specific gravity, Fr. Cod. It is also soluble in chloroform and carbon disulphide. Dissolved in solution of sodium or potassium hydroxide, it forms sodium- or potassium-guaiacol ($C_6H_4OCH_3Na$ or $C_6H_4OCH_3K$), unstable compounds readily decomposed by dilution with much water. If a trace of ferric chloride is added to a 1 per cent. alcoholic solution of guaiacol, an immediate blue color is developed, which changes to emerald-green upon addition of more ferric chloride, the color finally becoming yellowish.

Tests.—If 2 Cc. of guaiacol are shaken with 4 Cc. of petroleum-benzin, the mixture should separate on standing at once into two distinct layers. Turbidity or failure to separate into layers indicates the presence of impurities. 1 Cc. of guaiacol should dissolve in 2 Cc. of sodium hydroxide solution with heat, and on cooling the mixture should congeal to a white saline mass. Coloration, as well as failure to congeal, indicates the presence of impurities. The saline mass thus obtained should dissolve clear in 20 volumes of water (turbidity indicates oily hydrocarbons). 1 Cc. of guaiacol added to 10 Cc. of concentrated sulphuric acid should give a pure yellowish color (a reddish color indicates creosote).—U. S.

The presence of guaiacol in creosote may be determined and estimated colorimetrically by treating a dilute solution of the sample with a few drops of a 4 per cent. solution of cupric sulphate and a few drops of a 4 per cent. solution of potassium cyanide, and comparing the colorations with those produced in solutions containing known amounts of guaiacol under like conditions. In the absence of guaiacol the mixed solution appears greenish by transmitted light, and from reddish-gray to brownish-purple according to the quantity of guaiacol present (Fonses-Diacon).

Action and Uses.—Guaiacol is employed internally as an expectorant and intestinal antiseptic. When locally applied to the skin, it reduces fever and produces local anæsthesia. It has been employed as a substitute for creosote (which see) in the treatment of pulmonary tuberculosis, and as it is eliminated by the bronchial mucous membranes does good by diminishing the cough. It does not, however, have any specific action upon the tubercle bacillus. It may be applied to the tonsils with good result in the early stages of acute follicular tonsillitis, but its application should be cautiously made. Minute doses of guaiacol are sometimes efficacious in the treatment of vomiting. If from 30 to 40 minims (2–4 Cc.) are painted over the skin of the chest, abdomen, or thighs of a febrile patient, it produces a marked fall in temperature, and for this purpose it has been employed in the treatment of typhoid fever and other acute febrile conditions. It has been locally employed for reducing the fever of tuberculosis, but in any of these conditions it may produce excessive sweating and depression. Guaiacol may be locally applied for the relief of superficial neuralgias, or it may be hypodermically injected in 2-minim (0.10 Cc.) doses when the pain is in deep-seated nerves. This remedy has been employed by painting it over the scrotum every other day for the relief of orchitis. For this purpose it may be diluted with 3 parts of glycerin or lanoline. The beginning internal dose is 2 minims (0.10 Cc.), which may be gradually increased to 10 or 15 minims (0.60–1 Cc.), 3 times a day.

DERIVATIVES OF GUAIACOL.

The following derivatives of guaiacol are of more or less interest to physicians and pharmacists.

Guacamphol.—This name has been applied to the camphoric acid ester of guaiacol. Its composition is expressed by the formula $C_8H_{14}(CO_2.C_6H_4.OCH_3)_2$, and it is obtained by the action of camphoric acid chloride on sodium-guaiacol. It occurs as white odorless, tasteless needles, which are insoluble in water, but soluble in alcohol and chloroform. Has been recommended for the relief of the night-sweats of phthisis. Dose, 3 or 4 grains (0.20–0.25

Guaiacol Benzoate, *known also as Benzosol and Benzoyl-guaiacol.* $C_6H_4(OCH_3).C_6H_5CO_2$. —This compound is made by heating an alcoholic solution of potassium-guaiacol with the requisite amount of benzoyl chloride, and purifying the resulting benzoyl-guaiacol by recrystallization from alcohol. It is a colorless, odorless, and tasteless powder, almost insoluble in water, but readily soluble in ether, chloroform, and hot alcohol. It melts at 56° C. (132.8° F.). With concentrated sulphuric acid it forms a lemon-yellow colored solution, but ferric chloride does not produce the characteristic color reaction in an alcoholic solution. Benzosol has been given in doses of from 4 to 8 grains (0.25–0.50 Gm.) in the treatment of pulmonary tuberculosis.

If benzyl chloride be made to act on sodium-guaiacol, a different compound is produced, known as *guaiacol-benzyl ether* or *pyrocain*, and having the composition $C_6H_4(OCH_3)OCH_2C_6H_5$. It must not be confounded with the former.

Guaiacol-bisulphonate of Quinine, *or Guaiaquin.* $(C_6H_4O_2CH_3HSO_3)_2C_{20}H_{24}N_2O_2$.—A yellowish crystalline powder soluble in water, alcohol, and dilute acids. It is an acid salt, having a bitter taste and containing 44.29 per cent. of anhydrous quinine alkaloid.

Guaiacol Carbonic Acid. *Methoxysalicylic acid.* $C_6H_4(OH)(OCH_3)COOH + 2H_2O$.—It is prepared by a patented process in a manner somewhat similar to that of the salicylic acid manufacture; carbon dioxide is made to act on sodium-guaiacol previously heated, whereby guaiacol-sodium carbonate is formed; continued heating converts this into sodium guaiacol-carbonate, from which the free acid is obtained by acidifying with hydrochloric acid, and finally recrystallizing from hot water or diluted alcohol. It is a white, odorless crystalline powder of a bitter taste, difficultly soluble in cold, but readily in hot water, also in alcohol and ether, and likewise in a solution of sodium bicarbonate. The anhydrous acid melts at 148°–150° C. (298.4°–302° F.). A cold aqueous solution of the acid is colored blue by solution of ferric chloride. This compound should not be confounded with guaiacol carbonate. Guaiacol carbonic acid and its salts have been recommended as antiseptics and antirheumatics.

Guaiacol Cinnamate, *Styracol, Cinnamyl-guaiacol.* $C_6H_4(OCH_3)C_9H_7O_2$.—If equal molecular weights of guaiacol and cinnamyl-chloride are brought together at ordinary temperature, and after 2 hours heated for some time on a water-bath, hydrochloric acid is formed and also cinnamyl-guaiacol. The salt is crystallized from boiling alcohol. It occurs as colorless needle-shaped crystals which melt at 130° C. (266° F.). It is insoluble in water, but soluble in alcohol, chloroform, and acetone. Styracol is prescribed principally in catarrhal affections of the digestive tract and in the treatment of phthisis.

Guaiacol Phosphate, *Phosphoric guaiacyl-ether.* $(C_6H_4OCH_3)_3PO_4$.—Prepared by the action of phosphorus oxychloride upon sodium-guaiacol. In colorless crystals melting at

98° C. (208.4° F.), insoluble in water and alcohol, but soluble in ether, chloroform, and acetone. It is used as an intestinal antiseptic and in hectic fever.

Guaiacol Phosphite, *Phospho-guaiacol, Phosphite of guaiacyl-ether.* $P(OC_6H_4OCH_3)_3$.—White crystalline powder, quite odorless, having a warm, but not caustic taste, melting at 77.5° C. (171.5° F.), soluble in water (distinction from guaiacol phosphate), alcohol, ether, acetone, chloroform, toluene, fixed oils, slightly soluble in oil of turpentine and glycerin, and contains 92.36 per cent. of guaiacol and 7.64 per cent. of phosphorus. Guaiacol phosphite possesses about the same medicinal properties as guaiacol, but is thought by some to be less irritating. Dose, 15 to 30 grains (1–2 Gm.).

Guaiacol Salicylate, *Guaiacol-salol,* E. $C_6H_4OCH_3.C_7H_5O_3$.—This compound is analogous to salol, and is the result of the action of phosphorus oxychloride on a mixture of sodium-guaiacol and salicylate, when guaiacol salicylate, sodium chloride, and sodium phosphite are formed. It is a white, crystalline, odorless and tasteless powder, insoluble in water, but soluble in alcohol, ether, and chloroform. It melts at 65° C. (149° F.). An alcoholic solution of the salt is colored wine-red by ferric chloride. It is used as an intestinal antiseptic.

Guaiacol Succinate. $C_4H_4O_4(C_6H_4OCH_3)_2$.—Fine, silken, crystalline needles, melting at 136° C. (276.8° F.), insoluble in water, difficultly soluble in alcohol and ether, and easily soluble in chloroform, acetone, petroleum ether, and hot toluene. It is prepared by the action of phosphorus oxychloride upon the molecular equivalent of a mixture of guaiacol and succinic acid, or by the action of succinyl chloride upon sodium-guaiacol at a low temperature.

Guaiacol Valerianate, *Geosot.* $C_6H_4.OCH_3.C_4H_9CO_2$.—Prepared by the action of valeryl chloride upon sodium-guaiacol. A yellowish oily liquid, having an odor suggestive of guaiacol and valerianic acid, specific gravity 1.037, soluble in alcohol, ether, benzene, and chloroform, and difficultly soluble in water. It boils at 245°–265° C. (473°–509° F.).

Guaiamar, *or Guaiacolglycerylester.* $C_6H_4OC_3H_7O_2.OCH_3$.—It is obtained by the action of guaiacol on anhydrous glycerin, and occurs as a dry white crystalline powder, having a bitter, aromatic taste, melting at 75° C. (167° F.), and soluble in 20 parts of water, also in alcohol, chloroform, ether, and glycerin. It is used as a substitute for guaiacol.

Guaiperol, *or Piperidine guaiacolate.* $C_5H_{11}N(C_7H_8O_2)_2$.—Prepared by dissolving 85 parts of piperidine and 248 parts of guaiacol in benzene or petroleum ether and allowing the solution to crystallize. Colorless prisms or crystalline needles soluble in 30 parts of water and soluble in alcohol and chloroform.

GUAIACOLIS CARBONAS, *U. S.*—Guaiacol Carbonate.

Duotal, E.; *Carbonate de Gaïacol,* Fr.; *Guajacolkarbonat, Kohlensäure-Guajacyläther,* G.

Formula, $(C_6H_4OCH_3)_2CO_3$ or $(C_6H_4(OCH_3)O)_2CO$. Molecular weight, 272.05.

Preparation.—This compound is obtained by slowly passing carbonyl chloride, $COCl_2$ (phosgene gas), into guaiacol previously dissolved in caustic soda solution, when sodium chloride and guaiacol carbonate will be formed. The latter, being insoluble, is separated and washed with caustic soda solution, and finally crystallized from alcohol.

Properties.—Guaiacol carbonate occurs as a white crystalline powder, of neutral reaction, nearly void of odor and taste. It is insoluble in water, soluble at 25° C. (77° F.) in 48 parts of alcohol, 1.5 parts of chloroform, and 13 parts of ether; readily soluble in hot alcohol and benzene, slightly soluble in glycerin and fixed oils. It contains 91.5 per cent. of guaiacol and melts at 84°–87° C. (183.2°–188.6° F.). When in contact with alcoholic solution of potassium hydroxide it is at once decomposed, and from the solution so obtained guaiacol may be separated on addition of an acid.—U. S.

Test.—The alcoholic solution of guaiacol carbonate does not yield a characteristic color on addition of solution of ferric chloride (absence of free guaiacol).—U. S.

Action and Uses.—The action of this substance when taken internally is practically the same as that of GUAIACOL (which see), except that it is less liable to derange the stomach. It is employed as an expectorant in the treatment of tuberculosis and chronic bronchitis, and as it is decomposed into guaiacol in the intestine is frequently given as an intestinal antiseptic in the treatment of typhoid fever and intestinal indigestion. It may be given in powder or capsule in doses of from 2 to 10 grains (0.10–0.60 Gm.), 3 times daily.

GUAIACUM, *U. S.*—Guaiac.

Guaiaci resina, Br. (U. S., 1890); *Resina guaiaci—Guaiacum resin,* E.; *Guajakharz,* G.; *Resine de gayac,* Fr. Cod.; *Resina de guayaco,* Sp.

The resin of the wood of *Guaiacum officinale* L. or of *G. sanctum* L. (see GUAIACI LIGNUM).

Guaiac resin is official in most pharmacopœias.

Origin.—The resin is obtained partly as a natural exudation or from incisions, partly by setting fire to a billet of the wood which has been grooved or pierced lengthwise on the side, the resin as it melts running from the opening.

Description.—The resin is in separate or agglutinate tears, varying in size from 6 to 25 Mm. (¼ to 1 In.) in diameter, or more generally in irregular masses, intermixed with fragments of wood and bark. It is of a greenish- or reddish-brown color, brittle, breaks with a somewhat conchoidal fracture having a glassy luster, and is transparent in thin splinters. It yields a whitish powder which turns rapidly green on exposure to the air, has the specific gravity 1.2, fuses at about 85° C. (185° F.), emitting an agreeable odor suggesting that of vanilla, and at a higher temperature gives off irritating vapors. Its taste is not strong, but is distinctly acrid. The resin is soluble in caustic potassa and in nearly all of the solvents for resins, except carbon disulphide, benzene, and oil of turpentine; it is nearly insoluble in benzin and fats. The solutions, as well as the powder, are colored green or blue by nitric acid, chlorine, ferric chloride, and other oxidizing agents; the same color is produced by ozone and upon the inner surface of the paring of a raw potato. Guaiac resin should be soluble in alcohol, leaving but a slight residue; sometimes it is very impure, containing as much as 16 per cent. of wood and bark. Its alcoholic solution has a slight acid reaction, and when dissolved in solution of potassium or sodium hydroxide it is reprecipitated on the addition of an acid.

Hirschsohn states that guaiac resin should yield to petroleum benzin not more than 2 to 4 per cent. of its weight; colophony and damar dissolve to the extent of 77 to 90 per cent. The so-called *Peruvian guaiac resin*, of undetermined origin, has an odor resembling a mixture of rue and anise, and about 42 per cent. of it is soluble in benzin. The alcoholic solution of guaiac resin is precipitated by lead acetate (difference from carana resin), and with potassium hydroxide solution gives a precipitate easily soluble in excess of the alkali (difference from colophony).

Constituents.—The resin yields about 10 per cent. of guaiaretic acid ($C_{20}H_{26}O_4$), an equal quantity of guaiac beta-resin ($C_{20}H_{24}O_4$?), 50–70 per cent. of alpha-resin or guaiaconic acid ($C_{20}H_{24}O_5$ or $C_{19}H_{20}O_5$), a slight quantity of guaiacic acid ($C_{12}H_{16}O_6$), guaiac-yellow, 4–9 per cent. of gum and a little mineral matter. Paetzold finds that both wood and resin of Guaiac contain a saponin which he believes to be the active constituent. It is much more abundant in bark and sap-wood, which the author thinks may be substituted to advantage. This idea is, to say the least, at variance with known facts regarding the action of Guaiac.

Guaiac-yellow is a feeble acid, crystallizing in yellowish quadratic plates, bitter, and soluble in alcohol, ether, and alkalies, but not readily soluble in water, chloroform, or dilute acid.

Guaiac beta-resin is soluble in alcohol and acetic acid, but insoluble in ether, chloroform, or carbon disulphide. On destructive distillation, guaiac resin yields guaiacene (guaiol or tiglic aldehyde, C_4H_7COH), guaiacol ($C_7H_8O_2$), creosol ($C_8H_{10}O_2$), and pyroguaiacin ($C_{18}H_{18}O_3$).

Guaiaretic acid occurs in colorless concentrically grouped needles, insoluble in water and ammonia, but soluble in solution of potassium and sodium hydroxides, acetic acid, alcohol, chloroform, ether, and carbon disulphide. It is not colored blue by oxidizing agents. Heated with hydrochloric acid, it yields pyrocatechin and methyl chloride; fused with potassa it yields protocatechuic acid. Its alkaline salts are crystalline, those of the alkaline earths amorphous.

Guaiaconic acid is the substance which forms the blue color with oxidizing agents. It is tasteless, odorless, brownish, amorphous, insoluble in water, and easily soluble in alcohol, ether, chloroform, and acetic acid. Its reaction is not acid, but it forms soluble amorphous salts with alkalies, and insoluble salts with the heavy metals.

Guaiacic acid forms colorless needles, soluble in water, alcohol, and ether.

Pharmaceutical Preparations.—Ammoniated Tincture of Guaiac, U. S. P.; Compound Tincture of Guaiac (Dewees'), N. F.; Glycerite of Guaiac, N. F.; Mixture of Guaiac, N. F.; Tincture of Guaiac, U. S. P.

Action and Uses.—Guaiac is diaphoretic, stimulant, alterative, and in large doses purgative. As a cure for constitutional syphilis it has practically been abandoned, although formerly it ranked among the first remedies in the treatment of this condition. It is occasionally employed in amenorrhœa and dysmenorrhœa resulting from feeble uterine circulation, but other more valuable remedies have nearly replaced it. Guaiac may be used in chronic rheumatism and in gouty conditions, but its administration in these is of

doubtful efficacy. Internally the drug has been employed in simple tonsillitis and in diphtheria; in the former condition it may be of some value, but in the latter it is worthless.

Resin of guaiac is usually given in the dose of from 10 to 30 grains (0.60–2 Gm.). Both the ammoniated tincture and the tincture of guaiac are given in the dose of from 10 to 60 minims (0.6–4 Cc.), and is frequently combined with an equal amount of solution of potassium hydroxide in order to render it miscible with water. In order to render it more agreeable the following formula may be employed: tincture of guaiac, 15 minims; solution of potassium hydroxide, 15 minims; glycerin or syrup, 1 drachm; and cinnamon water sufficient to make 1 ounce (A. H. F. Cameron, in *British Medical Journal*).

A soap of guaiac made by saturating a solution of potassium hydroxide diluted with twice its weight of water, with resin of guaiac, and evaporating to a pilular consistency, is sometimes employed in the dose of from 10 to 20 grains (0.6–1.3 Gm.).

GUARANA, *U. S.*—Guarana.

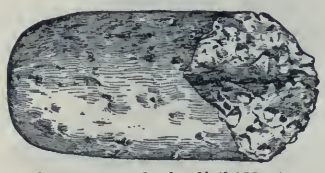
Pasta guaranæ.—*Guarana*, Fr., G., Sp.; *Uarana*, Port.; *Paullinia*, Belg., It.

A dried paste consisting chiefly of the crushed seeds of *Paullinia Cupana* Kunth (*P. sorbilis* Mart.—Fam. *Sapindaceæ*), yielding not less than 3.5 per cent. of its peculiar alkaloid.

Guarana is official in a number of pharmacopœias. The U. S. P. demands that when assayed by the process given below, it shall yield not less than 3.5 per cent. of its peculiar alkaloidal principle. The Italian requires that it retain 5 per cent., the Swiss at least 3 per cent., of caffeine.

Origin and Preparation.—The seeds are borne upon a stout, woody, tendril-bearing, high-climbing vine, related to the common balloon vine (*Cardiospermum*) of the gardens, native of Brazil, and there largely cultivated, especially along the Itenez River. It is cultivated upon trellises, or tied to stout stakes like vines in a vineyard. The globular fruit splits into 3 divisions, exposing 3 rounded seeds of the size of filberts. These, which look like large filberts, are washed free from a mucus-like coating and dried or slightly roasted, the kernel being thus caused to shrink from the testa. The brittle testa is then broken up by beating and is winnowed out. The kernels are broken up in wooden mortars, usually the hollowed stump of a tree, with wooden pestles, contact with iron causing blackening of the product. The best product is broken only sufficiently fine to allow of proper moulding into forms after the addition of a little water. A little tapioca is often added to favor cohesion, and, rarely, the amount of this is increased for purposes of adulteration. After being moulded into rolls, or other forms, it is laid upon wooden gratings, usually of bamboo strips, and slowly dried by fires built underneath. If dried too rapidly, if the wrong fuel be employed, or if the fire be not properly managed, the flavor is impaired; while if the process be too slow, moulding or fermentation is likely to occur. The curing process is therefore quite a critical one, and is usually not performed by the growers, but as a separate industry. Many lots are spoiled, and these are usually exported for medicinal purposes, those who purchase it for use as a beverage selecting as carefully as do our tea or coffee connoisseurs. Guarana constitutes the habitual beverage of millions of people in the Amazon valley. It is usually or frequently drunk suspended in cold water after being grated or filed from the roll or cake, about 1 or 2 teaspoonfuls to a cup of water. The guarana-habit is very similar to the tea- or coffee-habit. We have seen those who used it to excess suffer from a peculiar palsy, the limbs shaking violently under any excitement, but subject to control, the agitation gradually and perfectly ceasing under effort.

Fig. 210.



Guarana, end of roll (½ Nat.).

Description.—In subglobular or elliptical cakes or cylindrical rolls, hard and heavy; outer surface somewhat shortly nodular, smooth, slightly lustrous, deep chocolate-brown; rather brittle, the fracture uneven, often fissured in the center, of a deep flesh-color or pale reddish-brown, showing numerous coarse, angular, lustrous fragments of seeds partly invested with blackish-brown integuments; odor slight, peculiar, a little resembling that of chocolate; taste very astringent, somewhat bitter, afterward sweet, especially when chewing is followed by a swallow of water.

Constituents.—Besides caffeine and paullinitannic acid, Guarana contains gum,

starch, and an acrid, green, fixed oil, volatile oil, and saponin. Caffeine (guaranine) exists to the extent of from 3 to 5 per cent., probably in the form of tannate. The 25 per cent. or more of tannin, *paullinitannic acid*, gives precipitates with ferric salts (green-brown), gelatin, and most alkaloidal salts, but no precipitate with tartar emetic or copper sulphate. It reduces salts of silver and gold. It is evidently related to catechutannic acid. A very small amount of catechin was extracted by Schaer, and named *Paullinia catechin*.

Valuation of Guarana.—Put 6 Gm. of Guarana powder into a flask and pour upon it 120 Cc. of chloroform and 6 Cc. of ammonia water. Shake well at intervals for half an hour, and let stand for 4 hours. Pour off 100 Cc. of the liquid through a filter into a measuring cylinder, and transfer it therefrom to a flask, and distil off all the chloroform on a water-bath. Dissolve the residual alkaloids in a mixture of 2 Cc. of normal sulphuric acid and 20 Cc. of warm distilled water. Let cool and filter into a separator, rinse the beaker and filter with distilled water, add 10 Cc. of chloroform, 2 Cc. of ammonia water, and shake for a minute or two. Draw off the chloroformic solution into a tared flask and repeat the extraction 3 times more with 10 Cc. of chloroform, drawing each portion off into the tared flask. Distil off the chloroform, and when dry, add 2 Cc. of ether and evaporate this on a water-bath very carefully to avoid decrepitation. Dry the residue to constant weight on a water-bath and weigh. The weight found multiplied by 20 will give the percentage of total alkaloids in the drug.

Pharmaceutical Preparations.—Elixir of Guarana, N. F.; Fluidextract of Guarana, U. S. P.

Action and Uses.—The effects of guarana are due chiefly to the alkaloid which is present (see Caffeina), although it possesses in addition astringent and tonic properties. It was formerly used in the treatment of diarrhœa and dysentery, urethritis, leucorrhœa, and uterine oozing; but at present it is employed principally in the treatment of neuralgia, menstrual headache, and headache following a prolonged debauch. The powdered drug may be given suspended in sweetened water in doses of from 1 to 2 drachms (4–8 Gm.), or in the form of a fluidextract or elixir in equivalent amounts.

Allied Species.—Of the 120 or more species of *Paullinia*, no other is known to possess the properties of Guarana. The stems of a number are used as fish poisons, by virtue of their contained saponin. One of these, used under the name *Timbo*, has been observed by the writer to color the streams and pools intensely black, when so used. Martin reported the alkaloid *timbonine* in *P. pinnata*, which is probably the species last referred to.

Sapindaceæ.—This small family of some 600 species of woody plants, is distinguished for the frequency and abundance with which saponin occurs among its members. The fruits of various species of *Sapindus*, especially, are used in many tropical or warm regions as a soap-substitute under the name of *Soap-berries*, and are poisonous. These are globular or globoidal fruits, mostly about a half inch in diameter. The pericarp is either parchment-like or somewhat gummy and translucent, and loosely encloses a solitary large seed. The normal structure calls for 3 such carpels to form a fruit, but almost always there is but 1, sometimes 2, and rarely 3 or even 4. The pericarp contains the saponin, with formic and tartaric acids, and is bitter and acrid. The seeds commonly contain about 30 per cent. of a butyraceous fat. *S. marginatus* W. and *S. Saponaria* L., of our southern and southwestern districts and extending into Mexico, are there known as *Wild China tree*, and the fruit has been used, apparently only because of its resemblance to Azedarach fruit, as an antiperiodic. *S. Mukorossi* Gærtn. (*S. abruptus* Lour.; *S. detergens* Roxb.) is the East Indian *Dodan* and the Chinese *Wu-hwan-tsze*. *S. trifoliatus* L. (*S. laurifolius* Vahl.; *S. Rarak* DC.; *S. Saponaria* Burm.; *S. emarginatus* Vahl.; *Dittelasma Rarak* Hook.) is the Indian *Ritha* or *Aritha*, *Arishta* or *Pheuila*. *S. esculenta* St. Hil., the Brazilian *Pittomba*, the root known as *Caminhoa*, is said to yield an edible pericarp, but a poisonous seed and root. The fruit of *Pancovia Delavagi* Franch., the *Chinese Tie-ouassie-tsze-chou*, is widely used. The family yields many edible fruits, typified by the delicious East Indian *Nephelium* (*Li-chi*, *Tan-li*, *Rambutan*, *Rampostan*, *Chinese fruit*, or *Dragon's eye*). A number of *Dodonæas* also contain saponin and are used medicinally, and some are poisonous.

GUTTA-PERCHA, *P. G.*—Gutta-percha.

Getah-pertcha, *Gutta-percha depurata*, *Gutta-taban*, *Gummi plasticum*.—*Gutta-percha*, Fr., G.

The concrete milk-juice of *Palaquium Gutta* (Hook. f.) Burck (*Isonandra G.* Hook. f.; *Dichopsis G.* B. et H.—Fam. *Sapotaceæ*). Doubtless, a part of the commercial supply is collected from other species, and it is even claimed that most of it is

so. Thus, besides the special varieties mentioned under *Allied Substances*, commercial Gutta-percha is said to be derived in part from the following species: *Payena Leerii* Kurtz (*Ceratophorus L.* Hassk.); *Bassia sericea* Bl.; *Omphalocarpon procerum* Pal.; *Palaquium Borneense* Pierre; *Sideroxylon ferrugineum* H. et A. (*S. attenuatum* DC.), of the Philippines.

Origin and Collection.—The Taban is a good-sized, sparingly branched evergreen tree of southeastern Asia and the neighboring islands. It is much less abundant than formerly, owing to the destructive methods of collection, but, upon the other hand, it has been to some extent introduced to cultivation. Earnest efforts are now being made to acclimatize it in France and other countries, as a serious scarcity appears impending under the continuation of existing conditions. Various methods for collecting it, all more or less seriously destructive, have been depended on. The commonest is to fell the tree and at once encircle the trunk and large branches with notches cut through the bark, at short distances apart, the exuding milky juice trickling into cups set underneath. The bark is also removed in strips and the milk scraped from the surface of the wood. It is estimated that the amount obtained (from 6 to 20 pounds) is but a very small part of that in the tree, most of which can, by suitable means, be extracted from the ground bark, twigs, and leaves. Experiments have even been made, with fair success, in extracting it from the fresh leaves, so gathered from the living tree as not to injure it. It can be dissolved out of the ground-leaves by carbon disulphide (which is said to injure the product), by hot toluene or light petroleum spirit, the last probably being, all things considered, the most feasible method. By present methods, considerable vegetable tissue is retained in the mass, often involving a considerable loss of weight upon purification.

Description.—Gutta-percha is grayish or yellowish, frequently with red-brown streaks from fragments of bark and other impurities. It is hard and rather leathery or horny, in thin pieces somewhat flexible, is readily cut with a knife, between 45° and 60° C. (113° to 140° F.) is sufficiently soft to be rolled into sheets, is quite plastic at 65° C. (149° F.), and very soft at the temperature of boiling water. Its specific gravity, in bulk. is about 0.98, but it is heavier than water after the removal of all air-cavities. It is insoluble in water, alcohol, acids, alkalies, and fixed oils, but dissolves in boiling ether, chloroform, benzene, coal-tar oils, carbon disulphide, and oil of turpentine. On evaporating these solutions it is left behind with its original properties more or less nearly unimpaired. It is purified for dental and other purposes by agitating its solution with gypsum. If purified by treatment with water and hydrochloric acid, and then repeatedly dissolved in boiling ether and washed with cold ether and alcohol, a fine white powder is obtained of the composition $C_{20}H_{32}$, which is the composition of pure gutta. It absorbs and combines with oxygen from the air, yielding white crystalline resin, Payen's *albane*, $C_{20}H_{32}O$, and yellow amorphous *fluavil*, $C_{20}H_{32}O_2$, both of which are contained in commercial gutta-percha sometimes to the amount of 20 per cent. Subjected to dry distillation, various gases, water, and volatile acids are obtained, and two oils, one yellow, the other red-brown, both of the composition $C_{10}H_{16}$.

Pure gutta-percha is inodorous and tasteless; ignited, it burns with a bright flame. Its mixture with caoutchouc is readily vulcanized, and after the incorporation of insoluble earthy or metallic compounds is largely used in the preparation of various instruments.

Exposed to the air, with its changes of temperature, and especially to the rays of the sun, gutta-percha quickly deteriorates into a resinous, easily crumbled substance, but well preserved under salt or fresh water it is practically indestructible, scarcely any change having been observed in the gutta-percha of submarine cables after the lapse of half a century. Suspended in tunnels, its life is estimated at about 10 years; in underground pipes, about 20 years. In certain parts of the British Isles a tiny insect (*Templetonia crystallina*) has been found to eat off gutta-percha coverings.

Pharmaceutical Preparation.—Solution of Gutta-percha, N. F.

Action and Uses.—Gutta-percha possesses no medicinal properties, and is never employed in internal medicine. Externally, in the form of the Liquor Gutta-perchæ, it has been recommended as a substitute for collodion in excluding air from abrasions and fissured nipples, and for approximating the edges of incised wounds. The solution when locally applied is also said to be advantageous in the treatment of lepra, psoriasis, eczema, and other forms of skin disease. This substance is also employed in dentistry as a temporary filling for carious teeth, particularly during pregnancy. Gutta-percha is largely used in the manufacture of splints and other surgical appliances, and is of especial value because after immersion in hot water it may be moulded into any desired form.

Allied Substances and Substitutes.—The following very similar substances should perhaps be regarded as varieties of Gutta-percha: *Getah* or *Gutta maran* is said to come from *Payena Bawun* Scheffer; *G. Natu* from *P. Mentzelii* R. et Sch.; *G. Putih* or *G. Sundek* from a *Palaquium*, probably *P. ellipticum* (*Dichopsis e.* B. et H.). Two different substances are known in the East Indies as *G. Soosoo* (*Susu*). That of Perak is a *Gutta-percha*, but firmer than the ordinary, and is apparently from *Palaquium Sussu* Engl. That of Borneo is more like rubber, as is *G. Rambou*, a reddish-brown variety, doubtless from a *Ficus*, said to be *F. elastica* Roxb. *G. Singarip* is a soft, wet, spongy mass, more like rubber, and believed to come from an *Apocynaceous* climber. An artificial substitute, called "French Gutta-percha," has been obtained from an aqueous extract of birch bark, made by boiling.

Balata, or Gum Balata, is collected precisely as is Gutta-percha, from *Mimusops Balata* Gærtn. and *M. Schomburgkii* (Pierre) Rusby (*M. Balata Schomburgkii* Pierre), inhabiting Guiana and the adjacent northeastern portion of South America. The trees grow somewhat larger than the Gutta-percha and yield an edible sweet fruit of the size of a plum. The Balata is somewhat tougher and more flexible than Gutta-percha, yet more resinous, the resin being softer. It becomes soft and plastic in hot water (at 50° C.; 122° F.), hardening at once, but preserving its elasticity, when thence plunged into cold water. It melts at 150° C. (302° F.). About one-fourth of the ordinary article is dirt and water, about 41 per cent. gutta, and 35 per cent. resin. Its annual production is probably about four or five million pounds.

Chicle.—Somewhat like Gutta-percha in its general nature is Chicle, or Gum Chicle, now the principal substance used in the manufacture of chewing-gum, and derived from *Achras Sapota* L. (*Sapota Achras* Mill., the *Sabodilla*, *Sapotilla*, *White sapota*, *Naseberry*, or *Ya*, of tropical America, where this tree supplies one of the most important edible fruits. Although the substance is collected in many parts of Mexico and Central America, the principal sources of supply are in Yucatan. The milk-juice is obtained from incisions made in the bark, performed with great care and by experienced persons. Tapping may occur once in 3 years without great danger to the life of the tree. The raw milk is boiled and then allowed to harden in brick-shaped moulds. If carefully prepared, it usually turns out of a white or whitish color, though that of some trees is said to turn out red in any case, a result which will also occur if the ordinary milk be overcooked. If undercooked, it retains a large percentage of water, proportionately reducing its value. Various devices for adulterating substances of this class are resorted to. Chicle gum of good quality is whitish, of firm, tenacious, somewhat elastic consistency, yet may be crumbled between the fingers; somewhat aromatic and nearly tasteless. It becomes plastic on chewing. Examined by Prochozka and Endemann, 75 per cent. was found to be a resin, 9 per cent. calcium oxalate (with traces of magnesium sulphate).

From the seed of the Sapodilla has been extracted the glucoside *sapotin* ($C_{29}H_{52}O_{20}$), soluble in water, somewhat in alcohol, insoluble in ether, benzene, or chloroform.

GUTTIFERÆ.—The Gamboge Family.

This family, even inclusive of the *Hypericaceæ*, now generally regarded as pertaining to it, comprises only about 500 species. The Guttiferæ proper are tropical plants, commonly parasitic during at least a part of their existence, and containing milky juices. These juices, typified by Cambogia, are commonly irritant purgatives. Besides those named, the following yield substances similar to and used like *Cambogia: Garcinia Cowa* Roxb. (*G. Roxburghii* Wight; *G. umbellifera* Roxb.; *G. Wallichii* Chois.; *G. lobulosa* Wall.; *Oxycarpus Gangeticus* Ham.); *G. cornea* Roxb.; *Clusia macrocarpa* Spreng. (*Quapoya Parapanari* Aubl.; *Clusia P.* Chois.), and *Stalagmites ovalifolia* R. Br. (*Xanthochymus v.* Roxb.; *Cambogia Gutta* Burm.). Several of the juices are balsam-like and are used as Copaiba-substitutes, notably those of the West Indian *Calophyllum Calaba* Jacq., *Clusia flava* Jacq. (the *Fat pork monkey apple*), *Rheedia acuminata* Planch. (*Verticillaria a.* R. et P.; *V. Peruviana* Don), which yields the *Balsam Maria*, *Calophyllum apetalum* Wight (*C. Calaba* L.; *C. spurium* Chois.), *C. Tacamahaca* W., *Rheedia Madruno* Pl. et Tr. (*Calophyllum M.* H. B. K.), the balsams of the three last being known under the name *Tacamahaca*. The milk-juice of *Clusia galactodendron* is said to be used in Colombia as a milk-substitute, under the name *Kafa*, though the identity of the plant is doubtful. The East Indian *Calophyllum Wightianum* Wall. (*Sira punnai*) and *C. tomentosum* Wight (*C. elatum* Bedd.), the *Sirpoon*, yield gums. The juice of *Platonia insignis* Mart. (*Morronobea esculenta* Arruda), of tropical America, is converted into a rubber. The bark of the Peruvian *Clusia Pseudochina* Poepp. is used as a Cinchona-substitute.

A number of fats extracted from seeds pertaining to this family have more or less important local uses, and some are even of commercial importance. *Kokum butter* is thus obtained from *Garcinia Indica* Chois. (*G. purpurea* Roxb.; *Brindonia I.* Thouars). This fat is moulded into cakes or balls and is very extensively traded in. The natives use it as a food, the Europeans as an application, either in its own form or as an ointment-base, for which its high melting-point well adapts it in that country, it being "friable in the hottest weather"

(Dymock et Hooper). *Kanya butter* is a similar fat from the seeds of *Pentadesma butyracea* Don, of western Africa.

Several seeds of this family resemble Kola, and are used as substitutes for, or even as adulterants of it. This is true of the seed last-named, which is said to contain a poisonous resinous constituent. *Garcinia Kola* Heckel, of the same region, is also used as a Kola-substitute under the name of *False, Male,* or *Bitter kola.* Its only important constituents appear to be tannin and resin. On some accounts, especially for its reputed, and probably fanciful aphrodisiac properties, it is preferred to Kola by the natives.

. The seeds of *Mammea Americana* L. and the fixed oil from those of *Calophyllum Inophyllum* L. (*Balsamaria Onophyllum* Lour.) are used as adulterants. The latter bears a great many native names.

Mangosteen or Mangostan.—This is the product of *Garcinia Mangostana* L. The rind is a popular astringent, and contains resin, tannin, and the peculiar neutral body *mangostin,* crystallizable in golden-yellow tasteless scales, soluble in alcohol and ether, not in water, and with ferric chloride giving a dark-green color which is removed by acids.

The dried rind has been an article of commerce as a substitute for Bael fruit. It occurs in irregular fragments, somewhat resembling pomegranate rind, the outer surface being covered with a thin separable layer, of a red-brown color, the inner surface more commonly yellowish-brown and slightly ribbed longitudinally. The bark and leaves are similarly used as astringents.

The fruits of *G. Kydia* Roxb. and *G. pedunculata* Roxb. are similar but inferior to the Mangosteen.

The fruit of *G. Indica, Red mango, Kokum fruit,* or *Garcinia à fruit acide* (Fr.), is a popular antiscorbutic, and is largely sold for use as an ingredient of curry, either fresh or in the form of the dried pulp, to which a little salt is added. Its juice is sometimes used as a mordant. Both the leaves and the bark are astringent, and the former is acid, like the fruit. The fruit of *G. Zanthochymus* Hook. f. is similarly acid and its pulp is similarly used.

At least a score of species of *Garcinia* have been reported as yielding edible products. *Mammea Americana* L. yields the tropical American *Mammee apple* or *South American apricot,* a large but inferior edible fruit. An alcoholic beverage or wine is obtained from it. Other species yielding edible fruits are the following: *Platonia insignis,* the *Pacury-uva* of tropical America, its seed oily like the almond; *Rheedia lateriflora* L., and several other tropical American species of Rheedia; *Ochrocarpus Africanus* Oliv. (*Mammea A.* Sabin.); *O. longifolius* B. et H. (*Calysaccion l.* Wight.), the *Indian suringi,* its aromatic buds employed somewhat like cloves, under the names *Nagkassar puniga* and *Tamra naghe-sur; O. Madagascariensis* DC. (*Tovomita M.* G. Don); *Macoubea Guyanensis* Aubl. and *Mesua ferrea* L., the Indian *Naga-kesara,* etc., its petals being used as an aromatic and the fixed oil of its seeds as an antirheumatic. The fruit of *M. speciosa* Chois. yields a similar oil, similarly employed, and its fruit is purgative.

Many species of *Calophyllum* yield edible fruits. *C. Inophyllum* is an important medicinal plant of the Orient, under the names *Undi, Punnagamu,* etc. Its bark is used as a diuretic and emmenagogue.

Hypericaceæ.—This group of beautiful flowering plants, formerly regarded as a distinct family, contains a number of species which are mildly medicinal and some of which have been extensively used.

Hypericum, St. John's wort, Cammock, Rosin rose, or *Touch and heal* (E.), *Hartheu* or *Johanniskraut* (G.), *Millepertuis* or *Cassediable* (Fr.), *Hypericon* (Sp.), is the herbage of *H. perforatum* L. (*H. vulgare* Lam.; *H. officinale* Gater.; *H. officinarum* Crantz), used under the name *Herba* or *Summitates hyperici,* and official in the French Codex. It is a native of Europe and Asia, introduced to the United States as a garden-flower, and now widely naturalized as a roadside weed. It is a smooth perennial herb, about 6 Dm. (2 Ft.) high and widely branching; leaves opposite, sessile, oblong or linear-oblong, nearly 2.5 Cm. (1 In.) long, obtuse, entire, strongly pellucid-punctate and somewhat black-dotted; flowers in cymes, terminating the branches, bright-yellow, 1.5 to 2.5 Cm. (½ to 1 In.) broad, the 5 acute sepals shorter than the strongly black-dotted petals; stamens coherent in 3 bunches; pistil tricarpillary, with 3 styles; fruit about a fourth of an inch long, ovoid, glandular, bearing the persistent styles. The drug contains a small amount of volatile oil, considerable tannin, and much resin, part of the latter, amounting to about 8 per cent. of the drug, a coloring-matter known as *hypericum-red,* soluble in alcohol, ether, and volatile oils, dissolving with a green color in alkalies, and yielding yellow precipitates with calcium and lead salts and a yellowish-green precipitate with ferric chloride. It is believed to be a mixture of two coloring-principles, one red and the other yellow, and to be mostly contained in the black glands. St. John's wort is said to possess properties analogous to the turpentines. It was formerly employed locally as a stimulating, desiccating, and cleansing application, and was employed internally as an emmenagogue, diuretic, and stimulating expectorant. The recent drug may be bruised and employed as a discutient for the relief of local pains, contusions, ulcers, and burns. It may be given internally in the treatment of chronic catarrhal conditions of the

respiratory, intestinal, and urinary apparatuses. Red oil or oleum hyperici, made by macerating 4 ounces of the tops in 1 pint of olive or linseed oil, is employed quite largely among the laity as an embrocation.

The genus *Hypericum*, L., contains upward of 200 species, and many of them appear to have similar constituents and properties. *H. connatum* Lam. (*Brathys c.* Spach.), the *Orelha de gato* of Brazil, is used as an astringent, as is also *H. laxiusculum* St. Hil., the *Alecrin bravo* of the same region. In southern Europe, *H. Androsæmum* L. (*Androsæmum officinale* All.) is used as an antispasmodic under the names *Mannsblut* and *Konradskraut*. *Sarothra gentianoides* L. (*S. hypericoides* Nutt.; *Hypericum Sarothra* Mx.; *H. nudicaule* Walt.), of North America, is a much-used laxative, alterative, and vulnerary, under the names *Pineweed*, *False St. John's wort*, *Orange grass*, and *Nit-weed*. The closely related tropical American genus *Caopia*, Adans. (*Vismia*, Vell.), consists of about 25 species of soft shrubs or small trees, and yields a number of native remedies of considerable importance, mostly anthelmintics. The coloring-matter of *C. acuminata* (*Vismia a.* Pers.; *V. caporosa* Kunth) acts as a drastic. The Chinese drug *Kiu-sze-ts'au*, used as an astringent and alterative, is *Cratoxylon polyanthum* Korth (*Hypericum Chinense* Retz.). The African *Ooina-gina* is *Haronga Madagascariensis* Chois. (*H. paniculata* Lodd.).

GYNOCARDIA.—Chaulmugra.

The ripe seed of *Hydnocarpus Kurzii* (King) Warb. (*Taraktogenos K.*—King.—Fam. *Flacourtiaceæ*), and perhaps also of *Gynocardia odorata* R. Br. (*Chaulmoogra o.* Roxb.; *Hydnocarpus o.* Lindl.; *Chilmoria dodecandra* Ham.—Fam. *Flacourtiaceæ*).

The recent statement of Power and Gornall that chaulmugra oil is derived from the first-named species must be viewed in the light of statements to the contrary by all preceding writers, as well as of their own statements, that the oil from that species, examined by them, does not agree in character with that examined by preceding analysts. It must, therefore, be regarded as at least possible that the commercial oil is from more than one source.

Origin and Description.—The seeds are produced by large trees. The first-named is a native of Burmah, the second ranging farther to the southeastward. The seeds of the first-named are numerous in a 6- (or 3-)celled, large, spherical, slightly pulpy fruit. Those of the second are contained in a 4- or 5-celled fruit. The seeds are about 2.5 Cm. (1 In.) long and half as broad, irregularly angularly ovoid, without ridges at the base. dull gray or yellowish gray, finely tomentose, the kernel shrunken away from the somewhat brittle testa, which is frequently seen broken. The kernel consists of a brown (white at first), oily albumen containing the embedded large embryo, which has a pair of leafy cordate cotyledons upon a thick caulicle. The odor of the crushed kernel is peculiar, faint, and rather disagreeable, as is the taste.

Constituents.—The authors quoted obtained by expression 30.9 per cent. of chaulmugra oil, a fatty oil of a specific gravity of 0.951 at 25° C. and 0.940 at 45° C., melting at 22.33° C., having an acid value of 23.9, a saponification value of 213, and an iodine value of 103.2. It yielded phytosterol ($C_{26}H_{43}OH$), and several fatty acids of the series $C_nH_{2n-4}O_2$, now first reported from a fatty oil. They confirm the statement of Deprez that the seeds yield hydrocyanic acid. They regard the "gynocardic acid" of previous authors as a mixture, and find *chaulmoogric acid*, which combines with only two atomic proportions of bromine or iodine. Hirschsohn obtained 40 per cent. of oil with a melting-point of 26° to 28° C., the constants varying considerably with the method of extraction, cold pressure, pressure with heat, and petroleum ether extraction being employed. Schindelmeiser found the melting-point to be 26° C. Other authors have reported the melting-point as high as 40° C. Dymock states that if 20 m. of the expressed oil be stirred with 1 m. of sulphuric acid, a reddish-brown resin-like mass is formed around the acid, which is not true of an oil obtained by boiling the seeds.

Deprez states that the seeds yield considerable hydrocyanic acid.

Action and Uses.—Gynocardia is rarely employed in medicine in this country, but in England the oil is extensively used in veterinary practice in the treatment of abrasions, wounds, sprains, etc. Chaulmugra oil is highly esteemed in India as a remedy for the treatment of leprosy, syphilitic, and other chronic lesions of the skin. It may be tried also for itch, pediculosis, and other parasitic skin diseases. The remedy has been given internally and applied externally in the treatment of muscular rheumatism and chronic diseases of the respiratory tract, and is said to be especially valuable in phthisis. The beginning dose of the oil to an adult is from 2 to 6 minims (0.10–0.40

Cc.), which may be increased to 15 minims (1 Cc.), 3 times daily. Gynocardic acid has been employed as a substitute, and may be given in doses of 1 to 2 grains (0.06–0.12 Gm.).

Allied Species.—The seed of *Hydnocarpus anthelmintica* Pierre, of China, is sometimes called False Chaulmugra or Chinese Chaulmugra, and has occurred in market under the name Chalugra. It is the *Ta-fung-tsze* of the Chinese, who employ it for the same purposes as Chaulmugra is used for. It is about half as long as Chaulmugra, relatively broader, has a thicker and harder testa, and bears some slight ridges radiating from the base. This seed, it is said, yields no hydrocyanic acid. The seeds of *Hydnocarpus venenata* Gærtn., of western India, and *H. Wightiana* Blume, of Ceylon, yield a similar oil, similarly used.

H.

HÆMATOXYLON, *U. S.*—Logwood.

Hæmatoxyli lignum, Br.; *Lignum Campechianum, Lignum cæruleum.—Blauholz, Blutholz, Campecheholz*, G.; *Bois de Campeche, Bois d' Inde, Bois de sang*, Fr.; *Palo de Campeche*, Sp.; *Pao de Campeche*, Port.

The heart-wood of *Hæmatoxylon Campechianum* L. (Fam. *Leguminosæ*).

Logwood is official in nearly all pharmacopœias. The Br. P. requires that the chips and coarse powder shall not be fermented, while several describe the greenish metallic color which indicates such fermentation. Such logwood has undergone chemical change, which is almost certainly deleterious to its quality.

Origin.—The logwood tree is a native of various parts of Central America, and has become naturalized, through cultivation and escape, in many parts of the West Indies. It is also introduced to cultivation in the East Indies. It has an irregular, knotty, hard, and tough trunk, crooked and straggling branches, alternate, pinnate leaves with 4 pairs of obcordate leaflets, loose racemes of yellow flowers, and thin, oblong, 2-seeded legumes. The tree is felled after reaching an age of about 10 years, and, after removal of the sap-wood, is cut into sections from 3 to 6 feet long, in which form it is exported. For dyers' use, it is cut into small chips or splinters, soaked with water, and exposed to light and air, being kept wet and occasionally turned over. By this process the chips become dark-colored, with a bluish-black or greenish-black metallic superficial stain.

Description.—Heavy, hard, and marked with irregular, concentric circles, splitting irregularly; vessels large, distinct to the naked eye; medullary rays very fine. Under the microscope the cell-walls are seen to have a red color, and the ducts and wood-fibers to be filled with a red resin-like mass, occasionally forming in the ducts crystals of a green metallic luster; odor faint, agreeable; taste sweetish, astringent. When chewed, it colors the saliva a dark-pink.

Logwood is generally met with in the form of small chips or coarse powder, of a dark brownish-red color. When a large part of the surface exhibits a greenish-black metallic luster, it has undergone fermentation, and should be rejected.

Constituents.—Logwood contains a little volatile oil, much brown extractive containing tannin, fatty or resinous and glutinous matter, and about 12 per cent. of the crystalline substance *hæmatoxylin*. This can be obtained from powdered logwood extract by mixing it with much sand and exhausting with ether; the ether is mostly recovered by distillation, and the residue mixed with water and crystallized, a little sulphurous acid or solution of a sulphite being added to prevent oxidation. When pure, hæmatoxylin is $C_{16}H_{14}O_6$, and crystallizes with 1 or 3 molecules of water in colorless or pale-yellow prisms which have a strongly sweet taste of liquorice; acquire a red color on exposure to the light, are freely soluble in hot water, in alcohol, and ether, and, fused with potassa, yield pyrogallol. The aqueous solution is slightly precipitated by solution of isinglass, and produces with baryta solution, lead acetate, and with copper salts white or grayish precipitates which rapidly turn blue. Ammonia dissolves hæmatoxylin, the solution being rose-red, then purple, and finally blackish-red; the fixed alkalies produce similar solutions, and the color ultimately becomes yellowish-brown. The blackish ammonia solution contains *hæmatein-ammonia*, from which acetic acid separates *hæmatein*, $C_{16}H_{12}O_6$; this is soluble in alcohol and hot water, slightly so in ether, and forms a blackish-violet crystalline powder having a green metallic luster, seen on the surface of chips which have been fermented. Hæmatein-ammonia causes, in a warm solution of a small amount of alum and with ferric chloride, deep-violet precipitates; with lead acetate, a brown one.

Pharmaceutical Preparation.—Extract of Hematoxylon, U. S. P.

Action and Uses.—Hæmatoxylon is mildly astringent and tonic, and well adapted to the treatment of serous diarrhœa. It is especially useful in infantile diarrhœa because of its agreeable taste. It has also been recommended in dysentery, and is said to be beneficial in the treatment of leucorrhœa. It may be applied externally to gangrenous and ill-conditioned ulcers.

The extract is given in the dose of from 10 to 30 grains (0.6–2 Gm.); and an unofficial fluidextract may be employed in doses of from ½ to 2 drachms (2–8 Cc.).

Allied Woods.—*Brazil wood*, used for dyeing and coloring purposes, very largely as a chemical reagent, and to a very slight extent in medicine, is derived from several species of *Cæsalpinia*, a genus rather closely related to *Hæmatoxylon*, of Brazil and other parts of tropical America. The genuine Brazil wood, *Lignum Fernambuci* or *Pernambuci*, is from *C. echinata* Lam., the tree known in Brazil as *Pao Brāzil* or *Ibiraperanga*. Its bark is rich in tannin and is used as an astringent. The wood is originally of a yellowish color, but on exposure becomes of a purplish-red. It possesses a somewhat sweetish and astringent taste. It is imported in billets, but as found in retail commerce is mostly in shavings. Its coloring constituent is *brasilin* ($C_{16}H_{14}O_5$), which is somewhat soluble in water, colorless when first extracted, but quickly reddened by sunlight, which changes it to *brasilein* ($C_{16}H_{12}O_5$). It dissolves in alcohol and ether with a yellowish color. Alkalies change it to a bright-red. Another variety, apparently containing the same substance, is imported from Bahia, and is known as *Bahia Brazil wood*. A closely related wood is *Brasilietto*, *Nicaragua* or *Saint Martha's wood*, derived from *C. Brasiliensis* Swz., of Jamaica and other parts of the West Indies. The wood of *C. Crista* L., of the same region, is practically identical with the last, and *Sappan* or *Samfen wood*, from the Indian species *C. Sappan* L., is very similar. *C. tinctoria* Domb. (*Coulteria t.* DC.), *Coulteria Chilensis* DC. (*Cæsalpinia tinctoria* H. et B.), and some other members of the genus, also yield dyestuffs.

HAMAMELIDIS CORTEX, *U. S.*—Hamamelis Bark.

Witch-hazel, Spotted hazel, Winter-bloom, Snapping hazel, E.; *Hamamelis, Zauberhasel*, G.; *Hamamelis*, Fr.

The bark and twigs of *Hamamelis Virginiana* L. (Fam. *Hamamelidaceæ*).

Origin.—The witch-hazel is a crooked or straggling large shrub, or occasionally a small tree, abundant in damp woods and thickets, especially in rocky soil, throughout eastern and central North America. The trunk, purplish brown and smooth when young, brown gray and sparingly fissured when old, is very apt to bear conspicuous whitish blotches of lichen-growth. During late fall and early winter the branchlets are thickly covered with the small bright-yellow flowers, at once recognized by their 4 linear petals. At the same time there may be numbers of the persistent fruits of the preceding season. The 2 black, shining seeds are oily and somewhat edible.

Description.—Hamamelis bark occurs in quills or quilled strips of variable length and width, the bark being about 1 to 2 Mm. ($\frac{1}{25}$ to $\frac{1}{12}$ In.) thick. The outer surface varies from purplish brown, with or without whitish patches, to entirely silvery white, and from smooth with a few warts to lightly fissured and scaly, or ragged, from separation of the thin cork. The inner surface is more or less long straight-striate, and is commonly of a pinkish cinnamon color, occasionally smoother and with a yellow tinge. Care should be taken to exclude that with the whitish wood adhering to the inner surface. The fracture is weak but fibrous.

FIG. 211.

Hamamelis bark (Nat.).

This bark has a weak odor and an astringent and bitterish taste. The transverse section exhibits a whitish band of stone-cells just outside of the bast-layer. The twigs are flexible and tough, of irregular length, not more than 6 Mm. ($\frac{1}{4}$ In.) in diameter, branching or bearing nodes at intervals of 2 to 5 Cm. (1 to 2 In.); externally varying from yellowish brown to deep purplish brown, lightly longitudinally wrinkled, and having scattered small circular whitish or pale lenticels; bark occupying about one-fifth of the radius; wood greenish white, lightly radiate, and exhibiting one to three annual rings; pith centric, small.

Twigs having a larger diameter than that described contain an undue percentage of inert wood, and will not agree with the description as to relative thickness of the bark.

Constituents.—Witch-hazel bark yields a slight amount of volatile oil, oleic, palmitic, and stearic esters of phytosterin ($C_{29}H_{44}O$), two tannins, and some gallic acid. Of the tannins, one is a glucoside, but the most important is *hamameli-tannin* ($C_{14}H_{14}O_9 \cdot 5H_2O$), which is entirely converted to gallic acid by hydrolysis.

Pharmaceutical Preparation.—HAMAMELIS WATER, U. S. P.

Properties and Uses.—The properties of witch-hazel bark are practically identical with those of the leaves (see HAMAMELIDIS FOLIA). While a fluidextract of it is often used, the official preparation is made from the leaves. The chief use of the bark, and especially of the twigs, is for the preparation of the distilled extract.

HAMAMELIDIS FOLIA, *U. S., Br.*—Hamamelis Leaves.

The dried leaves of *Hamamelis Virginiana* L. (Fam. *Hamamelidaceæ*), collected in autumn.

Hamamelis leaves are official in several other pharmacopœias.

The origin of witch-hazel leaves has been stated under HAMAMELIDIS CORTEX.

FIG. 212.

Lower surface of hamamelis leaf (½ Nat.): *a*, flower (× 2); *b*, fruit (Nat.).

Description.—Stoutly and very shortly petioled, the blade 7 to 15 Cm. (3–6 In.) long and nearly as broad or occasionally even broader, highly inequilateral, oval, with a very oblique, slightly cordate base, and usually a very short obtusish point at the summit, the margin coarsely sinuate; thickish, dull green, and with obscure venation above, paler or brownish green, with a satiny lustre and very prominent principal veins underneath, nearly smooth, the few hairs of the lower surface having much thickened walls and a very small lumen; odor rather faint, characteristic; taste astringent, slightly aromatic, bitter.

Leaves which have been collected earlier in the season than the definition requires have the lumen of the epidermal hairs correspondingly larger, with the walls thinner.

Constituents.—Much effort has been expended to discover a constituent of witch-hazel leaves to which could be referred their unquestionable clinical effects, but with little success. The small percentages of tannin and of bitter constituent appear not different from those of many other leaves which have no such properties. The volatile oil, in view of its important use in perfumery, considered in connection with its minute amount, should be worthy of careful investigation.

Pharmaceutical Preparations.—FLUIDEXTRACT OF HAMAMELIS, U. S. P.; SOLUTION OF HAMAMELIS, Br.

Action and Uses.—Witch-hazel owes its virtue largely to the tannic acid it contains. The fluidextract is frequently employed as an astringent gargle in subacute sore throat. Given internally it has enjoyed, perhaps, an undeserved reputation as a hemostatic in uterine oozing, hemoptysis, and hematuria, although it may be used with some success to check hemorrhage from the stomach, and, if injected into the bladder, may arrest bleeding from the wall of the latter viscus.

Recommended at one time as a drug to be given internally in venous engorgement of different parts of the body, its use in this condition has practically been abandoned.

The extract in suppository, or ointment, is largely employed in the treatment of bleeding piles with varying success. Hamamelis water, popularly known as extract of witch-hazel, enjoys a greater reputation in household medicine than perhaps any other drug.

The good that it exerts in the treatment of sprains, bruises, wounds, chilblains, sore eyes, headache, and a host of other conditions, resides more in the activity of a cleansing and evaporating lotion and in the mind of the user than in any decided curative properties that the preparation may possess.

The dose of the fluidextract is from 5 to 40 minims (0.30–2.60 Cc.); of the aqua hamamelidis, from ½ to 1 drachm (2–4 Cc.).

HEDEOMA, *U. S.*—Hedeoma.

American or Mock pennyroyal, Squawmint, Mosquito-plant, E.; *Amerikanischer Polei,* G.; *Pouliot americain,* Fr.

The dried leaves and tops of *Hedeoma pulegioides* (L.) Pers. (*Mentha p.* L.; *Cunila p.* L.; *Ziziphora p.* Desf.—Fam. *Labiatæ*).

Hedeoma is not elsewhere official, being the equivalent, medicinally, of the true Pennyroyal of the old world (*Mentha pulegium* L.).

Origin and Description.—Hedeoma is a low annual, growing in open and pref-

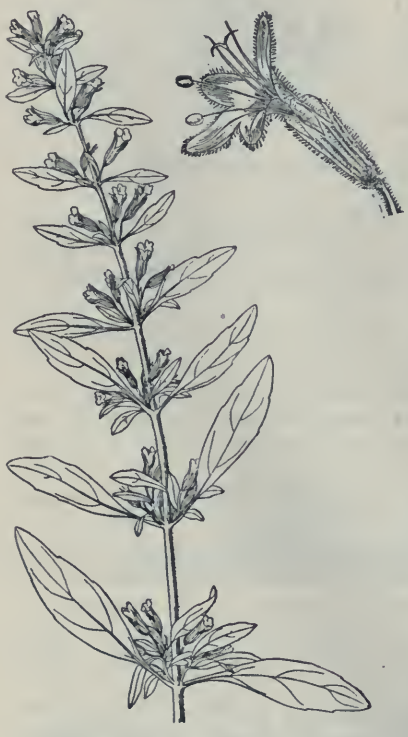
erably in dry and sterile situations throughout North America, except the far north and far west, and especially in the eastern central region.

Hairy throughout, the branches 4-angled, the leaves opposite, slenderly petioled; blades usually less than 2.5 Cm. (1 In.) long and 1 Cm. (⅔ In.) broad, oblong-ovate, narrowed gradually into the petiole, obtuse, distantly and shallowly serrate, pale- or grayish-green, thin, with few, strongly ascending secondary veins, and the lower surfaces beset with small, circular, depressed glands, which are usually golden-yellow and shining under a strong lens; flowers several in a leaf-axil, pedicelled, the calyx-tube cylindraceous, somewhat contracted at the mouth, strongly nerved, its tube 2-lipped and slenderly and sharply 5-toothed; corolla tubular, 2-lipped, pale-blue, spotted; stamens 4, 2 of them sterile; odor strong, somewhat mint-like; taste aromatic and pungent; nutlets 0.5 to 0.75 Mm. long, minutely papillose, oval or slightly obovoid, the summit rounded.

Constituents.—The only active constituent of Hedeoma is about 1 per cent. of volatile oil (see OLEUM HEDEOMÆ), with which there are a little tannin and a very small amount of a bitter principle.

Action and Uses.—Pennyroyal is a stimulant aromatic, which may be employed in the treatment of gastritis and colic attended with flatulence. It is occasionally combined with purgatives to prevent the griping effect which often attends their administration. A hot infusion, 1 ounce (30 Gm.) to 1 pint (480 Cc.), in conjunction with hot hip-baths and foot-baths, is frequently employed by the laity for the purpose of establishing retarded menstruation. The infusion may be given in doses of from 2 to 4 fluid-ounces (60–120 Cc.), every hour or two. It is very valuable for repelling mosquitoes by its odor.

FIG. 213.



a, Hedeoma (Nat.); *b*, flower (magnified).

Allied Drugs.—The genus Hedeoma contains about 15 species, all American, mostly of North America, all more or less aromatic, but none exactly like the official. *H. piperita* Benth., of Mexico, smells like peppermint, and is there used as a substitute for it. *H. thymoides* Gray, of Texas, etc., smells like Citronella, and is used as a stimulating aromatic. *Mentha Pulegium* L. (*s. Pulegium vulgare* Mill.) is the European pennyroyal (*Menthe pouliot, Pouliot commun*, Fr.; *Polei*, G.; *Poleo*, Sp.). It grows in moist sandy localities in central and southern Europe, has oval-obtuse and crenately serrate leaves, many-flowered axillary cymes forming globular whorls, and a purplish-colored 4-lobed corolla. It resembles the former in odor, while the taste is somewhat bitter and acrid.

One or more species of the related genus *Bystropogon*, large herbs or soft shrubs, and a *Micromeria*, all of the Andes, have an identical odor and could probably become cheap sources of supply for the oil of pennyroyal, since they could be mowed down in bulk.

HELLEBORUS.—Black Hellebore.

Radix hellebori nigri, Radix melampodii.—Christmas or New Year's rose, E.; *Schwarze Nieswurzel, Weinachtswurzel, Winterrose*, G.; *Hellebore noir*, Fr. Cod.; *Eleboro negro*, Sp.

The dried rhizome and roots of *Helleborus niger* L. (*H. grandiflorus* Salisb.—Fam. *Ranunculaceæ*).

Helleborus is official in many pharmacopœias.

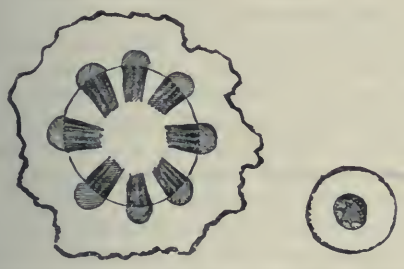
Origin.—The Christmas Rose is a low perennial herb of southern Europe, acclimatized also farther north, and often found in gardens in the United States. It derives its popular name from its habit of precocious spring-blooming, this occurring from December to March. It has long-petioled, radical, thickish, smooth, palmately 5- to 7-lobed leaves, red-mottled flower-stems, and large greenish-white or pinkish solitary flowers.

Description.—Grayish black and of an irregularly knotty appearance from the numerous short, stumpy branches, crooked, 2.5 to 7.5 Cm. (1 to 3 In.) long, 6 to 12 Mm. ($\frac{1}{4}$ to $\frac{1}{2}$ In.) thick, the branches annulate with the leaf-sheaths and terminating in single stem-scars, which are convex at first, becoming concave with age; roots numerous, brittle, originally long but mostly reduced by breakage to short stumps, about 2.5 Mm. ($\frac{1}{10}$ In.) thick, longitudinally wrinkled; transverse section of rhizome exhibiting a brownish-gray bark occupying about one-third of the radius, a zone of somewhat greater breadth consisting of 6 to 10 wedge-shaped bundles separated by broad medullary rays and a whitish pith; that of the roots showing a small slightly pentagonal or hexagonal wood in the center of a very thick bark; odor slight, taste sweetish, then bitterish and acrid.

Black Hellebore somewhat resembles Cimicifuga and has been mixed with it. The quadrangular roots of Cimicifuga, with their 4-lobed wood is characteristic, and it shows tannin reaction, which Hellebore does not. Hellebore has been adulterated with Actæa rhizome, which is thicker, shorter, with coarse roots, and more like Cimicifuga. Adonis is said to have been intermixed, but it bears no resemblance. Asphodel root has more than once been reported, but it has fusiform-thickened roots and a monocotyledonous structure. (For GREEN HELLEBORE, see *Allied Drugs.*)

Constituents.—Hellebore is free from tannin. Besides resin, gum, a little volatile oil, acrid fixed oil, a little wax, an acid (probably aconitic), bitter extractive, and gallates of calcium and potassium, it contains as its important constituents the 2 crystalline glucosides *helleborin* and *helleborein*. Helleborin ($C_{36}H_{42}O_6$) crystallizes from its aqueous solution, made by exhausting the concentrated tincture with hot water and filtering out the resin and fat. It is freely soluble in alcohol and chloroform, little so in ether and fixed oils, and scarcely in cold water. Its alcoholic solution has a burning taste. It yields sugar and helleboresin ($C_{30}H_{38}O_4$), which is in translucent crystals, slowly soluble in water, more so in alcohol and ether, bitter, and produces tingling of the tongue.

FIG. 214.



Helleborus niger L.: transverse section of rhizome and root.

FIG. 215.

Helleborus viridis L.: transverse section of rhizome.

Helleborein ($C_{26}H_{44}O_{15}$) can be obtained from the decoction by precipitating with basic lead acetate, then with sodium sulphate, and finally with tannin, decomposing this precipitate with lead oxide, exhausting the dry mass with alcohol, concentrating the tincture, and mixing with ether. It occurs in colorless nodules of minute crystals, readily soluble in water, less so in alcohol, insoluble in ether, and has a sweetish taste. It yields sugar and *helleboretin* ($C_{14}H_{20}O_3$), of a sweet and bitter taste, soluble in water, much less so in alcohol and ether, is precipitated by tannin, and crystallizes in rhomboidal crystals.

Action and Uses.—The internal administration of hellebore in moderate doses increases the force and decreases the rapidity of the heart's action. Arterial tension is increased partly because of the direct action of the drug upon the heart, and partly because of its stimulating effect upon the vagi. It augments the secretion of urine, and in full doses acts as a drastic hydragogue cathartic. Overdoses produce a violent gastro-enteritis with nausea, vomiting, and purging, and in pregnant women abortion sometimes occurs. If the dose is sufficiently large, headache, dizziness, muscular cramps, convulsions, and collapse ending in death may occur. Helleborein possesses local anæsthetic properties, and a solution containing $\frac{1}{160}$ grain (0.0004 Gm.) to each minim of water may be used in the eye as a substitute for cocaine. It does not dilate the pupil or increase intraocular tension. The drug cannot be employed hypodermically as an anæsthetic because of its powerful action upon the heart. Hellebore has been recommended in the treatment of acute mania and other forms of insanity, but is rarely employed at the present time for these conditions. Because of its drastic action it has been given for the

purpose of overcoming amenorrhœa and relieving ascites, but it is not a very desirable remedy in these states. The powdered drug has also been used to destroy vermin. As a drastic purge the dose is from 10 to 15 grains (0.60–1 Gm.); as an alterative, from 1 to 2 grains (0.06–0.12 Gm.).

Allied Drugs.—The rhizome and roots of *H. viridis* L., the *Green Hellebore*, etc. (not to be confused with American green hellebore or *Veratrum viride*), is regarded as more active than the Black, and is official in a number of pharmacopœias. It inhabits the same region and is naturalized in a few places in this country. Its green flowers are produced in spring. The rhizome is about half as large as the other and is knotty only at the summit, annulate with leaf-scars. Its transverse section exhibits 4 broad wood-bundles composed of a number of smaller ones, that of the roots a very small 4-lobed ligneous cord in the center. Its odor and taste are like those of the other, as is its composition, *helleborein* being the predominant constituent, as *helleborin* is of the black.

The rhizome of *H. fœtidus* L., the *Stinking hellebore*, *Bear's-foot*, *Garget-root* or *Setter-wort*, of Europe, is similarly used.

HEROINÆ HYDROCHLORIDUM.—Heroine Hydrochloride.

Chlorhydrate d'heroine, Fr.; *Salzsaures Heroin*, G.

Formula, $C_{17}H_{17}(C_2H_3O_2)_2NOHCl$. Molecular weight, 402.62.

The hydrochloride of diacetyl-morphine, an artificial alkaloid.

Preparation.—Heroine or diacetyl-morphine is obtained by heating pure morphine alkaloid with acetyl chloride, washing the product with water, then with dilute solution of sodium carbonate, and finally purifying by crystallization from hot alcohol. By dissolving the crystals in dilute hydrochloric acid, concentrating the solution, and setting aside to crystallize, heroine hydrochloride is obtained.

Properties.—Heroine hydrochloride is a white crystalline powder, soluble in 2 parts of water and soluble in alcohol, but insoluble in ether. An aqueous solution of the salt is readily precipitated upon addition of alkali hydroxide solutions, the base heroine, $C_{17}H_{17}(C_2H_3O_2)_2NO$, occurring as a white, odorless powder with alkaline reaction and having a bitter taste. Heroine melts at 173° C. (343.4° F.) and leaves no residue upon incineration. It is almost insoluble in water and ether, difficultly soluble in cold but readily soluble in hot alcohol, also soluble in chloroform and benzene. Solution of iodine causes a distinct turbidity in a solution of 1 part of heroine in 100,000 parts of water. The color-reactions produced by heroine are mostly similar to those of morphine. Unlike morphine, however, it does not liberate iodine from iodic acid, and produces a blue coloration with potassium ferricyanide and ferric chloride only after some time. With nitric acid it produces a yellow color, turning to red on warming. With concentrated sulphuric acid containing formaldehyde (2 drops of formaldehyde solution to 3 Cc. of acid) it produces a reddish-violet color changing to blue-violet. With Lloyd's test (1 part of hydrastine to 8 parts of the alkaloid to be tested, stirred into concentrated sulphuric acid) it produces a violet to purple coloration (J. L. Mayer). The alkaloid shaken with cold water gives a filtrate which decolorizes potassium permanganate solution, but gives no coloration with ferric chloride.

Action and Uses.—Heroine hydrochloride acts as a cough-sedative and respiratory stimulant, and has been proposed as a substitute for morphine for the relief of pain. When given in small doses, it has apparently no effect upon any of the vital functions except the respiration, which becomes deeper and slower. Large doses may cause dryness of the throat, dizziness, nausea, vomiting, depression, and, occasionally, constipation. Poisonous amounts, in addition to the above symptoms, produce twitching of the extremities, great exhaustion, and dimness of vision. The temperature becomes subnormal and the pulse rapid and thready. These symptoms should be treated by the application of heat, hypodermic injections of full doses of caffeine, and the administration of hot coffee by the stomach. Heroine has been employed in the treatment of acute and chronic bronchitis, emphysema, asthma, whooping-cough, the cough of phthisis, and uræmic dyspnœa. It has been proposed as a cure for the morphine-habit, and has been recommended as a substitute for opium in the treatment of diabetes mellitus. Heroine has also been recommended in the form of a suppository for the relief of pelvic pain. It is usually given in doses of from $\frac{1}{24}$ to $\frac{1}{12}$ grain (0.0025–0.005 Gm.), 3 or 4 times daily; but as much as $\frac{1}{6}$ grain (0.01 Gm.) may be employed.

HEXAMETHYLENAMINA, *U. S.*—Hexamethylenamine.

Hexamethylene tetramine, Urotropine, Uritone, Formin, Aminoform.

Formula, $C_6H_{12}N_4$ or $(CH_2)_6N_4$. Molecular weight, 139.18.

A condensation-product obtained by the action of ammonia upon formaldehyde.

Preparation.—The base hexamethylenamine may be obtained by adding to 100 parts of a 40 per cent. solution of formaldehyde, kept well cooled, gradually and in successive small quantities about 70 parts of stronger water of ammonia until an excess of ammonia is indicated by the odor after the solution has stood several hours. Then 10 parts of ammonia-water are added and the solution set aside for about 12 hours, after which it is poured into shallow dishes to crystallize. The crystals may be further purified by treatment with animal charcoal and subsequent recrystallization.

Properties.—Hexamethylenamine forms colorless, odorless, lustrous crystals of rhombohedral shape and having a sweetish taste. It dissolves at 25° C. (77° F.) in about 1.5 parts of water and at 100° C. (212° F.) in the same quantity of water. It is also soluble in 10 parts of alcohol at 25° C. (77° F.), and in about 8 parts of hot alcohol; soluble in 228 parts of ether.—U. S. The aqueous solution reacts alkaline with litmus. When heated to 230° C. (446° F.) in vacuo, hexamethylenamine sublimes almost without decomposition or previous melting. An aqueous solution (1 in 10), heated with diluted sulphuric acid is decomposed with liberation of formaldehyde (recognized by its odor or by its darkening paper moistened with silver ammonium nitrate test-solution), and if then supersaturated with sodium hydroxide solution, liberates ammonia. Tannic acid and mercuric chloride precipitate a 10 per cent. aqueous solution, the latter giving rise to a precipitate changing into colorless crystalline needles. —U. S. A bright-red color is produced on heating hexamethylenamine with concentrated sulphuric acid.

Action and Uses.—Hexamethylenamine, under the trade names Urotropine and Uritone, is employed as an antiseptic to the intestinal and genito-urinary tracts. When given internally it is rapidly absorbed and eliminated by the kidneys as an educt of urotropine which possesses acid and antiseptic properties. Urine loaded with pus, urates, and phosphates is rendered clear and acid in reaction by its administration. The remedy has been employed as a prophylactic, prior to operations upon the urinary tract, and is valuable in the treatment of pyelitis and phosphaturia. It is also largely used in the treatment of all stages of gonorrhœa, and is especially valuable when involvement of the posterior urethra occurs. It has been recommended in the treatment of typhoid fever as an intestinal antiseptic and for the purpose of rendering the urine free from the *Bacillus typhosus*. For the latter purpose it is very useful. Its continued administration may cause irritability of the bladder, and if the dose be excessive, hæmaturia may result. The ordinary dose is from 3 to 10 grains (0.20–0.60 Gm.), either in capsules or dissolved in water, 2 or 3 times daily. When taken in capsules it should be washed down with a copious draught of water.

Derivative Products.—Hexamethylene-tetramine Salicylate. *Urotropine salicylate, Saliformin.* $[(CH_2)_6N_4].C_7H_6O_3$. Molecular weight, 276.19.—This salt is prepared by dissolving equal parts of hexamethylene-tetramine and salicylic acid in 3 parts of water, and evaporating the solution to dryness at a temperature below 60° C. (140° F.). A colorless crystalline powder having a sweetish astringent taste, and soluble in water, alcohol, and chloroform. Soluble without color in cold sulphuric acid. The solution turns crimson on heating. Cupric sulphate produces a deep-green coloration and ferric chloride a violet color in the aqueous solution. Bromine causes a bright-yellow precipitate.

Hexamethylene-tetramine Bromethylate. *Bromalin, Bromalium, Bromoformin, Bromethylformin.* $[(CH_2)_6N_4]C_2H_5Br$. Molecular weight, 247.36. This product is formed by the interaction of equal parts of ethyl bromide and hexamethylene-tetramine dissolved in alcohol, and evaporation of the solution. Colorless scales or needle-shaped crystals, quite tasteless, soluble in water and alcohol, melting at 200° C. (392° F.) with decomposition, and on incineration producing a very voluminous cinder. Addition of bromine water to the aqueous solution yields a yellow precipitate. Hydroxide solutions liberate ammonia upon heating the aqueous solution.

Hexamethylene-tetramine Tannin. *Tannopin, Tannon.* $[(CH_2)_6N_4].[C_{14}H_{10}O_9]_3$. Molecular weight, 1098.16.—Prepared by precipitating 13 parts of hexamethylene-tetramine dissolved in water with a freshly prepared solution of 87 parts of tannic acid. A light-brownish odorless, tasteless powder, insoluble in water, dilute acids, alcohol, chloroform, and ether. It is soluble in alkaline solutions.

Ferrostyptin. $(CH_2)_6N_4HCl.FeCl_3$. Molecular weight, 336.4.—A double salt obtained by pouring a mixture of solutions of hexamethylene-tetramine hydrochloride and ferric chloride into 5 times its volume of alcohol, whereby crystals of the new compound are precipitated, which are subsequently washed with alcohol and dried. Yellowish-brown crystals, soluble in water, but insoluble in alcohol and ether, and containing 43–46 per cent. of anhydrous ferric chloride. Acids liberate formaldehyde upon heating the aqueous solution.

Hexamethylene-tetramine Iodoform. *Iodoformin.* $(CH_2)_6N_4.CHI$.—A fine, almost white powder of faint odor, and insoluble in alcohol, ether, and chloroform. It is obtained by triturating a mixture of 1 part of hexamethylene-tetramine and 3 parts of iodoform with absolute alcohol until dry. Exposed to light, it turns yellow. Cold as well as hot water decomposes the powder, liberating iodoform.

HIPPOCASTANUM.—Horse Chestnut.

Rosskastanie, G.; *Maronnier or Chataignier d'Inde*, Fr.; *Castagno d'India*, It.; *Castaño de Indias*, Sp.

The bark and seed of *Æsculus Hippocastanum* L. (*Hippocastanum vulgare* Gærtn.—Fam. *Hippocastanaceæ*), a beautiful shade and ornamental tree, introduced to the United States and Europe from India. The bark of the younger branches is preferred, and is used under the names *Cortex Hippocastani* or *C. castaneæ equinæ*. It is thin, brown-gray, somewhat warty and marked with opposite leaf-scars, which have the lower rounded margin marked with 5 or 7 small warts. The inner surface is whitish and smooth, the fracture fibrous and rather tough, and showing a brownish internal color. The bark has a peculiar and rather disagreeable odor, and a bitter, somewhat acrid and astringent taste.

Constituents.—The tannin of horse chestnut bark colors ferric salts green. Besides some fat, chlorophyll, and other common compounds, the bark contains *æsculin* ($C_{15}H_{16}O_9$) and *fraxin* (*paviin*, $C_{16}H_{18}O_{10}$), both principles being inodorous, of a slightly bitter taste, and showing a blue fluorescence when dissolved in water, particularly in the presence of an alkali. Æsculin is obtained by precipitating the decoction with lead acetate, treating the filtrate with H_2S, evaporating and recrystallizing. It forms small white needles containing 1½ molecules of water, which are insoluble in ether and have a slight acid reaction upon litmus. On boiling with dilute acid it is split into glucose and *æsculetin*. Baryta solution produces a like decomposition, and then yields *glucinic*, *apoglucinic*, and *æsculetinic acids*. Æsculetin ($C_9H_6O_4.H_2O$) crystallizes in colorless needles, is with difficulty soluble in cold water and alcohol, the solutions coloring ferric salts dark-green, dissolves in alkalies with a golden-yellow color, and on boiling with potassium hydroxide is decomposed into oxalic, formic, and protocatechuic acids. Fraxin is obtained by precipitating the alcoholic tincture with an alcoholic solution of lead acetate, diffusing the precipitate in water, decomposing by hydrogen sulphide, evaporating over sulphuric acid to dryness, and removing the tannin by washing with ice-cold water. It dissolves yellow in alkalies, colors ferric chloride green and then produces a lemon-yellow precipitate.

The integuments of the seeds contain some æsculin and *quercitrin*, which are likewise present in the flowers, but the leaves contain yellow *queræscitrin*. The cotyledons contain, besides starch and gummy matter, 2 to 4 per cent. of fixed oil (*Oleum hippocastani*), which is greenish-brown or yellow, has a turnip-like odor, a somewhat bitter taste, and the specific gravity 0.927, and congeals near the freezing-point of water. *Argyræscin* and *aphrodæscin* are 2 amorphous acrid bodies discovered by Rochleder (1862), which are insoluble in ether, soluble in alcohol, and yield with water solutions foaming like soap solution; the latter is precipitated by baryta water, and boiled with alkalies yields *butyric* and amorphous *æscinic acids;* the former is a glucoside.

A patented process is now in operation for extracting the bitter principles and saponin-like substance from the ground seeds by means of alcohol, the remaining portion being then used as food. It is said to contain 8 per cent. of proteid, 7 per cent. of fat, 77 per cent. of nitrogen-free extract containing 14 per cent. of sugar. The same substance can be made to yield richly of alcohol.

Action and Uses.—A decoction of the bark, and the active principle æsculin, have been largely employed in the treatment of malarial fevers. The leaves in decoction or infusion are employed as a remedy for whooping-cough. The fixed oil obtained from the fruit is used in France as an embrocation in the treatment of muscular rheumatism. The drug is said to possess sternutatory and antifermentative powers, but it is

rarely employed for this purpose. It is given in doses of ½ ounce (16 Gm.), in decoction, during the 24 hours. Æsculin may be given in 15-grain (1 Gm.) doses.

Æsculus Pavia L., *or Red buckeye.*—B. C. Batchelor (1873) obtained from the testa of this poisonous seed tannin, 3 per cent. of resin, a tasteless crystalline principle, and coloring-matter. The cotyledons were found to contain 5 per cent. of greenish-brown fixed oil, 2.5 per cent. of cane-sugar and syrup, and a brownish, bitter and acrid glucoside different from argyræscin, and apparently poisonous.

HIRUDO, *Br.*—Leech.

Hirudines, P. A., P. G.—*Sangsue médicinale*, Fr. Cod.; *Blutegel*, G.; *Sanguisuga, Mignatta*, F. It.; *Sanguijuela*, Sp.

Sanguisuga medicinalis Savigny, and *Sanguisuga officinalis* Savigny.

Class *Vermes;* Ord. *Annulata;* Sub-ord. *Apoda;* Family *Hirudineæ.*

Description.—Leeches are invertebrate animals with an elongated, roundish, or somewhat flattened body, which has numerous transverse wrinkles, and is generally attenuate toward both ends; the posterior one always terminates by a broad and muscular disk, by means of which the animal fastens itself upon objects. The blood-sucking leeches have their anterior end or head likewise terminated by a narrower disk, in the center of which is placed the mouth containing 3 jaws, which are provided with 2 rows of numerous pointed teeth, and are mutually inclined at an acute angle, so as to make a triangular incision through the skin. Respiration is carried on through small apertures or *stigmata* arranged in 2 rows on the abdominal surface and found at every fifth ring. Leeches are hermaphrodites, but mutually impregnate each other. Several pairs of testicles are located in the fore and middle part of the body; the filiform penis is projected from an abdominal orifice about one-third distant from the head, and the female organs with 2 ovaries have their aperture or vagina 5 rings below the penis. The ova are deposited near the edge of the water, invested with a kind of jelly or mucus, which contracts into a capsular or cocoon-like body having a spongy appearance and containing about 10 or more eggs. Leeches are aquatic animals, and swim with a vertical undulating motion. For medicinal use their weight should be between 1 and 5 Gm. (15 and 75 grains). The two species named have a soft smooth body, 5 Cm. (2 In.) or more in length, and have the back of an olive-green color, with 6 rusty-red longitudinal stripes, which are sometimes spotted with black.

Sang. (Hirudo L.) medicinalis Savigny has the belly greenish-yellow, more or less spotted with black, occasionally to such an extent that the prevailing color is black. The animal is indigenous to central and northern Europe, and is known in commerce as the *speckled, Sweedish*, or *German leech.*

Sang. officinalis Savigny (Hirudo provincialis Carena). The belly is light olive-green, unspotted, but marked with a black stripe on each side; the dorsal stripes are somewhat variable in width. This leech is indigenous to the southern part of Europe, and is known in commerce as the *green* or *Hungarian leech.*

Several other species of *Sanguisuga* of southern Europe are occasionally employed, but are not an article of commerce. Leeches are generally kept in ponds by the wholesale dealer, and even cultivated in this manner. They are usually transported imbedded in moist turf.

The *American leech, Hirudo decora* Say, which draws less blood, is sometimes employed. Its back is of a dark-green color and marked with 1 row of orange-brown and 2 lateral rows of black spots; the belly is of a light orange-brown color spotted with black.

Preservation.—Leeches require some attention to keep them healthy and in good condition. They are kept in clean river-water in a glass jar covered with a linen cloth and put in a shady place which is free from ammoniacal and other noxious vapors. The temperature is best kept between about 10° and 20° C. (50° and 68° F.), sudden changes being carefully prevented. As soon as the water begins to get turbid or colored the leeches should be placed in clean water of the same temperature and the jar well cleaned from the slimy deposit, which is caused by the transparent epidermis being thrown off every 4 or 5 days. To facilitate this removal, some material is often put into the jar through which the leech may draw itself, and which, by retaining this slime, will tend to keep the water clean; charcoal, pebbles, clay free from lime, moss, and Irish moss have been recommended and found advantageous for the purpose, and apparatuses have been constructed in which leeches may be kept on a bed of material which permits of a fre-

quent renewal of the water without handling the leeches. If they are kept in moist earth, turf, or clay, this should be examined from time to time and dead animals removed. The water should be changed at least once a week, and oftener in warm weather. It will be observed that the conditions for the preservation of leeches are pure air, pure water, and a pretty uniform temperature. Leeches are subject to several diseases which may become epidemic, and which are recognized by an excessive separation of mucus, ulcerations, tumors, or a flaccid appearance of the body; those thus attacked should be at once removed from the healthy ones, and placed in a separate vessel in clean water upon a layer of washed charcoal.

Action and Uses.—The employment of leeches as a therapeutic measure has long been a recognized procedure. The local abstraction of blood from the capillaries with leeches produces a very excellent effect in the early stages of acute local inflammatory conditions. Their employment is less painful and frequently more beneficial than any other form of local depletion. They may be applied to areas which are too tender to permit of cupping, and to parts where cups cannot be applied. Because of the slight pain attending their application this form of local depletion is admirably adapted to nervous cases. Before applying a leech, the skin should be thoroughly cleansed with soap and warm water, and afterward with plain hot water. The leech is usually placed in a tube or small bottle; which is then applied with the head toward the affected part, and as soon as the leech bites, the tube is withdrawn. Should the leech not take hold, a little milk, or blood from the patient, should be smeared over the selected spot, after which little or no difficulty will be experienced. They continue to suck until they become gorged with blood, when they usually drop off, but their removal may be effected at any time by sprinkling them with salt. The wound made by a leech usually bleeds for some time after the removal of the animal, and in some cases it is quite difficult to control the hemorrhage. Should the bleeding continue, simple pressure of the wound between the finger and thumb will usually control it. If the area is too painful for the employment of pressure, the application of styptics or the use of the actual cautery may be resorted to. The amount of blood drawn varies, depending upon the size of the leech, the part to which the leech is applied, and the severity of the existing inflammation. The European leech will draw from ½ to 1 fluidounce of blood, and the smaller varieties from 1 to 1½ fluidrachms. Leeches may be emptied by stripping them between the thumb and fingers, but this is not advisable.

HOMATROPINÆ HYDROBROMIDUM, *U. S.*, *Br.*—Homatropine Hydrobromide.

Homatropinum Hydrobromicum, P. G.; *Bromhydrate d'Homatropine*, Fr. Cod.; *Homatropinhydrobromid, Bromwasserstoffsaures Homatropin, Bromwasserstoffsaures Oxytoluyltropein*, G.

Formula, $C_{16}H_{21}NO_3.HBr$. Molecular weight, 353.49.

The hydrobromide of an alkaloid prepared synthetically by passing hydrochloric acid gas through a mixture of tropine and mandelic acid. It should be kept in well-stoppered vials, protected from the light.—U. S.

Preparation.—The base homatropine or oxytoluyltropine is obtained by heating for several days a strong solution of tropine mandelate (or a mixture of tropine and mandelic acid) on a water-bath with dilute hydrochloric acid. It may be more rapidly prepared by passing a current of hydrochloric acid gas over a mixture of tropine and mandelic acid heated to 110°–120° C. (230°–248° F.). The resulting product contains homatropine hydrochloride and some undecomposed tropine mandelate. By addition of ammonia water the homatropine is precipitated, the tropine salt not being decomposed by ammonia, and may be shaken out with chloroform. After dehydrating the chloroformic solution with potassium carbonate, the base is obtained in the form of a dark-colored syrupy liquid by distilling off the solvent. The residue is taken up with dilute hydrobromic acid, and the salt allowed to crystallize and further purified by re-solution and crystallization from alcohol.

Properties.—Homatropine hydrobromide occurs as colorless to white, non-deliquescent, odorless, crystalline powder or minute rhombic prisms, soluble in 6 parts of cold water (Br.) (4 parts, Hager), in 5.7 parts of water at 25° C. (77° F.) (U. S.), in 1 part of boiling water, in 32.5 parts of alcohol (U. S., 18 parts, Hager), in 8.7 parts

of alcohol at 60° C. (140° F.), U. S., in 133 parts of absolute alcohol, but insoluble in ether and almost insoluble in chloroform (620 parts at 25° C. (77° F.), U. S. (note that the hydrobromides of atropine and hyoscyamine are readily soluble in chloroform). It melts at 213.8° C. (417° F.), U. S., 210°–212° C. (410°–413.6° F.) (Hager). Its solutions are neutral. In aqueous solutions not too dilute fixed alkali hydroxides cause a precipitate soluble in excess of the reagent. Silver nitrate produces a white precipitate, and in solutions acidulated with hydrochloric acid yellow precipitates are caused by gold chloride and phosphomolybdic acid, and a white precipitate by phosphotungstic acid. Tannic acid and platinum chloride cause no precipitate in the acidulated solution. Picric acid produces a yellow amorphous precipitate changing to crystalline scales. Solution of iodine causes a brown, and mercuric chloride a white precipitate. The solutions are strongly mydriatic, dilating the pupil of the eye.

Tests.—The salt should be soluble in cold concentrated sulphuric acid without color. It should leave no ash after ignition. The free alkaloid obtained by extraction with chloroform or ether from an aqueous solution made alkaline with sodium hydroxide, should have a melting-point of 95°–96° C. (203°–204.8° F.), U. S. (distinction from atropine and hyoscyamine, melting respectively at 115.5° C. and 108° C.). If about 0.01 Gm. be dissolved in a little water and the solution rendered alkaline with solution of ammonia and shaken with chloroform, the separated chloroform will leave on evaporation a residue which will turn yellow, and finally brick-red, when warmed with about 1.5 Cc. of a 2 per cent. solution of mercuric chloride in a mixture of 5 volumes of alcohol and 3 volumes of water (U. S., Br.) (absence of other alkaloids, except atropine and hyoscyamine). If 2 Cc. of chloroform be shaken with 1 Cc. of an aqueous solution of the salt (1 in 10), to which a few drops of chlorine water have been cautiously added, the chloroform should assume a brownish color. If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should not acquire a violet color upon the addition of a few drops of alcoholic potassium hydroxide test-solution (absence of atropine, hyoscyamine, or hyoscine), U. S. The Ph. G., in giving the last-named test, states that a transient violet color will appear, followed by a reddish-yellow color. Sulphuric acid containing a trace of potassium dichromate, when added to a crystal of the salt, produces a momentarily pink color, changing rapidly to green (U. S.).

The base homatropine is hygroscopic, but only slightly soluble in water, soluble in alcohol and chloroform, less readily in ether, optically inactive to polarized light, and melts at 98° C. (208.4° F.) (Hager).

Homatropine hydrochloride, sulphate, and salicylate, are colorless crystalline salts, readily soluble in water and alcohol.

Action and Uses.—When given internally, homatropine closely resembles atropine in physiological action, except that it slows the action of the heart and decreases blood-pressure. When a solution is instilled into the eye, it produces some hyperæmia of the conjunctiva, dilatation of the pupil, and paralysis of accommodation. Mydriasis usually begins in from 10 to 20 minutes; paralysis of accommodotion is complete in from 60 to 90 minutes; and complete recovery usually takes place in from 36 to 48 hours after the repeated instillation of a few drops of a solution containing 4 grains (0.25 Gm.) of the drug to 1 fluidounce (30 Cc.) of distilled water. Because of its transient effect, and the fact that it rarely produces systemic effects, it has been employed by ophthalmic surgeons for the purpose of correcting anomalies of refraction. It is inferior to atropine in the treatment of the various diseased conditions of the eye in which a lasting mydriasis is desired. The internal dose is stated to be from $\frac{1}{80}$ to $\frac{1}{20}$ grain (0.0008–0.003 Gm.).

HORDEUM DECORTICATUM.—Pearl Barley.

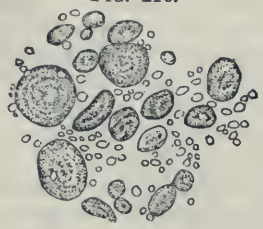
Hordeum perlatum.—Perlgerste, Perlgraupen, G.; *Orge perle,* Fr. Cod.; *Orzo perlado,* Fr., It.; *Cebada perla,* Sp.

The seeds of *Hordeum distichon* L. (Fam. *Gramineæ*), from which the integuments and outer portions of the kernel have been removed.

Origin.—The barley plant is an annual grass, indigenous probably in western Asia, now cultivated in all temperate regions. It presents a great number of cultivated forms,

some of them, distinguished respectively by the production of 2, 4, or 6 rows of seeds to the spike, being commonly regarded as distinct species. The official article may be obtained from any of these. When the outer integuments (pericarp) alone are removed, "Pot-barley" is produced. To obtain pearl barley, the seed so resulting is subjected to a farther partial grinding, by which the integuments and part of the kernel of the seed are removed, and the ends rounded off. Both the mill-stone and its case rotate vertically, in the same direction, the former about 20 times as rapidly as the latter.

Fig. 216.



Barley starch-granules.

Description.—From 2.5 to 4 Mm. ($\frac{1}{10}$ to $\frac{1}{8}$ In.) long, and from two-thirds to equally as broad, somewhat flattened, the broader sides oval to rotund, one of them marked by a longitudinal groove in which remains of the brownish integument are visible, the color elsewhere white. The smaller grains consist only of the central starchy portions; some of the larger bear a layer of gluten-tissue upon the surface. Barley is inodorous and has only an amylaceous and faintly sweetish taste. The starch-granules are mostly single and somewhat resemble those of wheat. The outline is somewhat irregularly elliptical to circular, and both the hilum and rings are indistinct. Their size averages about 26 mikrons.

Constituents.—Barley has the ordinary nutritive composition of the cereal grains. There are from 60 to 68 per cent. of starch, 12 to 16 per cent. of combined albumin and gluten, 2 to 3 per cent. each of fat and ash, 8 to 12 per cent. of cellulose, and 10 to 14 per cent. of moisture, with a little crystallizable sugar. The fat consists of glycerides of palmitic and lauric ("hordeic") acids. With these, are various enzymes, chiefly diastase. Sinistrin was reported by Kühnemann. Traces of tannin, an amaroid, and cholesterin have also been detected. Mills and Pettigrew have remarked that an aqueous solution of calcium carbonate or sulphate dissolves an increased amount of extractive, while the amount of albuminoids is thereby decreased.

Action and Uses.—Pearl barley is never employed medicinally in the solid state, but because of its non-irritating properties a decoction, made by adding 1 pint (480 Cc.) of cold water to 2 drachms (8 Gm.) of the drug, slowly boiling down to 12 fluid-ounces (360 Cc.) and straining, has long been given as a nutrient, diuretic, and demulcent in febrile complaints and in inflammatory states of the respiratory and urinary tracts. Unless a contraindication to the use of sugar exists, the decoction may be sweetened and flavored with lemon juice to suit the taste.

HUMULUS, *U. S.*—Hops.

Lupulus, Br.; *Strobili humuli or lupuli.—Hop*, E.; *Houblon*, Fr. Cod.; *Hopfen*, G.; *Lupudo, Hombrecilles*, Sp.; *Lupulo, Luparo, Pe de Gallo*, Port.; *Luppulo*, It.

The carefully dried strobiles of *Humulus Lupulus* L. (*Lupulus communis* Gærtn.—Fam. *Moraceæ*), bearing their natural glandular indumentum.

Hops are official in nearly all pharmacopœias, some of which require that they be renewed annually, or reject those which smell of valerianic acid or those which have been bleached with sulphurous acid.

Origin.—From a high-climbing (twining) perennial, dicœcious herb, with rough stems and herbage, and mostly opposite, broadly ovate, cordate, mostly 3- to 5-lobed leaves. It is native of northern and central Asia and Europe, and apparently of North America also, being common in our northwestern region. It is one of the most important of cultivated crops, being grown in all cool countries, but doing poorly under a warm climate. It is trained to poles or upon trellises. Effort is made to avoid the presence of the male plants near the fields, in order to prevent the fertilization of the ovules, which causes deterioration of the hops. The latter develop in pendulous clusters. Aside from insect pests, they are subject to the attacks of a fungus, which is objectionable in the product. The hops are picked when fully grown, but before ripening, and are very carefully dried. Very much of the quality depends upon care in drying, which should not be either over- or under-done. Artificial drying, under shade, by hot air, yields the best results. Hops are either stored loose or pressed into bales or cakes. In storage they turn brown, and are almost certain to undergo chemical changes, resulting

in the development of a strong valerianic acid odor, and many methods have been tried to prevent this. One is to treat them with sulphurous acid fumes, but this is in itself objectionable. It is sometimes resorted to for restoring the color to browned hops. Another method is to sprinkle them with alcohol before pressing. This results in the development of special odors, but prevents that of valerianic acid. Various substances are occasionally added, but, of course, should not be present in medicinal hops. It is very desirable that hops should not be used after keeping for more than a year. Very commonly, a portion of the glandular powder (*lupulin*) is removed by abrasion, before marketing, which proportionately reduces their value.

Description.—Ovoid-cylindrical, about 3 Cm. (a little more than 1 In.) long, consisting of a thin, hairy, flexuous rachis and many obliquely ovate, blunt, membranaceous, rigid, glandular scales, which are parallel-veined below, reticulately veined above and each bearing a globoidal akene near the base; color of scales yellowish-green to greenish pale-brown, free from reddish or brown spots; odor strongly and peculiarly aromatic, taste bitter, pungently aromatic, slightly astringent.

The most important element of the powder is its lupulin. (See LUPULINUM.) The ash amounts to about 10 per cent.

Careful attention should be given to the presence of the normal amount of the glandular coating, and this can scarcely be estimated except by experience in physical examinations. Hops from which it has been removed are apt to be much broken, and this condition is then concealed by pressing into cakes or bales. Hence unbroken loose hops are indicative of good quality, though these do not keep so well. Hops which have been kept for more than a year are called "olds"; those kept more than two years are often termed "old-olds." Both have to be sold at a heavy discount.

Constituents.—Besides other principles contained in the glands (see LUPULINUM), hops contain 0.8 per cent. of greenish- or reddish-brown volatile oil, 9–18 per cent. of resin, wax (myricyl palmitate), 4 per cent. of lupulotannic acid, phlobaphene, choline or lupuline, trimethylamine, pectin, 1 per cent. of asparagin, diastase (?), a fermentable sugar, phosphates, nitrates, malates, citrates, etc. Brand (1892) found boric acid in the strobiles, leaves, stalks, and tendrils. The volatile oil, which is an article of commerce, is aromatic, not bitter, varies from light-yellow to brown, thickens somewhat with age, has a specific gravity of 0.855 to 0.890, and is little soluble in alcohol. It consists chiefly of *humulene*, a sesquiterpene. The other constituents are little known. The resinous portion is a mixture of 3 distinct resins, of which one is crystalline and unites with bases, and another, the alpha-resin, retards lactic fermentation but not acetic. The *lupulotannic* (humulotannic) acid is whitish, amorphous, soluble in alcohol, hot water, and acetic ether, but not in ether. The phlobaphene ($C_{50}H_{46}O_{25}$) is a decomposition-product from the tannin. It is dark-red, amorphous, and on boiling with dilute acids splits into glucose and hop-red.

Pharmaceutical Preparations.—ELIXIR OF HOPS, FLUIDEXTRACT OF HOPS, N. F.; TINCTURE OF HOPS, U. S. P.

Action and Uses.—Hops are tonic, diuretic, sedative, and somewhat anaphrodisiac. They have been recommended in the treatment of certain nervous conditions associated with, or depending upon, general debility. As antispasmodics they may be employed with benefit in the treatment of delirium tremens, hysteria, priapism, seminal emissions, and incontinence of urine depending upon an irritable bladder. In the form of a hop pillow a soporific effect may be exercised in the treatment of insomnia, but it is probable that the fumes of the alcohol used to moisten the hops are the more active agents in producing this effect. A hop poultice made by mixing the powdered strobiles with some emollient substance may be employed in the treatment of boils, bruises, other painful inflammations, and in muscular rheumatism. Of the infusion, ½ ounce (16 Gm.) to 1 pint (480 Cc.), from 1 to 2 fluidounces may be given at intervals of an hour or two. The tincture is usually prescribed in doses of from 1 to 3 fluidrachms (4–12 Cc.).

HYDRANGEA.—Hydrangea.

The dried root of *Hydrangea arborescens* L. (*H. vulgaris* Mx.—Fam. *Saxifragaceæ*). *Seven-barks.*

Hydrangea is not elsewhere official.

Origin and Description.—A soft and weak shrub, common and abundant on banks, especially near streams and in rocky soil, in the Ohio valley and southward. The grayish stem-bark exfoliates in successive thin layers, whence the name *Seven-barks.* The accompanying cut illustrates the habit of the plant. The flowers are small and greenish, but there is often a marginal circle of large, white, and neutral ones. The fruit is a 2-celled and 2-beaked, many-seeded capsule. The roughly branched roots are of a very pale-yellowish or brownish-white, and the thin bark readily scales off from the white, smooth, tough, and soft wood. The bark is sweetish, afterward slightly pungent, but the wood is nearly tasteless.

FIG. 217.

Hydrangea: root (Nat.).

Constituents.—Hydrangea contains, besides fat, resin, starch, a little volatile oil, etc., about 1 per cent. of the glucoside *hydrangin*, giving a bluish fluorescence in alkaline solutions, disappearing on the addition of acids, soluble in ether and alcohol, and crystallizing in stellate masses

FIG. 218.

Hydrangea: branch (½ Nat.).

(Bondurant). Schroeter gives it a melting-point of 228° C. (442° F.) and the formula $C_{34}H_{25}O_{11}$.

Action and Uses.—Seven-barks is said to be diuretic and narcotic, and in addition to possess the power of dissolving renal calculi, which is manifestly impossible. In over-

dose it occasions headache, vertigo, and respiratory embarrassment. The remedy is employed to a limited extent in the treatment of gravel, and is said to cause the expulsion of small stones from the kidney and bladder. It is best given in the form of a fluid extract, of which 1 fluidrachm (4 Cc.) may be administered.

The common garden *Hydrangea root* (*H. paniculata grandiflora*) contains, according to Luebert, 2.38 per cent. of sugars, 2.42 per cent. of mucilage, a trace of dextrin, 2.37 per cent. of pararabin, 9.46 per cent. of starch, 8.12 per cent. of ash, parahydrangin (a glucoside), wax, and caoutchouc.

HYDRARGYRI CHLORIDUM CORROSIVUM, *U. S.*—Corrosive Mercuric Chloride.

Hydrargyri perchloridum, Br.; *Hydrargyrum bichloratum*, P. G.; *Hydrargyrum muriaticum corrosivum, Hydrargyrum corrosivum sublimatum, Hydrargyri bichloridum, Sublimatus corrosivus, Sublimatum corrosivum, Mercurius sublimatus corrosivus.*—*Mercuric chloride, Perchloride of mercury, Corrosive sublimate, Bichloride of mercury*, E.; *Deutochlorure de mercure, Sublimé corrosif, Chlorure mercurique*, Fr.; *Quecksilberchlorid, Aetzender Quecksilbersublimat*, G.

Formula, $HgCl_2$. Molecular weight, 268.86.

It should contain not less than 99.5 per cent. of pure mercuric chloride, and be kept in well-stoppered bottles.—U. S.

Owing to the intensely poisonous properties of this salt, great care should be exercised on the part of the compounder and others, not to confound it with mild chloride of mercury (calomel), which has a similar composition. Such names as perchloride, bichloride, or chloride, for corrosive sublimate, and subchloride, for calomel, may lead to confusion and mistakes, especially in a case of haste.

Preparation.—The pharmacopœias give no specific directions for preparing the salt. It is manufactured by subliming in a suitable apparatus an intimate mixture of mercuric sulphate and sodium chloride in the proportion of 20 parts of the former to 16 of the latter. The change taking place is expressed thus: $HgSO_4 + 2NaCl = HgCl_2 + Na_2SO_4$. At the temperature of sublimation $HgSO_4$ is decomposed; the acid residue attacks the sodium chloride, forming stable sodium sulphate, while the two volatile residues Hg and Cl pass off and condense in the cooler part of the apparatus as mercuric chloride. The commercial salt almost always contains a small quantity of calomel, from which it is freed by dissolving the chloride in water, filtering off the insoluble calomel, and recrystallizing.

The salt may also be prepared by dissolving mercuric oxide in hydrochloric acid, or mercury in nitrohydrochloric acid, and crystallizing.

Properties.—Corrosive sublimate occurs in colorless rhombic prismatic crystals, or, more generally, in heavy white crystalline masses. When ground, it forms a heavy pure-white powder. It melts near 265° C. (509° F.) and boils near 295° C. (563° F.). It has the density 5.4, sublimes without residue when pure, is permanent in the air, inodorous, has a disagreeable acid metallic taste, and dissolves in about 2 parts of boiling water (U. S., Br.), 3 parts (P. G.), and 13 parts of water at 25° C. (77° F.); also in 3 parts of alcohol, in 4 parts of ether (Br.), 12 to 14 parts of ether (P. G.), freely soluble in volatile oils, in 1.2 parts of boiling alcohol, and about 14 parts (2 parts, Br.) of glycerin. In the presence of camphor the solubility is increased, so that 4 parts of ether and 16 parts of camphor will dissolve 8 parts of corrosive sublimate, and 4 parts of alcohol, with 25 parts of camphor, will dissolve 16.5 parts of corrosive sublimate (Karls, 1827; Simon, 1836). The aqueous solution has an acid reaction, becomes neutral on the addition of sodium chloride, and when exposed to the light is partly decomposed, with precipitation of calomel and liberation of hydrochloric acid; the decomposition is prevented by the presence of free hydrochloric acid or of ammonium chloride. The aqueous solution yields yellow precipitates of mercuric oxide with an excess of lime water (see LOTIO HYDRARGYRI FLAVA) or potassium hydroxide solution, a white precipitate of ammoniated mercury with ammonia, and on the addition of silver nitrate a white curdy precipitate of silver chloride, insoluble in nitric acid but soluble in ammonia. Phosphorous and sulphurous acids separate calomel from the solutions; hypophosphorous acid and stannous chloride produce the same change, but when in excess and heated liberate metallic mercury. The salt is soluble without decomposition in sulphuric, hydro-

chloric, or nitric acid, and crystallizes on cooling. Solutions of albumen or of tannin form insoluble combinations; also sugar, gum, fats, resins, decompose it slowly with precipitation of calomel, light and warmth hastening the action. It forms insoluble combinations with most of the alkaloids, which fact is often utilized to prepare pure alkaloids from such insoluble double salts.

Tests.—If 1 Gm. of the finely powdered salt be dissolved in 10 Cc. of alcohol or 20 Cc. of water, it should leave not more than 0.005 Gm. of residue. If a solution of 0.5 Gm. of the salt in 20 Cc. of water and 5 Cc. of hydrochloric acid be completely saturated with hydrogen sulphide, allowed to stand for several hours in a corked flask, and then filtered, the filtrate should be colorless and leave no weighable residue upon evaporation (absence of many foreign salts). The precipitate of sulphide thus obtained is thoroughly washed with water, drained, and then rinsed into a beaker with about 20 Cc. of water; this mixture is digested with 5 Cc. of stronger ammonia-water for about 15 minutes on a boiling water-bath in the covered beaker, filtered, and washed with a little water; the filtrate and washings, after evaporating to dryness, moistening with 6 drops of nitric acid and again drying, should not respond to the modified Gutzeit's test for arsenic (see under Arseni Trioxidum). If the residue remaining on the filter be treated with diluted nitric acid (1 in 4), warmed, and then filtered, the filtrate, upon evaporation and gentle ignition, should leave no weighable residue (limit of foreign metals).—U. S.

Preparations.—Corrosive Sublimate Catgut.—Thin catgut is soaked for 8 hours, thicker kinds from 10 to 12 hours, in a 5 per cent. aqueous solution, after which it is kept in bottles with alcohol.

Corrosive Sublimate Cotton.—According to a sanitary regulation for the German army, the antiseptic solution is prepared by mixing: corrosive sublimate, 50 Gm.; alcohol, 6500 Gm.; water, 7500 Gm.; glycerin, 1000 Gm.; fuchsin, 0.5 Gm.; the latter serving to distinguish the cotton from others. This solution is sufficient for 10–12 kilograms of cotton, which is soaked in it and dried in loose layers.

Corrosive Sublimate Gauze.—The above quantity of solution is sufficient for 400 meters of gauze, which is well kneaded and soaked in it for 15 minutes, then pressed, and hung up to dry in a place free from light and dust.

Corrosive Sublimate Silk.—Well-washed silk is soaked in a solution of 100 parts of water, 20 parts of glycerin, and 5 parts of corrosive sublimate, and after drying, wrapped in waterproof material. Before being used, it is dipped into a 3 per cent. phenol or a 1 per cent. sublimate solution.

Action and Uses.—Corrosive sublimate is used in medicine for three purposes: as a germicide or antiseptic, as an antisyphilitic, and in some diseases as a tonic. Its most important use is as a germicide and antiseptic. Even in so weak a solution as 1 to 20,000 it is capable of destroying micro-organisms, and in stronger solutions of destroying their spores. In the strength of about 1 to 1000 it is in many respects the most powerful and best germicide that we possess. The chief objections to its use as a germicide are that it is expensive, comparatively speaking, and that it is decomposed when it comes in contact with albuminous or other organic matter. Again, it is a very powerful poison when taken internally, and as its solution is perfectly clear, it is a dangerous drug for common employment, because it is so readily taken in error. When used as an antiseptic in surgery, it is commonly employed in a solution varying from 1 to 10,000 to 1 to 2000, and occasionally much stronger solutions than this are employed. The objections to its use as an antiseptic are, first, its irritant properties; second, the fact that it forms with the albumin of the tissues an insoluble albuminate of mercury; third, if used in strong solution it devitalizes the tissues, or even acts as a caustic; and fourth, it may be absorbed.

As an antisyphilitic the drug may be given in the dose of $\frac{1}{30}$ to $\frac{1}{20}$ grain (0.001–0.003 Gm.) several times a day. Usually when it is employed for combating syphilis it is administered by the hypodermic needle, about $\frac{1}{6}$ grain (0.01 Gm.) being injected into the fold of the buttock or into the broad muscles of the back where the tissues are lax, on every second or third day; the drug is slowly absorbed from the area into which it is primarily injected, being precipitated by the juices of the tissues immediately after its injection. This method of treatment is not entirely devoid of pain, and careful antiseptic precautions should be carried out lest the injury to the tissues combined with an infection may cause an abscess. Sometimes in cases of obstinate syphiloderm, $\frac{1}{2}$ ounce (16 Gm.) of corrosive

sublimate and 1 ounce (30 Gm.) of chloride of ammonium are added to a warm bath, the patient then being immersed in the water for 20 minutes or half an hour, and the bath repeated 2 or 3 times a week.

As a tonic, corrosive sublimate is given internally by many practitioners in the dose of $\frac{1}{100}$ grain (0.0006 Gm.) in cases of anæmia. At one time corrosive sublimate was employed internally in large doses, frequently repeated, in the treatment of diphtheria; but with new and more clear conceptions of this disease, and the introduction of antitoxin, this use of the drug has almost entirely ceased. It is also worthy of note that it is employed as an antiseptic by surgeons very much less frequently than it was some years ago, because asepsis, or perfect cleanliness, has been found adequate for the rapid healing of wounds and the disadvantages of an irritant antiseptic have been recognized. Dermatologists quite frequently employ solutions of bichloride of mercury for the purpose of destroying parasites of the skin, and for the purpose of removing chloasma and freckles.

When corrosive sublimate is taken in poisonous dose, it produces violent inflammation of the stomach and bowels with vomiting and purging, and this is speedily followed by irritation of the kidneys and partial or complete suppression of urine. The symptoms of poisoning are quite rapid in their onset, and are usually severe, there being active vomiting, and purging, with great pain in the abdomen. The treatment consists in the administration at the earliest possible moment of a large quantity of white of egg to form an insoluble albuminate of mercury; in the administration of sufficient opium to relieve the pain and to check the excess of vomiting; in the application of heat to maintain the body temperature; and, after the acute stage of poisoning is passed, the administration of a saline purge to sweep the insoluble albuminate of mercury from the alimentary canal. Sometimes corrosive sublimate has been absorbed from surgical dressings, and produced symptoms of mercurialization, such as ptyalism and renal irritation. Other instances have been reported in which the administration of a vaginal douche containing large quantities of this chloride has resulted in local inflammation with secondary irritation of the kidneys.

HYDRARGYRI CHLORIDUM MITE, *U. S.*—Mild Mercurous Chloride.

Hydrargyri subchloridum, Br.; *Hydrargyrum chloratum*, P. G.; *Hydrargyri chloridum, Hydrargyrum chloratum (muriaticum) dulce, Mercurius dulcis, Calomelas.—Calomel*, E., Fr., G.; *Mercurous chloride, Protochloride of mercury, Mild chloride of mercury*, E.; *Protochlorure (Sous-muriate) de mercure, Mercure doux*, Fr.; *Quecksilberchlorür*, G.

Formula, HgCl. Molecular weight, 233.68.

Keep in bottles impervious to light. It should contain not less than 99.5 per cent. of pure salt.—U. S.

Preparation.—Mild mercurous chloride is manufactured by subliming in a suitable vessel an intimate mixture of mercuric chloride and mercury in the ratio of 4 to 3, during which the following change takes place: $HgCl_2 + Hg = 2HgCl$. It is also made by grinding together mercuric sulphate and mercury in the ratio of 10 to 7 till the mercury is no longer visible, and then thoroughly mixing with 5 parts of sodium chloride and subliming by heating. The changes taking place are: $HgSO_4 + Hg = Hg_2SO_4$, mercurous sulphate being formed, which when heated with sodium chloride reacts in the same manner as described under Mercuric Chloride; thus, $Hg_2SO_4 + 2NaCl = 2HgCl + Na_2SO_4$, forming vapors of mercurous chloride. If these vapors are cooled and condensed in a small space, white or yellowish-white crystalline masses are obtained, which should be finely powdered. To avoid this operation, the condensation is directed to be effected in a large chamber, whereby a fine crystalline powder is obtained; it is condensed in a similar form, but still finer and as a still softer powder, by injecting steam into the condensing-chamber while the sublimation is in progress. Calomel prepared in this way is designated in the German Pharmacopœia as *Hydrargyrum chloratum vapore paratum*, and is known in France as *Calomel à la vapeur*. Water being at the same time condensed, it will hold any corrosive sublimate in solution which may have sublimed with the vapors of calomel. It is for the purpose of removing the same impurity that the ordinarily condensed calomel requires to be washed with water as long as mercuric

chloride is dissolved, which is indicated by the filtrate producing a white turbidity with ammonia or a black one with ammonium sulphide. A current of cold air injected into the condensing-chamber will precipitate the calomel vapors as a soft powder in a manner similar to that produced by steam.

Very finely divided calomel, *Hydrargyri chloridum mite præcipitatione paratum*, known in France as *Précipité blanc* (which should not be confounded with ammoniated mercury), is obtained by gradually adding a not too concentrated solution of mercurous nitrate to a solution containing an excess of sodium chloride, digesting the mixture for a short time, and washing the precipitate thoroughly with water. Wöhler (1854) proposed the reduction of corrosive sublimate in solution by sulphurous acid and by warming the mixture. Good results and nearly the theoretical quantity of calomel are obtained, according to Sartorius (1855), if the corrosive sublimate has been dissolved in 80 parts, or, according to Stein (1857), in 45 parts of water. Concentrated solutions yield only one-half the mercury as calomel.

Some pharmacopœias and also many text-books on chemistry employ the formula Hg_2Cl_2, instead of HgCl, for calomel. This case is similar to that presented by ferric chloride (see under FERRUM). It seems to have been definitely settled that HgCl is the correct molecular formula for calomel, as shown by vapor density determinations. H. Erdmann (*Lehrb. d. Anorg. Chem.*, 2d ed., 1900) says that the formula Hg_2Cl_2 has no foundation, and should be discarded.

Properties.—Calomel is a heavy, fine, smooth, and impalpable white powder, which under the microscope is observed to consist of minute needle-shaped crystals, but when prepared by levigating the crystallized mass it forms irregular fragments of crystals which in bulk have a yellow cast. These two varieties are usually met with in commerce. Calomel obtained by precipitation is in very minute particles, either crystalline or amorphous, but on account of its more energetic action is rarely used. The salt is without action on test-paper, is entirely inodorous and tasteless, and is not altered in the dark on exposure to the air; but if kept in the light, it gradually acquires a gray or blackish color, indicating decomposition. Its density is about 7, but varies somewhat as prepared by different processes. When heated, it sublimes completely without previous fusion. It is insoluble in water and other simple solvents, but boiled with water it is slowly decomposed into metallic mercury and mercuric chloride. Solutions of the fixed alkalies and alkaline earths decompose it, with the formation of black mercurous oxide, Hg_2O (see LOTIO HYDRARGYRI NIGRA); ammonia water also colors it black, but the resulting product is a mixture of Hg and $NH_2.HgCl$. When mixed with a dry caustic alkali, alkaline earth, or an alkali carbonate, and heated, decomposition takes place, metallic mercury being produced. Moist calomel is reduced to the metallic state by many metals either in the cold or on being warmed, soluble chlorides and metallic mercury being formed. Boiling nitric or sulphuric acid dissolves calomel, with disengagement of nitric oxide or sulphurous acid vapors and the production of mercuric chloride and nitrate or sulphate. Boiling concentrated hydrochloric acid converts it into mercuric chloride and mercury; in the diluted state, and heated in contact with the air, mercuric chloride is slowly formed without separation of mercury. Calomel left in contact with solution of ammonium chloride is gradually converted into mercuric chloride, which dissolves; the decomposition occurs more rapidly with a concentrated solution and a somewhat elevated temperature. Potassium and sodium chlorides have a similar effect, but react more slowly. According to Jolly's observations (1878), corrosive sublimate is also formed from calomel in the presence of hydrochloric acid, citric acid, alkalies and their carbonates, and alkaline earths, but not with calcium carbonate nor with sugar that is absolutely free from lime. Chlorine water converts calomel into corrosive sublimate. With potassium iodide a green powder is produced containing mercurous iodide. When triturated with impure sugar some corrosive sublimate is formed.

Tests.—Calomel should volatilize without residue when heated (absence of fixed impurities). The filtrate obtained after shaking 1 Gm. of the salt with 10 Cc. of water or alcohol should not be colored or rendered turbid upon acidifying with hydrochloric acid and mixing with an equal volume of hydrogen sulphide solution after standing corked for at least half an hour at 35° C. (95° F.), either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals); nor should it leave any appreciable residue upon evaporation (absence of soluble impurities). If the filtrate obtained after

shaking 1 Gm. of the salt with 10 Cc. of ether be evaporated and 5 Cc. of distilled water be added, no opalescence should result upon adding silver nitrate test-solution (absence of mercuric chloride). When a portion of the salt is heated with potassium hydroxide test-solution ammonia should not be evolved; and when another portion is shaken with acetic acid and filtered, the filtrate should not be affected by hydrogen sulphide solution nor by silver nitrate solution (distinction from and absence of ammoniated mercury). If 0.5 Gm. of the salt and 5 Cc. of nitric acid be evaporated to dryness on a water-bath, the residue, when dissolved in 25 Cc. of water and 5 Cc. of hydrochloric acid and treated further as described under HYDRARGYRI CHLORIDUM CORROSIVUM, should show the absence of foreign salts, arsenic, and foreign metals.

Action and Uses.—The action of calomel upon the human body is very closely allied to that of metallic mercury; although if very large doses of it are given, it is likely to prove slightly more irritating to the gastro-intestinal mucous membrane. Indeed, very large doses are prone to produce vomiting and purging for this reason. The question as to the manner in which calomel is absorbed into the system is still *sub judice*, and is shrouded with so much doubt that it is scarcely worth while in this place to enter into a prolonged discussion as to the various theories which have been advanced concerning this point. Calomel undoubtedly is the most powerful of all the preparations of mercury in producing bilious stools, but here again very different opinions exist among pharmacologists and physicians as to the exact manner in which it produces this effect, some persons claiming that part of the calomel is changed into the bichloride of mercury; others that it is altered into the gray oxide before it exercises its cholagogue influence. Then, too, it is by no means as yet decided as to whether calomel actually increases the secretion of bile by the liver, or whether it simply increases the flow of bile from the gall-bladder. So far as we know, there are no experiments which prove the correctness of either of these views. Indeed, the only experiments which can be considered of value are certain investigations made upon the lower animals and man, which seem to prove that calomel does not increase the flow of bile at all, and are in direct antagonism to the clinical experience of the entire medical profession in active practice. While the experiments upon human beings have not been very numerous, all of them are in accord that the administration of calomel does not increase the flow of bile from a biliary fistula. On the other hand, every practitioner knows that the administration of an adequate dose of calomel not only produces a movement of the bowels, but a very great increase in the quantity of bile contained in the stools. Indeed, after one or two active calomel movements the following stool may consist almost entirely of bile. So far as we know, there is no explanation of this conflict between experimental and practical observation.

Calomel is used in medicine chiefly in cases of biliousness or torpidity of the liver as a stimulant to the flow of bile and as an intestinal antiseptic. It is indicated chiefly when the tongue is foul and the stools are light and putty colored, and is particularly valuable in those cases in which these symptoms complicate malarial fever, when quinine often fails to act against the infection until calomel is freely used. For the purpose of affecting the liver, the dose varies from 1 grain (0.06 Gm.) in divided doses, to 20 grains (1.3 Gm.) in divided doses, according to the severity of the malady and the degree of hepatic torpor. Sodium bicarbonate and ipecac are often given with it to increase its efficacy. Calomel is also used in small doses to check excessive vomiting complicating biliousness, and in cases of gastro-intestinal catarrh to relieve congestion of the gastric mucous membrane by unloading an engorged liver. It is also useful in the early stages of the infectious fevers to stimulate the liver.

Calomel should not be used in the treatment of jaundice unless there is reason to believe that the bile-ducts are patulous, since its administration when the ducts are closed probably increases the jaundice in that the bile which ordinarily would escape into the intestine under its influence is dammed up and so absorbed in large quantity.

In many cases of dysentery calomel is a useful remedy, acting more largely probably by the flow of bile which it produces and by the decreased hepatic congestion which results from its use than by any direct effect upon the intestinal wall.

Calomel is used as a dusting-powder for the removal of syphilitic condylomata, and in certain diseases of the skin in this form or in ointment. Placed on a plate over a water-bath it is sublimed and the vapors used by direct application to syphilitic skin lesions, or the sublimed fumes are inhaled for the cure of mucous patches in the mouth.

This measure may also be used to mercurialize the general system through its absorption by the lungs and skin. For inhalation, it is sufficient to sublime 1 to 2 grains (0.06–0.12 Gm.) a day. When a general skin effect is desired, as much as 20 grains (1.3 Gm.) are to be used, the patient being made to sweat during the process. In other instances, calomel is given hypodermically in the treatment of syphilis, being injected into the deep muscular tissue, as in the buttock, suspended in water by means of mucilage of gum arabic. From these injections slow absorption of the mercurial takes place, and, unless the greatest possible precautions are taken, great pain and abscess may follow. The method is not looked upon with much favor, since other preparations of mercury, such as the bichloride, lend themselves to this plan of treatment more readily. When used internally in the treatment of syphilis, it is common to combine it with opium to prevent it from being eliminated too rapidly by purgation.

Some years ago the profession had a very strong belief that mercury, chiefly in the form of calomel, exercised an antiphlogistic influence, diminished the coagulability of the blood, and also decreased active inflammatory processes in serous membranes in particular. As a consequence it was largely employed in pericarditis, pleurisy, meningitis, and peritonitis; but this use of the drug has now become almost entirely obsolete. In certain conditions of renal disease with dropsy, and also in dropsy depending upon cardiac disease with congestion of the liver, calomel not only acts as a purgative, but also as an efficient diuretic, and forms one of the ingredients of the celebrated pill which is composed of a grain of calomel, a grain of squill, and a grain of digitalis leaves.

The use of sublimated calomel by inhalations also has a high reputation with some physicians in the treatment of diphtheria.

After the internal use of full doses of calomel for its hepatic effect a saline purge should be given some hours later to sweep the drug from the body lest it cause general systemic effects by its absorption.

The best way in which to administer calomel is in tablet triturates, not compressed, or in powders.

HYDRARGYRI CYANIDUM.—Mercuric Cyanide.

Hydrargyrum cyanatum, P. G.; *Hydrargyrum borussicum*, *Mercurius cyanatus s. borussicus.*—*Mercuric cyanide*, *Cyanuret of mercury*, E.; *Cyanure (Bicyanure, Prussiate) de mercure*, Fr.; *Cyanquecksilber*, *Quecksilbercyanid*, G.

Formula, $Hg(CN)_2$. Molecular weight, 250.18.

Mercuric cyanide should be kept in well-stoppered bottles, protected from light.

Preparation.—It may be prepared by dissolving mercuric oxide in hydrocyanic acid, keeping the latter in slight excess to prevent the formation of an oxycyanide, $HgO.Hg(CN)_2$. The solution is concentrated, and set aside in a cool and dark place to crystallize.

Another method is to rub together 4 parts of Berlin Blue with 3 parts of yellow mercuric oxide and 20 parts of water, and heat the mixture 1 to 2 hours on a water-bath, replacing the water that evaporates from the dish. The mixture is then heated to boiling until the blue color disappears. If after 10 minutes' boiling the blue color remains, more mercuric oxide must be added. The liquid is filtered, the residue washed with hot water, the combined filtrates acidified with hydrocyanic acid, evaporated, and set aside to crystallize. The reaction taking place is: $Fe_4[Fe(CN)_6]_3 + 9HgO = 9Hg(CN)_2 + 3FeO + 2Fe_2O_3$.

Properties.—Mercuric cyanide is in colorless or white quadrangular prisms, which are inodorous, have a bitter, metallic taste, and are permanent in the air if light be excluded. The salt is soluble at 15° C. (59° F.) in 12.8 parts of water (P. G.) and in 12 parts of alcohol, also in 3 parts of boiling water and 6 parts of boiling alcohol, but is very sparingly soluble in ether. The solutions have a neutral reaction to test-paper. The aqueous solution is not decomposed by nitric or dilute sulphuric acid, but hydrochloric acid liberates hydrocyanic acid, recognizable by its odor, and mercuric chloride remains in solution; it yields a black precipitate with hydrogen sulphide, but does not give the ordinary reactions for mercuric salt or cyanide when tested with alkalies, potassium iodide, or silver nitrate, double compounds, mostly crys-

talline, being formed, which are more or less freely soluble in water. The salt is blackened by exposure to the light, and when carefully dried and heated is decomposed into mercury and cyanogen, which is inflammable, burning with a purplish flame; but when rapidly and strongly heated the crystals decrepitate violently, and black paracyanogen is first produced before the whole is finally dissipated, and in the presence of moisture carbon dioxide, ammonia, and hydrocyanic acid are evolved. When mixed with an equal weight of iodine, and heated in a dry test-tube, two crystalline sublimates are obtained, the lower one consisting of mercuric iodide, being yellow and becoming red on cooling, while the upper one, consisting of cyanogen iodide, CN.I, is white and has a penetrating, acrid odor. It is the only easily soluble cyanide of the heavy metals.

Tests.—Mercuric cyanide dissolved in water should not impart a brown color to turmeric paper (absence of mercuric oxycyanide). A 5 per cent. aqueous solution of the salt, when mixed with a dilute aqueous solution of potassium iodide, should not yield a red or reddish precipitate soluble in excess of the precipitant (absence of mercuric chloride). In the presence of a *little* chloride this test is apt to fail unless the potassium iodide solution be very cautiously added. A much better test is the following: The solution of the salt in 20 parts of water slightly acidulated with nitric acid, should not produce a white precipitate on the addition of test-solution of silver nitrate. The absence of salts of other metals is shown by the complete volatility by heat. Solution of mercuric cyanide does not give a stain of mercury on bright copper except in presence of hydrochloric acid.

Action and Uses.—Cyanide of mercury possesses the alterative powers of mercury and the depressant powers of hydrocyanic acid, and as it has no antisyphilitic value over safer and better tried mercurials it should be discarded. Not only is its influence depressing, but it is an irritant salt of mercury. Used in syphilis it may be given in the dose of $\frac{1}{12}$ grain (0.005 Gm.), 3 times a day. It has also been used hypodermically in the treatment of this disease in about half this dose.

Hydrargyri et Zinci Cyanidum, *Hydrargyro-zincum cyanatum.—Mercuric and zinc cyanide*, E.; *Lister's double salt; Quecksilberzinkcyanid*, G.; *Cyanure de mercure et de zinc*, Fr.—This preparation was proposed by Sir Joseph Lister in 1889 as an antiseptic non-irritating dressing. It is obtained by mixing a solution of 28 parts of zinc sulphate with a solution of 25 parts of mercuric cyanide and 130 parts of potassium cyanide, washing, and drying the precipitate. Lister thought the substance was a definite chemical compound, $Hg(CN)_2.Zn(CN)_2$, but it is found that the mercury varies from 15 to 46 per cent. according to conditions. It is used to impregnate gauze, on which it is fixed by mordanting the gauze in solution of aniline dyes, as gentian-violet and methyl-violet 1 in 50,000. Of late, hæmatoxylin has also been used as a mordant instead of the aniline dyes.

Hydrargyri Oxycyanidum, *Hydrargyrum oxycyanatum, Mercuric oxycyanide*, E.; *Quecksilberoxycyanid, Mercurioxycyanid*, G. $Hg(CN)_2.HgO$.—This is obtained by dissolving precipitated mercuric oxide in a solution of an equivalent amount of mercuric cyanide, heated on a water-bath, filtering through asbestos, and evaporating to crystallization. It forms a fine white crystalline powder with a tinge of yellow, soluble in 17 parts of water. The solution is precipitated by tannic acid and stannous chloride; with ammonia, the precipitate formed is soluble in excess of the reagent; hydrogen sulphide throws down black mercuric sulphide.

HYDRARGYRI IODIDUM FLAVUM, *U. S.*—Yellow Mercurous Iodide.

Hydrargyri Iodidum Viride, U. S. 1880.—*Hydrargyrum iodatum flavum, Hydrargyri proto-ioduretum.—Protoiodide of mercury, Yellow (or Green) iodide of mercury*, E.; *Protoiodure de mercure, Iodure mercureux*, Fr.; *Quecksilberjodür, Gelbes Iodquecksilber*, G.

Formula HgI. Molecular weight, 324.40.

It should contain not less than 99.5 per cent. of pure salt.—U. S.

Preparation.—Mercury, 50 Gm.; nitric acid, potassium iodide, distilled water, each a sufficient quantity. Mix 20 Cc. each of nitric acid and distilled water, and, when the liquid is cold, pour it upon the mercury contained in a small glass flask. Set the mixture aside in a cool and dark place, and agitate it occasionally until the reaction ceases and a little mercury still remains undissolved. Separate the crystals of mercurous nitrate which will have formed from the mother-liquid, allow them to drain in a glass funnel, and dry them on bibulous paper in a dark place. When the salt is dry, weigh off 40 Gm. of it, and dissolve it in 650 Cc. of distilled water to which 6 Cc. of nitric acid had

previously been added. Having prepared a solution of 16 Gm. of potassium iodide in 32 Cc. of distilled water, slowly pour the solution of potassium iodide into that of the mercurous nitrate, with constant stirring; stir the mixture for 15 minutes, allow the precipitate to subside, decant the supernatant liquid, and wash the precipitate by decantation with ten successive portions of 500 Cc. each of distilled water. Finally, transfer the precipitate to a filter, and dry it between sheets of bibulous paper, in a dark place, at a temperature not exceeding 40° C. (104° F.). Keep it in dark, amber-colored vials, and expose it to light as little as possible. Instead of weighing off 40 Gm. of the mercurous nitrate as above directed, the whole of the crystallized salt may be taken and the amount of potassium, etc., adjusted on the proportion given above.—U. S.

When solutions of a mercurous salt and potassium iodide are brought together, mutual decomposition results and mercurous iodide is formed, together with a salt of the alkali, as shown by the following reaction: $2HgNO_3 + 2KI = 2(HgI)$ or $Hg_2I_2 + 2KNO_3$.

The object of adding the potassium iodide to the mercurous nitrate in the official process is to avoid the formation of mercuric salt, which is apt to occur if the process were reversed; it is well known that solutions of alkali iodides and also ferrous iodide will decompose mercurous iodide into mercuric iodide and mercury, the mercuric salt being held in solution as the double potassium mercuric iodide, while the mercury is precipitated in a finely divided state. The decomposition is readily understood from the equation: $2HgI + 2KI = HgI_2 2KI + Hg$. Dilute solutions also insure a pure product, and the presence of nitric acid prevents the formation of basic salts.

The former U. S., Br., and German pharmacopœias all directed the preparation of mercurous iodide by triturating iodine and mercury together in proper proportions in the presence of a little alcohol; any mercuric iodide formed was removed by washing with alcohol. The Br. P. and P. G. dismissed this compound entirely in 1885 and 1890 respectively. When prepared by direct union, mercurous iodide is much more green in color, and this is also the case if appreciable quantities of mercuric iodide are present, as may be seen from the change of color caused by exposure of the yellow iodide to sunlight, which causes decomposition into mercuric iodide and metallic mercury, the bluish color of the latter, with the yellow iodide, giving a green effect.

Properties.—Mercurous iodide (official) is a bright-yellow amorphous powder, odorless and tasteless, and becoming darker by exposure to light in proportion as it undergoes decomposition into mercuric iodide and mercury. It is wholly insoluble in alcohol or ether, and almost insoluble in water. When slowly heated, it assumes at first an orange, and then a red or red-brown color, becoming yellow again on cooling; but when quickly and strongly heated, it is at first partially decomposed into mercury and mercuric iodide, and finally is completely volatilized. Mercurous iodide dissolves in ammonia water, leaving a gray residue, and in sodium thiosulphate solution, leaving mercury, and yielding a colorless liquid, which on heating deposits dark-red mercuric sulphide. When it is heated with sulphuric acid and a little manganese dioxide, vapors of iodine are evolved.

Tests.—If 0.5 Gm. of the salt be shaken with 10 Cc. of alcohol, and filtered, a portion of the filtrate should scarcely be affected by hydrogen sulphide test-solution, nor should it produce more than a very faint, transient opalescence when dropped into water; and if 5 Cc. of the filtrate be evaporated from a white porcelain surface, not more than a very faint red stain should remain (absence of more than traces of mercuric iodide).—U. S. Fixed impurities, if present, remain behind if a portion is heated to redness in a porcelain crucible.

Action and Uses.—This preparation is almost universally regarded as the best of all the mercurials for the treatment of secondary syphilis in that it combines the alterative influence of mercury and iodine, and is readily eliminated from the system. The best method of using it is to give the patient tablet triturates of ¼ grain (0.015 Gm.) each, and have him take 1 tablet 3 times a day after meals on the first day, and on the second day to increase the evening dose by 1 tablet; on the third day to take 1 tablet in the morning, 2 at noon, and 2 at night; and on the fourth day 2 tablets 3 times a day; increasing the dose day by day in this manner till symptoms of mild mercurialism develop, such as tenderness of the gums or diarrhœa, when the dose is cut down one-half and maintained at that level. This is the so-called "tonic dose."

If taken in overdose for a considerable period of time, the protiodide rapidly produces severe ptyalism, but it is not so prone to do so as is calomel. Single large poisonous doses cause gastro-enteritis and diarrhœa with vomiting. The antidote is starch and white of egg.

HYDRARGYRI IODIDUM RUBRUM, *U. S., Br.*—Red Mercuric Iodide.

Hydrargyrum bijodatum, P. G.; *Hydrargyrum iodatum rubrum.—Biniodide of mercury, Deutoiodide of mercury, Mercuric iodide*, E.; *Deuto-iodure (Bi-iodure) de mercure, Iodure mercurique*, Fr.; *Rothes Jodquecksilber, Quecksilberjodid*, G.

Formula HgI_2. Molecular weight, 450.30.

It should contain not less than 99.5 per cent. of pure salt.—U. S.

Preparation.—Corrosive mercuric chloride, 40 Gm.; potassium iodide, 50 Gm.; distilled water, a sufficient quantity. Dissolve the corrosive mercuric chloride and the potassium iodide each in 800 Cc. of distilled water, and filter the solutions separately. Pour both solutions simultaneously and in a thin stream, with constant stirring, into 2000 Cc. of distilled water. When the precipitate has subsided, decant the supernatant liquid, collect the precipitate on a filter, and wash it with cold distilled water until the washings give not more than a slight opalescence with silver nitrate test-solution. Finally, dry it in a dark place, between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.). Keep the product in well-stoppered bottles, protected from light.—U. S.

The Br. P. (1898) has dropped the process of preparing this salt, simply stating that it is formed by interaction between potassium iodide and mercuric chloride.

Mercuric chloride and potassium iodide, when mixed in the proportion of the weight of 1 molecule of the former to 2 of the latter salt, decompose each other into mercuric iodide, which precipitates, and potassium chloride, which remains in solution: $HgCl_2 + 2KI$ yields $HgI_2 + 2KCl$. The U. S. P. uses the two salts in the proportion of 4 to 5, which is a slight excess of the potassium salt over the theoretical quantity, but is generally necessary in practice, owing to the small percentage of impurities always present in commercial potassium iodide. By calculation it is found that 4 parts of mercuric chloride require for complete decomposition 4.898 parts of potassium iodide, or 9 parts of the former require 11.02 parts of the latter salt. By mixing the two solutions cold the red iodide is separated in the form of powder, but when the hot solutions are mixed and slowly cooled beautiful crystals are obtained. In either case the yield should be about 60 per cent. more than the weight of the corrosive sublimate used.

Properties.—Mercuric iodide is a scarlet-red amorphous or crystalline powder or is in brilliant crystals. It is permanent in the air if kept in the dark or in diffused daylight, but acquires a brownish tint in the sunlight. It is inodorous and nearly tasteless, a metallic taste being slowly developed when kept upon the tongue. On being heated to above 150° C. (302° F.), it turns yellow, but on cooling readily resumes its red color under various influences. It fuses at 253° C. (487.4° F.) to an amber-colored liquid, and at a higher heat sublimes to bright-yellow tabular crystals which after cooling are again converted into the prismatic or octahedral red crystals. The salt is very sparingly soluble in cold or hot water, little so in ether and diluted nitric acid, but more freely soluble in hydriodic or hydrochloric acid, in potassium iodide or chloride, in many ammonium salts, in solutions of mercuric salts, in chloroform, fixed oils, hot carbon disulphide, etc. It dissolves in 116 parts of alcohol, 85 parts of ether, and 1340 parts of chloroform at 25° C. (77° F.), and in 15 parts of boiling alcohol (U. S.), crystallizing on cooling; on pouring the alcoholic solution into cold water the salt separates as a fine yellow powder, remaining suspended in the liquid and gradually turning red. The solutions are colorless, and are partly decomposed by potassium hydroxide solution, a portion of the mercury being deposited as a mixture of $HgI_2.3HgO$ and HgO, the remainder forming a soluble iodide of potassium and mercury. On heating the salt with solution of soda and glucose or sugar of milk, metallic mercury will be precipitated, and on heating it with sulphuric acid and black manganese oxide, vapors of iodine will be given off. When a hot solution of potassium iodide is saturated with mercuric iodide and then allowed to cool, one-third of the latter salt crystallizes out; the remainder is obtained, on further concentration, as yellow prisms, which are soluble in alcohol and ether, but are partly decomposed by water. The crystals are *mercuric potas-*

sium iodide, $(2KI.HgI_2)3H_2O$, more generally known as *potassium iodohydrargyrate*, and are likewise formed on adding mercuric chloride to an excess of potassium iodide.

Tests.—Impurities, if present, are readily detected by the residue left on subliming the salt (red oxide of lead and other non-volatile compounds) and on dissolving it in hot alcohol (vermilion, etc.). The cold alcoholic solution should be colorless and without acid reaction (mercuric chloride), and on the addition of ammonia should acquire merely a brown color, but not be precipitated (mercuric chloride). If about 0.5 Gm. of the salt be shaken with 10 Cc. of water, the filtered liquid should not become more than very slightly colored by hydrogen sulphide test-solution, nor afford more than a slight opalescence with silver nitrate test-solution (limit of *soluble chlorides* or *iodides*). —U. S.

Pharmaceutical Uses.—The observation of Nessler (1856) of the effect of ammonia upon solutions of mercuric iodide has resulted in the discovery of a very delicate reagent for minute quantities of ammonium salts, known as the

Nessler Reagent.—It is made by dissolving 50 Gm. of potassium iodide in a little boiling distilled water, and adding to it, carefully, sufficient boiling hot concentrated solution of mercuric chloride until the red precipitate formed is no longer redissolved on agitation; the liquid is decanted and filtered, and the filtrate mixed with 200 Gm. of potassa dissolved in a small quantity of water; when cold the mixture is diluted to the measure of 1 liter by the addition of distilled water. The addition of 5 Cc. of cold saturated solution of corrosive sublimate is recommended by some, but is not necessary. It will be observed that this is a solution of mercuric potassium iodide in caustic potassa. On the addition of ammonium salt this is decomposed by the potassa, ammonia is liberated, and reacts now with the double iodide and another portion of the potassa, resulting in the formation of brown insoluble dimercur-ammonium iodide, potassium iodide, and water, as will be seen from the equation: $NH_3 + 2(HgI_2.2KI) + 3KOH = NHg_2I + 7KI + 3H_2O$. If the ammonia is present in minute quantity, the color is observed best by looking through the column of the liquid contained in a tall test-tube and placed on white paper.

Winckler (1830), von Planta (1846), and Groves (1858) observed the behavior of solutions of the double iodide upon solutions of vegetable alkaloids, which led F. F. Mayer (1862) to the adoption of one-tenth normal solution, now known as

Mayer's Solution.—It is prepared by dissolving 13.546 Gm. of mercuric chloride and 49.8 of potassium iodide in sufficient distilled water to obtain 1 liter of liquid. It is identical with the test-solution of mercuric-potassium iodide of the U. S. P., and is an excellent qualitative test for the presence of alkaloids, which must be applied in acidulated aqueous solutions, free from alcohol, chloroform, etc. For the quantitative determination of alkaloids, Mayer's Solution is not well suited, since the titration equivalent (amount of alkaloid precipitated by 1 Cc. of the reagent) has been found to vary in many cases with the acidity and dilution of the alkaloidal solutions.

Action and Uses.—The red iodide of mercury is a far more irritant and poisonous preparation than the yellow iodide, producing death when taken internally in overdose in a manner similar to that caused by the bichloride. Violent gastro-intestinal irritation and inflammation, abdominal pain, vomiting, and even convulsions may ensue. The antidote is white of egg.

The red iodide is used in medicine as an antisyphilitic, but as it is irritating it cannot be given freely. Its dose for this purpose is $\frac{1}{16}$ grain (0.004 Gm.), 3 times a day, gradually increased to larger amounts if the stomach will stand it.

Locally the red iodide has been employed as an antisyphilitic lotion and in concentrated form as a caustic to growths on the skin, particularly in cases of lupus. When it is used as an antiseptic the strength of its solution should be about 1 to 5000 to 1 to 1000.

HYDRARGYRI OXIDUM FLAVUM, *U. S., Br.*—Yellow Mercuric Oxide.

Hydrargyrum oxydatum via humida paratum, P. G.; *Hydrargyrum oxydatum præcipitatum (vel flavum).—Precipitated oxide of mercury, or Mercuric oxide*, E.; *Oxyde mercurique jaune (précipité)*, *Deutoxyde jaune de mercure*, Fr.; *Präcipitirtes (Gelbes) Quecksilberoxyd*, G.

Formula, HgO. Molecular weight, 214.38.

It should contain not less than 99.5 per cent. of pure salt.—U. S.

Preparation.—Corrosive mercuric chloride, 100 Gm.; soda, 40 Gm.; distilled water, a sufficient quantity. Dissolve the corrosive mercuric chloride in 1000 Cc. of warm distilled water, and filter the solution. Dissolve the soda (which should contain 90 per cent. of sodium hydroxide) in 1000 Cc. of cold distilled water, and into this solution pour gradually, and with constant stirring, the solution of corrosive mercuric chloride. Allow the mixture to stand for an hour at a temperature of about 30° C. (86° F.), stirring frequently. Then decant the supernatant clear liquid from the precipitate, and wash the latter repeatedly by the affusion and decantation of distilled water, using 1000 Cc. of water each time; collect the precipitate on a strainer, and continue the washing with warm distilled water until a small portion of the washings, when poured on a little mercuric chloride test-solution, no longer affords a yellowish turbidity at the line of contact of the two liquids. Then allow the precipitate to drain, and dry it between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C. (86° F.). Keep the product in well-stoppered bottles, protected from light.—U. S.

The Br. P. (1898) has dropped the process of manufacture.

On mixing solutions of mercuric chloride and soda, sodium chloride, water, and mercuric oxide are formed, the latter being precipitated: $HgCl_2 + 2NaOH$ yields $2NaCl + H_2O + HgO$. The alkali must be in excess, lest some mercuric oxychloride be precipitated with the oxide, and it is essential to pour the mercuric solution into the alkali. The foregoing equation shows that 270.54 parts of mercuric chloride require 79.92 parts of sodium hydroxide for complete decomposition, and as the Pharmacopœia orders for 100 parts of mercuric chloride 40 parts of soda containing at least 90 per cent. of NaOH, the necessary excess is assured, for 40 at 90 per cent. = 36, and 100 parts of $HgCl_2$ require only 29.9 parts of NaOH. If the soda is contaminated with carbonate, brown mercuric carbonate will also be precipitated, and it is therefore essential that pure alkali be used.

Of great importance for the appearance of the oxide is the temperature at which it is prepared; the lower it be kept the brighter will be the yellow color, while with an elevation of temperature the red tint will become more decided. The yield is nearly 60 per cent.

Properties and Tests.—Yellow mercuric oxide is a heavy, smooth, impalpable, amorphous, yellow or reddish-yellow powder, which is not altered in the air, but on exposure to light becomes dark, in consequence of partial reduction to mercurous oxide; when heated, it assumes a red color, and at a sufficiently strong heat is decomposed and volatilized like red mercuric oxide. It has the specific gravity 11.0, is without odor or taste, and is insoluble in water and other simple solvents, but dissolves readily and completely without effervescence in diluted hydrochloric or nitric acid. When digested or agitated with a solution of oxalic acid it forms white mercuric oxalate (difference from red oxide). Heated with an alcoholic solution of mercuric chloride, it speedily turns black from the formation of an oxychloride; red mercuric oxide slowly undergoes a similar change (Roucher). It should be completely volatilized by heat, and its solution in dilute nitric acid should become merely opalescent on the addition of silver nitrate test-solution (limit of chloride). 0.5 Gm. of the oxide dissolved in 2 Cc. of hydrochloric acid and 25 Cc. of water should not respond to the tests for foreign salts, metals, or arsenic given under HYDRARGYRI CHLORIDUM CORROSIVUM.

The yellow oxide is much more finely divided than the red, and hence is much more easily acted on chemically and has a stronger therapeutic action.

Action and Uses.—Yellow oxide of mercury is used in medicine as a local application in the form of an ointment to cure and prevent the formation of styes, and in the treatment of conjunctivitis, blepharitis, etc., in the strength of 2 grains (0.12 Gm.) to the ounce (30 Gm.) of lard or lanolin. Held in solution in olive oil, it has been used by some physicians hypodermically in the treatment of syphilis, but it has not been a popular remedy for this disease.

HYDRARGYRI OXIDUM RUBRUM, *U. S., Br.*—Red Mercuric Oxide.

Hydrargyrum oxydatum, P. G.—*Peroxide of mercury, Red precipitate.* E.; *Deutoxyde (Peroxyde) rouge de mercure, Oxyde mercurique, Précipité rouge, Poudre de Jean de Vigo*, Fr.; *Rothes Quecksilberoxyd, Rother Präcipitat (Quecksilber-Präcipitat)*, G.

Formula, HgO. Molecular weight, 214.38.

It should contain not less than 99.5 per cent. of pure oxide, and should be kept in well-corked bottles, protected from light.—U. S.

Preparation.—None of the pharmacopœias give a method of preparation. Red mercuric oxide is made on a large scale by heating mercuric nitrate, or an intimate mixture of molecular quantities of mercuric nitrate and mercury, until acid vapors cease to escape, The temperature must not be allowed to rise too high, else the mercuric oxide formed will be decomposed into mercury and oxygen. When mercuric nitrate alone is heated, it is decomposed thus: $Hg(NO_3)_2 = HgO + 2NO_2 + O$. Red fumes of nitrogen peroxide mixed with oxygen are given off. To avoid the loss of oxygen, a mixture of the nitrate with mercury is often used, where the change is represented thus: $Hg(NO_3)_2 + Hg = 2HgO + 2NO_2$. Occasionally a minute quantity of nitrate remains undecomposed.

Should the nitric acid employed be contaminated with hydrochloric acid, a corresponding quantity of mercuric chloride, and finally oxychloride, would be formed, the latter remaining with the mercuric oxide as an impurity. The last traces of acid may be removed by boiling with diluted sodium hydroxide solution.

The preparation formerly official in various pharmacopœias as *Mercurius præcipitatus per se* or *Mercurius calcinatus* was red oxide of mercury in the form of crystalline scales, which are obtained by keeping metallic mercury in a loosely covered flask or retort at a temperature near its boiling-point. The process required several weeks for its completion.

Properties.—When made on a small scale, red mercuric oxide is a finely granular powder of a yellowish-red color, without luster; but made in larger quantities it is obtained in the form of bright brownish-red shining crystalline scales, which on trituration yield a fine orange-red powder, the yellowish tint increasing with the fineness of the powder. It is inodorous, and at first tasteless, but slowly develops a metallic taste. It is very slightly soluble in water and other simple solvents, but completely soluble in diluted hydrochloric and nitric acids. It is permanent in the air if kept in the dark, but on exposure to light it becomes superficially black—however, much more slowly than the yellow oxide. When heated, its color is changed to dark-red, brown, and near 400° C. (750° F.) to black, the original color reappearing on cooling; but at a red heat it is completely decomposed into metal and oxygen. The oxide, being easily decomposed, forms explosive mixtures with such bodies as sulphur, carbon, phosphorus, when heated or struck. It is reduced by many substances, such as sulphurous and phosphorous acids, fats, gums, sugar, etc. Hence weak ointments of the oxide made with lard become decolorized or gray after a time.

Tests.—When strongly heated, mercuric oxide should not give off red nitrous vapors (absence of nitrate), and when heated to full redness it should be decomposed and volatilized without residue (absence of non-volatile impurities). On being agitated or digested with a solution of oxalic acid in 10 parts of water the red color should not be changed (difference from yellow mercuric oxide). Treated with diluted nitric acid in excess, it should yield a colorless solution. A red-colored residue would indicate the presence of brick-dust or of vermilion, the latter being volatilizable by heat; a brown residue (of puce-colored oxide of lead) would prove adulteration with red lead, and the nitric acid solution would contain lead, recognizable by the white precipitate appearing on the addition of a little sulphuric acid. The nitric acid solution should remain undisturbed or merely become slightly opalescent on the addition of silver nitrate test-solution (limit of chloride).—U. S. If to 1 Gm. of red mercuric oxide 5 Cc. of water be added, followed by 2 Cc. of sulphuric acid, and after cooling 1 Cc. of concentrated solution of ferrous sulphate be carefully poured upon the acid mixture, a brown color should not appear at the junction of the two liquids (absence of nitrate). 0.5 Gm., dissolved in 2 Cc. of hydrochloric acid and 25 Cc. of water, should not respond to the tests for foreign salts, metals, or arsenic given under HYDRARGYRI CHLORIDUM CORROSIVUM.

Action and Uses.—Red precipitate is used as a dusting-powder on syphilitic ulcers, usually diluted at least one-half with some inert powder. It may also be employed in ointment in the treatment of the same conditions in the form of the official ointment (see UNGUENTUM HYDRARGYRI OXIDI RUBRI), which should be diluted one-half with lard.

HYDRARGYRI SALICYLAS.—Mercuric Salicylate.

Hydrargyrum salicylicum, P. G.; *Salicylate mercurique*, Fr.; *Mercurisalicylat, Salicylsaures Quecksilberoxyd*, G.

Formula, $C_6H_4<\begin{matrix}O\\CO_2\end{matrix}>Hg$. Molecular weight, 333.51.

Preparation.—Dissolve 27 parts of corrosive sublimate in 600 parts of water, precipitate mercuric oxide from this, as described under HYDRARGYRI OXIDUM FLAVUM, by adding it to a mixture of 85 parts of sodium hydroxide solution (specific gravity 1.178–1.182) and 200 parts of water. The oxide, properly washed, is digested in a flask with a little water and 15 parts of salicylic acid, on a boiling water-bath, until the mixture has become pure white. The mercury salicylate is then filtered and washed until the filtrate is no longer acid in reaction, dried on porous plates at 30°–40° C. (86°–104° F.), and finally at 100° C. (212° F.).

Properties.—It forms a very fine, white, amorphous, tasteless and odorless powder, neutral to litmus, insoluble in water and alcohol. It is not decomposed by hydrogen sulphide or ammonium sulphide. It is stable toward weak acids, such as carbonic, acetic, tartaric, lactic; but it is decomposed by concentrated hydrochloric, nitric, sulphuric, and nitrohydrochloric acids. Solutions made with the latter acids give a black mercuric sulphide with hydrogen sulphide.

The salt is soluble at ordinary temperature in sodium hydroxide or sodium carbonate solution, forming a double salt; it is reprecipitated from such a solution by a weak acid, as acetic. Solutions of chlorides, bromides, and iodides, when warmed, dissolve the salt; but on cooling a double salt separates, containing 1 molecule of the halogen salt to 1 of the salicylate. It contains at least 59 per cent. of mercury.

Tests.—If 0.1 Gm. of the salt be shaken with 5 Cc. of water, the liquid will assume a violet color with a drop of ferric chloride solution (salicylic acid). The salt, when heated in a dry tube, gives a sublimate of mercury. Heated in a porcelain crucible in the air, no residue should be left (absence of sodium salicylate), and it should have no acid reaction to litmus-paper (absence of salicylic acid). 0.5 Gm. converted into chloride by evaporating to dryness with 7 Cc. of nitric and 21 Cc. of hydrochloric acid, should yield not less than 0.34 Gm. of mercuric sulphide, when the residue is taken up with dilute hydrochloric acid and treated with hydrogen sulphide, corresponding to 58.6 per cent. of mercury.

Action and Uses.—Salicylate of mercury is used in the dose of from $\frac{1}{8}$ to 1 grain (0.008–0.06 Gm.) in the treatment of secondary syphilis, and as an ointment (16 grains to the ounce (1.05–30 Gm.) of lard) for lesions of the skin.

HYDRARGYRUM, *U. S., Br., P. G.*—Mercury.

Hydrargyrum vivum, Mercurius vivus, Argentum vivum.—Quicksilver, E.; *Mercure, Vifargent*, Fr.; *Quecksilber*, G.

Symbol, Hg. Atomicity univalent and bivalent. Atomic weight, 198.50.

It should be 99.9 per cent. pure, and be kept in strong bottles.—U. S.

Origin.—Mercury became known before the Christian era, but long after silver and gold had been in use. It is principally obtained from New Almaden, in California, from Peru, China, Idria, in Austria, and Almaden, in Spain. It is found to some extent in the metallic state in the form of minute or large globules, also in combination with oxygen, chlorine, selenium, etc.; but the principal ore for extracting it is *cinnabar*, which is the sulphide.

Preparation.—Most of the mercury is obtained by roasting the ore in a kiln. It is placed upon an arch of brickwork containing several openings, through which the flames pass, whereby the sulphur of the ore is ignited and burns, air being admitted at the same time; the heat thus produced volatilizes the mercury, the vapors of which, mingled with the smoke and sulphur dioxide gas, are passed through a series of condensing-chambers, where the metal is condensed, the incondensable gases finally escaping through the flue. This is essentially the process as carried on at Idria and New Almaden; like-

wise at Almaden, except that the vapors are passed through the so-called *aludels*, consisting of cylinders adapted to each other, first in a descending and then in an ascending direction, where most of the mercury is condensed and collects in a gutter placed under the angle, the remainder being condensed in a large terminal chamber, from which the gases pass into the flue. In the Palatinate the cinnabar is mixed with lime, and in Bohemia with hammerslag, and then distilled, calcium sulphide remaining behind in the former, and sulphide of iron in the latter, case.

Mercury appears in commerce in cylindrical iron flasks containing 75 pounds each. In this condition it still contains small quantities of other metals, as lead, bismuth, copper, antimony, tin silver, which, however, do not interfere with its uses in the silvering of looking-glasses, in the amalgamation process for the extraction of gold and silver, nor in the preparation of some chemicals. For barometers and thermometers, as well as for some pharmaceutical preparations, a purification of the metal is required or advisable, and may be effected by distillation or by the following process directed in several European pharmacopœias:

Hydrargyrum Depuratum s. Purificatum.—Take of mercury, 100 parts; nitric acid, distilled water, each, 5 parts. Digest in a suitable vessel for 3 days, shaking frequently. Having poured off the acid liquid, wash well the mercury with distilled water, and dry it completely.

The operation is conducted best in a broad glass or porcelain vessel, so as to expose a very large surface of the metal to the action of the dilute acid; or, as proposed by L. Meyer, by allowing the mercury to run slowly in a fine stream into a long glass tube containing the diluted acid. Lead, iron, and other metals, being far more easily oxidized and dissolved than the mercury, are thereby removed, though a little of the latter likewise passes into solution. After washing, most of the water may be removed by bibulous paper. These metals may also be removed by agitating the crude mercury with concentrated sulphuric acid or with solution of ferric chloride, the latter process being preferable for operations on a small scale.

Absolutely pure mercury may be obtained by distilling a mixture of pure precipitated mercuric sulphide with quicklime or iron filings.

Properties.—Mercury is solid at a temperature of —39.44° C. (—39° F.), and crystallizes in octahedrons and needles, which are ductile and may be cut with a knife. At the ordinary temperature it forms a bright silvery, lustrous, inodorous, and tasteless liquid, which is very cohering, and not adhering to glass or paper unless it be impure, when small globules will *tail* or leave a streak upon it. When triturated with sugar, fat, various salts, oil of turpentine, etc., it is converted into a gray powder consisting of minute globules separated by the foreign substances and running together again on their removal; this finely divided state is called the *extinction* of mercury, and is accomplished in making mercurial ointment and several other official preparations. Mercury has at 4° C. (39.2° F.) the specific gravity 13.59, and at 15° C. (59° F.) 13.5584. It boils at about 357.2° C. (675° F.), giving a colorless vapor of 6.98 specific gravity, and leaving no residue; it volatilizes very slowly even at the ordinary temperature. It is permanent at the ordinary temperature, the whitish pellicle which forms upon the surface of commercial mercury being due to the presence of foreign metals (lead, zinc, etc.). It unites directly with chlorine, bromine, and iodine, and dissolves completely even in dilute nitric acid, with the evolution of nitric oxide. All simple solvents and boiling hydrochloric and dilute sulphuric acids are without action upon it, but hot concentrated sulphuric acid dissolves the metal, sulphur dioxide being given off. When heated to near its boiling-point in contact with the atmosphere it combines with oxygen, forming scales of red oxide.

Mercury unites with oxygen in two proportions, and forms two series of salts, the *mercurous* and *mercuric*. In the latter salts the valence of mercury is 2, but vapor density determinations point to the conclusion, that in the mercurous salts the valence of mercury is 1 (see under HYDRARGYRI CHLORIDUM MITE).

Mercurous compounds are readily converted into mercuric compounds by the action of oxidizing agents, and the latter are easily converted into the former by the action of reducing agents. All soluble salts of mercury are poisonous, have a strong metallic taste, and mostly an acid reaction upon test-paper. The normal salts are usually white, and the basic salts yellow; treated with stannous chloride, phosphorous or sulphurous acid, or other deoxidizing agents, they are blackened, and finally reduced to metal. Their

solutions deposit a silvery coating of metallic mercury upon a bright piece of metallic copper, and yield black precipitates with hydrogen sulphide and white ones with sodium phosphate. *Mercurous* salts yield black precipitates with potassium hydroxide, ammonia, and, on boiling, also with alkali carbonates. Hydrochloric acid causes a white precipitate of calomel, and potassium iodide separates a greenish-yellow iodide. *Mercuric* salts yield with potassium or sodium hydroxide, if added in insufficient quantity, brown-red, and if added in excess yellow, precipitates—with ammonia and ammonium carbonate white, and with potassium or sodium carbonate red-brown, precipitates. Hydrochloric acid does not disturb the solutions; potassium iodide causes a scarlet-red precipitate, which is soluble in an excess of either solution. All compounds of mercury are either volatilized or decomposed by heat. The vapor density of mercury shows that the molecule is identical with the atom—*i. e.*, the molecular and atomic weights are the same.

Amalgams.—The alloys which mercury forms with other metals are called *amalgams.* They are generally obtained without difficulty simply by bringing mercury in contact with the metals. Amalgams of sodium, ammonium, silver, and gold are among those of chief interest. Amalgams vary in consistency according to the amount of mercury present. Several varieties of amalgams are employed in dentistry, containing gold, tin and silver, tin and cadmium, gold and copper, gold and tin, tin and silver.

Tests.—The purity of mercury is ascertained from its behavior and properties as described above. When mercury is agitated for a few minutes with the official solution of ferric chloride, which is free from ferrous chloride, the liquid should afterward not yield a blue precipitate on the addition of potassium ferricyanide, which would result through the solution of a foreign metal and the reduction of some ferric to ferrous chloride; nor should the liquid, after being acidulated with hydrochloric acid if necessary, yield more than a mere trace of a colored precipitate on the addition of hydrogen sulphide. Hager's test for distinguishing the purified from crude mercury has been adopted by the U. S. P., as follows: On boiling 5 Gm. of distilled water with 5 Gm. of mercury, and 4.5 Gm. (1.5 Gm., Hager) of sodium thiosulphate, in a test-tube for about 1 minute, the mercury should not lose its luster, and should not acquire more than a slightly yellowish shade (absence of more than slight traces of foreign metals).

Commercial.—The importation of mercury from Spain and Austria has gradually fallen off until at present the production of the American mines is more than sufficient for our needs. This country produced 2,224,540 pounds of mercury in 1897, the world's production for the same year being 8,550,000 pounds. The exported mercury goes principally to China, Chili, Peru, and Mexico.

Action and Uses.—Metallic mercury produces when rapidly absorbed a chain of symptoms which is very characteristic. The most notable of these is salivation, or ptyalism, and associated with this are great fetor of the breath, swelling of the mucous membrane of the mouth, and general wretchedness, with more or less intestinal disturbance. If the drug is continued, wasting of the mamma or of the testicles is said to occur, and the condition of the patient is one of greatly diminished vitality. When the drug is absorbed gradually over a long period of time, as in artisans handling it or inhaling its fumes, it is apt to cause neuritis and symptoms of paralysis agitans or chorea.

When one of the soluble salts of mercury, of which the bichloride is probably the most notable, is taken in excess, it usually acts as a more or less active gastro-intestinal irritant, death ensuing rapidly when these salts are taken, because of the intense gastro-enteritis produced. The antidote to the bichloride and the biniodide is white of egg, to form an insoluble albuminate of mercury.

When mercury is given in medicinal doses, it acts in the body as an alterative—that is, as a substance which influences the nutrition of the tissues. How it does this is not known. All medicinal preparations of mercury capable of being taken internally are regarded as being possessed of specific curative influence in syphilis. Locally applied, certain medicinal preparations have a most favorable effect on external syphilitic lesions in many instances. How mercury does good in syphilis is not known, and will not be till the cause of syphilis is discovered.

Practically all the preparations of mercury increase the flow of bile in the stools, but whether they do this by stimulating the liver to an increased secretion of this fluid or by causing the gall-bladder to expel it in excess, is not known. That they do cause bile to appear in the stools is a well-known fact, although experimental studies indicate that

even calomel does not act as a cholagogue. Some mercurial drugs affect the liver much more than others (see MASSA HYDRARGYRI and HYDRARGYRI CHLORIDUM MITE).

At one time the various preparations of mercury were largely used with the idea that they possessed distinct antiphlogistic effects in inflammations of serous membranes, such as meningitis, peritonitis, pericarditis, etc. This practice has largely gone out of favor.

For the disinfectant and antiseptic properties of mercury, see HYDRARGYRI CHLORIDUM CORROSIVUM.

COMPOUNDS OF MERCURY.

Hydrargyri Acetas. *Mercurous acetate*, E.; *Mercuroacetat*, G. CH_3COOHg.—White, satiny, scaly crystals soluble in 330 parts of water, insoluble in alcohol and ether. It is decomposed when boiled with water, and by exposure to light, into mercury and mercuric acetate. It should be kept dry and away from the light. It is used as a wash (1 in 500–300) in skin diseases, or in ointment (1 in 20–10). It is given internally in pills in from $\frac{1}{6}$ to 1 grain (0.01–0.05 Gm.), for syphilis.

Mercuric Acetate. $(CH_3COO)_2Hg$.—Colorless, glistening plates, soluble in 4 parts of water, also in alcohol and ether. The aqueous solution gradually gives off acetic acid, and the surface becomes yellow by the formation of a basic acetate. It is used as a wash (1 in 300) for freckles, and internally as an antisyphilitic in doses of from $\frac{1}{6}$ to 1 grain (0.01–0.06 Gm.), 2 or 3 times daily.

Hydrargyri Albuminas. *Mercuric albuminate*, E.; *Quecksilberalbuminat*, G.—The composition of this body is not constant. It is obtained by adding 4 per cent. mercuric chloride solution to a solution of dried egg albumin (1 in 8) and heating. The albumin is kept in excess, so that the filtrate still gives a precipitate with the mercuric chloride solution. After 48 hours the moist precipitate is rendered dry by mixing with milk-sugar, which, after thorough drying in a desiccator over sulphuric acid, is diluted with milk-sugar until the mercury present corresponds to 0.4 per cent. of mercuric chloride. Blood-serum, sodium chloride, or potassium iodide, separates mercuric chloride from the albuminate. It is used as an antiseptic powder in surgery.

Hydrargyri Amidopropionas. *Mercuric amidopropionate* or *alanate*, *Alanin-mercury*, E.; *Alanin-Quecksilber*, G. $(CH_3CH.NH_2.CO_2)_2Hg$.—Obtained by dissolving mercuric oxide in amidopropionic acid and crystallizing in the usual way. It forms colorless needles, soluble in 3 parts of water. It was one of the first organic mercury compounds to be used therapeutically which does not precipitate albumin. It was used in 0.5 per cent. aqueous solution for subcutaneous injection in syphilis in place of corrosive sublimate.

Hydrargyri Amidosuccinamas. *Mercuric amidosuccinamate*, *Asparagin-mercury*, E.; *Asparagin-Quecksilber*, G. $Hg(C_4H_7N_2O_3)_3$.—Obtained by dissolving mercuric oxide in a warm solution of asparagin, and crystallizing. Colorless needles, soluble in water, used subcutaneously in syphilis in 1 per cent. solution.

Hydrargyri Benzoas. *Mercuric benzoate*, E.; *Mercuri-benzoat*, G.; *Benzoate mercurique*, Fr. $(C_6H_5COO)_2Hg$.—Prepared in the same manner as MERCURIC SALICYLATE (which see), by digesting the oxide from 27 parts of mercuric chloride with 22–23 parts of benzoic acid and 2000 parts of water. The benzoate is recrystallized from much hot water and dried at 50° C. (122° F.). It consists of colorless, glistening, inodorous needles, slightly soluble in water, but easily soluble in a solution of sodium chloride. It gives a precipitate with albumin, which, however, is soluble in sodium chloride solution. The salt contains 45.2 per cent. of mercury. It is used for injections in syphilis, 3 parts of the benzoate, 1 part of sodium chloride to 400 parts of water; and for urethral injections, 0.1 per cent. solution with an equal quantity of sodium chloride may be used.

Hydrargyri Bromidum Corrosivum. *Mercuric bromide*, E.; *Bromide de mercure*, Fr.; *Quecksilberperbromid*, *Mercuribromid*, G. $HgBr_2$.—Obtained by shaking together 10 parts of mercury, 8.5 parts of bromine, and 120 parts of water, and crystallizing the product from hot water. It is a white crystalline powder, less soluble in water, alcohol, or ether than the chloride. It is soluble in 10 parts of hot or 80 parts of cold water. It is employed as is the corrosive chloride, but much more seldom.

Hydrargyri Bromidum Mite. *Mercurous bromide*, E.; *Bromure de mercure*, Fr.; *Quecksilberbromür*, *Mercurobromid*, G. HgBr.—Obtained by precipitation of mercurous nitrate with potassium bromide, or by subliming a mixture of mercury and mercuric bromide—the procedure being exactly as in the case of calomel. It is very like calomel in its physical and chemical properties. It is given comparatively seldom, under the same indications and dose as calomel.

Hydrargyri Carbolas s. Phenas. *Hydrargyrum carbolicum s. phenylicum s. phenolicum*; *Mercuric carbolate*, *phenolate*, or *phenylate*, E.; *Neutrales Quecksilberphenolat*, *Diphenol-Quecksilber*, G. $(C_6H_5O)_2Hg$.—Two preparations occur under this name, *Gamberini's* basic mercuric phenate, $(C_6H_5O)HgOH$, and *Merck's* normal mercuric phenate or mercuric diphenate,

$Hg(OC_6H_5)_2$; the latter is a stable combination, and should be dispensed whenever mercuric phenate is prescribed. It is prepared by dissolving 188 parts of liquefied carbolic acid and 56 parts of potassium hydroxide in just sufficient alcohol with the aid of heat, and adding to this under constant stirring an alcoholic solution of 135 parts of mercuric chloride: a yellowish-colored precipitate is formed, which becomes almost colorless as the mass is evaporated to dryness. After washing with hot water slightly acidulated with acetic acid the salt is crystallized from hot alcohol. It is usually given in pill-form to adults in doses of from $\frac{1}{3}$ to $\frac{1}{2}$ grain (0.02–0.03 Gm.), twice daily.

Hydrargyri Chloridi Carbamidum. *Hydrargyrum bichloratum carbamidatum solutum, Solution of mercuric chloride-urea.*—This was introduced for hypodermic use by Schutz and Doutrelepont. As the solution readily changes, it should be prepared extemporaneously as follows: 1 Gm. of mercuric chloride is dissolved in 100 Cc. of hot water, and when cold 5 Gm. of urea are added and the liquid filtered. The daily dose is 15 minims (1 Cc.), corresponding to $\frac{1}{6}$ grain (0.01 Gm.) of mercuric chloride.

Hydrargyri Formamidum. *Hydrargyrum formamidatum solutum. Solution of mercuric formamide,* E.; *Quecksilberformamidlösung,* G.—Solution of mercuric formamide, $(HCONH)_2Hg$, was first introduced by Liebreich for hypodermic use in the treatment of syphilis, in daily doses of 16 minims (1 Cc.), which corresponds to about $\frac{1}{6}$ grain (0.01 Gm.) of mercuric chloride. It is prepared by dissolving the freshly precipitated oxide obtained from 10 Gm. of mercuric chloride in a sufficient quantity of formamide and adding sufficient distilled water to bring the volume up to 1000 Cc. The solution does not precipitate albumin; when boiled with acids or alkalies, or exposed to light, metallic mercury is precipitated.

Hydrargyri Gallas. *Mercuric gallate,* E.; *Mercurigallat,* G. $[C_6H_2(OH)_3CO_2]Hg$.—Equivalent quantities of gallic acid and moist precipitated mercuric oxide are rubbed together and dried in the dark in a sulphuric acid desiccator. It is a greenish or blackish powder, containing, besides the gallate, oxidation-products of gallic acid, mercuric oxide, and reduced mercury, insoluble in ordinary solvents. It is used as an antisyphilitic in place of the less stable tannate, in doses of from $\frac{1}{2}$ to 1 grain (0.03–0.06 Gm.), daily.

Hydrargyri Iodas. *Mercuric iodate,* E.; *Mercurijodat,* G. $Hg(IO_3)_2$.—Obtained by digesting moist precipitated mercuric oxide with a solution of iodic acid on a water-bath, and washing and drying the salt. It is insoluble in water, but soluble in a solution of sodium chloride or potassium iodide. It is used as an antisyphilitic injection, for which 1.2 parts of the salt and 0.8 part of potassium iodide are dissolved in 100 parts of water. Salivation or other unfavorable effects are said not to be produced by it. Dose, $\frac{1}{6}$ grain (0.01 Gm.).

Hydrargyri Naphtolas. *Mercuric naphtolate, Naphtol-Quecksilber.* $(C_{10}H_7O)_2Hg$.—Obtained by precipitating a solution of mercuric nitrate by a solution of sodium beta-naphtolate. It is a yellowish-white, odorless powder, soluble in caustic alkali but not in a solution of sodium chloride. It is used for injections, like the salicylate, in the dose of from $\frac{1}{6}$ to $\frac{1}{3}$ grain (0.01–0.02 Gm.).

Mercuric naphtol-acetate, $(C_{10}H_7O)C_2H_3O_2.Hg$, is a double salt which crystallizes out when the naphtolate is dissolved in excess of mercuric acetate. The colorless needles, soluble in alcohol, ether, and chloroform, are used for the same purposes as the naphtolate.

Hydrargyri Nitras. *Mercurous and Mercuric nitrate,* E.; *Azotate mercureux et Azotate mercurique,* Fr.; *Mercuronitrat und Mercurinitrat,* G. $HgNO_3.H_2O$ and $Hg(NO_3)_2.H_2O$.—Mercurous nitrate is obtained by the action of cold nitric acid of about 25 per cent. on an excess of mercury. The crystals which form on the mercury are dissolved by warming, and the solution is then poured off and allowed to crystallize in a cool place. It forms colorless or slightly yellow prismatic crystals, having an acid reaction and a metallic taste, and soluble in an equal quantity of warm water, preferably with addition of a few drops of nitric acid. It is decomposed by a large volume of water into a soluble acid nitrate and an insoluble yellow basic nitrate, the composition of which varies with the bulk and temperature of the water. Caustic alkalies decompose it, giving a dark precipitate of mercurous oxide, Hg_2O. Ammonia water gives a dark precipitate consisting of mercury and a compound of the formula $(NH_2HgNO_3)_2HgO$. The presence of basic salt gives to mercurous nitrate a yellow tint. A solution of the salt may be kept free from mercuric nitrate by adding metallic mercury to the solution. The dry salt should be kept in small well-stoppered bottles. Mercuric nitrate is usually employed in solution, and may be prepared by dissolving 1 part of mercuric oxide in 2.5 parts of nitric acid of about 25 per cent.; crystals can be obtained by evaporating the solution over sulphuric acid. The salt is stable only in the presence of acid (nitric). Water alone decomposes it, forming an insoluble basic salt. Mercuric nitrate may also be obtained by dissolving mercury in excess of nitric acid. (See LIQUOR HYDRARGYRI NITRATIS and UNGUENTUM HYDRARGYRI NITRATIS.)

Hydrargyri Paraphenolsulphonas. *Mercuric paraphenolsulphonate,* E.; *para-Phenolsulfosaures Quecksilber,* G. *Hydrargyrol.*—Obtained by dissolving yellow mercuric oxide in a solution of p-phenolsulphonic acid and evaporating to dryness. It occurs in brownish scales, with an odor like ginger-cake, insoluble in absolute alcohol, decomposed by dilute alcohol or acetic acid, soluble in water, forming a red solution in which neither mercury nor phenol

responds to the usual tests. The aqueous solution does not precipitate albumin, but alkaloids, and does not attack iron and nickel, nor is it corrosive. A 0.4 per cent. solution is said to be a thorough sterilizer, especially when hot. It is far less poisonous than corrosive sublimate.

Asterol is a combination of the above salt with ammonium tartrate. It is a nearly white powder, slowly soluble in cold, more readily in hot water, with an acid reaction and contains 14 per cent. of mercury. It is intended to displace corrosive sublimate as an antiseptic, since it does not precipitate albumin, does not act on iron, and is less poisonous than sublimate although accomplishing the same results as an antiseptic. It is used in 0.2–0.4 per cent. solution.

Hydrargyri Peptonas. *Hydrargyrum peptonatum solutum. Solution of mercuric peptonate.*—The mercury compound is first obtained by mixing a solution of 1 Gm. of mercuric chloride in 20 Cc. of water with a solution of 3 Gm. of dry peptone in 10 Cc. of water; after the lapse of an hour the precipitate is collected on a filter, drained, and added to a solution of 3 Gm. of sodium chloride in 47 Cc. of water; solution is effected by agitation and sufficient water then added to bring the final volume up to 100 Cc. The solution should only be used when clear and free from sediment; the daily dose hypodermically for syphilis is 1 Cc., corresponding to $\frac{1}{6}$ grain (0.01 Gm.) of mercuric chloride.

Hydrargyri Pyroboras. *Mercuric pyroborate or borate*, E.; *Borate de mercure*, Fr.; *Mercuriborat*, G. HgB_4O_7.—Obtained by pouring a solution of borax into one of mercuric chloride, while stirring. It is an amorphous brown powder, insoluble in water or alcohol, soluble in hydrochloric or nitric acid, and contains 56.2 per cent. of mercury. It is used in ointment or as dusting-powder on moist wounds.

Hydrargyri Sozoiodolas. *Mercuric sozoiodolate*, E.; *Sozoiodol-Quecksilber*, G. $C_6H_2I_2O.SO_3.Hg$.—Obtained by mixing solutions of mercuric nitrate and sodium sozoiodolate (di-iodo-paraphenolsulphonate) as a fine yellow powder, soluble in 500 parts of water, and easily soluble in sodium chloride solution. A 10 per cent. solution is caustic. The salt is employed chiefly in syphilis: dose for subcutaneous injection, 1 grain (0.06 Gm.); for local application, 1–2 per cent. ointment, or in dry powder, or wash.

Hydrargyri Subsulphas Flavus (U. S. 1890). *Hydrargyrum sulphuricum basicum. Yellow mercuric sulphate, Basic mercuric sulphate, Turpeth mineral*, E.; *Soussulfate mercurique*, Fr.; *Mercurisubsulfat, Mineralischer Turpeth*, G. $HgSO_4.2HgO$.—This preparation, which is very rarely used, is made by adding in small portions finely powdered mercury sulphate obtained from 100 Gm. of mercury to 2000 Cc. of boiling water while constantly stirring, and continuing the boiling for 10 minutes after all has been added. The precipitate is filtered and thoroughly washed with warm water and dried at moderate temperature. On adding the normal sulphate to boiling water it is converted into basic sulphate, while an acid sulphate remains in solution. The result varies somewhat, depending upon the amount and the temperature of the water. Using boiling water in the above proportions, the yield will be about 75 per cent. of the weight of the dry mercuric sulphate used. The same compound is also formed by slowly pouring a solution of mercuric nitrate into an excess of a boiling solution of sodium sulphate. Yellow mercuric subsulphate is a heavy, bright lemon-yellow powder, which has the specific gravity 6.44, is permanent in the air, inodorous, has a slight metallic taste, on heating becomes red, and yellow again on cooling; at a red heat it is completely volatilized. It is insoluble in alcohol and ether, requires 2000 parts of cold and 600 parts of boiling water for solution, is decomposed by potassium hydroxide solution, yellow mercuric oxide being formed, and dissolves completely in sulphuric, nitric, or hydrochloric acid, the latter solution, according to Mohr, containing corrosive sublimate and free sulphuric acid. The salt should be soluble in 10 parts of hydrochloric acid without residue (absence of mercurous salt or of lead). The presence of nitrate is detected by sulphuric acid and ferrous sulphate in the same manner as stated for red mercuric oxide. Non-volatile impurities are left behind on heating to bright redness. Turpeth mineral is a powerful emetic, alterative, and in large dose corrosive poison. In poisonous dose it produces the same symptoms as corrosive sublimate (see HYDRARGYRI CHLORIDUM CORROSIVUM). This remedy was formerly employed in the treatment of croup, but at the present time has largely fallen into disuse. The dose for a child 2 years old is from 2 to 4 grains (0.10–0.25 Gm.).

Hydrargyri Sulphas. *Hydrargyrum sulphuricum. Mercuric sulphate, Normal mercuric sulphate*, E.; *Sulfate mercurique*, Fr.; *Mercurisulfat*, G. $HgSO_4$.—This salt is prepared by heating on a sand-bath until reddish vapors cease to be given off, 18 parts of mercury, 10 parts of concentrated sulphuric acid, 3 parts of water, and 4 parts of nitric acid of about 25 per cent., in a flask. The contents are then dried on a sand-bath in a porcelain dish while constantly stirring. It is a heavy white crystalline powder which, on being mixed with a small quantity of water, is at first colored yellow, but after some time is converted into colorless shining prisms or silvery scales of the hydrated salt $HgSO_4.H_2O$. A larger quantity of water decomposes it permanently into yellow basic sulphate. When heated to redness it is decomposed into mercury, oxygen, sulphurous acid, and mercurous sulphate, and is finally completely volatilized. It is employed for the preparation of turpeth mineral, corrosive sublimate, and calomel. It is not used in medicine.

Hydrargyri Sulphidum Nigrum s. Æthiops Mineralis. *Black sulphide of mercury*, E.; *Sulfure noir de Mercure*, Fr.; *Quecksilbermohr, Schwarzes Schwefelquecksilber*, G.—This preparation is no longer official in any of the pharmacopœias. It was made by triturating equal weights of mercury and sulphur until all metallic globules disappeared. It forms a fine black and heavy powder, which, when viewed with a lens, does not show any globules of uncombined mercury. Heated in a test-tube, it yields a red sublimate of vermilion. Ethiops mineral is a mixture of black amorphous mercuric sulphide, HgS, with a large excess of sulphur. Triturated with an equal weight of antimony sulphide, *æthiops antimonialis* is obtained. Pure black mercuric sulphide, HgS, is obtained by the action of hydrogen sulphide on mercuric salts.

Hydrargyri Sulphidum Rubrum. *Red mercuric sulphide, Cinnabar, Vermilion, Paris red*, E.; *Sulfure rouge de mercure*, Fr.; *Quecksilbersulfid, Zinnober*, G. HgS.—Cinnabar occurs in nature, and is the sole ore from which mercury is prepared. It is identical in composition with the black sulphide obtained by hydrogen sulphide, and occurs in crystalline or amorphous masses. Vermilion is manufactured on the large scale by subliming an appropriate mixture of mercury and sulphur. If the black mass obtained in the first part of this process is digested with solution of potassium hydroxide and potassium sulphide at a temperature of about 45° C. (113° F.), it will be gradually converted into vermilion. This is also produced by digesting white precipitate with a solution of sulphur in ammonium sulphide or of sodium thiosulphate. Sublimed mercuric sulphide forms brilliant dark-red crystalline masses having a fibrous fracture; after levigation it is seen in commerce in the form of a bright scarlet-red, fine, inodorous, and tasteless powder. It has the specific gravity 8.12, acquires a darker color on exposure to sunlight, but remains unaltered in the dark. When heated to above 250° C. (482° F.) it becomes brown, then black, and finally volatilizes, and assumes a red color again on cooling; heated in contact with the air, it burns with a blue flame, emitting the odor of sulphur dioxide. It is insoluble in water, alcohol, ether, hydrochloric or nitric or diluted sulphuric acid, cold concentrated sulphuric acid, or diluted alkaline solutions. Nitromuriatic acid dissolves it without heat, with the separation of sulphur and the production of sulphuric acid and mercuric chloride. It dissolves in boiling sulphuric acid, forming mercuric sulphate and separating sulphur; also in alkali sulphides containing potassa or soda. Metallic mercury is separated by heating vermilion with soda to redness; by boiling with water and iron or zinc; by zinc and warm diluted sulphuric acid, etc. Its complete volatility by heat insures the absence of red lead and basic lead chromate (American vermilion); and when it is treated with warm solution of potassium hydroxide the colorless solution, on being acidulated, should not yield a yellow or orange precipitate (absence of arsenic or antimony), nor should it produce a colored precipitate with lead acetate (absence of chromates, iodides, or other sulphides). If agitated with warm diluted nitric acid, it should not turn brown (absence of red lead), nor should the filtrate be colored or become dark-colored on the addition of hydrogen sulphide (lead) or of ammonia and ammonium sulphide (iron). Vermilion is seldom used in medicine, and then only by fumigation, the powder being thrown upon hot coals or iron. Vapors of mercury and sulphur dioxide are formed, the latter being very irritating and objectionable. This preparation is occasionally employed by fumigation. Because of the fact that sulphurous acid is present in the fumes, the irritating effect renders it an objectionable preparation.

Hydrargyri Tannas. *Hydrargyrum tannicum oxydulatum. Mercurous tannate*, E.; *Tannate de mercure*, Fr.; *Quecksilbertannat*, G.—Obtained by rubbing finely ground mercurous nitrate 50 parts, with 30 parts of tannin in 50 parts of water, until a uniform pasty mass is obtained, which is then rubbed up with 4–5 liters of water. The precipitate is filtered, washed with cold water, and dried at 30°–40° C. (86°–104° F.). It forms brown-green scales, odorless and tasteless, losing some tannic acid to water or alcohol. It contains about 43 per cent. of mercury. It is used in syphilis in pills, in the dose of from 1 to 2 grains (0.06–0.12 Gm.), 3 times a day.

Hydrargyri Thymolacetas. *Mercuric thymolacetate*, E.; *Thymolquecksilberacetat*, G.—Obtained by adding a warm alkaline thymol solution to a warm solution of mercuric acetate as long as the precipitate formed redissolves on shaking. The crystals formed on cooling are recrystallized from dilute sodium hydroxide. The salt is colorless, crystalline, difficultly soluble in water and alcohol, and contains 55 per cent. of mercury. Easily soluble in dilute alkalies, from which acids precipitate it unchanged. It is used by injection in syphilis, suspended in paraffin oil, in the dose of $\frac{1}{2}$ grain (0.01 Gm.), once a week.

Hydrargyrum Colloidale. *Colloidal mercury*, E.; *Colloïdales Quecksilber*, G. *Hyrgol.*—This is obtained by mixing very dilute solutions of stannous and mercurous nitrates containing a small quantity of nitric acid, salting out the colloidal mercury by adding a concentrated solution of ammonium citrate, and finally neutralizing with ammonia water. It occurs in dull-black porous pieces, forming a dark, neutral, non-corrosive solution with water, which turns silver-gray on heating as well as by addition of alkali or certain acids. Rubbed in a mortar it forms globules of mercury; hence if it is to be used in an ointment, it should be rubbed first with water.

According to Höhnel, colloidal mercury contains only 73–80 per cent. of mercury, the rest being tin salts, ammonium salts, nitric and citric acids in combination.

HYDRARGYRUM AMMONIATUM, *U. S., Br.*—Ammoniated Mercury.

Hydrargyrum præcipitatum album, P. G.; *Hydrargyrum amidato-bichloratum (ammoniato-muriaticum)*, *Hydrargyri ammonio-chloridum*, *Mercurius præcipitatus albus*.—*White precipitate*, *Mercuric ammonium chloride*, E.; *Chloramidure de mercure*, *Oxychlorure ammoniacal de mercure*, *Lait mercuriel*, *Mercure précipité blanc*, Fr.; *Weisser Quecksilberpräcipitat*, *Quecksilber-Chloridamid*, G.

Formula, NH_2HgCl. Molecular weight, 249.61.

It should contain not less than 78 per cent. nor more than 80 per cent. of metallic mercury.—U. S.

Preparation.—Corrosive mercuric chloride, 100 Gm.; ammonia water, distilled water, of each a sufficient quantity. Dissolve the corrosive mercuric chloride in 2000 Cc. of warm distilled water; filter the solution, and allow it to cool. Pour the filtrate gradually, while constantly stirring, into 150 Cc. of ammonia water, taking care that the latter shall remain in slight excess. Collect the precipitate upon a filter, and when the liquid has drained from it as much as possible wash it twice with a mixture of 400 Cc. of distilled water and 20 Cc. of ammonia water. Finally, dry the precipitate between sheets of bibulous paper in a dark place, at a temperature not exceeding 30° C. (86 F.). Keep in well-stoppered bottles, protected from light.—U. S.

The process of the German Pharmacopœia is in all respects identical with the foregoing, except that the washing of the precipitate is accomplished with distilled water instead of diluted ammonia. The process of the British Pharmacopœia is like the last, but a somewhat smaller quantity of ammonia is directed, and the precipitate is dried at a temperature not exceeding 100° C. (212° F.). The French Codex no longer recognizes this preparation; it should, however, be remembered that the *précipité blanc* of French pharmacy is *calomel* prepared by precipitation (see page 771).

The change in the above process consists in a replacement of half the chlorine in corrosive sublimate by the ammonia residue NH_2, known as the *amido* group, the remaining hydrogen atom forming hydrochloric acid with the displaced chlorine; thus, $HgCl_2 + NH_4OH = NH_2HgCl + HCl + H_2O$. The hydrochloric acid is neutralized by the excess of ammonia present. Another view of the constitution of the salt is that it is derived from ammonium chloride by replacement of two hydrogen atoms by a bivalent atom of mercury, as is suggested by the name mercuric ammonium chloride. The ammonium chloride formed in the preparation of the salt must be washed out, for which purpose the Pharmacopœia very properly uses a very dilute ammonia to prevent decomposition. If water be used, it should be cold, and the washing should not be continued too long, to prevent the precipitate from acquiring a yellowish tint in consequence of the formation of oxydimercur-ammonium chloride, $NH_2HgCl.HgO$. The above formula yields nearly 93 Gm. of ammoniated mercury.

Properties.—Ammoniated mercury is a white, amorphous, inodorous powder, or is often in friable masses, permanent in the air and having an earthy, afterward metallic taste. It is insoluble in ether, alcohol, and ammonia water; but is slowly decomposed by cold water, and yields with boiling water a lemon-yellow basic compound, $NH_2HgCl.HgO$, ammonium chloride being dissolved. When rapidly heated, it turns yellow, and above 360° C. (680° F.) is decomposed and completely volatilized without fusion, yielding nitrogen, ammonia, and calomel; when slowly heated, intermediate compounds are first formed. It is completely soluble in a cold solution of sodium thiosulphate, with evolution of ammonia; on digesting this solution for a short time it separates red mercuric sulphide, or vermilion, which on protracted boiling turns black.

Ammoniated mercury is decomposed by potassium hydroxide solution or lime water, ammonia being evolved and a yellow compound separated. It is soluble in hot solutions of ammonium salts and in hydrochloric as well as in nitric and acetic acids; these solutions yield white precipitates with potassium hydroxide (ammoniated mercury) and silver nitrate (silver chloride). When ammoniated mercury is triturated with iodine the mixture will after some time puff up, from the spontaneous decomposition of nitrogen iodide or iodamine formed in it, but in the presence of alcohol the decomposition takes place suddenly and with violent explosion.

Tests.—Ammoniated mercury should dissolve in hydrochloric acid without effervescence (absence of carbonate) and without residue (absence of mercurous salt, calcium sulphate, starch, etc.). 0.5 Gm., dissolved in 2 Cc. of hydrochloric acid and 25 Cc. of

water, should not respond to the tests for foreign salts, metals, or arsenic given under HYDRARGYRI CHLORIDUM CORROSIVUM.

Fusible white precipitate, which was formerly considered to be identical with the preceding, until Wöhler and Kane proved its difference, was prepared by dissolving ammonium and mercuric chlorides in water and precipitating with sodium carbonate. Thus obtained, it has the composition $(NH_3)_2HgCl_2$, or perhaps $NH_4Cl.NH_2HgCl$, and differs from the official ammoniated mercury in fusing to a yellowish liquid when heated, evolving nitrogen and ammonia and yielding a transparent and an opaque white sublimate.

Action and Uses.—Internally this drug acts as an irritant poison. It is used in an ointment externally in pustular acne and some chronic skin diseases.

HYDRARGYRUM CUM CRETA, *U. S., Br.*—Mercury with Chalk.

Æthiops cretaceus.—Gray powder, E.; *Mercure avec la craie, Poudre de mercure crayeux*, Fr.; *Quecksilber mit Kreide*, G.

Preparation.—Mercury, 38 Gm.; clarified honey, 10 Gm.; prepared chalk, 57 Gm.; water, a sufficient quantity to make 100 Gm. Weigh the mercury and clarified honey successively into a strong vial of the capacity of 100 Cc., and add 2 Cc. of water. Cork the vial, and shake it for 15 to 30 minutes at a time, until the aggregate time of shaking reaches 10 hours or until globules of mercury are no longer visible under a lens magnifying 4 diameters. Rub the precipitated chalk to a stiff paste, in a mortar, with water, and, having added the contents of the vial, washing the last portions in with a little water, triturating the whole to a uniform mixture. Finally, dry the mixture between ample layers of bibulous paper, at the ordinary temperature, until it weighs 100 Gm. Then reduce it to a uniform powder, without trituration, and keep it in well-stoppered bottles, protected from light.—U. S.

Take of mercury, by weight, 1 ounce; prepared chalk, 2 ounces. Rub the mercury and chalk in a porcelain mortar until metallic globules cease to be visible to the naked eye and the mixture acquires a uniform gray color.—Br. P.

When certain substances are triturated with metallic mercury they acquire a gray tint, and the metallic luster of the mercury gradually disappears in consequence of its division (see HYDRARGYRUM). To effect this with chalk alone is a tedious operation. Dr. Squibb (1857) constructed an apparatus in which the mercury is shaken with honey or syrup, and when completely extinguished mixed with the chalk, most of the sugar being afterward washed out with cold water; this process yields a very pure product, but the globules are larger than in the products of the other processes, and the powder cannot be triturated with pressure without separating metallic globules. This plan of succession has been adopted by the pharmacopœia; it is probably better adapted for large manufacturers than the retail pharmacist.

In this state of fine division mercury is very prone to oxidation if exposed to air and light; hence the powder should be kept well protected from both. While traces of mercurous oxide cannot be entirely avoided, the presence of mercuric oxide should carefully be guarded against, and any change in color from gray to pink or reddish, indicating dangerous oxidation, renders the article unfit for use; neither should mercury with chalk be dispensed if the color has turned very dark-gray or blackish, as this shows excessive mercurous oxidation.

Properties and Tests.—Mercury with chalk is a gray, uniform, non-gritty, inodorous, and nearly tasteless powder, from which the mercury may be volatilized by heat. When treated with an excess of diluted acetic acid the chalk dissolves with effervescence, finely divided metallic mercury being left behind; the solution thus obtained should not become more than slightly opalescent on the addition of a few drops of hydrochloric acid (limit of mercurous oxide).—U. S. The presence of this oxide is disregarded by the British Pharmacopœia, which requires the preparation to be partly dissolved by dilute hydrochloric acid; any mercurous oxide present would be converted into calomel and remain with the finely divided, undissolved mercury; but it insists on the total absence of *mercuric oxide*, which is detected in the clear solution in hydrochloric acid by a white or gray precipitate with stannous chloride or by a black one with hydrogen sulphide. Arsenic may be detected in this solution in the same manner as in corrosive sublimate.

Action and Uses.—Mercury with chalk may be used for the same purpose as blue mass, but is much less active as a laxative and cholagogue. Indeed, in many instances

the constipating effect of the chalk prevents the mercury from moving the bowels at all. It is used in medicine chiefly in children with sluggish digestion, who also suffer from alternate attacks of constipation and fermentative diarrhœa. The dose for this purpose is usually from $\frac{1}{6}$ to $\frac{1}{2}$ grain (0.01–0.03 Gm.) every hour for 6 or 8 doses. Gray powder is also a useful mercurial for the purpose of treating infantile syphilis, as it does not irritate the stomach as do the preparations of mercury commonly used by adults suffering from this disease. In such cases it should, of course, be given continuously for a long time in doses varying from 1 to 5 grains (0.06–0.30 Gm.).

HYDRASTINA, *U. S.*—Hydrastine.

Hydrastine, Fr.; *Hydrastin*, G.

Formula, $C_{21}H_{21}NO_6$. Molecular weight, 380.32.

Hydrastine is the characteristic colorless alkaloid of *Hydrastis Canadensis*. It should be kept in well-stoppered bottles.—U. S.

The name hydrastine was first applied by Rafinesque in 1828 to the alkaloid now known as berberine, and was so continued by eclectic practitioners for many years. The eclectics were in the habit of using the hydrochloride of the alkaloid, which was known to them also as *muriate of hydrastine* and *neutral hydrastine*. At one time the terms *resinoid hydrastin* and *hydrastin, principles combined*, were applied to the precipitate obtained by pouring a concentrated alcoholic tincture of Hydrastis into cold water. This latter product is no longer on the market, but the terms *yellow hydrastine muriate* and *yellow hydrastine sulphate* are still used in some parts of the country, and invariably refer to the respective berberine salts. In 1850 A. B. Durand isolated the alkaloid now known as hydrastine (see *Am. Jour. Pharm.*, vol. xxiii. p. 13), but failed to obtain it free from yellow color, and it was first obtained white by J. D. Perrins, of England (*Pharm. Jour.*, May, 1862).

Preparation.—Hydrastine is prepared principally from the mother-liquors left after separation of the crystalline berberine sulphate, obtained by addition of a large excess of sulphuric acid to concentrated alcoholic or aqueous extracts of Hydrastis. The filtrate is treated with ammonia water and the resulting precipitate of crude hydrastine is purified by repeated solution and crystallization from alcohol or ethyl acetate. In case an alcoholic extract has been used, ammonia water is added until the liquid is nearly neutral, when the resulting deposit of ammonium sulphate is removed, the filtrate further concentrated and mixed with cold water to precipitate resinous and oily matter, and again filtered. Upon now adding an excess of ammonia water to the filtrate crude hydrastine is precipitated and then purified as stated above.

Properties.—Hydrastine occurs as colorless to white 4-sided prisms, which are odorless and quite tasteless, although the salts of hydrastine have a very bitter taste. It melts at 131° C. (267.8° F.) to a light amber-colored liquid, and is insoluble in petroleum ether. Hydrastine is almost insoluble in water at 25°C. (77° F.); soluble in 135 parts of alcohol, 124 parts of ether, and in 2 parts of chloroform at 25° C. (77° F.); soluble in 4000 parts of water at 80°C. (176° F.), and in 17 parts of alcohol at 60°C. (140°F.); easily soluble in benzene (U. S.). Hydrastine is lævorotatory, its specific rotation having been determined in chloroformic solution by F. B. Power as $[a]_D = -170°$ (*Proc. Am. Pharm. Assoc.*, 1884).

It dissolves in concentrated sulphuric acid with a faint-yellow color, changing to reddish purple on warming, or on the addition of manganese dioxide an orange-yellow color is developed which changes through cherry-red and carmine to a pale orange-yellow color. In sulphovanadic acid hydrastine dissolves with a rose-red tint, which fades slowly. Froehde's reagent produces a green color which gradually turns brown. Hydrastine mixed with 8 to 9 parts of morphine and dissolved in sulphuric acid produces a faint-yellow color, which after long standing develops into a purple, or if touched at once with a crystal of potassium dichromate (Lloyd) a play of colors is produced, of which the purple is the most conspicuous and quite permanent. In nitric acid hydrastine dissolves to an orange-colored solution, from which water precipitates an insoluble substance, while the supernatant liquid shows a strong blue fluorescence. A similar blue fluorescence is produced by chlorine in the aqueous solution of the hydrochloride (Mahla). A solution of hydrastine in dilute sulphuric acid instantly decolorizes potas-

sium permanganate solution, the liquid developing a deep-blue fluorescence (distinction from hydrastinine).

Hydrastine is precipitated amorphous from its aqueous solutions upon the addition of alkali hydroxides or carbonates, the precipitate gradually assuming a crystalline form. The salts of hydrastine yield precipitates with the alkaloidal reagents, platinic chloride producing an orange-yellow precipitate, gold chloride a yellowish-red precipitate, picric acid a yellow precipitate, potassium dichromate a yellow precipitate which instantly turns red when touched with sulphuric acid. Dilute solution of hydrastine added to a solution of iodine in potassium iodide yields a brown precipitate consisting of hydrastine hexa-iodide, which contains 60.40 per cent. of hydrastine (Prescott and Gordin, *Jour. Am. Chem. Soc.*, 21, pp. 732–741).

With oxidizing agents in acid solution hydrastine yields *hydrastinine* and *opianic* acid, while in alkaline solution hemipinic and narcotinic acids are produced.

The salts of hydrastine form more or less hygroscopic crystalline powders. They crystallize with difficulty. The hydrochloride and sulphate are preferred.

Action and Uses.—In toxic doses hydrastine increases reflex activity and produces muscular twitchings followed by tonic and clonic convulsions. At first there are a marked increase in the respiratory function, and a notable decrease followed by an increase in blood-pressure. Late in the poisoning there are decreased reflex activity, partial paralysis, and failure of respiration. Death usually results from respiratory paralysis, but may occur from cramp-asphyxia during a convulsion. This drug first stimulates and afterward depresses the motor side of the spinal cord. The sensory side of the cord, the motor and sensory nerves, and the muscles are also depressed after the administration of very full doses.

Hydrastine is usually employed for its local effect in the treatment of subacute and chronic inflammatory conditions of mucous membranes. It is especially useful in the form of an injection in treating gonorrhœa in males, vaginal gonorrhœa, leucorrhœa, and uterine catarrh. It may be employed internally in the treatment of gastro-intestinal catarrh and catarrhal jaundice, but is probably inferior to Hydrastis. The internal dose of pure hydrastine is from $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015–0.03 Gm.). The mixture of alkaloids termed impure hydrastine may be given in doses of from 3 to 10 grains (0.20–0.60 Gm.).

HYDRASTININÆ HYDROCHLORIDUM, *U. S.*—Hydrastinine Hydrochloride.

Hydrastininum hydrochloricum, P. G.; *Hydrastininhydrochlorid, Salzsaures Hydrastinin*, G.

Formula, $C_{11}H_{11}NO_2.HCl$. Molecular weight, 223.88.

The hydrochloride of an artificial alkaloid derived from hydrastine.

Preparation.—Schmidt and Wilhelm (1888) found that when hydrastine is treated with oxidizing agents in acid solution, hydrastinine and opianic acid are produced, the reaction being illustrated by the following equation: $C_{21}H_{21}NO_6$ (hydrastine) + O = $C_{11}H_{11}NO_2$ (hydrastinine) + $C_{10}H_{10}O_5$ (opianic acid). Dissolve 10 Gm. of hydrastine in 75 Cc. of nitric acid, specific gravity 1.20, and heat the solution to not over 60° C. (140° F.), until ammonia fails to produce a precipitate in a portion removed for testing. The solution is cooled and the opianic acid allowed to crystallize, after which the solution is filtered and the hydrastinine precipitated from the filtrate by adding an excess of potassium hydroxide solution. The precipitate is purified by recrystallization from benzene or acetic ether, and the crystals converted into the hydrochloride by dissolving them in concentrated hydrochloric acid and crystallization from alcohol.

Properties.—Hydrastinine hydrochloride forms light-yellow amorphous granules, or a pale-yellow crystalline deliquescent powder. It is odorless, and possesses a bitter, saline taste. It is very soluble in cold and hot water and in alcohol; soluble in 286 parts of chloroform and 1300 parts of ether at 25° C. (77° F.), U. S. When heated to 173° C. (343.4° F.) the salt undergoes partial fusion, but does not liquefy; on ignition it is wholly consumed. It fuses at 212° C. (413.6° F.), U. S., near 210° C. (410° F.), P. G. "The aqueous solution, especially when highly diluted, shows a blue fluorescence and is neutral to litmus-paper. On ignition it should be perfectly consumed. In an aqueous solution of the salt (1 in 20) bromine test-solution produces a yellow precipitate, which should be perfectly soluble in ammonia-water, forming an almost

colorless solution. In an aqueous solution of the salt, potassium dichromate test-solution produces a precipitate which redissolves if gently heated, but on cooling the solution it separates in glistening needles. If ammonia-water be added to an aqueous solution of hydrastinine hydrochloride (1 in 20), no turbidity should be produced. On slowly adding to a solution of 0.19 Gm. of the salt in 3 Cc. of water 4 to 5 drops of a solution of sodium hydroxide (1 in 7), each drop will cause a milky turbidity, which disappears again on shaking. From this solution, after standing for some time, pure white hydrastinine should separate, and the supernatant fluid should be almost colorless. With a crystal of the salt, sulphuric acid or nitric acid produces a deep-yellow color; sulphuric acid with a trace of nitric acid, a reddish-brown color; sulphuric acid with a crystal of ammonium vanadate, a light-brown color changing to dark brown."—U. S.

Action and Uses.—This artificial alkaloid is said to increase the force of the cardiac contractions, to decrease the rapidity of the heart's action by stimulating the vagus, and to increase blood-pressure by its action on the bloodvessels. It is a depressant to the motor side of the cord, causing complete paralysis when given in sufficient amount. It has been recommended for the control of uterine hemorrhages, and is said to be a very efficient oxytoxic. The dose hypodermically is from $\frac{1}{2}$ to 1 grain (0.03–0.05 Gm.).

HYDRASTIS, *U. S.*—Hydrastis.

Golden seal, Yellow root, Yellow puccoon, Orange-root, Indian dye, Indian turmeric, Yellow eye, Jaundice-root, E.; *Racine orange, Sceau d'or,* Fr.; *Canadische Gelbwurzel, Gelbes Blutkraut,* G.; *Rizoma di Idraste,* It.; *Raizamarilla sello de oro,* Sp.

The dried rhizome of *Hydrastis Canadensis* L. (*Warnera C.* Mill.—Fam. *Ranunculaceæ*), yielding, when assayed by the U. S. P. process, not less than 2.5 per cent. of hydrastine.

Hydrastis is official in most pharmacopœias, several of which refer to its yellowing the saliva when masticated.

Origin.—A low perennial of rich woodlands in the eastern United States, especially in the Ohio valley, and rapidly becoming scarcer. It bears above 2 roundish, heart-shaped, palmately lobed leaves, and a single greenish-white flower, consisting of 3 caducous petal-like sepals, numerous stamens, and about a dozen or more pistils, each becoming in fruit a scarlet 1- to 2-seeded berry. Lloyd has shown that the rhizome is much richer in alkaloid than the roots.

FIG. 219.

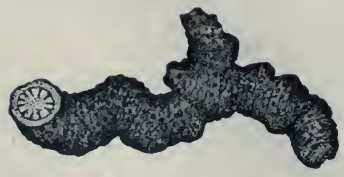


FIG. 220.

Hydrastis (Nat.).

FIG. 221.

Hydrastis (½ Nat.).

Description.—Of oblique growth, 2.5 to nearly 5 Cm. (1 to nearly 2 In.) long and 0.5 to 1 Cm. ($\frac{1}{5}$ to $\frac{2}{5}$ In.) thick, cylindraceous, usually with a few short branches, longitudinally wrinkled, but plump, somewhat annulate, externally brownish-gray, often with a yellow

tinge or yellowish patches; fracture short and sharp, waxy, golden-yellow or bright reddish yellow, with a thickish bark, about 10 short and narrow wood-wedges and broad medullary rays; roots, if present, rather coarse, brittle, with a thick bark and somewhat quadrangular wood; odor slight, characteristic; taste very bitter, but not disagreeable, producing a somewhat astringent effect.

The powder, except under chemical treatment, shows little that is characteristic. There should be no crystals present, and the starch-grains are almost invariably single, presenting a nearly circular outline, with indistinct rings and central hilum, and are mostly 5 to 10 mikrons in breadth.

As adulterants of Hydrastis, Cypripedium, Stylophorum, Serpentaria, Asarum, and various other rhizomes have been reported, but none of them, nor indeed any other article known to us, can be reasonably mistaken for it, in the entire condition. All others presenting a like bright-yellow color have a tough or splintery fracture and a distinct form. Several pharmacopœias specify that in a 1 per cent. infusion mixed with a half volume of sulphuric acid, and a few drops of chlorine water (or bromine water) poured upon it, a dark-red layer will be observed; also that small yellow crystals will separate a few hours after $\frac{1}{10}$ volume of nitric acid has been added to a 10 per cent. infusion. The most important adulteration is an undue amount of earthy matter, resulting from imperfect cleansing. This is indicated by an increase in the ash.

Constituents.—Besides fixed oil, starch, gum, sugar, yellow coloring-matter, etc., hydrastis yields 2 to 3 per cent. of the alkaloid hydrastine (see HYDRASTINA), 3 to 4 per cent. of berberine, and some canadine. The ash is about 5 per cent. Hydrastis probably contains also a volatile odorous principle, and at least one other alkaloid.

Berberine, $C_{20}H_{17}NO_4$, was first obtained by Hüttenschmid (1824) from the Jamaica cabbage tree (*Geoffroya inermis*), and named by him *jamaicine*. In 1828 it was found by Rafinesque in Hydrastis, and called hydrastine. It occurs in a number of other plants, such as Berberis (from which it takes its name), Xanthorriza, Coptis, etc., but according to H. M. Gordin is not present in Calumba, Pareira, Menispermum, and Jeffersonia, which were formerly supposed to contain the alkaloid. It may be obtained from hydrastis, or any other drug containing it, by boiling the same with water acidulated with acetic acid. The decoction is filtered, evaporated to a syrupy liquid, and mixed with 3 times its volume of diluted sulphuric acid (1 in 5). The resulting yellow needle-shaped crystals of berberine acid sulphate, $C_{20}H_{17}NO_4H_2SO_4$, are washed with cold water, dissolved in boiling water, and, after addition of alcohol and some sulphuric acid, again allowed to crystallize. From this purified salt the alkaloid may be liberated by treating a warm aqueous solution with baryta water in slight excess, filtering, passing carbon dioxide into the filtrate, again filtering, and concentrating the solution, which is then allowed to crystallize. Or a solution of berberine acid sulphate is mixed with acetone and then rendered alkaline by addition of sodium hydroxide solution, when berberine-acetone, $C_{20}H_{17}NO_4.C_3H_6O$, is formed, which separates in form of pale-yellow needles, and, being insoluble in water, may be freed from adhering impurities by washing with water. This berberine-acetone, when boiled with a mixture of alcohol and chloroform for 10 or 12 hours in a flask provided with a reflux condenser, yields pure berberine, which may be obtained by concentrating the solution and crystallizing, and afterward purifying by recrystallization from water. Berberine occurs in form of odorless, shining, yellowish-brown needles, having a neutral reaction and a bitter taste. If crystallized from water, it contains 6 molecules of water, of which 4 are lost if the crystals are heated to 100° C. (212° F.). It is readily soluble in boiling water or alcohol, but far less soluble in these liquids when cold, and is practically insoluble in ether, benzene, ethyl acetate, ligroin, carbon disulphide, and benzin. Berberine melts at about 140° C. (284° F.). Besides the berberine-acetone mentioned above, freshly precipitated berberine is capable of forming compounds with alcohol, chloroform, bromoform, and other bodies. When boiled with chloroform, berberine decomposes the same, forming berberine hydrochloride.

The salts of berberine are less soluble in water than the alkaloid, and may be obtained by adding the respective acid in excess to a hot aqueous solution of berberine and allowing the mixture to cool.

For estimating berberine in liquids containing much other matter, it is best to precipitate it as an insoluble hydroiodide, washing this thoroughly with weak potassium iodide solution and converting the salt into crystalline berberine-acetone. (For details of the process see *Proc. Am. Pharm. Assoc.*, 1901, pp. 238–245.)

Canadine (xanthopuccine), $C_{20}H_{21}NO_4$, which according to E. Schmidt is tetrahydroberberine, forms white acicular crystals or small white warty nodules, insoluble in water, and soluble in alcohol, ether, chloroform, and benzene. It melts at 132°–133° C. (269.6°–271.4° F.). The isolation of canadine free from color is a tedious operation, requiring

repeated precipitation. Exposed to light, canadine gradually becomes yellow, changing to berberine. The nitrate, hydrochloride, and hydrobromide are difficultly soluble in water, especially if an excess of acid be present. Canadine sulphate, however, is readily soluble in water. Upon heating canadine to 100° C. (212° F.) with alcoholic solution of iodine, it is converted into berberine hydroiodide.

Assay of Hydrastis.—The value of hydrastis lies in the amount of hydrastine present, and of this alkaloid the U. S. P. demands the presence of not less than 2.5 per cent. in the drug, which may be determined as follows: Into a 250 Cc. flask put 15 Gm. of hydrastis in No. 60 powder; add 150 Cc. of ether, shake the flask during 10 minutes, and add 5 Cc. of 10 per cent. ammonia water, shaking the flask frequently during a half hour. Then add 15 Cc. of distilled water and shake until the drug collects in masses, and at once carefully decant 100 Cc. of the ethereal fluid, representing 10 Gm. of the drug, into a measuring-cylinder and transfer the same to a separator, rinsing the cylinder with a little ether. To the contents of the separator add 20 Cc. of normal sulphuric acid, shake moderately, and allow the liquids to separate. Draw off the lower acid solution into another separator, and to the contents of the first separator add 5 Cc. more of normal acid and 5 Cc. of distilled water and shake. After complete separation, again draw off the lower liquid into the second separator. Wash the contents of the first separator with 5 Cc. of distilled water, and after separation draw this also off into the second separator. Introduce a small piece of red litmus paper into the second separator, add 25 Cc. of ether and an excess of ammonia-water, shake moderately for a few minutes and allow the liquids to separate, after which draw the lower aqueous fluid carefully into a clean separator, and pour the upper ethereal solution into a tared Erlenmeyer flask or beaker. Shake out the alkaline aqueous fluid twice more with ether, using 20 Cc. each time, and proceed as before, adding the ethereal solutions to the contents of the beaker or flask. Evaporate or distil off the ether carefully on a water-bath and dry the alkaloidal residue to constant weight at 100° C. (212° F.). The weight of dry residue found multiplied by 10 gives the percentage of hydrastine in the drug.

Pharmaceutical Preparations.—Fluidextract of Hydrastis, Glycerite of Hydrastis, Tincture of Hydrastis, U. S. P.

Action and Uses.—In medicinal amounts hydrastis has little effect upon the vital functions, but in large amounts is exceedingly poisonous. Its activity is largely due to the hydrastine which is present, and if this be injected into the circulation, an immediate fall of blood-pressure, followed afterward by a rise, occurs. This rise is probably due to contraction of the peripheral capillaries. Upon the nervous system it at first acts as an excitant, causing an increase in reflex activity, followed by muscular twitchings, tetanic convulsions, complete paralysis, and death from respiratory failure. In moderate amounts it is said to possess oxytoxic properties, producing contractions in the non-pregnant uterus and abortion in the pregnant uterus of lower animals. Hydrastis is quite largely employed in the treatment of depraved mucous membranes, as, for example, in chronic rhinitis, the atonic stomach of drunkards, chronic intestinal catarrh, catarrhal jaundice, vaginal leucorrhœa, and the later stages of gonorrhœa. It has been recommended also in the treatment of uterine hemorrhages resulting from endometritis, such as menorrhagia, and metrorrhagia, and is said to act well in those cases in which ergot has proved useless. The dose of the fluidextract is from 5 to 10 minims (0.30–0.60 Cc.); of the tincture, from ½ to 2 fluidrachms (2–8 Cc.). Pure hydrastine is employed in doses of from ¼ to ½ grain (0.015–0.03 Gm.). The impure variety of hydrastine containing berberine may be given in doses of from 3 to 10 grains (0.20–0.60 Gm.).

HYOSCINÆ HYDROBROMIDUM, *U. S., Br.*—Hyoscine Hydrobromide.

Scopolaminum Hydrobromicum, P. G.; *Hyoscinum Hydrobromicum.—Scopolamine hydrobromide*, E.; *Bromhydrate d'hyoscine*, Fr.; *Skopolaminhydrobromid, Hyoscinhydrobromid, Bromwasserstoffsaures Hyoscin*, G.

Formula, $C_{17}H_{21}NO_4.HBr + 3H_2O$. Molecular weight, 434.92.

The hydrobromide of an alkaloid identical with scopolamine, obtained from hyoscyamus and other plants of the *Solanaceæ*. It should be kept in well-stoppered, amber-colored vials.—U. S.

The name hyoscine was first applied by Ladenburg in 1880 to an alkaloid obtained by him from the mother-liquors remaining in the manufacture of hyoscyamine and having the composition $C_{17}H_{23}NO_3$. It was also found in the leaves of *Duboisia myoporoides* by the same investigator. Later, in 1890, E. Schmidt obtained from *Scopola Japonica* and *Scopola atropoides* an alkaloid having the composition $C_{17}H_{21}NO_4$, to which he gave the name scopolamine and which was later proved to be identical with hyoscine. Schmidt

also obtained this alkaloid from the root of *Belladonna*, the seed of *Stramonium*, and the leaves of *Duboisia*. Since the true composition of this alkaloid, as now recognized in all pharmacopœias, is associated with the name given it by Schmidt, it would seem but proper also to apply the name given by him, but this has been done only in the German Pharmacopœia, although the British gives scopolamine as a synonym, and the U. S. declares the two alkaloids to be identical. Commercially, the name hyoscine is better known than scopolamine.

Preparation.—Hyoscine or scopolamine hydrobromide is obtained chiefly from the seed of hyoscyamus and stramonium, either by neutralizing the mother-liquors remaining, after removal of hyoscyamine, with hydrobromic acid and adding absolute alcohol, when after the lapse of some time crystals of hyoscine hydrobromide will separate and may be purified by recrystallization from hot alcohol, or by neutralizing the mother-liquors with hydrochloric acid, diluting the solution with water, and then precipitating the alkaloid in the form of a double chloride by addition of gold chloride solution. By recrystallization the double chloride of alkaloid and gold is finally obtained pure, having a constant melting-point of 198° to 199° C., from which, by treatment with hydrogen sulphide, the gold may be removed and the alkaloid, after subsequent liberation by means of potassium carbonate, be shaken out with chloroform and obtained in the form of a tough, syrupy residue by evaporation of the solvent. It is then dissolved in ether and allowed to crystallize. The crystals or the syrupy residue mentioned above are dissolved in sufficient diluted hydrobromic acid to produce a neutral solution, from which, by slow evaporation, crystals of hyoscine hydrobromide are obtained.

Properties and Tests.—"Colorless, transparent, rhombic crystals, sometimes of large size, odorless, having an acrid, slightly bitter taste; slightly efflorescent in dry air. Soluble in 1.5 parts of water, in 16 parts of alcohol, and in 750 parts of chloroform at 25° C. (77° F.); soluble in 1.33 parts of alcohol at 60° C. (140° F.); insoluble in ether. Hyoscine hydrobromide, when heated, softens at about 100° C. (212° F.); it first melts and then loses its water of crystallization at 110° C. (230° F.). If dried over sulphuric acid until its water of crystallization is lost, it then melts at 179.7° C. (355.5° F.). When ignited it leaves no residue. Hyoscine chloraurate crystallizes in yellow prisms and melts at 197° C. (386.6° F.). Hyoscyamine chloraurate crystallizes in yellow leaflets and melts at 160° C. (320° F.). Atropine chloraurate crystallizes in dull yellow grains and melts at 136° C. (276.8° F.).) Its aqueous solution shows a slightly acid reaction to blue litmus-paper. If 2 Cc. of chloroform be shaken with 1 Cc. of a solution of hyoscine hydrobromide (1 in 10), to which a few drops of chlorine water have been cautiously added, it should assume a brownish color. If 0.01 Gm. of the salt be added to 5 drops of nitric acid and evaporated to dryness in a porcelain dish, it should yield a violet color upon the addition of alcoholic potassium hydroxide test-solution. Silver nitrate test-solution, when added to solutions of the salt, affords a yellowish-white precipitate insoluble in nitric acid, but the washed precipitate is soluble in an excess of ammonia-water. Mercuric potassium iodide test-solution, in aqueous solutions of the salt acidified with hydrochloric acid, yields a yellowish-white precipitate. Mercuric chloride test-solution and solution of phosphotungstic acid give a white precipitate in aqueous solutions of the salt. Picric acid test-solution and platinic chloride test-solution yield a yellow precipitate when added to concentrated solutions of the salt. Sulphuric acid should give no color when added to hyoscine hydrobromide (absence of carbonizable impurities); nor should any color be developed on the subsequent addition of a drop of nitric acid (absence of morphine)."—U. S.

The British Pharmacopœia gives the solubility of the salt as 1 part in 1 part of water and in 13 parts of 90 per cent. alcohol at 15.5° C. (60° F.), and states the melting-point of the hyoscine aurochlorate to be 198° C. (388.4° F.).

Action and Uses.—In certain cases of great nervous excitement hyoscine produces the most happy results, acting as a soporific, quieting the disturbed nervous system, and at times producing deep sleep lasting from 6 to 8 hours. It is, however, quite uncertain, at times producing delirium, and respiratory and circulatory depression. The drug is said to be especially advantageous in those cases in which an idiosyncrasy to morphine exists, or in which renal or other organic changes contraindicate the latter remedy. If given in full dose, it acts as a depressant to the respiratory center and the spinal cord, decreasing respiration and reflex action. As a rule, little or no change is noted in the circulation, even when it is given in poisonous amounts. Full doses produce flushing of

the face, drowsiness or delirium, and dryness of the mouth. Excessive amounts cause an exaggeration of the above symptoms, with Cheyne-Stokes respiration, muscular relaxation, a peculiar hoarseness of the voice, and dilated pupils. Profound stupor lasting a number of hours may also occur. This condition is to be treated by the administration of pilocarpine and suitable stimulants as required.

Hyoscine has been employed in the treatment of acute mania, during exacerbations occurring in chronic mania, and as a cure for the morphine-habit. It has also been successfully employed in the treatment of nymphomania, hypochondriasis, spermatorrhœa, and nocturnal emissions.

The drug may be given by the mouth or hypodermically in doses varying from $\frac{1}{150}$ to $\frac{1}{100}$ grain (0.0004–0.0006 Gm.).

HYOSCYAMINA, *Fr. Cod.*—Hyoscyamine.

Hyoscyamine, Fr.; *Hyoscyamin*, G.

Formula, $C_{17}H_{23}NO_3$. Molecular weight, 287.04.

The alkaloid hyoscyamine occurs not only in hyoscyamus, but also in belladonna, stramonium, and other solanaceous plants, and is an isomer of atropine, into which it is readily converted. It was discovered by Geiger and Hesse in 1833, and is recognized in the French Pharmacopœia.

Preparation.—Hyoscyamine is so readily altered by contact with alkalies and heat that all manipulation and heating should be reduced to a minimum during its isolation. It may be obtained from henbane seed or recovered from the mother-liquors left in the preparation of atropine. The process of Thorey tends to the least alteration of the alkaloid during its extraction. Hyoscyamus seeds are freed from fatty matter by repeated extraction with petroleum-ether and after drying are exhausted with 85 per cent. alcohol and acidulated with hydrochloric acid. The tincture, after removal of the alcohol in a vacuum apparatus, is filtered, and the filtrate again treated with petroleum-ether to remove fatty and coloring-matter, after which it is made alkaline with ammonia (potassium carbonate is to be preferred), and shaken with repeated portions of chloroform. Upon evaporation of the chloroformic solution at low temperature the hyoscyamine is obtained as a gummy residue, and may be purified by solution in dilute sulphuric acid, filtering, and crystallizing. From the sulphate thus obtained, the alkaloid is liberated by rendering an aqueous solution alkaline, extracting with chloroform, and evaporating the latter solution at a low temperature.

Properties.—Hyoscyamine crystallizes in the form of anhydrous slender, silky needles, which are colorless, odorless, have an acrid, disagreeable taste, and melt at 108.5° C. (227.3° F.). The commercial article is usually amorphous. Hyoscyamine is soluble to some extent in water, more readily in diluted alcohol, and is soluble in alcohol, ether, chloroform, benzene, and amyl alcohol. It dissolves in concentrated sulphuric acid without color. From its solution in chloroform it crystallizes in rhombic plates, and from benzene in the form of needle-shaped crystals. Hyoscyamine is but incompletely precipitated from aqueous solutions of its salts by alkali hydroxides and carbonates. In aqueous solution by itself or in contact with alkalies it undergoes change into atropine, and like the latter undergoes hydrolysis into tropine and tropic acid (Ladenburg). In its general behavior toward alkaloidal reagents it acts like atropine, with but few exceptions, but is strongly lævorotatory, while atropine is optically inactive. Until recently only one optically active hyoscyamine was known, although the existence of a dextrorotatory variety was strongly suspected. The exact relation between atropine and hyoscyamine was revealed by Amenomiya (*Arch. d. Pharm.*, 1902, 240, p. 498), who succeeded in converting the former alkaloid into d- and l-hyoscyamine. By boiling pure atropine with water for some time (24 to 27 hours) under a reflux condenser, it was split into tropine and optically inactive tropic acid, which latter was then neutralized with quinine alkaloid. Upon concentrating a solution of the quinine tropate thus formed, a dextrorotatory salt crystallized out, leaving a lævorotatory compound in the mother-liquors, from which it was subsequently separated upon further concentration. The two salts were decomposed with stronger acids, when the respective d- and l-tropic acids were liberated and then mixed with a nearly equal quantity of tropine, 1.69 Gm. of tropine and 2 Gm. of the respective acid, and 50–70 Cc. of 5 per cent. hydrochloric acid, the mixtures being evaporated to a volume of 5–7

Cc. on a water-bath, whereby the hydrochlorides of the respective new bases were obtained. Rendering the solutions alkaline and shaking out repeatedly with ether, yielded the respective crude bases, which were purified by conversion into aurochlorides, subsequent decomposition by means of hydrogen sulphide, and final crystallization. The synthetic dextro-hyoscyamine thus obtained showed a specific rotation of + 23.15° and the lævo-hyoscyamine of − 24.12°, while natural hyoscyamine has a specific rotation of —21.8°. Hyoscyamine shows an alkaline reaction with phenolphtalein, and causes a yellow to red precipitate when touched with a 2 per cent. solution of mercuric chloride in diluted alcohol (Gerrard). In 5 per cent. solution platinic chloride produces no precipitate, but on evaporation triclinic crystals, melting at 200° C. (393° F.), are formed. Gold chloride produces a precipitate which forms lustrous golden-yellow scales which melt at 160°–162° C. (320°–323.6° F.). Picric acid causes a precipitate of yellow needle-shaped crystals, melting at about 162° C. (321.8° F.).

The alkaloid *pseudohyoscyamine*, $C_{17}H_{23}NO_3$, has been found in *Duboisia myoporoides*, associated with hyoscyamine. It differs from hyoscyamine in crystallizing in yellow needles which melt at 133°–134° C. (271.4°–273.2° F.), and being difficultly soluble in water and ether, although readily soluble in alcohol and chloroform. It is readily hydrolized by boiling with alkalies in alcoholic solution, yielding tropic acid and a base isomeric with tropine. Aside from its higher melting-point, pseudohyoscyamine may be distinguished from hyoscyamine by forming with platinic chloride a precipitate melting at 116° C. (240.8° F.), with gold chloride thin yellow plates melting at 176° C. (348.8° F.), and with picric acid yellow needles melting at 220° C. (428° F.).

Action and Uses.—The properties and uses of this alkaloid are practically the same as those of HYOSCYAMINÆ SULPHAS (which see).

HYOSCYAMINÆ HYDROBROMIDUM, *U. S.*—Hyoscyamine Hydrobromide.

Hyoscyaminum hydrobromicum.—Bromhydrate d' hyoscyamine, Fr.; *Hyoscyaminhydrobromid, Bromwasserstoffsaures Hyoscyamin*, G.

Formula, $C_{17}H_{23}NO_3HBr$. Molecular weight, 367.40.

The hydrobromide of an alkaloid obtained from *Hyoscyamus* and other solanaceous plants. It should be kept in amber-colored, well-stoppered bottles.—U. S.

Preparation.—Hyoscyamine hydrobromide may be prepared by dissolving 10 parts of hyoscyamine in 11 parts of 25 per cent. hydrobromic acid, evaporating the solution, and crystallizing.

Properties and Tests.—"White, prismatic crystals, or a yellowish, amorphous, resin-like mass, having, particularly when damp, a tobacco-like odor and an acrid, nauseous, and bitter taste; deliquescent on exposure to the air. Very soluble in water, in 2 parts of alcohol, in 1600 parts of ether, and in 2.5 parts of chloroform at 25° C. (77° F.). It melts at 151.8° C. (305.3° F.). It leaves no residue on incineration. Hyoscyamine chloraurate melts at 160° C. (320° F.). Atropine chloraurate melts at 136° C. (276.8° F.). Hyoscine chloraurate melts at 197° C. (386.6° F.). Hyosoyamine picrate melts at 162° C. (323.6° F.). Atropine picrate melts at 175° C. (347° F.). Its aqueous solution is neutral to litmus-paper and is strongly lævogyrate. Silver nitrate test-solution, when added to a solution of the salt, yields a yellowish-white precipitate which is insoluble in nitric acid, but the washed precipitate is soluble in ammonia water. Gold chloride test-solution, when added to a solution of the salt, yields a precipitate which, when recrystallized from a small quantity of boiling water acidulated with hydrochloric acid, is deposited on cooling in minute, lustrous, golden-yellow scales (difference from atropine). Platinic chloride test-solution does not form a precipitate with solutions of the salt (difference from most alkaloids). If 0.01 Gm. of the salt be added to 5 drops of nitric acid, then, on evaporation to dryness in a porcelain dish, it should yield a violet color upon the addition of alcoholic potassium hydroxide test-solution. Sulphuric acid should produce no color when added to hyoscyamine hydrobromide (absence of carbonizable impurities), nor should any color be developed upon the subsequent addition of a drop of nitric acid (absence of morphine)."—U. S.

Action and Uses.—The action and uses of this salt are identical with those of hyoscyamine sulphate.

HYOSCYAMINÆ SULPHAS, *U. S., Br.*—Hyoscyamine Sulphate.

Hyoscyaminum sulfuricum.—Sulfate d'hyoscyamine, Fr. ; *Hyoscyaminsulfat, Schwefelsaures Hyoscyamin*, G.

Formula, $(C_{17}H_{23}NO_3)_2H_2SO_4$, U. S. ; $(C_{17}H_{23}NO_3)_2H_2SO_4 + 2H_2O$, Br. Molecular weight, 671.43, or for the British salt 707.19.

The neutral sulphate of an alkaloid obtained from *Hyoscyamus* and other solanaceous plants. It should be kept in amber-colored, well-stoppered bottles.—U. S.

Preparation.—Hyoscyamine may be dissolved in alcohol and the solution carefully neutralized with diluted sulphuric acid and evaporated at a low temperature ; or a solution of the alkaloid in diluted sulphuric acid may be concentrated under a bell-glass over sulphuric acid.

Properties and Tests.—"White, indistinct crystals, or a white powder, odorless, having a bitter, acrid taste ; deliquescent in damp air. Very soluble in water, in 6.4 parts of alcohol, 2500 parts of ether, and in 2300 parts of chloroform at 25° C. (77° F.). It melts at 198.9° C. (390° F.). Upon ignition it is rapidly consumed without residue. Hyoscyamine chloraurate melts at 160° C. (320° F.). Atropine chloraurate melts at 136° C. (276.8° F.). Hyoscine chloraurate melts at 197° C. (386.6° F.)). Its aqueous solution is lævogyrate and neutral to litmus-paper. Barium chloride test-solution, when added to an aqueous solution, yields a white precipitate, insoluble in hydrochloric acid. Gold chloride test-solution, when added to an aqueous solution, yields a precipitate which, when recrystallized from a small quantity of boiling water acidulated with hydrochloric acid, is deposited on cooling in minute, lustrous, golden-yellow scales (difference from atropine). Platinic chloride test-solution does not form a precipitate with solutions of the salt (difference from most alkaloids). If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should yield a violet color upon the addition of alcoholic potassium hydroxide test-solution. Sulphuric acid should produce no color when added to hyoscyamine sulphate (absence of carbonizable impurities), nor should any color be developed upon the subsequent addition of a drop of nitric acid (absence of morphine)."—U. S.

Action and Uses.—This salt apparently has the same physiological action upon the vital functions as atropine (which see), with the exception of the respiratory function. It is stated by some and denied by others that the drug slows the respiration, but this may be easily accounted for from the fact that an impure product may have been employed. Its effect as a mydriatic, in the strength of 2 grains (0.12 Gm.) to 1 ounce (30 Cc.) of distilled water, is not so lasting as that of atropine, continuing, as a rule, from 7 to 9 days. When a solution of hyoscyamine sulphate is first instilled, it may cause considerable pain, due to spasm of the ciliary muscle, which pain may be relieved by pushing the drug until muscular relaxation occurs. The beginning internal dose is $\frac{1}{75}$ grain (0.0008 Gm.), which may be gradually increased if necessary. (See HYOSCYAMUS.)

HYOSCYAMUS, *U. S.*—Hyoscyamus.

Hyoscyami folia, Br. ; *Herba hyoscyami*, P. G. ; *Henbane, Black henbane, Stinking nightshade, Insane root, Poison tobacco ; Belene, Chenile, Jusquiame noir*, Fr. Cod. ; *Bilsenkraut*, G. ; *Beleno negro*, Sp. ; *Meimendro Negro*, Port. ; *Giusquiamo Nero*, It.

The dried leaves and flowering tops of *Hyoscyamus niger* L. (Fam. *Solanaceæ*) collected from plants of the second year's growth, yielding, when assayed by the U. S. P. process, not less than 0.08 per cent. of mydriatic alkaloids. (*H. agrestis* Kit. and *H. pallidus* Willd. are forms of the above.)

The presence of the flowers, required by this definition, excludes the use of the biennial plant in the first year of its growth, as it does not then flower. The presence of small purple veins in the corollas, as required by the description, renders it reasonably certain that they do not pertain to the annual plant.

Henbane is official in all pharmacopœias, most of which require the leaves only. Some require that it be collected from uncultivated plants, others that it be not used after keeping for more than a year.

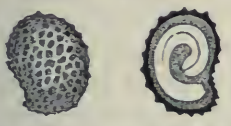
Origin.—The Henbane plant is a native of central and southern Europe and adjacent Asia, occurring even as far east as India. It is considerably cultivated for medicinal purposes, in various European countries. It is more or less naturalized

in nearly all temperate regions, including the United States. It presents two distinct forms. The first is an annual, and concerns us only as to its exclusion, in accordance with the definition. It seldom exceeds 2 feet in height, is slender, and little if at all branched. All its parts are smaller, its leaves are less strongly toothed, and its corollas faintly or not all veined with purple. The other is the biennial form, which, during the first year, develops a large fleshy, fusiform root, somewhat resembling a small horse-radish, and a radical rosette of very large leaves with very long petioles, the blades coarsely toothed, lobed, or sub-pinnatifid. During the second year, the flowering and fruiting stem is produced, after which the plant dies. In this stage the root becomes spongy, then hollow, the radical leaves are wanting, those of the stem being relatively broader and with shorter petioles, these modifications increasing toward the summit of the stem, where the leaves are sessile. The stem is thick and coarse, widely branched, and from 3 to 5 feet high. The inflorescence characters are shown in the accompanying illustration. The whole plant is clammy or viscid, due to numerous hairs with glandular tips. The corallas of this form are deeply purple-veined. The commercial drug presents varieties representing all three of these stages, and these are distinguished by the trade-names "Annual," "First-biennial" (for leaves from the biennial in its first year), and "Biennial" or "Second Biennial" for that described in our definition. The latter is scarce and high-priced.

FIG. 222.

Hyoscyamus niger L.

FIG. 223.



Hyoscyamus seed and longitudinal section (× 7).

Statements of the most positive character differ radically as to the relative quality of the drug as grown in different regions, on different soils, and collected in the three stages named above. The discrepancies are apparently due in part to different methods of estimation, and in part to differences in the articles compared other than those under consideration at the time. Evidently a great number of comparisons must yet be made before these points can be regarded as settled, and the observations must begin with the collection of the materials so as to guarantee the absolute identity of all the conditions and characters except the one under investigation. There is a general belief that the annual drug and the first biennial are very inferior, though Gerrard's results showed no differences in alkaloidal content. He also found the biennial root at the close of the first year to be nearly 3 times as rich as any of the herbs examined, a report which appears *a priori* most rational. He carried his comparisons into clinical results with the preparations, these appearing to confirm those of his assay methods.

Description.—Coarsely, roughly and glandularly hairy throughout, except the corollas; larger leaves shortly and broadly petioled, 15 to 25 Cm. (6 to 10 In.) long, and two-thirds as broad, the upper becoming smaller and sessile; blades angularly ovate, acute, coarsely and angularly toothed or lobed, grayish-green or slightly yellowish-green; flowers in pseudo-racemes, short-pedicelled, the calyx cylindraceous, somewhat contracted above the ovary, unequally 5-toothed, the teeth triangular, acute, the corolla campanulate, 5-lobed, sulphur-yellow, with deep-purple veins; capsule a 2-celled pyxis; odor heavy, narcotic; taste bitter, somewhat acrid. The powdered leaf displays numerous oblong prismatic crystals of calcium oxalate, almost invariably occurring singly in their cells. Besides the simple hairs, there are many which are glandular, and these may terminate in a single cell, or in a head of many cells regularly or irregularly arranged.

Usher points out that the annual drug (as to the British-grown plant) lacks odor and taste sufficiently to lead at once to its recognition. Its leaves are shorter and its flowers, though frequently having light-purple veins, sometimes show none, which is never true of the biennial. The first biennial drug is entirely wanting in flowers and stems, except the leaf-petioles, which are very long, stout, and conspicuous.

Henbane, except for the use of the above-described unofficial forms, is scarcely subject to adulteration in the entire condition. It, however, frequently contains an undue amount of stem, which reduces its alkaloidal percentage.

Constituents.—The important constituents of Henbane are the alkaloids hyoscyamine and hyoscine, also known as scopolamine. Their combined percentage is ordinarily from 0.08 to 0.15 per cent. Their relative percentages are extremely difficult of determination, but the amount of hyoscyamine is many times greater than that of hyoscine.

Gerhard extracted and examined the odorous principle of Henbane, and found it a butyric compound, probably a butyric ether or a butyrin. Resin, fixed oil, and ordinary plant-constituents are also present.

Assay of Hyoscyamus.—As stated above, the alkaloids of hyoscyamus are present only in small quantity, and the U. S. Pharmacopœia demands that the leaves shall contain not less than 0.08 per cent. when assayed by the methods given for BELLADONNA (see page 286), using, however, 25 Gm. of hyoscyamus, in No. 60 powder, in place of 10 Gm. of belladonna. The increased quantity of drug is necessary on account of the small yield of alkaloid.

Pharmaceutical Preparations.—EXTRACT OF HYOSCYAMUS, FLUIDEXTRACT OF HYOSCYAMUS, TINCTURE OF HYOSCYAMUS, U. S. P.

Action and Uses.—Hyoscyamus is closely allied to belladonna in its action, but is more of a sedative to the nervous system. It may be employed in all of those conditions in which the latter drug is indicated. Combined with silver nitrate it is especially useful in the treatment of gastric ulcer and chronic gastric catarrh. It has also been highly recommended in the treatment of hysteria, whooping-cough, nervous cough, and colic. When combined with purgatives it is a useful drug to prevent their griping effect. The extract in the form of a suppository is frequently employed to relieve the pain of hemorrhoids, and a poultice made from the leaves may be applied to allay the pain of cancerous and other ulcers. For the symptoms of poisoning by hyoscyamus and the treatment of this condition, see BELLADONNA. The powdered leaves are given in doses of from 5 to 10 grains (0.30–0.60 Gm.); the alcoholic extract, from $\frac{1}{2}$ to 2 grains (0.03–0.12 Gm.); and the tincture, from 1 to 2 fluidrachms (4–8 Cc.).

Allied Drugs and Other Species.—Henbane seeds are also very largely used. They are roundish, reniform, and flattened; have a gray-brown, finely and densely rough-pitted testa, and contain a whitish oily albumen which encloses a curved embryo of the shape of the figure 9. The hilum is in the concave side of the seed. The seeds are without odor, and have an oily, bitter, and acrid taste. Their composition, as to active constituents, is identical, except that the percentage of alkaloids is a trifle lower than that of the herb. They contain in addition about 25 per cent. of fixed oil. The bitter glucoside *hyoscypicrin* ($C_{27}H_{52}O_{14}$) is neutral, soluble in alcohol and water, precipitated by tannin, and is decomposed into sugar and a yellowish-white resin.

The genus *Hyoscyamus*, L., comprises 11 species. All those which have been investigated contain similar principles and possess similar properties to those of the one above described.

H. muticus L. is considerably used as a narcotic, in India, under the name *Sakran*. Dunstan reported it as containing about 1 per cent. of hyoscyamine, which was readily extractible.

Duboisia, the leaf of *Duboisia myoporoides* R. Br. (*Corkwood elm*), a tree or large shrub of Australia, is the practical equivalent of Belladonna or Henbane. It is 3 or 4 inches long, by about a sixth as broad, lanceolate, with tapering ends and entire, smooth, thickish, and drying of a brownish color. As they reach the market the leaves are usually much broken. They possess a slight narcotic odor and a bitter taste. With ordinary plant-constituents, Duboisia contains about 1 per cent. of alkaloid, mostly hyoscyamine, with a little hyoscine and the crystalline alkaloid *pseudohyoscyamine* ($C_{17}H_{23}NO_3$), which is peculiar to this plant, so far as known (see description above, under Hyoscyamine). *D. Leichardtii* F. v. Müll., said to contain a larger amount of alkaloid, the nature of which has not been definitely ascertained, is probably only a form of the last. Duboisia is rarely employed in medicine, but the

sulphate of its alkaloid duboisine may be used as a mydriatic in the various conditions in which atropine is indicated. Taken internally it is said to possess soporific properties, and may be given interchangeably with hyoscine in the treatment of insanity. If given in full dose, it sometimes occasions vomiting without nausea, and leaves a peculiar soapy taste in the mouth. Excessive doses are said to produce muscular weakness and coma without delirium or convulsions. Extreme dryness of the fauces occurs, but, as a rule, flushing of the face is absent. Occasionally, it may produce salivation or severe sweating when idiosyncrasy exists. The treatment of the symptoms of poisoning consists in stimulation with brandy as needed, the application of external heat, and rest in bed. The remedy has been given quite largely in the treatment of paralysis agitans, and is said to be of value in the treatment of psychic epilepsy. The dose of duboisine sulphate hypodermically is from $\frac{1}{80}$ to $\frac{1}{60}$ grain (0.0008–0.001 Gm.). As a mydriatic it may be instilled into the eye in aqueous solution 1 grain to the ounce (0.05 Gm.–30 Cc.).

D. Hopwoodii F. v. Müll., also Australian, yields the *Pituri* ("*Pitchery*" or "*Pedgery*") *leaves*, so largely used by the Australian natives for chewing and smoking, as tobacco is used. Like tobacco, it varies greatly in its percentage of alkaloid (piturine), which has been extracted to the extent of 2.5 per cent. *Piturine* ($C_{12}H_{16}N_2$) is a heavy liquid alkaloid, of a sharp, biting taste, and pungent odor, miscible with water, alcohol, and ether, closely resembling nicotine.

I.

ICHTHYOCOLLA.—Isinglass.

Colla piscium.—Fish glue, E.; *Hausenblase, Fischleim*, G.; *Ichthyocolle, Colle de Poisson*, Fr. Cod.; *Cola de pescado*, Sp.; *Gelatina* (or *Gomma*) *de Peixe*, Port.; *Colla* (or *Gelatina*) *de Pesca, Itiocolla*, It.

The dried swimming-bladder of *Acipenser Huso* L. and of other species of *Acipenser* (Class *Pisces;* Ord. *Sturiones*).

Ichthyocolla is official in nearly all pharmacopœias, but they differ greatly in their statements of its solubility in boiling water to form a jelly on cooling, the amount of water named varying from 24 to 50 parts. The amount of ash is given as 0.5 per cent. by the Russian, 1 per cent. by several others. The Italian points out that ichthyocolla is precipitated by tannic acid, but not by iron salts.

Origin.—The sturgeons named in the definition chiefly inhabit the waters of, and tributary to the Black and Caspian seas, and this product is known as Russian isinglass. It is prepared by cutting the air-bag or swimming-bladder open, washing and soaking it in water, and spreading it upon boards, the outer silvery membrane being turned upward and removed by rubbing. The bladder is then merely dried in sheets, and constitutes *leaf isinglass*, or several are put together and then folded before they are completely dry, forming *book isinglass*, or each bladder is rolled up, and folded around a few pegs in the form of a horseshoe, heart, or lyre, in which shape it is dried. The latter is the *staple isinglass*, which, according to its dimensions, is again divided into *long* and *short* staple. The kind now most commonly met with in United States commerce is the leaf isinglass.

Description.—Russian isinglass is a somewhat horny and tough membranous tissue, which is semitransparent, of a whitish or pale-yellowish color, pearly appearance, and iridescent; it is easiest torn in the direction of its fibers, is inodorous, and quite insipid in taste. Immersed in water or diluted alcohol, it swells, becomes opaque, and dissolves at a somewhat elevated temperature, leaving a flocculent residue not exceeding 2 per cent.; on cooling, its solution with 24 parts of water congeals to a transparent jelly. On incineration, it leaves 0.5 per cent. of ash. Isinglass which is discolored, of bad odor, or less soluble in water, is not adapted for medicinal purposes.

Constituents.—Besides membranous matter and some salts, isinglass consists of that variety of gelatin known to chemists as *glutin*. (See GELATINUM, p. 709.)

Adulterations.—In the place of Russian isinglass the swimming-bladder of other fishes is sometimes sold, and the intestines of various animals are said to be coated with gelatin and used for a like purpose. Such substitutions or adulterations are easily recognized by the larger amount of ash (3 to. 10 per cent.) left on incineration or by the larger proportion of matter insoluble in hot water. Gelatin immersed in cold water swells, retains its transparency, and becomes soft and easily disintegrated.

Action and Uses.—Isinglass was at one time employed as a protective to the skin for the same conditions for which we now use collodion. It has also been used in place of gelatin to aid the digestibility of milk by preventing the formation of tough curds.

Other Varieties of Isinglass.—The air-bags of most large fishes appear to be adapted for some of the purposes for which isinglass is used in the arts; when they are dried without being split open they are known as *purse* or *pipe isinglass*.

American isinglass, according to C. T. Carney (1857), is prepared from the sounds of *Gadus merluccius* L., or *hake;* they are cleansed, soaked in water, passed through rollers, and dried in the form of ribbons (*ribbon isinglass*) or thin and transparent sheets (*sheet isinglass*). C. C. Meyer (1873) found the former to leave 30 per cent., and the latter only 18 per cent., of matter insoluble in water; a fresh hake-bladder weighing 15 ounces left 1 ounce undissolved. Storer states that the swimming-bladder of *Otolithus regalis* Cuvier, the *weakfish*, likewise furnishes some isinglass.

Brazilian isinglass comes from species of the genera *Pimelodus* and *Silurus*, the entire sounds being often dried so as to adhere together (*lump isinglass*), and the lumps are sometimes split open (*honeycomb isinglass*). A false isinglass from Para consisted, according to Pereira (1853), of the ovaries of a fish, probably *Sudas gigas*.

East Indian isinglass is produced from several large fishes, and is met with in the form of purses and of leaves.

Japanese or *Chinese isinglass* is a vegetable product. (See AGAR-AGAR.)

ICHTHYOLUM.—Ichthyol.

The name ichthyol, derived from the Greek ἰχθύς (*ichthus*, fish), is commercially applied to the ammonium salt of ichthyolsulphonic acid. Other compounds are designated by prefixing the name of the respective base, as sodium-ichthyol, calcium-ichthyol, etc.

The source of all ichthyol compounds is a crude oil—ichthyol-oil—resulting from the destructive distillation of a bituminous rock filled with fossil fish and found in large quantities near Seefeld, in the Tyrol mountains of Europe, at an elevation of 3000 to 4000 feet. This oil is a brownish-yellow transparent liquid of 0.865 specific gravity, boiling between 100° and 225° C. (212° and 437° F.), and possessing a peculiar penetrating, somewhat aromatic odor. If subjected to fractional distillation, about 6 per cent. will pass over between 100° and 120° C., 53 per cent. between 120° and 160° C., 33 per cent. between 160° and 225° C., and about 6 per cent. between 225° and 255° C. It contains about 10 per cent. of sulphur, which is combined in a manner not yet explained, and cannot be extracted by boiling with alkali hydroxide solution nor by treatment with sodium amalgam.

When crude ichthyol oil is mixed with an excess of concentrated sulphuric acid the mixture becomes heated spontaneously to near 100° C. (212° F.), evolves much sulphur dioxide, and forms ichthyoldisulphonic acid ($C_{28}H_{36}S.(SO_3H)_2$?), which latter may be separated in form of a dark extract-like mass, by repeated treatment with concentrated solution of common salt, whereby sulphurous and sulphuric acids are removed. The dark mass consists of 3 distinct substances: ichthyoldisulphonic acid proper, which may be extracted by absolute alcohol; a sulphone, to which the odor is due, and which may be extracted with petroleum ether; and a third substance soluble in alcohol and benzene. The acid, which is dibasic, forms salts with organic and inorganic bases and is used for the preparation of the various ichthyol compounds.

Ichthyol or Ammonium-ichthyol. *Ammonium Ichthyolsulphonate.*—This, as stated above, is the article commercially known simply as ichthyol, and is prepared by neutralizing ichthyolsulphonic acid with concentrated ammonia water and evaporating the product to the consistence of a syrupy extract. It is a clear, reddish-brown syrupy liquid with a bituminous odor and taste, soluble in water, glycerin, and in a mixture of equal volumes of ether and alcohol. Alcohol or ether alone takes up only a part of it, so also petroleum ether. Dried on a water-bath ammonium ichthyolsulphonate loses about 45 per cent. of its weight, the residue when heated and ignited intumesces and burns without residue upon continued heating. It is employed usually in the form of an ointment (10 to 50 per cent.), made with lanolin or petrolatum. From a 10 per cent. aqueous solution acids precipitate the dark resinous ichthyolsulphonic acid. Fixed alkali hydroxides added to the solution liberate ammonia. The ammonium salt should be dispensed when "ichthyol" is called for without further specification.

Ichthyol may be rendered quite odorless by treatment with hydrogen peroxide. 200 parts of ammonium-ichthyol are mixed with 250 parts of distilled water and 100 parts of hydrogen peroxide ("10 volumes") solution and allowed to stand in the cold until the peculiar odor of ichthyol has disappeared, after which the solution, previously neutralized with ammonia, is evaporated to 200 parts. Deodorized ichthyol is commercially marketed under the name of "Desichtol."

When ichthyol is dried and extracted with absolute alcohol the residual purified mass constitutes the commercial "Anytin." The latter in a dry form is a brown hygroscopic mass soluble in water in all proportions. Anytin occurs usually in a thick, syrupy form, leaving about 50 per cent. of residue upon drying. It is used as a solvent for substances otherwise difficultly soluble in water, the combinations being termed anytoles.

Sodium-ichthyol. *Sodium-ichthyolsulphonate.*—This may be prepared by neutralizing ichthyolsulphonic acid with an aqueous solution of sodium hydroxide. It contains from 20 to 30 per cent. of water, and is a dark-brown mass resembling the ammonium compound in general solubilities. It leaves a strongly alkaline ash on ignition which evolves the odor of hydrogen sulphide upon the addition of an acid.

It is distinguished from "ichthyol" in not giving off ammonia upon the addition of sodium hydroxide solution. It contains about 15 per cent. of sulphur. Other salts of ichthyolsulphonic acid may be prepared by direct neutralization of the acid with the oxide or carbonate of the respective metal, or by an organic base. When the compound is insoluble, it may be prepared by transposition by precipitation of a solution of the salt with ammonium ichthyolsulphonate. The various compounds may be rendered quite odorless and tasteless by heating to 125° and 140° C. (257° and 284° F.), or by extraction with alcohol.

The salts of metallic bases which have been introduced commercially are the Lithium-ichthyol, Zinc-ichthyol, Calcium-ichthyol, containing 2.5 per cent. of calcium; Ferricthol, containing 3.5 per cent. of iron; Ichthargol, containing 12 per cent. of silver; and Ichthermol, containing 24 per cent. of mercury.

The two first-named compounds resemble sodium-ichthyol in appearance, while the four latter occur as brown odorless and tasteless powders, insoluble in water.

Action and Uses.—Ichthyol has been extensively employed both internally and externally as an alterative and antiseptic. Its efficiency is thought by those who have used it most, to depend upon the sulphur which it contains. When given internally, it is said to decrease tissue-waste, and for this reason it has been employed in the treatment of tuberculosis and other chronic wasting diseases. Ichthyol has been employed both internally and externally in the treatment of gouty, rheumatic, and scrofulous conditions. An ointment containing 50 per cent. of this drug in lanolin is one of the best remedies we have for the local treatment of erysipelas and acute articular rheumatism; and the same may be employed as a remedy for many chronic skin affections, such as acne, acne rosacea, and eczema, in their indurated forms, and lupus. This drug is said to be particularly efficacious also as a local application to burns, scalds, frostbites, and chilblains. Tampons containing ichthyol are frequently introduced into the vagina for the purpose of promoting the absorption of pelvic exudates, and rectal suppositories containing from 2 to 10 grains (0.12–0.60 Gm.) are said to allay the pain of anal fissure and afford relief in chronic prostatitis. A 1 per cent. aqueous solution has been highly recommended as an injection in the treatment of gonorrhœa. The internal dose of ichthyol is from 2 to 10 grains (0.12–0.60 Gm.), given either in pill or capsule.

Other Derivatives of Ichthyol.—Ichthalbin. *Ichthyol albuminate. Ichthyol-Eiweiss*, G.—Ichthalbin is prepared by precipitating a solution of albumin by a solution of ichthyolsulphonic acid, washing the precipitate with water, drying it at 25°–30° C. (77°–86° F.) and later at 100° C. (212° F.). A grayish-brown powder, insoluble in water and in the juices of the stomach, but is decomposed in the intestinal canal into albumin and ichthyolsulphonic acid. It is prescribed in doses of 1–2 Gm., 3 times per day, to be taken before meals.

Ichthoform.—A combination of ichthyolsulphonic acid with formaldehyde. It is a dark-brown, odorless, tasteless powder, insoluble in water and dilute acids, soluble slowly in alkaline solutions, and only partly soluble in alcohol or ether. It contains about 14.5 per cent. of sulphur. It is prescribed in doses of 8 Gm. per day for internal use, and applied externally as a substitute for iodoform.

Allied Substances.—Thiolum.—*Thiol.*—This compound has been proposed as a substitute for ichthyol, and occurs both in dry and liquid form. It is prepared by heating brown-colored paraffin or gas oils of 0.890 to 0.900 specific gravity with sulphur and extracting the sulphurated unsaturated hydrocarbons with alcohol. Upon removing the alcohol by distillation a dark-brown oily liquid remains; this oil when treated with concentrated sulphuric acid is changed into a water-soluble compound, which is then purified by ammonia to remove free acid, and finally precipitated by sodium chloride or sulphate. Pure thiol is a neutral solid body, non-hygroscopic and soluble in water; it occurs in powder form and also in aqueous solution, the former of dark-brown color, and the latter a dark reddish-brown syrupy liquid, containing about 40 per cent. of thiol.

Tumenolum—*Tumenol.*—This is a mixture of sulphones and sulphonic acids, obtained from purified mineral oils by the direct action of concentrated sulphuric acid, without previous sulphuration. It occurs as a dark-colored acid syrup; the separated sulphones (extracted by ether from a neutral mixture prepared with soda) are known as tumenol oil, a dark-yellow thick liquid, insoluble in water, but readily soluble in ether and benzene. Crude tumenol may be freed from adhering acid by repeated solution in water and precipitation by sodium chloride; it is a tough brown mass, resembling ichthyol, and consists of a mixture of tumenol, sulphone, and tumenolsulphonic acid; the latter substance occurs as a dark-colored faintly bitter powder, readily soluble in water. Like ichthyol and thiol, tumenol has been successfully employed in eczema, pruritus, etc.

ILEX.—Holly.

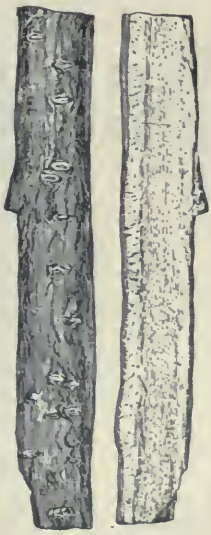
The genus *Ilex*, L. (Fam. *Ilicineæ*), comprising about 150 species, mostly of tropical America, but some extending into temperate regions, is of much interest because of the fact that several of its species contain caffeine and are used like tea. These will be found discussed under THEA. The following species possess more or less medical interest:

The title *Ilex* or *Holly* is commonly understood to apply to the leaves of several species, especially to those of *I. aquifolium* L., the *European Christmas, Crocodile, Sparked* or *Prick holly*, or *Hollen, Stechpalma* or *Christdorn* (G.), *Houx* (Fr.), or *Acebo* (Sp.). This species is a shrub or small tree, rather widely distributed through Europe, and also cultivated, and contributes the well-known red-berried and spiny-leaved evergreen branches so largely used for Christmas decoration, and the fine hard, white holly-wood of the cabinet-makers. The scarlet fruits are commonly known as *Poison-berry* and are bitter and reputed emetico-cathartic poisonous, though these properties have not been investigated. The inner bark is said to be used in the manufacture of bird-lime. Although this species is somewhat imported into the United States, that chiefly used here for decorative purposes, as well as for its wood, is the closely related and very similar species *I. opaca* Ait. (*I. quercifolia* Meerb.), abundant in the eastern and central United States, especially southward. Both leaves are shortly and stoutly petioled, 4 to 5 Cm. (about 1½ to 2 In.) long, evergreen, thick, tough and leathery, and with a wavy-toothed margin, the teeth terminating in spines. The European are mostly ovate, the American mostly oval or rounded and more glossy. Various active constituents of the leaves have been reported by different analysts, but their reports are very discordant. An acrid, alliaceous volatile oil exists in small amounts. The bitter principle is extracted by both alcohol and water. That extracted from the European variety has been called *ilicin*, but since it is unknown in a pure form, it is uncertain whether the bitter principle of the American leaves is identical. From the European leaves was also obtained water-soluble, syrupy *ilicic acid*, yielding scaly crystals with calcium, but amorphous with barium, and the yellow coloring-matter *ilexanthin* ($C_{17}H_{22}O_{11}$). The latter is yellow, melts at 198° C. (388.4° F.), is scarcely soluble in water or ether, but soluble in alcohol, yields an orange precipitate with lead acetate, and does not reduce Fehling's Solution. The leaves of European holly are reported to be diaphoretic and antiperiodic. They were formerly employed in decoction in the treatment of catarrhal and rheumatic conditions and in intermittent fever, but at present they are rarely used. American holly (*I. Opaca*) is said to be demulcent and expectorant, and to possess also the same properties as the European variety.

FIG. 224.

Prinos (⅔ Nat.).

FIG. 225.



Prinos (Nat.).

Prinos, Black, False or *Striped alder, Winter-berry*, or *Feverbush*, is the bark of *I. verticillata* (L.) A. Gray (*Prinos v.* L.), a dicœciously polygamous shrub or small tree, with deciduous leaves, growing in swampy or low ground throughout eastern North America. Its abundant, beautiful, scarlet, shining fruits persist into the winter season. The bark occurs in slender,

partially quilled strips or fragments, about 1 Mm. ($\frac{1}{25}$ In.) thick, externally of a brownish-ash color with ashy-gray or whitish patches which have blackish margins and are sprinkled with minute black or dark-brown circular spots. The older pieces have short, oblong, transverse markings. The inner surface varies from pale-green or greenish-white to deep-yellow, is short-striate, and often bears strips of adhering white wood. It is fragile, the fracture short, and showing a greenish color and a tangential structure. The odor is slight and peculiar, the taste bitter and astringent. This drug has not been subjected to careful chemical analysis, though Collier has reported the bitter principle as being amorphous and yellow and existing in connection with considerable tannin and resin and small amounts of starch, sugar, and wax.

Black alder has been employed for its tonic and astringent properties. It is used in the treatment of diarrhœa, and was formerly substituted for cinchona in the treatment of periodical fevers, but it is probably of no more value than other simple bitters for combating the latter condition. It has also been employed both internally and locally in the treatment of ill-conditioned ulcers and chronic skin eruptions. It may be given in doses of 30 grains (1.94 Gm.); or a decoction made by boiling 2 ounces (62 Gm.) of the drug with 3 pints (1420 Cc.) of water until only 1 quart (946 Cc.) remains, may be given in doses of from 1 to 3 fluidounces (30–89 Cc.), as required.

The similar bark of *I. lævigata* (Pursh.) A. Gray (*Prinos l.* Pursh.), the *Smooth winter-berry* or *Hoopwood*, of the eastern United States, and that of *I. glabra* (L.) A. Gray (*Prinos g.* L.), the *Ink-berry*, *Gall-berry* or *Evergreen winter-berry*, of the southeastern United States, extending northward to Massachusetts, are said to be similarly employed.

ILLICIUM.—Illicium.

Anisi stellati fructus, Br.; *Semen badiani.*—*Star-anise*, *Chinese anise*, E.; *Sternanis*, G.; *Badiane*, *Anise ẽtoilé*, Fr.; *Semen estrellado*, Sp.; *Aniz Estrellado*, *A. da China*, Port.; *Anice Stellato*, It.

The dried fruit of *Illicium verum* Hook. f. (Fam. *Magnoliaceæ*).

Illicium is official in most pharmacopœias, among which there is great confusion between the botanical name of this and those of the Japanese or poisonous variety; yet nearly all caution against the substitution of the latter. The drug was known to science long before the plant which yielded it, and when Linnæus received specimens of the Japanese tree with the statement that it was the source of the Chinese drug, he described and figured it as *I. anisatum*. The real Chinese anise tree thus remained without a botanical name and description until published by the younger Hooker as *I. verum*. Thus, through the error of Linnæus, "I. anisatum" becomes a mere synonym with *I. religiosum* Sieb., and does not belong to the drug at all.

Fig. 226.

Illicium verum.

Fig. 227.

Illicium religiosum.

Origin.—From a beautiful large evergreen shrub or small tree of the mountains of southern China.

Description.—From 2 to 4 Cm. ($\frac{4}{5}$ to $1\frac{1}{2}$ In.) broad, consisting of 6 to 10 (usually 8) radially arranged follicles, each 1 to 2 Cm. ($\frac{2}{5}$ to $\frac{4}{5}$ In.) long and about two-thirds as broad, laterally flattened, broadly ovate, abruptly contracted into a short, nearly straight beak, dark-brown, more or less rough-wrinkled, especially on the lower edge, but not knotty nor woody, dehiscent along the upper (inner) edge to show the light yellow-brown, somewhat shining, inner surface, and the solitary, strongly shining, brown seed; odor pleasantly aromatic, resembling anise, as does the taste.

Very dark, knotty and woody Illicium, with the beaks strongly and abruptly upturned, the taste bitter, is the poisonous *I. anisatum* L., and should be rejected.

Constituents.—The pericarp constitutes about 78 per cent., the seeds about 22 per cent. of the weight of the drug. The latter are oily and little aromatic, the active portion residing more abundantly in the former. Ostwald found the pericarp to contain about 5 or 6 per cent. of volatile oil, and about 1.5 per cent. of fixed oil, while the seeds contained 2.5 to 3 per cent. of volatile and between 20 and 25 per cent. of fixed oil. He also found a little protocatechuic and a little shikiminic acids. There are also about 10 per cent. of resin in the pericarp, 2 to 3 per cent. in the seeds, and a little mucilage and pectin. Reference to the presence of an alkaloid in this species does not appear to have been verified. (For an account of the volatile oil, see Oleum Anisi.)

Action and Uses.—Star anise, like the official anisum (which see), possesses the properties of a stimulant carminative and anodyne, and may be employed in the treatment of flatulent colic and dyspepsia. Its oil is commonly employed, but the powdered drug may be given in doses of from 10 to 20 grains (0.60–1.3 Gm.), either in substance or in infusion.

Allied Products.—*Japanese star anise*, from *I. religiosum* Sieb. et Zucc. (*I. anisatum* L.; *I. Japonicum* Sieb.), is very similar, but it is woody and shrivelled, has near the apex a short and rather deep depression, terminates with a short curved beak, and has a faint clove-like odor and an unpleasant taste. The plant is known in Japan as *Sikimi* or *Shikimi*. Eykman found in the fruit an alkaloid and a poisonous neutral principle, *sikimin*, which crystallizes in hard prisms or needles, is insoluble in hot water, ether, and chloroform, and easily soluble in alcohol and glacial acetic acid. The volatile oil is somewhat heavier than water, slightly lævogyre, reduces ammoniacal silver solution, and consists of a terpene boiling near 175° C. (347° F.), and of liquid anethol boiling at 232° C. (350° F.). Although poisonous, this fruit is used by the natives as a spice. Six other species, two of them natives of our Southern States, are known. All have aromatic barks and fruits, but none is like the official. *I. Floridanum* Ellis (*Poison bay* or *Stink-bush*), of our Gulf region, is reputed poisonous in all parts.

INDIGO.—Indigo.

Indicum, Pigmentum indicum.—Indigo, Fr., G., Sp.; *Indigoblau*, G.; *Indaco*, It.; *Añil*, Sp.

A blue dyestuff extracted from different species of *Indigofera* (Fam. *Leguminosæ*).

Origin.—The genus consists of herbaceous or suffruticose plants which are indigenous to and cultivated in tropical and subtropical countries. The most important species are *Indigofera tinctoria* L. (*I. indica* Lamarck), *I. Anil* L., and *I. argentea* L. (*I. glauca* Lamarck, *I. cærulea* Roxb.). The same coloring-matter is also contained in the *woad*, *Isatis tinctoria* L. (*Cruciferæ*), of Europe, in *Polygonum tinctorium* L. (*Polygonaceæ*), of China, in *Gymnema* (*Asclepias*) *tingens* Sprengel, and in *Wrightia* (*Nerium*) *tinctoria* R. Brown, of Hindostan, which plants are employed for dyeing.

Indigo was known in the East from the earliest times, but was not introduced into Europe until the sixteenth century, where, owing to the *woad* (*weid*, *pastel*) industry, its use was restricted and prohibited until its use was finally permitted about 1737 through legal enactment.

The principal supply of natural indigo comes from Bengal, about 2000 tons, with Madras and Central America producing about 500 tons each, and Manila, Java, Bombay, China, and other countries producing together about 1000 tons per annum. The importations into the United States in 1900 were crude indigo 2,747,043 pounds ($1,446,490), indigo carmine 18,204 pounds ($15,787), extracts or pastes of indigo 251,538 pounds ($20,094). The average annual importation of crude indigo into the United States from 1891 to 1900 was 2,745,666 pounds, the lowest 1,717,635 pounds in 1894, and the highest in 1895, amounting to 3,411,539 pounds.

Preparation.—The plants immediately after blooming are packed in bundles, covered with water in vats and subjected for 10 to 18 hours to fermentation. The coloring-principle is mostly in the leaves, and is extractable in 2 hours (A. Schulte, *Ber. D. Phar. Ges.*, 1902, 12, pp. 19–30) at 53° C. (127.4° F.). When the liquor has turned a yellowish-green color it is aërated for several hours by brisk stirring, whereby the *indican* is oxidized to the insoluble indigo-blue, which rapidly deposits after the liquid is at rest. Addition of milk of lime or ammonia hastens the settling and also produces a better product. The supernatant liquid is then drawn off and the residue boiled to check fermentation, after which the indigo-blue is washed, collected, pressed, and dried. The yield is about 0.3 per cent.

Properties.—Indigo is met with in the form of porous, hard, but brittle lumps or cubical cakes, which are inodorous, tasteless, and of a deep-blue color, assuming a coppery luster when scratched or rubbed with a hard body. Inferior qualities are of a dull hue, with a greenish or grayish tint, dense, firm, and not brittle. The commercial varieties are classified by Sadtler as "first the Asiatic, of which the Bengal is the best, followed by the Java, Madras, Coromandel, and Manila varieties; second, the American, of which the Guatamala is the best, followed by the Caracas and the Brazilian varieties; and, third, the African, including the Egyptian, Senegal, and the Isle of France varie-

ties." The best varieties are lighter than water and show a coppery hue where rubbed with a hard object, and when burned do not leave over 7 per cent. of ash, and do not contain over 6 per cent. of water. Indigo is hygroscopic. Indigo is insoluble in the ordinary solvents, dissolves freely in concentrated sulphuric acid, and when rapidly heated sublimes partly at about 300° C. (572° F.) in purple colored vapors which sublime in copper-colored needles. The blue color of indigo is destroyed by reducing agents in the presence of alkali and by oxidizing agents.

Constituents.—Indigo varies much in composition, containing from 20–80 per cent. of indigotin (indigo-blue), 5–18 per cent. of moisture, 2–10 per cent. of indigo-red, 1–6 per cent. of indigo-brown, 1–5 per cent. of indigo-gluten, and leaves upon incineration 3–20 per cent. of ash. The value of indigo lies principally in the amount of indigotin which it contains. Rawson recommends the following process for assay: 1 Gm. of the sample of indigo, finely pulverized, is mixed in a small mortar with about its own weight of ground glass. This mixture is gradually added during constant stirring with a glass rod to 20 Cc. of concentrated sulphuric acid (specific gravity 1.845), which is then heated to about 85° C. (185° F.) for 1 hour. The product is then cooled, diluted with water to about 1 liter, and filtered from indigo-brown and other insoluble matter. 50 Cc. of the filtered solution are treated with 50 Cc. of water and 32 Gm. of common salt, which quantity is almost sufficient to saturate the solution. After standing for 2 hours the solution is filtered, and the precipitate washed with about 50 Cc. of brine of 1.2 specific gravity. The precipitated *sodium sulphindigotate* is dissolved in hot water, the solution cooled, mixed with 1 Cc. of sulphuric acid, and diluted to 300 Cc. This solution is then titrated in a porcelain dish with a solution of potassium permanganate containing 0.5 Gm. of $KMnO_4$ per liter, the exact oxidizing power of which has been ascertained by experiment with a solution of pure indigotin. This is made by dissolving 0.5 Gm. of indigotin in strong sulphuric acid, diluting the solution to 1 liter, and employing 50 Cc. and 250 Cc. of water for the titration. The oxidation is regarded as complete when the liquid, which first takes a greenish tint, changes to a light-yellow, with a faint-pink color in the margin. In place of the above permanganate solution a $\frac{N}{50}$ solution containing 0.6324 Gm. of $KMnO_4$ per liter may be used for the titration. Each Cc. of this solution oxidizes 0.0015 Gm. of indigotin.

Indican, $C_{26}H_{31}NO_{17}$, the mother-substance of indigo-blue, was first isolated by E. Schunk. It is a colorless syrupy bitterish glucoside, soluble in water, alcohol, and ether, dissolves in dilute alkaline solutions to a bright-yellow solution, and when boiled with concentrated alkali evolves ammonia. The alcoholic solution gives a yellow precipitate with lead acetate. When treated with dilute acids indican is split up into *indigotin* and *indiglucin*, $2C_{26}H_{31}NO_{17}$ (indican) $+ 4H_2O = C_{16}H_{10}N_2O_2$ (indigotin) $+ 6C_6H_{10}O_6$ (indiglucin). The same change occurs during the fermentation of the plants, as described above, when the indican disappears.

Indigotin. *Indigo-blue*, $C_{16}H_{10}N_2O_2$, or $C_6H_4<\begin{matrix}CO\\NH\end{matrix}>C:C<\begin{matrix}CO\\NH\end{matrix}>C_6H_4$. Molecular weight, 260.18.

Indigotin occurs as a neutral, odorless, tasteless, dark-blue powder or as purplish to copper-hued rhombic crystals. It is insoluble in water, dilute acids or alkalies, alcohol, ether, and oils. It is but slightly soluble in hot alcohol, acetone, or amyl alcohol, more readily in chloroform, or boiling solutions of glacial acetic acid, phenol, aniline, and nitrobenzene, from which solutions it may be recovered in the crystalline form on cooling. It is sublimable in a vacuum without decomposition, but when subjected to dry distillation by itself it sublimes in part and yields aniline. Oxidizing agents destroy the color and yield *isatin*, $C_8H_5NO_2$, which subjected to dry distillation yields aniline. With strong nitric acid, isatin, nitrosalicylic acid, and picric acid result. It is soluble in cold concentrated sulphuric acid with a yellowish-green color, which on exposure to air, or more rapidly on heating, turns blue, forming indigosulphonic acid. According to conditions, varying amounts of monosulphindigotic acid (sulphopurpuric acid, indigo-purple), $C_{16}H_9N_2O_2.HSO_3$, and disulphindigotic acid (sulphocœrulic acid), $C_{16}H_8N_2O_2(HSO_3)_2$, are obtained; the first one of these is insoluble in dilute acids, in which the second remains dissolved, and is obtained pure by transferring it from its dilute solution to wool and dissolving it from the latter by means of a weak alkali. The sodium salt of this latter is sold in commerce as *indigo-carmine*, and is usually obtained by adding a sodium salt to a solution of sulphate of indigo ("soluble indigo," prepared by

gradually adding 1 part of powdered indigo to 5 parts of Nordhausen sulphuric acid or 8 parts of oil of vitriol, and preventing a rise of temperature by immersing the vessel in cold water), washing the precipitate with a solution of the same salt, and expressing; the product is soluble in cold water. By the action of reducing agents in alkaline solutions, or hyposulphite in acid solution indigotin by assimilation of hydrogen is reduced to *indigo-white* (*hydringotin, reduced indigo*), $C_{16}H_{12}N_2O_2$. Indigo-white is a grayish-white amorphous substance, insoluble in water and dilute acids, but soluble in alkaline solutions, alcohol, ether, and chloroform, and oxidizes rapidly on exposure to air to indigo-blue.

Artificial or Synthetic Indigo.—Artificial indigo is now a successful competitor of the natural product, although the improvements made in the process for the manufacture of the latter overcame for years the earlier commercial competition by indigo synthetically prepared. The early processes of Baeyer for the manufacture of artificial indigo, for which no less than ten patents were issued in this country between May, 1880, and June, 1882, have been succeeded by more economical methods during recent years. In 1899 K. Heumann obtained four patents, Nos. 617,652, 619,488, 619,883, and 620,442, covering the use of glycocoll derivatives for the manufacture of indigo dyes, and in April, 1900, two patents, Nos. 647,279 and 647,281, were granted to T. Sandmeyer for processes for making isatin and alpha-isatinanilid, which by reduction are made to yield indigo. Sandmeyer's process threatens at present to become the most formidable rival of the natural process for making indigo.

The vastness of the industry in the manufacture of artificial indigo is shown by the data given by Lachmann regarding the Heumann process (German patent No. 91,202), as used by the Badische Anilin und Soda Fabrick, employing naphthalene as the starting-point. In the process naphthalene is oxidized by concentrated sulphuric acid to *phthalic acid*, this is converted to *phthalimide* by the use of ammonia, phthalimide to *anthranilic acid* by means of sodium hypochlorite, the anthranilic acid united with chloracetic acid to form *phenylglycocollorthocarboxylic acid*. This latter by fusion with caustic soda is converted into *indoxyl* and *indoxylic acid*, and these latter through atmospheric oxidation into *indigo*. The quantities of material involved in the operation in working up 10,000 tons of naphthalene are according to Lachmann 40,000 tons of sulphur dioxide as a by-product, 600 tons of ammonia, 2250 tons of glacial acetic acid, besides the chlorine generated from 5000 tons of salt. The process through recent improvements has been simplified by the use of sodium amide. The present production of artificial indigo is estimated at about 3,000,000 pounds per annum, or about one-fourth of the world's production.

Adulteration.—Indigo when dried at 100° C. (212° F.) should lose not over 6 per cent. of moisture, and yield not over 8 per cent. of ash when incinerated. Gum or starch, if present, forms with hot water a mucilaginous liquid or paste, and if treated with strong sulphuric acid is carbonized, coloring the indigo black. Adulteration with Prussian Blue is detected with caustic potassa or soda, which does not alter indigo, but liberates from Prussian Blue ferric hydroxide, while potassium or sodium ferrocyanide remains in solution.

Action and Uses.—Indigo was formerly employed in the treatment of nervous and menstrual disorders, but is rarely used at the present time. Large doses disorder the digestion, produce nausea and purging, and impart a bluish color to the urine and sweat. The dose is from 5 to 20 grains (0.30–1.3 Gm.).

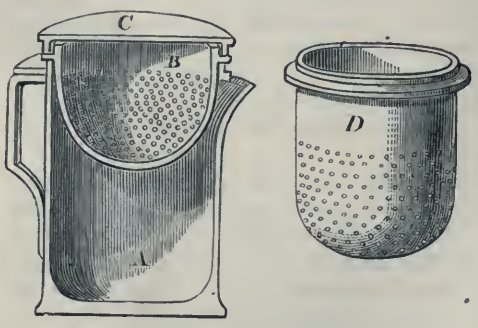
INFUSA, *U. S., P. G.*—Infusions.

Tisanes, Fr.; *Infusionen, Aufgüsse*, G.

Infusions are aqueous solutions of the soluble principles of vegetable or animal drugs obtained by maceration or digestion in hot or cold water, and differ from decoctions only in the lower degree of heat employed in their preparation. Substances containing volatile or other principles which would be dissipated or injured by boiling are particularly adapted for this purpose. Except in a few cases in which percolation is directed, the pharmacopœial infusions are prepared by pouring boiling or cold water upon the material and allowing them to remain in contact for a definite length of time, at the expiration of which the solution is poured upon a strainer, and the solid material expressed to recover the liquid absorbed by it. A convenient apparatus, well adapted for making these

preparations, is Squire's infusion-pot: this consists of a jar A, with a projecting ledge near the top, which supports a strainer, B or D, containing the material to be exhausted; the jar is closed by a well-fitting cover, C. The advantages of this contrivance are—that the material is exhausted by circulatory displacement, the liquid, as it becomes charged with the soluble ingredients descending to the bottom, giving place to fresh portions of less saturated menstruum, and that no further straining is required should care have been taken not to use too fine a powder.

Fig. 228.



Squire's infusion-pot.

The drugs are best adapted for exhaustion with water if cut into thin slices by a suitable knife, so that they may be easily permeated by the liquid; when cutting is inadmissible they should be bruised to a coarse powder. Ligneous drugs, however, should be in a fine or moderately fine powder, which is also best adapted for most of those which may be made by percolation.

The time directed for the maceration with boiling water is, in the U. S. Pharmacopœia, usually ½ hour, and in the British Pharmacopœia 15 or 30 minutes.

The strength of the infusions of the British Pharmacopœia is usually such that the virtues of 1 part of the drug are represented by 20 or 40 parts of the infusion; the simple infusions for which special directions are given in the U. S. Pharmacopœia are made in the proportion of 1½ or 4 parts to 100 parts by weight. The French Codex classifies these preparations according to their strength, and designates such, 100 or 200 parts of which represent 1 part of the drug, as *tisanes, ptisanæ;* they are made either by maceration, infusion, or decoction, and are intended to be used freely. *Apozèmes* are infusions or decoctions differing from tisanes only in being more concentrated.

Infusions are not intended to be kept, except for a very limited period. Exposed to air, as they necessarily must be in the sick chamber through the vial containing them being opened from time to time, decomposition must ensue after a day or two, and may be retarded somewhat only by keeping the vessel in a cool place, or, better still, on ice.

Nearly all the infusions will yield precipitates or become discolored with the salts of iron, lead, mercury, silver, and other heavy metals, and are therefore incompatible with them.

The U. S. Pharmacopœia has adopted the plan of ordering all infusions unless otherwise directed by the physician, and with the exception of those specially enumerated, to be made of 1 part of material to 20 parts of infusion according to the following directions: An ordinary infusion, the strength of which is not directed by the physician nor specified by the pharmacopœia, shall be prepared by the following formula: Take of the substance, coarsely comminuted, 50 Gm.; boiling water, 1000 Cc.; water, a sufficient quantity to make 1000 Cc. Put the substance into a suitable vessel provided with a cover, pour upon it the boiling water, cover the vessel tightly, and let it stand for ½ hour. Then strain, and pass sufficient water through the strainer to make the infusion measure 1000 Cc. *Caution.*—The strength of infusions of energetic or powerful substances should be specially prescribed by the physician.

The official strength of infusions is equal to about 23 grains of drug for each fluid-ounce.

The Pharmacopœia omits to direct the expression of the drug after infusion, but it is evident that bulky herbs and flowers, which are best adapted to this process, would retain a considerable proportion of the liquid, which cannot be washed out simply by passing water through the strainer to make up the deficiency in volume.

The strength of infusions of the German Pharmacopœia is double that of our own, but the general directions given for their preparation are nearly identical with the above, from which they differ only in this, that the mixture of drug and boiling water is heated for 5 minutes in a vapor-bath of boiling water, occasionally stirred, allowed to cool, and strained. The *concentrated* and *highly concentrated infusions*, made respectively with 1½ and 2 parts of drug to 10 parts of infusion, are no longer recognized.

INFUSUM AURANTII, *Br.*—Infusion of Orange-peel.

Tisane d'écorce d'orange, Fr.; *Pomeranzenschalenaufguss*, G.

Preparation.—Take of bitter orange-peel, cut small, 1 ounce; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

Uses.—A stimulant tonic and stomachic in doses of from 1 to 2 fluidounces (30–60 Cc.).

INFUSUM AURANTII COMPOSITUM, *Br.*—Compound Infusion of Orange-peel.

Tisane d écorce d'orange composée, Fr.; *Pomeranzen- und Citronenschalen-aufguss*, G.

Preparation.—Take of bitter orange-peel, cut small, ½ ounce; fresh lemon-peel, cut small, ¼ ounce; cloves, bruised, 55 grains; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

Uses.—A stimulant, stomachic, and carminative employed in doses of from 1 to 2 fluidounces (30–60 Cc.) in the treatment of flatulent colic and diarrhœa.

INFUSUM BUCHU, *Br.*—Infusion of Buchu.

Infusum diosmæ s. barosmæ.—Tisane de bucco, Fr.; *Buchuaufguss*, G.

Preparation.—Take of buchu leaves, bruised, 1 ounce; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

A fluidounce of this infusion represents 22 grains of buchu.

Uses.—Infusion of buchu is employed for its diuretic properties and forms a convenient method for the administration of the drug from which it is prepared. The dose is from 1 to 2 fluidounces (30–60 Cc.).

INFUSUM CALUMBÆ, *Br.*—Infusion of Calumba.

Infusion of columbo, E.; *Tisane de colombo*, Fr.; *Kolomboaufguss*, G.

Preparation.—Take of calumba root, thinly sliced, 1 ounce; cold distilled water, 20 fluidounces. Macerate in a covered vessel for 15 minutes, and strain.—Br.

The infusion made with hot water is much more mucilaginous and unsightly than if made with cold water, either by maceration or percolation. Each fluidounce represents 22 grains of calumba.

Uses.—This preparation possesses the bitter properties of columbo, and may be administered in doses of 2 fluidounces (60 Cc.), several times daily.

INFUSUM CARYOPHYLLI, *Br.*—Infusion of Cloves.

Tisane de girofle, Fr.; *Gewürznelkenaufguss*, G.

Preparation.—Take of cloves, bruised, ½ ounce; boiling distilled water, 20 fluidounces. Macerate in a covered vessel for 15 minutes, and strain.—Br.

1 fluidounce of this infusion represents 11 grains of cloves.

Uses.—Infusion of cloves is a carminative and may be employed for the purpose of overcoming nausea and vomiting and for the relief of flatulent colic. The dose is from ½ to 2 fluidounces (16–60 Cc.).

INFUSUM CASCARILLÆ, *Br.*—Infusion of Cascarilla.

Tisane de cascarille, Fr.; *Kaskarillaufguss*, G.

Preparation.—Take of cascarilla bark, in No. 20 powder, 1 ounce; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

Uses.—This forms a convenient method for the administration of cascarilla. Dose, 2 fluidounces (60 Cc.).

INFUSUM CHIRATÆ, *Br.*—Infusion of Chiretta.

Tisane de chirette, Fr.; *Chiretta-Thee*, G.

Preparation.—Take of chiretta, cut small, 1 ounce; distilled water, boiling, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

Uses.—This infusion is employed as a simple bitter, and may be given in doses of from 1 to 3 fluidounces (30–90 Cc.).

INFUSUM CINCHONÆ ACIDUM, *Br.*—Acid Infusion of Cinchona.

Tisane acidulée de quinquina, Fr.; *Saurer Chinarindenaufguss*, G.

Preparation.—Red cinchona bark, in No. 40 powder, 1 ounce; aromatic sulphuric acid, 2 fluidrachms; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 1 hour, and strain.—Br.

The U. S. Pharmacopœia, 1890, directed infusion of cinchona to be made as follows, preference being given to yellow cinchona: mix 10 Cc. of aromatic sulphuric acid with 500 Cc. of water, and moisten 60 Gm. of cinchona, in No. 40 powder, with 30 Cc. of the mixture; pack it firmly in a conical percolator, and gradually pour upon it first the remainder of the mixture, and afterward water until the infusion measures 1000 Cc.

Uses.—Infusion of cinchona is employed for its tonic properties. It is too weak to be used as an antiperiodic. The dose is from 1 to 2 fluidounces (30–60 Cc.).

INFUSUM CUSPARIÆ, *Br.*—Infusion of Cusparia.

Infusum angusturæ, U. S. 1870.—*Infusion of angustura*, E.; *Tisane d'angusture*, Fr.; *Angusturaaufguss*, G.

Preparation.—Take of cusparia bark, No. 20 powder, 1 ounce; distilled water, boiling, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

1 fluidounce of this infusion contains the virtues of nearly 22 grains of angustura bark.

Uses.—Infusion of angustura may be given for its tonic properties in the treatment of atonic dyspepsia in doses of from 1 to 2 fluidounces (30–60 Cc.), several times daily.

INFUSUM DIGITALIS, *U. S.*, *Br.*—Infusion of Digitalis.

Tisane de digitale, Fr.; *Digitalisaufguss*, G.

Preparation.—Digitalis, bruised, 15 Gm.; alcohol, 100 Cc.; cinnamon water, 150 Cc.; boiling water, 500 Cc.; water, cold, a sufficient quantity to make 1000 Cc. Upon the digitalis, contained in a suitable vessel, pour the boiling water, and allow it to macerate until the mixture is cold. Then strain, add the alcohol and cinnamon water to the strained liquid, and pass sufficient cold water through the residue on the strainer to make the product measure 1000 Cc.—U. S.

To make 1 pint of the infusion, 110 grains of digitalis should be macerated in 8 fluidounces of boiling water until cold; after straining, 13 fluidrachms of alcohol, 2½ fluidounces of cinnamon water, and sufficient cold water are to be added to bring the volume of the liquid up to 16 fluidounces.

Take of digitalis leaves, dried, 60 grains; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

The bitter taste of digitalis is masked in the first preparation by the cinnamon, and the small quantity of alcohol and oil of cinnamon will preserve the infusion for several days before a precipitate makes its appearance. Infusion of digitalis contains the water-soluble principles of the drug, chiefly digitonin and digitalin, both of which, while but sparingly soluble in water, increase the solubility of each other. It is a most valuable preparation of the drug, and its large dose, as compared with that of the tincture of digitalis, is due in part to the absence of digitoxin and other principles soluble in the hydroalcoholic menstruum of the latter preparation. 1 fluidounce of the infusion represents 7 grains U. S. P., 3 grains Br., of digitalis.

Uses.—The action of this preparation is fully described under DIGITALIS (which see). The dose is from 2 to 4 fluidrachms (8–16 Cc.).

INFUSUM ERGOTÆ, *Br.*—Infusion of Ergot.

Tisane de seigle ergoté, Fr.; *Mutterkornaufguss*, G.

Preparation.—Take of ergot, in coarse powder, ¼ ounce; boiling distilled water, 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—Br.

Uses.—The action and uses of this infusion are described under ERGOTA (which see). The dose is from 1 to 2 fluidounces (30–60 Cc.).

INFUSUM GENTIANÆ COMPOSITUM, *Br.*—Compound Infusion of Gentian.

Tisane de gentiane composée, Fr.; *Enzianaufguss*, G.

Preparation.—Take of gentian root sliced, bitter orange-peel cut small, each, 55 grains; fresh lemon-peel, cut small, ¼ ounce; boiling distilled water, 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—Br.

While the U. S. P. does not recognize compound infusion of gentian, the National Formulary directs a stronger preparation to be made from which a compound infusion may be prepared by simple dilution with water. The formula is as follows:

INFUSUM GENTIANÆ COMPOSITUM FORTIUS. *Stronger Compound Infusion of Gentian.*—Take of gentian, 125 Gm.; coriander, 35 Gm.; bitter orange-peel, 35 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Reduce the drugs to a No. 40 powder, moisten it with diluted alcohol, pack it in a percolator, and percolate with diluted alcohol until 1000 Cc. are obtained.—N. F. When compound infusion of gentian is prescribed, mix 1 volume of this preparation with 3 volumes of water.

Uses.—Compound infusion of gentian is occasionally employed as a stimulating bitter tonic in doses of from ½ to 1 fluidounce (16–30 Cc.).

INFUSUM KRAMERIÆ, *Br.*—Infusion of Krameria.

Infusion of rhatany, E.; *Tisane de ratanhia*, Fr.; *Ratanhiawurzelaufguss*, G.

Preparation.—Take of krameria root, bruised, 1 ounce; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

This infusion should be made in glass or porcelain vessels and all contact with metal avoided.

Uses.—Infusion of rhatany is employed for its astringent effect in doses of from 1 to 2 fluidounces (30–60 Cc.).

INFUSUM LUPULI, *Br.*—Infusion of Hops.

Infusum humuli.—Tisane de houblon, Fr.; *Hopfenaufguss*, G.

Preparation.—Take of hops, freshly broken, 1 ounce; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

Uses.—Infusion of hops may be employed for the sedative effect of the drug in doses of from 1 to 2 fluidounces (30–60 Cc.).

INFUSUM PRUNI VIRGINIANÆ, *U. S.*—Infusion of Wild Cherry.

Tisane d'écorce de cerisier sauvage, Fr.; *Wildkirschrinden-Thee*, G.

Preparation.—Wild cherry, in No. 20 powder, 40 Gm.; glycerin, 50 Cc.; water, a sufficient quantity to make 1000 Cc. Moisten the powder with 60 Cc. of water and macerate for 1 hour; then pack it firmly in a conical glass percolator, and, having placed the glycerin in the receiving bottle, gradually pour water upon it until the infusion measures 1000 Cc.—U. S.

To make 1 pint of the infusion, 293 grains of wild-cherry bark should be macerated with a fluidounce of water for 1 hour, and then percolated with water until, after addition of 7 fluidrachms of glycerin, 16 fluidounces have been obtained.

Made with cold water as directed by the Pharmacopœia, this infusion contains volatile oil and hydrocyanic acid, which are not generated by the use of hot water.

Uses.—Infusion of wild-cherry bark may be employed for its sedative effect in the treatment of nervous cough and the cough of tuberculosis. The dose is from 2 to 3 fluidounces (30–90 Cc.), several times daily.

INFUSUM QUASSIÆ, *Br.*—Infusion of Quassia.

Tisane de quassie, Fr.; *Quassiaaufguss*, G.

Preparation.—Take of quassia wood, finely rasped, 88 grains; cold distilled water, 20 fluidounces. Macerate in a covered vessel for 15 minutes, and strain.—Br.

We can perceive no objection to the use of warm water in making this infusion, whereby time might be materially economized without interfering with the appearance

or efficiency of the preparation; maceration, as directed above, will yield a very bitter infusion, containing, however, only a portion of the quassia. If made by the general formula (see page 802), the infusion will be about five times the strength of the above.

Uses.—Infusion of quassia is employed as a simple bitter in doses of 1 or 2 fluidounces (30–60 Cc.), several times daily. Injected into the rectum it is also an effective remedy for the removal of pinworms.

INFUSUM RHEI, *Br.*—Infusion of Rhubarb.

Tisane de rhubarbe, Fr.; *Rhabarberaufguss*, G.

Preparation.—Take of rhubarb root, in thin slices, 1 ounce; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

Rhubarb being easily permeated by water, it is preferable to employ it for this purpose cut into thin slices, instead of bruising it; in the latter case the finer powder should be sifted off. But in either case the preparation is unsightly, and becomes still more so by long-continued digestion. A handsomer though weaker infusion is obtained by the formula of the French Codex, by maceration for 4 hours with cold water. In Germany a preparation has long been in use under the name of *Infusum rhei kalinum* or *Tinctura rhei aquosa*, which is now prepared as follows: rhubarb, sliced, 100 parts; borax and potassium carbonate, each 10 parts; boiling distilled water, 900 parts. Infuse for 15 minutes, add alcohol, 90 parts, and macerate for 1 hour; then express lightly, and to 850 parts of the liquid add cinnamon water 150 parts. The finished preparation represents nearly 10 per cent. of rhubarb, is of a dark red-brown color, transparent in thin layers, mixes clear with aqueous liquids, and has not an alkaline reaction, but is incompatible with all preparations which are decomposed by alkalies. It may be preserved for several months if kept in small vials and in a cool place.

Uses.—This infusion is rarely employed, but may be given when a gentle laxative is indicated, or as a vehicle for saline purges. The dose is from 1 to 3 fluidounces (30–90 Cc.), to be repeated as needed.

INFUSUM ROSÆ ACIDUM, *Br.*—Acid Infusion of Roses.

Infusum rosæ compositum.—Compound infusion of rose, E.; *Tisane de rose composée*, Fr.; *Saurer Rosenaufguss*, G.

Preparation.—Take of dried red rose petals, broken up, ½ ounce; diluted sulphuric acid, 2 fluidrachms; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

This infusion should not be made in a metallic vessel; it has a fine-red color and agreeable flavor.

A similar preparation was official in the U. S. Pharmacopœia of 1870, and may now be found in the National Formulary. It is made as follows:

Infusum Rosæ Compositum. *Compound Infusion of Rose.*—Take of red rose, 13 Gm.; diluted sulphuric acid, 9 Cc.; sugar, 40 Gm.; boiling water, 1000 Cc. Pour the boiling water upon the rose in a glass or porcelain vessel, add the acid, cover the vessel, and macerate for 1 hour. Then dissolve the sugar in the liquid and strain.—N. F.

Uses.—This acid infusion of rose has been employed for its astringent effect in the treatment of stomatitis and pharyngitis. Its virtue is principally due to the aromatic sulphuric acid which it contains, and the latter ingredient renders it a useful preparation in the treatment of night-sweats resulting from depression. It is commonly given in doses of from 2 to 4 fluidounces (60–120 Cc.).

INFUSUM SCOPARII, *Br.*—Infusion of Broom.

Tisane de genêt à balais, Fr.; *Besenginsteraufguss*, G.

Preparation.—Take of broom tops, dried and bruised, 2 ounces; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes and strain.

This preparation was introduced into the British Pharmacopœia of 1898 in place of the Decoction of Broom of the preceding issue.

Uses.—The employment of this preparation is noted under Scoparius (which see). It may be given in doses of 1 ounce (30 Gm.), every 3 hours.

INFUSUM SENEGÆ, *Br.*—Infusion of Senega.

Tisane de polygale de Virginie, Fr.; *Senegaaufguss*, G.

Preparation.—Take of senega root, in No. 10 powder, 1 ounce; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—Br.

Uses.—Infusion of senega is occasionally prescribed in doses of from 1 to 2 fluidounces (30–60 Cc.) as an expectorant.

INFUSUM SENNÆ COMPOSITUM, *U. S., P. G.*—Compound Infusion of Senna.

Infusum sennæ, Br.—*Infusion of senna, Black draught*, E.; *Tisane de séné composée*, Fr.; *Sennaaufguss*, G.

Preparation.—Senna, 60 Gm.; manna, 120 Gm.; magnesium sulphate, 120 Gm.; fennel, bruised, 20 Gm.; boiling water, 800 Cc.; cold water, a sufficient quantity to make 1000 Cc. Upon the senna and fennel, contained in a suitable vessel, pour the boiling water, and macerate it for half an hour. Then strain with expression, dissolve in the infusion the magnesium sulphate and manna, and strain again. Lastly, add sufficient cold water through the strainer to make the infusion measure 1000 Cc.—U. S.

To make 1 pint of the infusion, 440 grains of senna and 148 grains of fennel should be macerated with 13 fluidounces of boiling water for half an hour; after expression and straining 880 grains each of manna and magnesium sulphate should be dissolved in the infusion and sufficient water added to make the liquid measure 16 fluidounces.

Take of senna, 2 ounces; ginger, sliced, 55 grains; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

The first formula yields a preparation which is equivalent to the *black draught* of British pharmacy (see MISTURA SENNÆ COMPOSITA), and is recognized as such by the U. S. Pharmacopœia. The second formula may be regarded as yielding a simple senna infusion containing merely a corrective. Long-continued contact with hot water appears to increase the tendency of the senna to produce griping, particularly if digestion be resorted to. If the leaves have been cut or bruised, digestion for not over 10 minutes will yield an active infusion. The flavor being a matter of taste, the selection of aromatics had probably best be left to the physician.

POTION PURGATIVE MÉDECINE NOIRE, Fr. Cod.—Senna, 10 Gm.; rhubarb, 5 Gm.; boiling water, 120 Gm.; infuse for 30 minutes, express, and dissolve sodium sulphate 15 Gm. and manna 60 Gm.

TISANE ROYALE, Fr. Cod.—Senna, sodium sulphate, and fresh parsley leaves, each, 16 Gm.; anise and coriander, each, 5 Gm.; 1 lemon, sliced; cold water, 1000 Gm.; macerate for 24 hours.

INFUSUM SENNÆ COMPOSITUM, P. G., also known as *Aqua* (*s. Potio*) *laxativa Viennensis*—*Vienna draught*, E.; *Eau laxative de Vienne*, Fr.; *Wiener Trank*, G.—Is made by macerating 5 parts of cut senna with 45 parts of boiling water, and exposing it to the heat of a steam-bath for 5 minutes; when cold the liquid is expressed, and 5 parts of sodium and potassium tartrate, 1 part of sodium carbonate, and 10 parts of manna are dissolved in it; after straining add sufficient water up to 47.5 parts and add 2.5 parts of alcohol.

Uses.—The uses of this preparation are discussed under SENNA and MAGNESII SULPHAS. The carminative action of the fennel in the formula is said to prevent the griping effect of the senna. The dose is from 2 to 4 fluidounces (60–120 Cc.), to be repeated every hour until thorough purgation is effected.

INFUSUM SERPENTARIÆ, *Br.*—Infusion of Serpentary.

Tisane de serpentaire, Fr.; *Schlangenwurzelaufguss*, G.

Preparation.—Take of serpentary rhizome, in No. 10 powder, 1 ounce; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

Uses.—This preparation has been recommended in the treatment of chronic dyspepsia. The dose is from 1 to 2 fluidounces (30–60 Cc.), as indicated.

INFUSUM UVÆ URSI, *Br.*—Infusion of Bearberry.

Tisane d' uva ursi, Fr. ; *Bärentraubenblätteraufguss*, G.

Preparation.—Take of bearberry leaves, bruised, 1 ounce ; boiling distilled water, 20 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—Br.

Uses.—Infusion of uva ursi has been employed as a diuretic in doses of from 1 to 2 fluidounces (30–60 Cc.).

INJECTIO APOMORPHINÆ HYPODERMICA, *Br.*

Hypodermic injection of apomorphine, E.; *Injection hypodermique d'apomorphine*, Fr.; *Subcutane Apomorphineinspritzung*, G.

Preparation.—Take of apomorphine hydrochloride, 1 grain ; diluted hydrochloric acid, 1 minim ; distilled water, 110 minims or a sufficient quantity. Boil the distilled water for a few minutes; cool ; add the diluted hydrochloric acid ; dissolve the apomorphine hydrochloride in the resulting liquid ; add, if necessary, sufficient recently boiled and cooled distilled water to produce 110 minims of the injection.—Br.

The solution should be recently prepared, as it does not keep well. 11 minims represent $\frac{1}{10}$ grain of apomorphine hydrochloride.

Uses.—The injection should be freshly prepared and given subcutaneously in doses of from 2 to 8 minims (0.10–0.50 Cc.).

INJECTIO COCAINÆ HYPODERMICA, *Br.*

Hypodermic injection of cocaine, E. ; *Injection hypodermique du cocaine*, Fr. ; *Subcutane Cocaineinspritzung*, G.

Preparation.—Take of cocaine hydrochloride, 33 grains ; salicylic acid, $\frac{1}{2}$ grain ; distilled water, 6 fluidrachms or a sufficient quantity. Boil the distilled water ; add the salicylic acid ; dissolve the cocaine hydrochloride in the solution when cool ; add, if necessary, sufficient recently boiled and cooled distilled water to produce 6 fluidrachms of the injection.

11 minims of this solution contain $\frac{1}{10}$ grain of cocaine hydrochloride. The addition of salicylic acid prevents the formation of micro-organisms.

Uses.—Prepare this solution as needed and give subcutaneously in doses of from 2 to 5 minims (0.10–0.30 Cc.).

INJECTIO ERGOTÆ HYPODERMICA, *Br.*

Hypodermic injection of ergot, E. ; *Injection hypodermique d'ergot de seigle*, Fr. ; *Subcutane Mutterkorneinspritzung*, G.

Preparation.—Extract of ergot, 100 grains ; phenol, 3 grains ; distilled water, 220 minims or a sufficient quantity. Mix the phenol with the distilled water ; boil for a few minutes ; cool ; add the extract of ergot, and, if necessary, sufficient recently boiled and cooled distilled water to produce 330 minims of the injection.

This solution should be prepared recently. 10 minims contain 3 grains of extract of ergot.

Uses.—This solution should be freshly made when needed, and given subcutaneously in doses of from 5 to 10 minims (0.30–0.60 Cc.).

INJECTIO MORPHINÆ HYPODERMICA, *Br.*

Hypodermic injection of morphine, E. ; *Injection hypodermique de morphine*, Fr. ; *Subcutane Morphineinspritzung*, G.

Preparation.—Morphine tartrate, 50 grains; distilled water, a sufficient quantity. Dissolve the morphine tartrate in sufficient recently boiled and cooled distilled water to produce 1100 minims of the injection.

The use of morphine tartrate in place of the acetate, formerly directed, is a decided improvement, as solutions of the latter salt spoil readily. 11 minims of the solution contain $\frac{1}{2}$ grain of morphine tartrate.

Uses.—Prepare freshly as needed and give subcutaneously in doses of from 1 to 5 minims (0.05–0.30 Cc.).

INJECTIONES HYPODERMICÆ.—Hypodermic Injections.

This class of solutions although still recognized in the British Pharmacopœia, have been entirely replaced in this country by hypodermic tablets for preparing the solution extemporaneously. The tablets when carefully made are more convenient than a ready-made solution and keep much better. They are made by mixing the active medicinal agent with sufficient diluent—cane-sugar, milk-sugar, or sodium sulphate—to produce tablets of the required size, usually $\frac{5}{32}$ inch in diameter and from $\frac{1}{10}$ to $\frac{1}{8}$ inch thick, which are readily soluble in 10 or 15 minims of water previously drawn into the barrel of the hypodermic syringe.

INULA.—Elecampane.

Radix helenii, R. inulæ, R. enulæ.—Alicompane, Elf-dock, Wild sunflower, Velvet dock, E.; *Alantwurzel, Helenenwurzel, Glockenwurzel, Ottwurz,* G.; *Aunée officinale, Grande aunée,* Fr. Cod.; *Enula,* Sp.; *Elenio,* It.; *Enula Campane,* It., Sp., Port.

The dried root of *Inula Helenium* L. (*Corvisartia H.* Merat.; *Aster H.* Scop.—Fam. *Compositæ*).

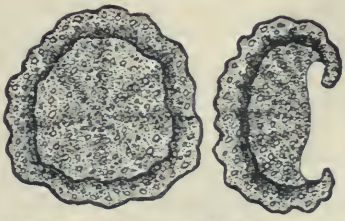
Inula is official in most pharmacopœias. The Belgian describes it as having a violet-like odor.

Origin.—From a large, very stout and coarse perennial herb, native of the temperate regions of Europe and Asia, and thoroughly naturalized in the eastern United States, where it can often be seen abundant in pastures, growing like the Mullein, preferring wet, rocky ground at and near the base of eastern and southern slopes. It produces a radical rosette of enormous ovate, acute leaves, with long margined petioles, somewhat toothed and softly- or velvety-hairy underneath. Those of the stem become shorter and relatively broader, and are clasping. The yellow heads form a loose terminal corymb and resemble small sun-

Fig. 229.

Inula (¾ Nat.).

Fig. 230.



Elecampane root: transverse sections (× 2).

flowers, but the florets have a hairy pappus. The root is supposed to be collected in the fall of the second or the spring of the third year, but there is little uniformity in custom. The thick root-branches are much interlaced and cling tenaciously to a large mass of soil which comes up with them, so that cleansing is difficult, requiring that the root be cup up and separated, and it is often very imperfectly performed.

Description.—Branching irregularly from an enlarged crown, crooked, rarely exceeding 2.5 Cm. (1 In.) in thickness, mostly cut into transverse or longitudinal slices, the latter mostly less than 15 Cm. (6 In.) in length; outer surface dark-brown, or in the smaller roots light-brown, longitudinally, and for the most part rather finely wrinkled; cut surfaces somewhat concave, pale-yellow, becoming gray with long keeping, smoothish, very finely striate, the edges only slightly incurved, thin and sharp; flexible in damp weather, breaking, when dry, with a short, sharp, fleshy fracture, the bark brown, the wood-zone yellow, somewhat radiate; coarsely dotted with resin-cells, the central portion paler; free from starch; odor peculiarly and sharply aromatic; taste bitter, pungent, and somewhat acrid.

Constituents.—Elecampane contains a trace of volatile oil, 2 per cent. of soft acrid resin, a bitter principle, wax, alantic anhydride ($C_{15}H_{20}O_2$), liquid aromatic alantol

($C_{10}H_{16}O$), helenin (C_6H_8O), true alant-camphor, inulin, pseudoinulin, and inulenin. *Helenin* occurs in odorless bitterish crystals. *Alant-camphor* is a white stearopten with a minty odor and taste, and melting at 64° C. (147.2° F.). *Inulin* (*alantin*, $6C_5H_{10}O_5.H_2O$) is a fine white, odorless, tasteless, very hygroscopic powder, resembling starch in appearance, but differing from it in giving a yellow instead of a blue color with iodine, in being soluble in boiling water without forming a paste, and in being deposited unchanged from the hot aqueous solution when it cools. By prolonged heat or the action of dilute acids it is changed first to *met-inulin*, then to *levulin*, and finally to *levulose*, of which it is probably the anhydride. It is only slightly changed to sugar by ferments. Dragendorff found 44 per cent. of inulin in the autumn roots, but only 19 per cent. in the spring, its place being taken by levulin, mucilage, sugar, and several glucosides. Inulin is closely associated in the plant with *inulenin* ($(C_6H_{10}O_5)_{10}2H_2O$), obtainable in microscopical needles, slightly soluble in cold water and weak alcohol, and *pseudoinulin* ($(C_6H_{10}O_5)_{16}.H_2O$), which occurs in irregular granules very soluble in hot water and weak, hot alcohol, only slightly soluble in cold water, and insoluble in cold alcohol.

Action and Uses.—Elecampane was formerly employed as a tonic, stimulant, diuretic, diaphoretic, expectorant, and emmenagogue, but has now largely fallen into disuse. It was recommended in the treatment of chronic pulmonary affections, typhoid states, menstrual disorders, dyspepsia, and chronic skin lesions. Externally applied, it is somewhat rubefacient, and it has been employed as an embrocation in the treatment of sciatica, lumbago, facial and other neuralgias. The internal dose is from 10 to 30 grains (0.60–2 Gm.), either in powder or in decoction.

Allied Drugs.—The leaves of *I. squarrosa* (L.) Bernh. (*Conyza s.* L.; *I. Conyza* DC.), the *Plowman's spikenard* or *Cinnamon root*, *Dürrwurz* or *Conyze*, of Europe, are used for their diuretic and emmenagogue properties, and burned as an insecticide.

Also classed with *Inula*, as possessing similar constituents and properties, are the following: *Pulicaria dysenterica* (L.) Gærtn. (*Inula d.* L.), the *Fleawort*, *Flohkraut* (G.), or *Pulicaire* (Fr.), a woolly European herb, and *Carlina acaulis* L., the *Carline thistle*, *Eberwurz* (G.), *Carline* or *Chardon doré* (Fr.). The root of the latter European perennial herb is used under the name *Radix carlinæ*. It is long, fleshy, about 25 Mm. (1 In.) thick, usually cut lengthwise, deeply wrinkled, and has a rather thin, light-brown bark and a grayish meditullium, with broad medullary rays. Rather large brown-red resin-cells are found in all parts of the parenchyma. It has a penetrating, unpleasant odor and a sweetish, burning, and bitter taste; its principal constituents are a little resin and a volatile oil, to which the odor and taste are due.

IODOFORMUM, *U. S., Br.*—Iodoform.

Iodoformium, P. G.—*Carboneum jodatum*, *Triiodomethane*, *Formyl teriodide*, E.; *Iodure de formyle*, *Iodoforme*, Fr.; *Jodoform Trijodmethan*, G.

Formula, CHI_3. Molecular weight, 390.61.

Iodoform should be kept in well-stoppered bottles in a cool and dark place.

Origin.—Iodoform was discovered by Serullas in 1822, and its composition was determined by Dumas in 1834. It is formed by the action of iodine in the presence of fixed alkalies or alkali carbonates upon alcohol, acetic and other easily saponifiable ethers, aldehyde, acetone, amylene, butyl, capryl, and propyl alcohols, kinic, meconic, and lactic acids, oil of turpentine, and some other compounds (Lieben, 1870). Pure ethyl ether, ethyl iodide, and allied compounds, methyl and amyl alcohol, chloral, chloroform, the fruit acids, lower fatty acids, various aromatic acids, glycerin, and other compounds, according to Lieben, do not yield iodoform under the conditions mentioned above.

Preparation.—For many years either Bouchardat's or Filhol's process was employed in the manufacture of iodoform. The former consists in heating iodine, potassium bicarbonate, alcohol, and water, in a long-neck flask, to between 60° and 80° C. (140° and 176° F.) until the color has disappeared, then adding small portions of iodine as long as these are taken up and decolorized; the mixture is finally set aside for 24 hours and the crystals collected on a filter. About one-third of the iodine is recovered as iodoform, the remainder forming potassium iodide.

Filhol's process insures a much larger yield. Iodine is added in small portions to a warm mixture of sodium carbonate, water, and alcohol, and, after cooling, the crystals

are collected; the filtrate is again warmed, some alkali carbonate added, and a rapid current of chlorine passed through the liquid as long as iodoform is separated, which is again collected and the filtrate made to yield more iodoform by repeating the treatment. The formation of iodoform may be illustrated by the following equation: $C_2H_5OH + I_8 + 6KHCO_3 = CHI_3 + 5KI + KCHO_2 + 6CO_2 + 5H_2O$, alkali formate being probably always produced, together perhaps with ethyl iodide, acetic ether, and other compounds. The result appears to be greatly influenced by the relative proportions of the materials used and the temperature employed.

In 1889 Sulliot and Raynaud devised a process for the preparation of iodoform direct from the ash of sea-weed (kelp), and this is now largely used in France. The ash is lixiviated, the sulphides and sulphites entering into solution are removed, and the amount of iodine present then determined; from the latter the necessary quantity of the other ingredients is calculated, thus a solution of 50 parts of sodium or potassium iodide is prepared, and to it are added 6 parts of acetone and 2 parts of caustic soda in 1000 to 2000 parts of water; finally a dilute solution of sodium hypochlorite is added, drop by drop, as long as iodoform is produced. The yield is about the theoretical quantity according to the following equation: $3NaI + 3NaClO + C_3H_6O = CHI_3 + 3NaCl + NaC_2H_3O_2 + 2NaOH$. Iodoform thus prepared is called by Casthélaz "absolute iodoform," since it is obtained in a state of great purity, without production of free iodine capable of giving rise to iodic compounds.

At present considerable quantities of iodoform are made by subjecting a solution of 50 parts of potassium iodide in 300 parts of water and 30 parts of alcohol to electrolysis, while a constant current of carbon dioxide is passed into the liquid.

Properties.—Iodoform is in small, lemon-yellow, scale-like, hexagonal crystals (microscopically quite characteristic), which have a pearly luster, are somewhat fatty to the touch, and have a strong characteristic odor and a peculiar sweetish and unpleasantly iodine-like taste. It is nearly insoluble in water, but by heating it with water for about 30 minutes to between 80° and 90° C. (176° and 194° F.) a permanent yellow solution is obtained, which, according to Schadewald (1882), contains between 0.5 and 0.7 per cent. of iodine. Iodoform dissolves at 25° C. (77° F.) in 9391 parts of water, to which it imparts its odor and taste, in 46.7 parts of alcohol, and in 5.2 parts of ether (U. S.); in 50 parts (P. G.), 80 parts (Br.) of alcohol at 15° C. (59° F.), in 12 parts (U. S.), about 10 parts (Br. P. G.), of boiling alcohol, in 5 parts (Br.), 6 parts (P. G.), of ether, and, according to Vulpius (1881), in 100 parts of petroleum benzin, in 67 parts of benzene, in 25 parts of oil of turpentine, in 14.3 parts of oil of lavender, in 12.5 parts of oil of cloves, in 11 parts of oil of fennel, lemon, or rosemary, in 7 parts of oil of cinnamon, and in 6 parts of oil of caraway; it is readily soluble in chloroform, carbon disulphide, and fixed oils; the solutions have a neutral reaction to test-paper, but when exposed to sunlight liberate iodine. Iodoform has the specific gravity 2.0, volatilizes slowly on exposure at ordinary temperatures, fuses at about 115° C. (239° F.), U. S., about 120° C. (248° F.) P. G., to a brown liquid, and sublimes partly unaltered, but at a higher heat is mostly decomposed into iodine and hydriodic acid, with a residue of glossy charcoal, which finally burns without residue. Heated with water, it volatilizes with the vapors without decomposition; but when boiled with potassium hydroxide solution a portion of it is decomposed, yielding potassium formate and iodide, and when distilled with alcoholic solution of potassium hydroxide an oily liquid of an ethereal odor and containing iodine is obtained in the distillate. On digesting about 0.1 Gm. of iodoform with 5 Cc. of an alcoholic solution of potassium hydroxide (1 in 20), and after adding 2 Cc. of chloroform, followed by chlorine-water, cautiously, drop by drop, with constant agitation, the chloroform should be colored violet.

Iodoform contains 96.69 per cent. of its weight of iodine, and the amount present in any of its preparations may be estimated gravimetrically with silver nitrate solution, insoluble silver iodide being formed: $CHI_3 + 3AgNO_3 + H_2O = 3AgI + 3HNO_3 + CO$ — 390.61 grains of iodoform requiring 506.07 grains of silver nitrate for complete decomposition and yielding 699.06 grains of silver iodide.

The odor of iodoform in mixtures and ointments is unpleasant, and may be disguised by the addition to 1 ounce of from 3 to 5 drops of oil of peppermint; Peru balsam, cumarin, the oils of fennel, anise, and others, have also been recommended. The odor adheres persistently to the vessels in which preparations of iodoform have been made, but may be removed by a few drops of oil of turpentine followed by soap and water.

Impurities are not likely to be present; the physical properties, and particularly its odor, behavior to solvents, neutral reaction, and complete volatility, determine the absence of impurities which might result from the process of manufacture. Fixed impurities would be left behind on heating a portion upon platinum-foil until the charcoal has been consumed. "On being dried over sulphuric acid to remove water, the loss in weight should not exceed 1 per cent. If 2 Gm. of iodoform be thoroughly shaken with 10 Cc. of water, the filtrate should be colorless and free from bitter taste (absence of soluble yellow coloring-matters, picric acid, etc.), should not affect the color of litmus-paper (absence of free acids), and should not be rendered more than faintly opalescent by silver nitrate test-solution (absence of soluble iodides)."—U. S.

Pharmaceutical Preparations.—Aromatized Iodoform, N. F.; Compound Powder of Iodoform, N. F.; Iodoform Ointment, U. S. P.; Iodoform Collodion, N. F., Iodoform Gauze, N. F.

Action and Uses.—Iodoform was at one time very largely employed as a local antiseptic in the dressing of wounds, burns, and other solutions of continuity; but investigation has shown that it possesses little antiseptic power on dry surfaces, and acts only when it is decomposed by moist organic matter. Even under these circumstances it is not a very powerful germicide. At the present time its surgical use has become very limited, although it is regarded as being perhaps the best local antiseptic which can be used when there is tubercular infection. Many surgeons still employ it in the form of iodoform gauze in the dressing of sinuses and deep wounds, but still others believe that they get equally good results, when the sinuses are non-tubercular, by the use of plain aseptic gauze. It is not safe to apply more than a drachm of the powdered iodoform over a large broken surface, as cases are on record in which serious poisoning has followed its absorption under these circumstances. Where, however, there are induration of the underlying tissues and low vitality, larger amounts than this may be used without danger of absorption. As already stated, it is in tubercular lesions that iodoform finds its greatest use as an antiseptic. Injected into cavities formed by tubercular abscesses after they have been drained, it is a most efficient form of treatment, and it is largely used in tubercular joint-affections.

Iodoform is also largely used as a dressing for syphilitic sores, particularly in tertiary syphilis, and when made into a fine powder is often puffed into the larynx in laryngeal tuberculosis. Fissure of the anus and inflamed hemorrhoids may be temporarily relieved by a 5-grain suppository of iodoform, because of the local anæsthesia produced in the mucous membrane by the drug.

Many gynecologists use iodoform gauze, iodoform ointment, or iodoform tampons for local alterative effect in subacute or chronic inflammations of the pelvic organs.

Iodoform is employed internally for chronic gastric catarrh, and for catarrh of the duodenum and hepatic ducts, with asserted advantage. The dose is from 1 to 3 grains (0.06–0.20 Gm.), in pill-form.

The symptoms of poisoning produced by the absorption of iodoform from surgical dressings may occur in several forms. If the poisoning is mild, there may be a general feeling of wretchedness, with headache and vomiting; while if it is more severe, there may be cerebral excitement, rapid pulse, disturbance of thought, and anorexia; in still more grave cases convulsions and active delirium followed by coma may develop. The urine is usually scanty or suppressed; and if the poisoning is severe, fatty degeneration in various organs may ensue. The onset of the poisoning may be sudden, and may occur several days after the iodoform has been applied. The treatment of iodoform-poisoning consists in the use of full doses of sodium bicarbonate to aid in the elimination of the iodine, the employment of alcoholic stimulants, copious draughts of water to flush the kidneys, the use of saline infusion, and the application of artificial heat if the temperature of the body falls. Sometimes iodoform may produce a rash on the skin resembling that of scarlet fever.

Derivatives and Allied Products.—Diiodoform. *Tetraiodoethylene.* C_2I_4.—Prepared by the action of iodine on silver acetylide, whereby acetylene diiodide is formed, to a solution of which in carbon disulphide the necessary amount of iodine is then added. After recovery of the carbon disulphide by distillation, the residue is crystallized from benzene. Its formation is indicated by the following equations: $C_2Ag_2 + I_4 = 2AgI + C_2I_2$; $C_2I_2 + I_2 = C_2I_4$. Diiodoform occurs as yellow faintly aromatic crystals, insoluble in water, difficultly soluble in alcohol and ether, but soluble in chloroform.

ANTISEPTOL. *Cinchonine-iodosulphate. Cinchonine herapathite.*—This compound was added to the list of iodoform-substitutes by Yvon in 1891. It is prepared by adding a solution of 25 Gm. of cinchonine sulphate in 2000 Cc. of water to a solution of 10 Gm. each of iodine and potassium iodide in water; the resulting precipitate is washed with water and dried at a moderate heat. Antiseptol occurs as a light powder of reddish-brown color, insoluble in water, but soluble in alcohol and chloroform. It contains about 50 per cent. of iodine, and its chemical formula is uncertain, varying with the mode of preparation.

ANTISEPTIN. *Borothymol zinc-iodide.*—Although claimed by the originator, Dr. Radlauer, to be of a definite chemical composition, antiseptin has been shown by Goldmann to be simply a mixture of zinc sulphate 85 parts, zinc iodide 2.5 parts, thymol 2.5 parts, and boric acid 10 parts.

EUROPHEN. *Diisobutylorthocresoliodide.* $C_{22}H_{29}O_2I = C_4H_9OCH_3C_6H_3C_6H_2.C_4H_9CH_3OI$. Molecular weight, 448.68.—This compound is prepared in a manner analogous to aristol, except that isobutylorthocreosol is used in place of thymol. It is an amorphous yellow powder, of a slightly saffron-like odor, insoluble in water and glycerin, but readily soluble in alcohol, ether, chloroform, and fixed oils. It contains 28.06 per cent. of iodine. It is permanent when dry, but when moistened with water splits up into iodine and a new soluble iodine compound; alkali hydroxides and carbonates likewise liberate iodine. Europhen fuses at 110° C. (230° F.), forming a clear brown liquid. It is 5 times as bulky as iodoform.

LOSOPHANE. *Triiodometacresol.* $C_6HI_3OH.CH_3$.—Introduced in 1892. It is prepared by adding an aqueous solution of iodine and potassium iodide slowly and with constant stirring to a solution of orthooxyparatoluic acid in sodium bicarbonate and water; after 24 hours the triiodometacresol will have separated, and may be washed with water and recrystallized from alcohol. Losophane occurs as colorless, odorless, needle-shaped crystals, which are almost insoluble in water, very difficultly in alcohol, but readily in ether, benzene, and chloroform, and at 60° C. (140° F.) also in fixed oils. It contains 78.39 per cent. of iodine, and melts at 121.5° C. (250.7° F.). Losophane is soluble in dilute sodium hydroxide solution without decomposition, but is decomposed by concentrated sodium hydroxide solutions with the formation of a greenish-black compound insoluble in alcohol.

SOZOIODOL. *Sozoiodolic acid. Diiodoparaphenolsulphonic acid.* $C_6H_2I_2OHSO_3H + 3H_2O$. Molecular weight, 476.25.—This acid and its salts have been especially recommended on account of the large proportions of iodine, phenol, and sulphur present. It is prepared by heating 2 parts of phenol and 1 part of strong sulphuric acid to about 110° C. (230° F.) for 2 or 3 days, whereby paraphenylsulphonic (sozonic) acid is formed. Any excess of carbolic acid is removed, and then iodine is added to form sozoiodolic acid. It contains about 54 per cent. of iodine, 20 per cent. of carbolic acid, and 7 per cent. of sulphur. It is a monobasic acid. The ammonium, lead, mercury, potassium, sodium, and zinc salts of this acid are the agents mostly employed, being recommended as substitutes for iodoform on account of their complete lack of odor; the lithium, aluminum, and magnesium salts have also been prepared. The sodium sozoiodolate, however, is most preferred on account of its ready solubility in water and glycerin (13–14 parts); it occurs in bright, prismatic, needle-shaped crystals. A 3 to 10 per cent. solution in water is found to be most desirable. The solubility in water of these various salts is as follows: the aluminum compound, 3 parts; sodium, 14; magnesium, 16; zinc, 20; ammonium, 30; lithium, 30; potassium, 70; lead, 200; silver, 350; mercury, 500 parts of water.

SULPHAMINOL. *Thioxydiphenylamine.* $C_{12}H_9OS_2N$.—This compound has been especially recommended on account of the absence of odor and taste. Although it is insoluble in water, it is supposed to be decomposed into carbolic acid and sulphur compounds by the digestive fluids. Sulphaminol is prepared as follows: Metaoxydiphenylamine is boiled with sodium hydroxide solution and sulphur; the filtered solution is treated with ammonium chloride, yielding sodium chloride in solution, and a yellow precipitate of sulphaminol which does not combine with ammonia, and which is washed with water and dried. It is a yellow powder, insoluble in water, readily soluble in alkalies, alcohol, and glacial acetic acid. When heated, it turns brown and softens, melting at 155° C. (311° F.). Under the names Sulphaminol—menthol, S. creosote, S. guaiacol, and S. eucalyptol, 8 per cent. solutions of the compound in the different liquids, have been introduced to the medical profession, especially for use in laryngeal tuberculosis.

THIOPHENE. C_4H_4S.—This hydrocarbon was discovered in 1883 by V. Meyer; it occurs in all commercial benzenes, and is isolated by active agitation with concentrated sulphuric acid: it is a colorless, mobile, oily liquid, with a feeble odor, boiling at 84° C. (183.2° F.), and not miscible with water. Thiophene itself has not been used in medicine, but two of its compounds have been successfully employed in Europe. Thiophene diiodide, $C_4H_2I_2S$, has been used as a substitute for iodoform in many surgical cases; it occurs in crystalline plates, is insoluble in water, but soluble in the other usual solvents; it contains about 9.5 per cent. of sulphur, 75.5 per cent. of iodine, melts at 40.5° C. (60° F.), and is volatile at ordinary temperatures. Sodium thiophene-sulphonate, $C_4H_3SNaSO_3$, is a white crystalline powder, containing 33 per cent. of sulphur; it has been used with favorable result in prurigo, proving superior to beta-naphtol, being non-toxic and non-irritating.

IODOLUM, *U. S.*—Iodol.

Tetraiodopyrrol, Pyrrol tetraiodide, E.; *Jodol, Tetrajodpyrrol,* G.

Formula, C_4I_4NH. Molecular weight, 566.17.

A derivative of the base pyrrol, $(CH)_4N$, obtained by direct replacement of hydrogen by iodine in an alcoholic solution of the base, and containing 88.97 per cent. of iodine.

Iodol is the oldest of the iodoform-substitutes, having been introduced by Ciamician and Silber in 1885.

Preparation.—It may be prepared, as stated above, by interaction of iodine and pyrrol in alcoholic solution, when upon addition of water iodol is separated in the form of yellow crystalline flocculi. It can also be obtained by adding a solution of pyrrol in sodium hydroxide solution to a solution of iodine and potassium iodide in water, the resulting precipitate being subsequently washed with water.

Properties.—Pure iodol is a pale-yellow (light grayish-brown, U. S.) bulky powder, more or less crystalline, which should be free from odor and taste. It is soluble at 25° C. (77° F.) in about 4900 parts of water, 9 parts of alcohol, 1 5 parts of ether, 105 parts of chloroform, and in fixed oils. It is soluble in concentrated sulphuric acid, with a green color gradually changing to brown.—U. S. Its alcoholic solution is miscible with glycerin. When heated, iodol remains unaffected up to 100° or 120° C. (212°–240° F.), but is decomposed at a temperature of 140°–150° C. (284°–302° F.), with liberation of violet vapors of iodine. If a mixture of iodol and sodium hydroxide be heated with metallic zinc, vapors of pyrrol will be given off, which will color pine-wood moistened with hydrochloric acid a deep-red color.

Tests.—Iodol when heated in a porcelain capsule should burn without residue (absence of inorganic impurities). 0.5 Gm. of iodol shaken with 100 Cc. of water gives a filtrate which should not be made more than slightly opalescent with silver nitrate test-solution (absence of hydriodic acid or other iodides). 0.5 Gm. of iodol shaken with 100 Cc. of water gives a filtrate which should not communicate more than a light-yellowish tinge to carbon disulphide (absence of appreciable amount of free iodine).—U. S.

Action and Uses.—Iodol possesses the same medicinal properties as iodoform, and because of its less disagreeable odor is sometimes substituted for the latter drug. It has been recommended internally in the treatment of diabetes and tertiary syphilis, and may be used by insufflation in tubercular laryngitis. Externally it has been employed in the treatment of eczema and syphilitic sores, and as an antiseptic dressing for small wounds and abrasions. The internal dose is from 2 to 5 grains (0.12–0.30 Gm.).

IODUM, *U. S., Br., P. G.*—Iodine.

Iode, Fr.; *Jod,* G.

Symbol, I. Atomicity usually univalent. Molecular weight, 125.9.

A non-metallic element, obtained principally from the ashes of seaweeds and from the mother-liquor of Chilian sodium nitrate. Iodine should be preserved in glass-stoppered bottles in a cool place, and be not less than 99 per cent. pure.—U. S.

Origin.—Iodine was discovered in 1811 by Courtois in the ash of seaweeds, and was soon afterward thoroughly investigated by Gay-Lussac; also by Davy, Soubeiran, and others. It is very widely distributed in nature, but is usually met with in small, and even quite minute quantity, almost invariably in combination. The only known occurrence of iodine in the free state in nature is in Woodhall Spa spring at Lincoln, Nebraska, which is colored brown by it. It is found in some minerals combined with mercury, silver, lead, and other metals; in Chile saltpeter, principally as sodium iodate; in many mineral spring-waters, in sea water, in coal, and in many plants and animals living in sea water or near the seacoast. It is often a constituent of the atmosphere in minute quantities, and occasionally of the ashes of some plants growing inland. The soluble iodine compounds of the sea are absorbed and accumulated to a wonderful extent in seaweeds and sponges. The investigations of Vogel, W. Marshall, and Fr. Hundeshagen, in 1895, were the first to give an explanation of this phenomenon, in showing that the iodine is stored in the form of complex carbon compounds. Hundeshagen found 8–14 per cent. of iodine in some sponges, which were rich in iodospongin, an organic com-

pound, classed as an albuminoid substance and yielding tyrosin when decomposed. Gautier (1899) showed that sea water contains no sodium iodide, but that the iodine is in the form of organic compounds to the extent of 2.3–2.4 milligrams per liter, of which 1.8 milligrams are dissolved, the rest suspended. He also showed that iodine exists in the atmosphere, not as iodides, but as organic material in the form of spores.

Since Emminghaus and Reinhold administered the thyroid gland with success in the cure of goiter, E. Baumann has isolated (1895) the active constituent of sheep's thyroid, which is present to the extent of only about 0.2 per cent., and has phenolic properties, being soluble in alkalies and reprecipitated by acids. It is remarkable for its great stability toward boiling 10 per cent. sulphuric acid, its intense physiological action, and, above all, its large amount of iodine, which has led to the names thyroiodine, thyrein, or iodothyrin. A pure sample of thyroiodine gave 9.3 per cent. of iodine. In the market it appears diluted with milk-sugar until it contains 0.03 per cent. of iodine, which is the same as in fresh thyroid glands.

Preparation.—Most of the iodine is now obtained from the mother-liquors of Chile saltpeter in South America, but some is still obtained from *kelp*, which contains about $\frac{1}{224}$ of its weight of iodine. Kelp is the ash left on the burning of seaweeds. The weeds are first dried, and then charred or burned at as low a temperature as possible, to avoid loss of iodine. The ash is exhausted with hot water, and the solution concentrated and cooled to remove by crystallization potassium chloride and sodium carbonate and sulphate. More of the latter salt will crystallize after the addition of sulphuric acid, whereby the sulphides and thiosulphates present are decomposed. To the mother-liquor, heated in lead retorts to a temperature a little over 60° C. (140° F.), manganese dioxide is added in small quantities, when iodine distils over, and is collected in glass receivers, several of which are connected with each other. The liberation of iodine from the sodium iodide of the liquor is explained by the following equation: $2NaI + 3H_2SO_4 + MnO_2 = I_2 + 2NaHSO_4 + MnSO_4 + 2H_2O$, acid sodium sulphate and manganous sulphate being formed at the same time. Improved processes of obtaining iodine from seaweeds have been introduced. One of these consists in charring the dried weeds in retorts to avoid loss of iodine. Another process consists in boiling the weeds with sodium carbonate solution, whereby iodine is extracted. The solution is acidified to precipitate algin and then neutralized and evaporated. The iodine is then liberated.

At Tarapaca, Chile, the mother-liquor from the saltpeter, which contains on an average 22 per cent. of sodium iodate, is treated with the calculated quantity of sulphurous acid, according to the equation: $2NaIO_3 + 5H_2SO_3 = Na_2SO_4 + 4H_2SO_4 + 2I$. The liberated iodine is filtered or distilled off, and sent into market as crude iodine. If it is not feasible to set up the apparatus on the spot for distilling off the iodine liberated as just described, it is reduced further to hydriodic acid by means of sodium sulphite or thiosulphate, and then converted into insoluble cuprous iodide by adding copper sulphate; thus, $2HI + H_2SO_3 + 2CuSO_4 + H_2O = 2CuI + 3H_2SO_4$. Cuprous iodide offers a convenient form for shipment. It is not employed to yield free iodine, but alkali iodides.

Purification.—In the crude state iodine is chiefly contaminated with water, but it sometimes contains also cyanogen iodide, and occasionally iodine chloride, ICl, and iodine bromide, IBr. The iodine is dried as much as possible by mechanical means and then mixed with potassium iodide and sublimed. The first portion is rejected as containing some possible cyanogen iodide, which is easily volatilized, after which sublimation is continued. The potassium iodide decomposes ICl and IBr; thus, $KI + ICl = KCl + 2I$. The product is the resublimed iodine of commerce. Iodine absolutely free from chlorine and bromine may be obtained by distilling a mixture of potassium iodide and a concentrated solution of ferric ammonium sulphate. Iodine is liberated by the ferric sulphate and sublimes.

Properties.—Iodine is in flat, scale-like rhombic crystals of a grayish-black or bluish-black color and a bright metallic luster, in thin splinters transparent with a red color. It is soft and friable, and has a peculiar odor, suggestive of chlorine, and a very caustic and acrid taste. The skin or paper is colored red-brown to dark-brown, the stain disappearing gradually. Iodine has neither an acid nor alkaline reaction, but slowly destroys all vegetable colors. It has the specific gravity 4.95, vaporizes slowly and without residue at ordinary temperatures, fuses near 115° C. (239° F.), congeals at 113.6° C. (236.5° F.), and boils above 175° C. (347° F.), according to Stas, when

quite pure at 250° C. (482° F.); its vapor has the density 8.7, and a reddish or purple, or above the boiling-point a deep-blue color. Iodine dissolves with a brown-yellow color in about 60 parts of glycerin, and in 7000 parts (Gay-Lussac) (5000 parts, according to U. S. P.) of water, and forms with it gradually hydriodic acid, which dissolves more iodine; its solubility in water is also increased by tannin and by many salts, and particularly by iodides. It requires for solution about 10 parts of alcohol at 25° C. (77° F.), and dissolves freely in ether, both solutions having a brown color; it is easily soluble in chloroform, carbon disulphide, benzene, and other hydrocarbons, with a purplish or violet color.

Iodine is readily recognized by the blue color which it imparts to starch-paste, by which test $\frac{1}{400000}$ part of free iodine is recognized. Water containing traces of free iodine will yield it to carbon disulphide, etc., in which solution it is recognized by the purplish color and by the blue color produced with starch-paste. Iodine in combination must previously be liberated by chlorine gas, avoiding an excess of the latter, or, if present as iodate, sulphurous acid or other deoxidizing agent will set it free.

Impurities and Adulterations.—At present iodine is usually met with in commerce in a very pure condition, containing but minute quantities of impurities. An excessive proportion of water is indicated by the iodine adhering to the bottle, and may be removed by placing it under a bell-glass over oil of vitriol at a low temperature; moist iodine yields with benzene or chloroform a turbid solution, from which the water gradually separates, the solution becoming clear. Iodine cyanide and iodine chloride are rather freely soluble in water, and their solutions dissolve iodine with a brown color; they may be separated by heating the iodine in a suitable apparatus for about 15 minutes to 100° C. (212° F.) and cooling the vapors well; the former impurity will sublime as white or yellowish needles, the latter as hyacinthe-red prisms or red-brown oil; both have a pungent odor. For their detection the following processes are given: If 0.5 Gm. of iodine be triturated to a fine powder, then shaken with 20 Cc. of water for a few minutes, the liquid filtered, and to one-half of the filtrate, contained in a test-tube, decinormal sodium thiosulphate solution carefully added until the liquid becomes discolored, then a few drops of solution of ferrous sulphate and subsequently a little sodium hydroxide test-solution added, and the mixture gently heated, on finally adding a slight excess of hydrochloric acid the liquid should not assume a blue color (absence of iodine cyanide). If to the other half of the above-mentioned filtrate, contained in a test-tube, a slight excess of silver nitrate test-solution be added, and the mixture actively shaken then, after subsidence of the precipitate, the clear, supernatant liquid be carefully and completely decanted, and the precipitate shaken with a mixture of 1 Cc. of ammonia water and 9 Cc. of water, the filtered liquid, after the addition of a slight excess of nitric acid, should not become more than slightly opalescent (limit of chlorine or bromine).—U. S. The following is the same test somewhat modified: If iodine be dissolved in sulphurous acid, the solution strongly supersaturated with ammonia, and completely precipitated by silver nitrate, the filtrate, on being supersaturated with nitric acid, should not at once become more than faintly cloudy (absence of more than traces of bromine or chlorine). The amount of pure iodine present is estimated volumetrically as follows: Place about 0.5 Gm. of iodine (1 Gm., Br., 0.2 Gm., P. G.) in a tightly-stoppered weighing-bottle and weigh accurately; add 1 Gm. of potassium iodide (2 Gm., Br. P., 1 Gm., P. G.), and dissolve in 50 Cc. of water (50 Cc., Br., 20 Cc., P. G.); then add tenth-normal sodium thiosulphate solution until the liquid is decolorized; The number of Cc. of tenth-normal sodium thiosulphate solution consumed, when multiplied by 1.259 (0.01259×100), and divided by the weight of the iodine taken, gives the percentage of pure iodine present. —U. S. The Br. P. requires in the above test 78.4 Cc. and the P. G. 15.6 Cc. of tenth-normal sodium thiosulphate solution, indicating respectively 98.7 and 98.94 per cent. of pure iodine. The reaction taking place during titration is: $2I + 2Na_2S_2O_3 = 2NaI + Na_2S_4O_6$. Owing to the fact that the pharmacopœias adopt different atomic weights for iodine, 1 Cc. of tenth-normal thiosulphate is equivalent to 0.012685 Gm. of iodine (P. G.), 0.01259 Gm. of iodine (Br., U. S.).

Fixed impurities, such as graphite, charcoal, sawdust, metallic compounds, etc., are left behind on volatilizing a little iodine from a porcelain dish.

Pharmaceutical Preparations.—Carbolized Solution of Iodine, Churchill's Tincture of Iodine, Decolorized Tincture of Iodine, N. F.; Compound Solution of Iodine, U. S. P.; Iodine Caustic, Iodine Liniment, Iodized Carbolic Acid, Iodized Collodion, Iodized Starch, N. F.; Tincture of Iodine, Ointment of Iodine, U. S. P.

Action and Uses.—When iodine is applied to the skin in concentrated form, in ointment or in alcoholic solution, it produces a sense of warmth in the part, which may increase in degree till it amounts to a painful burn, causing redness and swelling of the part and adjacent tissues. The tincture stains the skin a brownish-yellow; or if it has been applied freely, a brownish-black. A considerable amount of this discoloration disappears as the drug is volatilized by the heat of the body if the application has been a mild one; but if it has been severe, a large part of it remains. A very small quantity of iodine is absorbed through the skin unless the epiderm is broken. In one instance in which a colored boy was painted with tincture of iodine from the knees to the ankles, acute poisoning ensued 24 hours afterward; the symptoms consisting of headache, of pain over the kidneys and in the bladder, followed by vomiting, thirst, suppression of urine, priapism, and hiccough. The stools became bloody, and death occurred from exhaustion 6 days later. There are a few other instances in which small areas of unbroken skin have seemed to absorb iodine in sufficient quantity to produce systemic symptoms, but this occurrence must be considered a rare one. When the epiderm is broken, iodine is rapidly absorbed through the skin. The vapors of iodine, when inhaled, act as a stimulant, and then as an irritant to the mucous membrane, and cause headache, coryza, lachrymation, and general respiratory irritation. The drug is eliminated from the body in practically all the secretions, particularly if a sodium or potassium salt is given simultaneously, when it escapes in the form of a soluble iodide.

Iodine is employed externally as a counterirritant over deep-seated inflammations and to cause the absorption of abnormal fluids in synovial membranes. Under these circumstances it is wise to apply several coats of tincture of iodine with a camel's-hair brush, and to repeat the application every day till signs of desquamation of the epiderm or slight tingling is produced, when the applications should cease till the skin is once more able to stand the application of the drug. Should too much iodine be inadvertently applied, the part may be washed with alcohol and a starch poultice placed over it, since starch is the antidote.

Taken internally, iodine, both in substance and solution, acts as an intense gastro-intestinal irritant, and so produces vomiting, diarrhœa, and collapse. But it is a noteworthy fact that while the symptoms are often of the greatest possible severity, death has rarely occurred from this accident. It is possible, however, when death does not ensue as a result of the acute gastro-enteritis for the patient to die of the secondary fatty degeneration in the various organs of the body which is produced by the iodine.

Internally, iodine has been used in the free state to a limited extent. Some practitioners have strongly recommended its use in the dose of 2 or 3 minims (0.10–0.20 Cc. of the tincture 3 times a day in the treatment of typhoid fever and intermittent fevers, but this use of it has become obsolete. Iodine as iodine is very seldom given internally. Perhaps its most common use is in the dose of ½ to 1 minim (0.025–0.05 Cc.) of the tincture with the same quantity of carbolic acid in a little water in the treatment of obstinate vomiting.

At one time tincture of iodine was largely employed in the cure of hydrocele. After the fluid had been evacuated, the pure tincture was injected directly into the sac. This method of treatment has now been largely displaced by more modern and less painful methods.

The best antidote for a poisonous dose of iodine is starch mixed with warm water; white of egg and milk are also advantageous. Sodium bicarbonate may also be given freely. The stomach should be washed out by means of a stomach-tube or emptied by means of emetics, and after this viscus has been thoroughly rid of the poison opium should be given to relieve pain and quiet the patient.

Various preparations of iodine are more commonly used in internal medicine than is iodine itself, as, for example, Lugol's Solution (see Liquor Iodi Compositus) and Donovan's Solution (see Liquor Arseni et Hydrargyri Iodidi).

COMPOUNDS OF IODINE.

Iodine combines in several proportions with oxygen, the most important compound being **iodic acid**; it unites with hydrogen to form hydriodic acid, and combines with most of the other elements and with many organic compounds.

The **iodides** of the metals are partly crystallizable, and are either white or not infre-

quently of a bright color. With the exception of those of gold and allied metals, they are mostly not decomposed by heat, except in contact with air or with oxidizing agents. The alkali iodides are more volatile than the corresponding chlorides, and on being heated with calcium sulphate in the air evolve iodine, while alkali sulphate and calcium oxide remain. The iodides are decomposed by chlorine, bromine, nitric acid, and strong sulphuric acid, and on being heated with acid sulphates. Most of the iodides are soluble in water, and these solutions are precipitated dingy white by cuprous and cupric salts, the latter liberating a portion of the iodine; bright-yellow by lead salts; brown by bismuth salts; green-yellow by mercurous salts; scarlet-red by mercuric salts; yellowish-white by silver salts; yellow or green by gold salts; black with palladium salts; and dark-brown by platinum salts, the solution acquiring at first a deep brown-purple color. The valence of iodine is variable; in hydriodic acid and iodides it is univalent, while in iodic acid, chloride and bromide of iodine, and some other compounds, it is evidently trivalent or pentavalent.

Iodi Bromidum. *Bromide of iodine, Iodine pentabromide; Bromure d'iode,* Fr.; *Jodbromid,* G. IBr_5.—Iodine pentabromide is prepared by dissolving 20 parts of iodine in 63 parts of bromine, and heating the solution for some time in a large flask to about 60° C. (140° F.) until it yields a clear solution with 6 or 8 parts of water. It is a dark reddish-brown liquid, resembling bromine in appearance and sensible properties, but yielding a perfectly transparent brown-red solution with less than 6 parts of water. In the presence of a small quantity of water and at a low temperature the hydrate crystallizes in brown-yellow needles or prisms, melting again at 4° C. (39.2° F.), with separation of water. A solution containing 15 per cent. of the bromide is found in commerce. When the compound is kept for some time at or above 63° C. (145.4° F.), the boiling-point of bromine, a portion of the latter distils off, and iodine monobromide, IBr, is left as a dark-brown sublimable crystalline mass. Iodine tribromide, IBr_3, may be prepared by using only 37.8 parts of bromine for every 20 parts of iodine. The pentabromide is used locally in diphtheria in solution of 2 drops to a fluidounce of mucilage.

Iodi Chloridum. *Chloride of iodine. Iodine trichloride,* E.; *Chlorure d'iode,* Fr.; *Jodtrichlorid, Dreifach-Chlorjod,* G. ICl_3.—If dry chlorine gas be passed over dry iodine, union of the two elements takes place, a liquid results, and iodine monochloride will have been formed; the reaction is ended when the iodine has acquired the calculated increase in weight. ICl_3 is a reddish-brown liquid which in the course of time deposits crystals melting at 25° C. (77° F.). If the process be somewhat modified, so that dry iodine be sublimed in vessels containing a constant excess of dry chlorine gas, iodine trichloride will be formed as orange-yellow needles having the specific gravity 3.11, and gradually changing to large transparent rhombic plates. It has a penetrating, pungent odor, resembling bromine; when heated to 25° C. (77° F.) it liquefies and is decomposed, chlorine being given off and iodine monochloride formed. Iodine trichloride is soluble in 5 parts of water, and also in alcohol and ether; a concentrated aqueous solution keeps well, but a diluted aqueous or an alcoholic solution gradually changes even in the cold, forming iodine monochloride, iodic acid, and hydrochloric acid. If concentrated sulphuric acid be added to a strong aqueous solution, a white curdy precipitate will form, which is iodine trichloride, and soon assumes the characteristic orange-yellow color. Iodine trichloride contains 54.39 per cent. of iodine and 45.61 per cent. of chlorine, and has been employed internally in doses of about $\frac{1}{6}$ grain and externally in aqueous solution (0.1–0.2 per cent.) as lotion or injection.

Iodo-tannin.—It has long been known that iodine dissolves in solutions of tannic and gallic acids, forming reddish-brown liquids in which free iodine can no longer be detected by starch-paste. Until recently the view prevailed that the iodine entered into chemical combination with tannin, and the name iodo-tannin was given to this compound as early as 1854. Formulas have been repeatedly published for preparing a syrup, tincture, and wine of iodo-tannin, and these preparations have been used to some extent, especially in France. Power and Shedden (*Pharm. Jour.*, Aug. 5, 1901) have shown that true or definite compounds of iodine with either tannic or gallic acid cannot be formed by the simple interaction of these bodies in the presence of water, for under these circumstances the iodine acts simply as an oxidizing agent. The resulting products, therefore, contain the iodine in the form of hydriodic acid associated with unaltered tannic or gallic acid and the oxidation-products of the latter.

IPECACUANHA, *U. S.*—Ipecac.

Ipecacuanhæ radix, Br. P.; *Radix ipecacuanhæ,* P. G.—*Ipecac,* E.; *Ipécacuanha annelé (officinale)* Fr. Cod.; *Radix Cephaëlidis,* Nor.; *Brechwurzel, Ruhrwurzel,* G.; *Racine brésilienne,* Fr.; *Ipecacuanha officinal, Bejuquillo,* Sp.; *Hippo, Cipo Emetico, Poaya Verdadera,* Port.

The dried root, to which may be attached a portion of the stem not exceeding 7 Cm. in length, of *Cephaëlis Ipecacuanha* (Brotero) A. Richard (*Callicocca I.* Brotero; *Psy-*

chotria I. Stokes; *C. emetica* Pers.; *Ipecacuanha officinalis* Arruda; *Uragoga I.* Baillon. —Fam. *Rubiaceæ*), known commercially as *Rio, Brazilian,* or *Para Ipecac,* or the corresponding portion of *C. acuminata* Karsten, known commercially as *Carthagena Ipecac,* yielding, when assayed by the process given below, not less than 2 per cent. of ipecac alkaloids.

Ipecac is official in all pharmacopœias, and all but the Italian restrict it to the root first named above, though various synonyms are employed by them in naming it. The British calls it *Psychotria,* on the ground that the establishment of this name was prior to that of *Cephaëlis;* but this claim is without weight, since the structure of the plant excludes it from the genus *Psychotria.* The German calls it *Uragoga,* because that name was established by Linné as early as 1737; but in accordance with the agreement, now almost uniform, that botanical nomenclature shall not date from any period prior to the year 1753, the first name used upon or after that date must be adopted, and "*Uragoga*" was not employed until 1867–69, when it was taken up by Baillon. In the meantime (1788), the name *Cephaëlis* was established for the genus by Swartz. In 1805 Brotero named the Ipecac plant *Callicocca Ipecacuanha,* in disregard of the generic name already established, and Richard subsequently transferred the specific name *Ipecacuanha* to its proper connection with Cephaëlis. The Italian Pharmacopœia specifies the Carthagena variety, named above. The Swedish Pharmacopœia directs that roots denuded of bark are to be rejected. Most pharmacopœias specify that only the bark is to be included in the powder. Several regard the rejected wood as amounting to about 25 per cent., one (the Swiss) to but 15 per cent., a question which will be found discussed under *Constituents.* The Russian provides that in decoctions and infusions the entire root may be used.

Origin.—The Brazilian Ipecac plant is rather widely distributed through Brazil and adjacent Bolivia, and the drug is chiefly collected in the vicinity of the Itenez River, whence it is exported, either southeastward *via* Rio Janeiro, or northeastward *via* Para. The plant is a low, straggling, soft-wooded shrub, growing in rich forest-loam, the base of the stem partly prostrate and more or less covered with vegetable débris. This habit of growth results in a sharp distinction between the lower and upper portions of the stem, this lower portion being quite largely collected with the root, such a product being designated commercially as "stemmy." Its relative quality is discussed under *Constituents.* The bulk of the crop is gathered between January and March, when the ground is soft. The roots are torn up by means of a curved and sharpened stick. The irritating character of the plant-juice results in the production of sores upon the hands, and even upon other parts of the bodies of the collectors, so that the labor is highly objectionable, the natives only engaging in it when other work, such as rubber-gathering, is unobtainable. The high price of the drug is largely due to this cause. The drug is dried in the sun, often imperfectly, and is then packed very tightly in hide-bound bales, called *serons.* Storage of the bales is careless and continues until chance traders visit the region. Subsequent transportation is subject to great vicissitudes of weather and exposure to river-water, so that moulding of the root is of the most common occurrence. It is estimated that the contents of about 75 per cent. of the imported serons are damaged by mouldiness or otherwise by water. Little is known regarding the Carthagena Ipecac plant and its collection. Various attempts to cultivate Ipecac have been made in India, but with little success, owing apparently to a lack of adaptability to soil and climate. Ipecac grown at Johore, Straits Settlement, is practically equal in appearance and quality to that from Brazil.

Description.—*Rio Ipecac.*—In pieces of irregular length, rarely exceeding 25 Cm.; stem portion 2 to 3 Mm. thick, light gray brown, cylindrical, and smoothish; root portion usually red brown, occasionally blackish brown, rarely gray brown, 3 to 6 Mm. thick, curved and sharply flexuous, nearly free from rootlets, occasionally branched, closely annulated with thickened, incomplete rings, and usually exhibiting transverse fissures with vertical sides through the bark; fracture short, the very thick, easily separable bark whitish, usually resinous, the thin, tough wood yellowish white, without vessels; odor very slight, peculiar, the dust sternutatory; taste bitter and nauseous, somewhat acrid.

Carthagena Ipecac.—Is similar to Rio Ipecac, but about one-half thicker, dull gray externally, with thinner, merging annulæ, and the fracture-surface of the bark gray.

The stem-portions should show no marked indications of having been leaf-bearing, such an indication applying to portions which have been exposed to light and air, which

would probably tend to decrease the alkaloidal percentage. Ipecac in which the bark is very thick as compared with the woody centre is denominated "fancy" or "bold," while that in which the woody centre is relatively thick is denominated "wiry."

The powder of Ipecac is of a light brownish gray. Under the microscope, its characteristic elements are seen to be chiefly thin-walled parenchymatic cells containing an abundance of starch, the grains mostly compound, and usually of 2 to 4 units, the single ones mostly less than 10 mikrons in diameter. Bundles of needle-shaped crystals, or the scattered crystals, are common. Thin-walled cork-cells are rather abundant, as well as tracheids bearing numerous small pores. Wood-fibres should be nearly or quite absent.

Fig. 231.

Ipecacuanha.

Fig. 232.

Striated ipecacuanha.

Fig. 233.

Undulated ipecacuanha.

The presence of large, rather thick-walled pith-cells indicates a more or less stemmy quality of drug.

Ipecac root grown in the East Indies has been noted as exhibiting a much greater number of delicate rootlets than the Brazilian.

Damaged Ipecac, as indicated under *Origin*, is very common. It is frequently washed for the purpose of improving its appearance and then dried, the latter process usually imparting a smoky odor to it. By this process, much of the bark is caused to peel off; but by subsequent garbling it is easy to obtain an article which, to the uninitiated, presents an even better appearance than the natural, notwithstanding that it is almost uniformly deficient in alkaloid.

When Rio Ipecac only was official, the Carthagena variety was sometimes garbled and stained to resemble it, and was imported for it.

Several pharmacopœias specify that the aqueous infusion of Ipecac should yield a copious precipitate with Mayer's Solution; the German, that hydrochloric acid with which the root has been shaken should turn blue on the addition of an aqueous solution of iodine, or intensely red on being sprinkled with chloride of lime; the Swiss, that picric acid turns the hydroalcoholic infusion opaque and produces a yellow precipitate, and that the addition to such an infusion of dilute hydrochloric acid, with a little potassium chlorate, colors it orange-red, with reddish fluorescence.

Substitutes and Adulterants.—A very large number of drugs share the emetic and nauseating-expectorant properties of Ipecac, and have been proposed as substitutes for it (see *N. Y. Med. Jour.*, Feb. 11, 1893). Most of these, like the Spurges, Gillenia, Cocillana, Naregamia, and Asclepias, are considered elsewhere in this work. Many others, most of them also resembling Ipecac in properties, have been employed as adulterants, because of their resemblance to it in appearance, and because of the general term "Poaya" being applied in Brazil to plants possessing such properties.

The most important adulterant and substitute is *Undulated* or *Farinaceous Ipecac*, the root of *Richardia scabra* L. (*Richardsonia s.* St. Hil.; *Richardia pilosa* R. et P.;

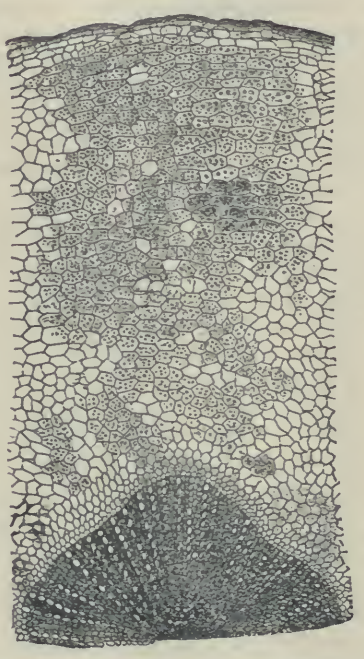
Richardsonia p. H. B. K.), a low herb, in the same family with Ipecac, very widely distributed and abundant in tropical and subtropical America. The root is vertical, often with several small, usually parallel, branches from near the crown, waving or flexuous, tapering gradually, of a pale gray-brown color, usually marked alternately on the sides with sharp constrictions, which pass only part of the way around. Its bark is thick, like that of Ipecac, and of a white fracture. The wood is softer and weaker than that of Ipecac, and is porous and of a yellowish color. This root has also been used to adulterate Senega. A somewhat similar form of it, known as *Small Striated Ipecac*, is referred to the same genus. Both contain a principle very similar to, if not identical with, emetine, and are emetic.

Large Striated Ipecac, or *Black Striated Ipecac*, is the root of *Cephaëlis emetica* Mutis, of the Andean region. The greater portion of its surface is of a dark-brown or even blackish color. It is less crooked than Ipecac, about as large as large Carthagena samples, longitudinally striate, and with scattered deep constrictions or fissures. The bark-fracture is similar to that of the Carthagena, but even darker, and often purplish brown or gray.

The root of *Cephaëlis tomentosa* Vahl. is somewhat employed in tropical America, where it is very widely distributed. It is little constricted, somewhat striate, of a dark gray brown, and its bark is not nearly so thick as that of Ipecac. Various other species of Cephaëlis are also more or less used, especially *C. violacea* Willd.

The term *White Ipecac* is applied to what appears to be the roots of several species of *Ionidium* (Fam. *Violaceæ*), especially to those of *I. Ipecacuanha* Vent., of Brazil, and apparently from other parts of tropical America. It is crooked and irregularly branched. Externally, it resembles Ipecac in its constricted and fissured character, but is larger and much lighter colored. Internally, it bears little resemblance, being more starchy and radiate, and with a thin bark. Other species of Ionidium reported as similarly employed are *I. microphyllum* H. B. K., *I. parviflorum* Vent., and *I. polygalifolium* Vent.

FIG. 234.



Ipecacuanha root, transverse section (× 65).

Various species of Polygala, especially *P. violacea* St. Hil., *P. caracasana* H. B. K., and *P. angulata* DC., have been reported as similarly employed, but their use appears neither common nor important.

The root of *Heteropterys pauciflora* Juss. has been recently introduced as an adulterant. It rather closely resembles Ipecac, but contains no starch, this being replaced by an inulin-like body.

Constituents.—As to its mechanical elements, the bark of the root of Rio Ipecac is variously estimated to represent from 75 to 90 per cent. of the weight, the remainder consisting of the woody portion. In the stem the percentage of bark is somewhat less. Research Committee "C" of the U. S. P. Revision Committee of 1890 found that the wood represented a little less than 11 per cent. in a first-class article. 13½ ounces of root yielded 8⅞ ounces of No. 60 powder and 3⅜ ounces of No. 80 powder.

A good quality of Carthagena Ipecac has been found to yield 20 per cent. of wood, and 25 ounces of it yielded 8⅛ ounces of No. 60, and 12 ounces of No. 80, powder.

The important constituent from a medical standpoint is the mixed alkaloid considered below. In a root of good quality the alkaloid amounts to between 2 and 3 per cent. All authorities agree that this alkaloid exists to but a very slight extent in the wood, and it appears that in the bark it is most abundant just underneath and in the corky layer. The relative richness in alkaloids of the root and stem has been the subject of much discussion, and the conclusions of different experimenters vary most widely. Dohme has reported that stemmy Ipecac is actually richer than the root in alkaloid; Paul and

Cownley, who have devoted much time to studying the composition of this drug, report the stem as containing about one-third less alkaloid than the root. Attfield found 1.95 per cent. in Ipecac of which 34.3 per cent. was stem, and 1.82 per cent. in one of which 37.4 per cent. was stem. He found the difference in content of alkaloid between root and stem to amount from 0.13 to 0.6 per cent. The probability is that this relation depends largely upon the character of the stem examined. Judging from what we know of other drugs, and from theoretical considerations, that portion of the stem which is excluded from light and air would develop practically as much alkaloid as the root itself, while the production should decrease in the exposed portion. Another question which has received much attention is the relative value of wiry and bold roots. Since it is known that alkaloid is almost wanting in the wood, it would seem almost certain that a bold root would be richer than a wiry one; yet Dohme and Kebler both report the wiry root to be the richer. It is not impossible that this difference may be due to the larger amount of starch existing in the bolder root, and this in turn might be modified by the season of collecting; but this question must be regarded as still unsettled.

The non-alkaloidal constituents of Ipecac are about 40 per cent. of starch; usually some cane-sugar; resin, wax, and fat; a trace of nauseating volatile oil; *erythrocephælin*, a coloring-matter becoming deep-purple with alkalies; and about 2.25 per cent. of *ipecacuanhic acid* ($C_{14}H_{18}O_7$), a glucoside resembling caffeotannic and kinic acids, and which, in the drug, holds the alkaloids in combination. Paul and Cownley regard this acid as a mixture, consisting in part of saponin. It is an irritating substance.

The alkaloids of Ipecac are almost wholly emetine and cephæline, there being present a very small amount of psychotrine, and apparently a trace of a fourth alkaloid. Of the total alkaloid of Rio Ipecac, nearly three-fourths is emetine, and about one-fourth cephaëline, whereas in Carthagena Ipecac Paul and Cownley found only 0.89 per cent. of emetine, against 1.25 per cent. of cephaëline.

Emetine (methyl-cephæline, $C_{15}H_{22}NO_2$) is an amorphous white alkaloid, soluble in alcohol, ether, chloroform, fixed oils, benzene, and acetic acid, slightly soluble in water and hot petroleum ether, and insoluble in alkalies and essential oils. It melts at 69° C. (156.2° F.) and upon exposure to light gradually assumes a yellow color. Emetine forms crystalline halogen salts and nitrate, the acetate and sulphate being amorphous. Commercial emetine is a mixture of alkaloids, sometimes contaminated with resin or ipecacuanhic acid, and varies in color from brownish-gray to brown. *Cephæline* ($C_{14}H_{20}NO_2$) occurs in white silky needles, soluble in alcohol, chloroform, benzene, and caustic alkalies. It is less soluble in ether, but more soluble in boiling petroleum ether than emetine, and may be readily separated from the latter by its solubility in sodium hydroxide solution. Its salts are amorphous. *Psychotrine* is an uncrystallizable alkaloid which is decomposed by light.

If a drop of Fröhde's reagent be applied to emetine on porcelain, a dirty green color is produced, changed to grass-green by hydrochloric acid. Cephæline, in the same way, gives a purple coloration, changing to a Prussian blue with hydrochloric acid. Psychotrine gives a dull purple changing to a green. (*Allan and Scott-Smith.*)

Assay of Ipecac.—The following is the official process for the assay: Introduce 15 Gm. of ipecac, in No. 80 powder, into an Erlenmeyer flask of 250 Cc. capacity, add 115 Cc. of ether and 35 Cc. of chloroform, shake the flask during 5 minutes, and then add 3 Cc. of ammonia water and shake the flask at intervals during half an hour. Now add 10 Cc. of distilled water, shake the liquid until the powder collects in masses, and pour off 100 Cc. of the clear ether-solution into a measuring cylinder. Transfer the latter to a separator, add 10 Cc. of normal sulphuric acid and 10 Cc. of distilled water. Shake the separator moderately during 2 minutes, and when the liquids have separated, draw off the lower solution into a second separator. Repeat the shaking out of the ether-solution with 3 Cc. of normal sulphuric acid and 5 Cc. of distilled water, drawing off the acid solution into the second separator. Repeat the shaking out again, using 10 Cc. of distilled water, and add the aqueous solution to the second separator. Reject the ether in the first separator, introduce a small piece of red litmus-paper into the second separator, add enough ammonia water to render the liquid alkaline, and 25 Cc. of ether, and then shake the separator vigorously during 5 minutes; draw off the alkaline liquid into the other separator, and the ether-solution into a flask. Again shake out the alkaline liquid with 10 Cc. of ether, and, having shaken the separator during 1 minute, add the ether-solution to the liquid in the flask, rejecting the alkaline liquid. Distil the ether from the flask with the aid of a water-bath, and

dissolve the alkaloidal residue in exactly 12 Cc. of tenth-normal sulphuric acid, warming gently on a water-bath if necessary. Then add 5 drops of hematoxylin test-solution and titrate with fiftieth-normal potassium hydroxide solution. Divide the number of cubic centimetres of fiftieth-normal potassium hydroxide solution used, by 5, subtract the quotient from 12 (the 12 Cc. of tenth-normal sulphuric acid taken), and multiply the remainder by 0.0254 and this product by 10, which will give the percentage of alkaloids in the ipecac.—U. S.

Pharmaceutical Preparations.—Fluidextract of Ipecac, Powder of Ipecac and Opium, Syrup of Ipecac, Tincture of Ipecac and Opium, Wine of Ipecac, U. S. P.; Syrup of Ipecac and Opium, N. F.

Deemetinized Ipecac (*Pulvis Ipecacuanhæ Deemetinisatus*) has been used to some extent. While freed from the emetic principles of the drug, it retains its antidysenteric properties, and is prepared by extracting powdered ipecac root with ammoniacal chloroform, acidulating the resulting solution with diluted sulphuric acid, shaking out the alkaloids with water and then adding the chloroformic liquid to the extracted residuary powder, which mixture is finally dried and again powdered.

Action and Uses.—When locally applied, ipecac acts as a counterirritant, and if allowed to remain in contact with the skin for any length of time, causes a vesicular eruption and considerable irritation. In very minute doses it stimulates the gastro-intestinal tract, thereby increasing the flow of the gastric juice and aiding in digestion. Small doses are diaphoretic and expectorant. In large doses ipecac produces nausea, vomiting, muscular relaxation, and profuse bronchial secretion, and it sometimes causes purging. If emetic doses remain in the stomach sufficiently long, the drug produces circulatory depression and diminishes the activity of the spinal cord. Ipecac is eliminated by the skin, kidneys, and gastro-intestinal tract. Ipecac may be employed as an emetic for the purpose of emptying an overloaded stomach, and is particularly useful in removing mucus from the stomach of young children suffering from digestive disorders. Minute doses are sometimes used in treating vomiting due to depression and for the vomiting of pregnancy. It has been employed successfully in the treatment of cholera morbus, choleraic dysentery, and dysentery, It may be given as a sedative expectorant in the early stages of acute bronchitis, and the wine of ipecac in the form of a spray has been recommended in the treatment of chronic bronchitis. A paste made with powdered ipecac when locally applied is said to relieve the pain and swelling caused by the sting of bees, and a 25 per cent. ointment may be used for its counterirritant properties.

As an emetic, powdered ipecac may be given in doses of 20 grains (1.3 Gm.), and repeated in a half hour if needed. To a child the syrup may be given in doses of from 1 to 3 fluidrachms (4–12 Cc.). As a gastric stimulant the dose is from $\frac{1}{6}$ to $\frac{1}{2}$ grain (0.01–0.03 Gm.), every half hour for 6 doses. As a diaphoretic the dose is about 1 grain (0.06 Gm.). The dose of pure emetine as an emetic is $\frac{1}{8}$ grain (0.008 Gm.). The alkaloid is much more nauseating and prolonged in its action than the drug itself.

IRIS.—Iris.

Blue, Water, or Poison flag, Flag lily, Liver lily, E.; *Verschiedenfarbige Schwertlilie, Amerikanischer Schwertel,* G.; *Rhizome d'iris varié, Flambe variée, Glaïeul bleu,* Fr.; *Liria americana,* Sp.

The dried rhizome and roots of *Iris versicolor* L. (Fam. *Iridaceæ*).

Iris is official only in the United States.

Origin.—A perennial herb of swamps or low grounds throughout eastern and central North America, 2 or 3 feet high, with narrow, equitant, sword-shaped leaves, and large, 3-merous, lily-like flowers, blue except for the yellow and whitish markings at the base of the sepals. Owing to similarity of name, as well as of appearance before blooming, this is sometimes mistaken by children for Sweet Flag, or Calamus, which grows in the same localities, with the production of results more or less poisonous.

Description.—Rhizome of horizontal growth, branched, the branches 5 to 10 Cm. (2 to 4 In.) long and 1 to 2 Cm. ($\frac{2}{5}$ to $\frac{4}{5}$ In.) thick, cylindrical in the lower half, thence becoming vertically flattened toward the crown, where it is terminated by a circular scar; dark-brown, wrinkled, annulate with the leaf-bases; fracture short, purplish; roots long, slender, simple, crowded near the flattened end; odor peculiar; taste pungent, acrid, and nauseous.

Constituents.—The rhizome contains starch, gum, tannin, oil, 25 per cent. of acrid resinous matter, and possibly an alkaloid (Cressler, 1881). Distilled with water, the

fresh rhizome yields an opalescent distillate, from which separates a white, camphoraceous substance with a faint odor and soluble in alcohol. The resin is soluble in ether, chloroform, and hot alkalies. The oil possesses the taste and smell, but only partly the medicinal activity of the drug.

Action and Uses.—Fresh iris is quite acrid, and if employed internally produces nausea, vomiting, purging, and colicky pains. The dried root is less acrid, and is occasionally employed as an emetic, diuretic, and cathartic. It is believed by some practitioners to be an hepatic stimulant second only to podophyllin, but if given in full dose it may occasion considerable nausea and severe prostration. The dose is from 10 to 20 grains (0.60–1.3 Gm.), either in substance or in decoction. The *irisin* or *iridin* prepared by the "Eclectics" may be given in doses of from 2 to 4 grains (0.12–0.25 Gm.).

Other Species.—Of the 100 species of *Iris*, 22 inhabit the United States, but only 1 of these (*I. Missouriensis* Nutt.) much resembles the official, or has a rhizome likely to be mistaken for it. This grows abundantly in the Southwest, and it is very probable that it will be found to be practically identical in constituents and properties.

IRIS FLORENTINA.—Florentine Orris.

Radix iridis Florentinæ, Radix ireos.—Rhizoma iridis, P. G.; *Orris root*, E.; *Veilchenwurzel, Schwertelwurz*, G.; *Iris de Florence*, Fr. Cod.; *Liria de Florencia*, Sp.

The rhizome of *Iris Germanica* L., *I. pallida* Lam., or *I. Florentina* L. (Fam. *Iridaceæ*), deprived of the periderm.

Origin.—These well-known and very beautiful ornamental plants are natives of the eastern Mediterranean region, extending into northern India and northern Africa, and largely cultivated for their rhizomes in southern Europe, mostly on the mountain slopes. The flowers of the first named are blue, and constitute the European Blue Flag; those of the second are pale-blue, and of the third almost pure white. The rhizomes are gathered in late summer, soaked in water, and the outer bark scraped off, after which they are dried, by a careful process requiring about 2 weeks. The fresh rhizome lacks the fragrance of the dried, the aromatic principle being developed by the curing process.

Description.—Rhizome horizontal, consisting of vertically flattened joints from 5 to 15 Cm. (2 to 6 In.) long, and 2.5 to 4 Cm. (1 to 1½ In.) broad at the summit, gradually tapering below, abruptly contracted at the top into the stem-scar, at either side of which similar joints are given off; white or faintly yellowish externally and internally; marked on the upper side by transverse rows of fibrovascular bundles pertaining to the leaf-scars and underneath by brownish circular root-scars which are crowded toward the upper end; hard and heavy, the fracture irregular, showing a distinct nucleus-sheath close to the surface, which encloses scattered wood-bundles; odor mild, agreeably violet-like; taste farinaceous, afterward bitter and somewhat acrid.

The powder is whitish and exhibits large thick-walled parenchymatous cells containing simple, oval, or ovoid starch-grains with indistinct markings, and slenderly prismatic calcium oxalate crystals.

Commercial Orris represents two principal varieties, namely, *Veronese*, derived from *I. germanica*, and *Florentine*, from the other two species, more especially from *I. Florentina*. The two varieties are well distinguished by the stronger and finer odor of the latter; not so by their external appearance, although the Florentine is commonly somewhat larger and plumper, and with a less rough surface. The larger and finer joints are often turned into pretty forms to be used for ornamental purposes as well as for use by teething babies. The less handsome rhizomes, as well as the chips, are distilled.

Constituents.—Besides a large quantity of starch, some soft brownish acrid resin, a little tannin which is colored green by ferric salts, and a small amount of iridin, described below, Iris yields, when distilled with water, a peculiar fat-like volatile oil, known commercially as *orris butter*. Different authorities state the yield at from 0.1 to 0.8 per cent. It is claimed that this substance does not pre-exist, but is formed during the distillation process. A method for converting it into a liquid oil is that of adding oil of cedar wood to the powdered rhizome before distilling. The fatty oil above mentioned consists principally (about 85 per cent.) of *myristic acid*, together with small amounts of its methyl-ester, oleic acid and its derivatives, and a minute amount of the

ketone *irone* ($C_{13}H_{20}O$), which last constitutes the ultimate odorous principle. *Iridin* ($C_{24}H_{26}O_{13}$) is a glucoside, occurring in white needles, soluble in 500 parts of water and in hot alcohol, insoluble in ether, chloroform, and benzol. It yields *irigenin* ($C_8H_{16}O_8$), which, heated with concentrated alkali, forms *iretol* ($C_7H_8O_4$), *iridic acid* ($C_{10}H_{12}O_5$), and formic acid. Iridic acid yields *iridol* ($C_9H_{12}O_3$).

Action and Uses.—Orris root is rarely employed in medicine at the present time. The fresh root is said to be emetic and cathartic, and if given in large dose to occasion nausea, vomiting, purging, and colic. The dried powder is said to be a sialagogue and sternutatory. Pieces of the root are occasionally chewed for the purpose of overcoming disagreeable odor of the breath, and the powdered drug enters into the composition of many tooth-powders. The drug was formerly employed in the treatment of bronchitis and chronic diarrhœa, and was considered a useful remedy in dropsy. The internal dose is stated to be from 5 to 15 grains (0.30–1 Gm.).

J.

JALAPA, *U. S., Br.*—Jalap.

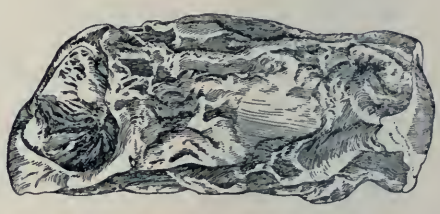
Tubera jalapæ, P. G. (and most pharmacopœias); *Radix jalapæ, Radix Ipomœarum.*—*Jalape, Jalapenknollen*, G.; *Jalap tubéreux J. officinal*, Fr. Cod.; *Jalapa*, Sp.; *Sciarappa, Gialappa*, It.

The dried tuberous root of *Exogonium purga* (Wend.) Benth. (*Convolvulus p.* Wend.; *Ipomœa p.* Hayne; *I. Schiedeana* Zucc.; *I. Jalapa* Schiede et Deppe; *Exogonium J.* Baill.; *E. dumosum* Benth.—Fam. *Convolvulaceæ*).

The first name applied to this plant was "*Ipomœa Jalapa,*" but another species of Ipomœa had previously been called "Jalapa," by Linné, although he placed it in the genus *Convolvulus;* hence the name is not tenable for the Jalap plant, which would give us two of the same name in the same genus.

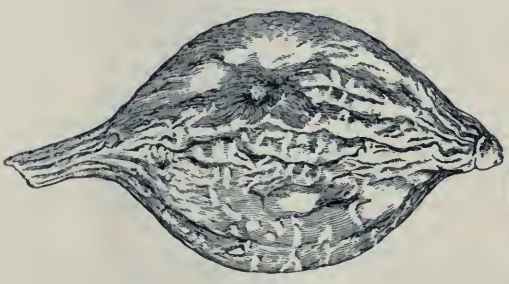
Jalap is official in all pharmacopœias, which differ greatly in the percentage of resin required, this requirement ranging from 7 to from 15 to 18 per cent. The required limitations of solubility of this resin in chloroform

Fig. 235.



Male jalap (Nat.).

Fig. 236.



Jalap: a small tuber.

Fig. 237.

Jalap (½ Nat.): A, showing a starchy, B, a resinous fracture.

range from 6 to 7 per cent.; in ether from "almost insoluble" to 10 per cent. soluble. Either of the two last requirements will exclude the so-called Male Jalap (*Stipites Jalapæ*) and Tampico Jalap. Most pharmacopœias call attention to the fact that the tubers should be heavier than water.

Origin.—The Jalap plant is a perennial twining climber, bearing handsome rose-purple flowers similar to the cultivated Morning-Glory. It is a native of the eastern slopes of the Mexican Andes, flourishing at an elevation of 5000 to 8000 feet, where rain is very frequent and abundant. Its habitat is thus very similar to that of the Cinchona. The drug proceeds chiefly from plants cultivated in their native home. Jalap has also been introduced to culture in other tropical regions, but only in India have any practical commercial results been obtained. The Indian product appears to be inferior to the Mexican. Grown in England and other temperate regions, frost is apt to overtake it before the tubers are matured. In cultivation, the soil must be a rich forest-loam, the fertility of which is quickly exhausted by Jalap cropping. Trellises or other forms of artificial support have to be supplied. The plants should be three years old before cropping is begun, and a crop can be gathered from the same plants each third year thereafter. Natural drying is a long and tedious process, as well as a risky one, and is usually substituted or assisted by drying over wood fires, which process imparts a slight smoky odor to the product, and hydrates much of the starch. Large tubers are often sliced to facilitate drying, but this form is not so highly esteemed. From 3000 to 5000 pounds of fresh jalap are said to be yielded per acre, and this is reduced by about 70 per cent. in drying.

Description.—Napiform, pyriform or oblong, occasionally reaching 3 or 4 inches in diameter, the large ones often incised or sliced; externally, more or less wrinkled, dark brown with lighter-colored spots and short transverse ridges; hard, compact, sinking in water

either before or after being broken open; internally pale grayish brown, with numerous concentric circles consisting of the ends of resin-ducts; fracture resinous, not fibrous nor starchy; odor slight, but peculiar, smoky and sweetish; taste sweetish and acrid.

The dark-brown powder exhibits large quantities of starch, the grains solitary or in masses of 2 or 3, rarely more. The solitary grains range from 10 to 35 mikrons in size (*Jelliffe*). They are mostly rounded, with a slightly eccentric, rarely fissured hilum and moderately distinct rings. Numerous masses of calcium oxalate crystals, mostly about twice the size of the solitary starch-grains, are also seen. The more abundant the starch, the fewer the crystals. Laticiferous ducts, with their abutting end-walls, can be seen.

When assayed by the process which follows, jalap should contain not less than 8 per cent. of total resin nor more than 1.5 per cent. of ether-soluble resin.

Assay of Jalap.—Jalap, in fine powder (No. 60), 10 Gm.; ether, alcohol, chloroform, distilled water, each a sufficient quantity. Plug the tube of a funnel or small glass percolator with absorbent cotton, and put into it 10 Gm. of powdered jalap. Drench with ether, and percolate with ether, after covering the percolator, until 50 Cc. of percolate have been obtained. Evaporate off the ether from a tared beaker, and weigh the residue as ether-soluble resin. The weight so found multiplied by 10 will give the percentage of ether-soluble resin in the drug.

Percolate the powder in the percolator further with alcohol until 100 Cc. of percolate have been obtained. Measure 20 Cc. of this percolate into a separator, add 20 Cc. of chloroform, and mix. Then add 20 Cc. of distilled water, shake the liquids thoroughly for a minute, and when they have completely separated draw off the chloroform into a tared beaker. Wash the separator with 5 Cc. more of chloroform, which add to the tared beaker. Evaporate off the chloroform on a water-bath, and when perfectly dry weigh. The weight of ether-insoluble resin so found multiplied by 50 will give the percentage of ether-insoluble resin in the drug. Add to this the percentage of ether-soluble resin already determined, and the result will be the percentage of total resin contained in the drug.—U. S.

Adulterants and Substitutes.—A number of similar and related products have been used for this purpose, the principal being *Tampico Jalap* and *Male* or *Orizaba Jalap.* The former is apparently a rhizome, and is derived from *I. simulans* Hanbury. Although of irregular form, it is more inclined to be cylindrical than is jalap. Its surface is very deeply and heavily wrinkled, and the transverse markings described under jalap are wanting. This product yields rather less resin than true jalap, and this resin (tampicin) is mostly ether-soluble. It is believed to be identical with the resin of scammony. Male Jalap is less frequently seen. It is produced by *I. Orizabensis* (Pell.) Leden, and occurs mostly in irregular fragments, sometimes in entire fusiform roots, which exhibit a strong radiate structure, with projecting fibers, on transverse fracture. Its resin seems to be identical with that last mentioned.

Constituents.—Jalap contains a soft resin soluble in ether, a hard resin insoluble in ether, 2 per cent. of uncrystallizable sugar, 15 per cent. of gum, bassorin, starch, albumen, and a coloring-matter which turns red with alkaline carbonates. The Pharmacographia gave 12–18 per cent. as the average yield of resin some years ago, but now as much as 12 per cent. is seldom found. In 1888, Squibb obtained 8 per cent., and in 1889, of the finest jalap from London, New York, and Hamburg, he found only one lot that yielded over 7.5 per cent. He then had 200 pounds gathered at Jalapa, Mexico, in the old way, at the old locations, and found in it (1890) 16.9 per cent. of resin, though in appearance and fracture it was inferior to samples containing 6.5–7.5 per cent. To account for this, Flückiger suggested that the root might be washed in alcohol before shipment. The soft resin, considered a mixture by Maisch, and called *jalapin* by Mayer, is acid, has the odor and taste of jalap, and is soluble in ether and alkalies. From the latter solution it is reprecipitated by acids. It constitutes 4 to 10 per cent. of the total resin and is medicinally inert. The hard resin, *convolvulin* ($C_{31}H_{56}O_{16}$ or $C_{61}H_{108}O_{27}$, the *jalapin* of Buckner and Herberger,—*rhodeoretin*, or *jalapurgin*), is a white odorless glucoside, of acrid and nauseating taste in alcoholic solution, otherwise tasteless, soluble in alcohol and acetic acid, and insoluble in water (nearly), ether, chloroform. carbon disulphide, and turpentine. By alkalies, it is dissolved and converted into the glucoside *convolvulinic* or *convolvulic acid* ($C_{28}H_{52}O_{14}$ or $C_{62}H_{106}O_{35}$), which is amorphous, white, hygroscopic, soluble in water and alcohol, insoluble in ether, and not precipitated from alkaline solution by acids. By warming with dilute acids or by the ferment "emulsin," convolvulin is split into glucose, volatile methyl-ethyl-acetic acid ($C_5H_{10}O_2$), and convolvulic acid. This latter, by continuance of the above treatment, yields glucose and the crystalline insoluble *convolvulinolic acid* ($C_{16}H_{30}O_3$). It is unfor-

tunate that the name *jalapin* should have been applied by different authors to both resins.

In view of the great irregularity in the quality of Jalap, a convenient and accurate method for selecting the tubers is a great desideratum. Hager finds such in his way of estimating their specific gravity, which varies pretty closely with the amount of resin. Assuming that the specific gravity of good tubers is between 1.15 and 1.18, he makes a solution of common salt of a specific gravity of 1.14 to 1.142 at 15° to 17° C. (59° to 62.2° F.), and rejects all tubers which do not sink in it. Heineberg points out that in applying this method the tubers should be broken up, since cavities are often contained. He also finds that the increased specific gravity is due more to the presence of calcium oxalate than of resin. Those possessing more calcium oxalate are also richer in resin and poorer in starch, though equivalence in these ratios was not established.

Pharmaceutical Preparations.—Compound Powder of Jalap, U. S. P.; Compound Tincture of Jalap, Fluidextract of Jalap, N. F.; Resin of Jalap, U. S. P.; Tincture of Jalap, N. F.

Action and Uses.—Jalap is an active hydragogue cathartic, producing when given in overdose copious watery stools at times containing blood, severe griping, and nausea and vomiting. Combined with calomel it may be employed in congested conditions of the portal circulation, and in conjunction with potassium bitartrate it is largely used for the relief of dropsy. The jalap may be employed as a depletant, and has been given with success in cerebral congestion and plethora. It may be given in substance in the dose of from 15 to 20 grains (1–1.3 Gm.) as an active hydragogue. As a purge it may be given in 5-grain (0.30 Gm.) doses. The dose to children is from 1 to 2 grains (0.06–0.12 Gm.).

Allied Products.—The genus *Ipomœa*, L., comprises, in its broadest sense, several hundred species, mostly tropical, and well typified in our ordinary cultivated morning-glories. As thus considered, the genus includes a number of subordinate groups which are by modern botanists, and doubtless correctly, regarded as distinct genera. Many of these plants produce tuberous roots similar to those of Jalap, which, being storage-reservoirs, are rich in nutrients, so that the irritant and purgative resins which many of them contain may be properly regarded as defensive provisions, whatever other relations they may possess in the plant economy. In the *Sweet potato* or *Camote*, the tuberous root of *I. Batatas* Poir. (*Batatas edulis* Chois.), native of tropical America, and extensively cultivated in all tropical and warm-temperate regions, these resinous constituents are wanting, so that these roots constitute one of the most important of human and stock foods with a digestible nutrient content of 0.9 per cent. of albuminoids, 28 per cent. of carbohydrates, and 0.3 per cent. of fat. Besides being consumed in their natural form, enormous quantities of sweet potatoes are extracted for their starch, and alcohol or alcoholic beverages are made from them in many countries. Their starch (see Amylum) is largely employed for the adulteration of other starches, as well as of spices and other ground products. The plant exhibits many well-marked varieties, differing greatly in their economic value. Besides these, there are several other species of the genus which are similarly employed, the root of *I. graminea* R. Br. being thus used in Australia under the name *Malamak*.

The following species, containing purgative resins similar to those of Jalap and Scammony, are more or less medicinally employed.

Turpeth Root, *Vegetable turpeth* or *Indian jalap*, is the tuberous root of *Operculina Turpethum* (L.) Peter (*Convolvulus T.* L.; *Ipomœa T.* R. Br.), a species widely distributed through the East Indies, where, and to some extent in Europe and America, it has been largely used like Jalap. The root is elongated, cylindraceous, somewhat twisted, from 1.25 to 5 Cm. (½ to 2 In.) thick, and occurs cut into pieces of variable length, often with portions of the woody stem attached. It is dull-gray externally, grayish-white and somewhat spongy or porous within, the transverse section showing a thick bark containing concentric circles of small yellowish-brown resin-dots, laticiferous ducts, and cells containing calcium oxalate crystals. The inner portion of the bark exhibits also well-developed phlœm-bundles, greater in number according to the age of the bark. The meditullium is brownish-gray and softly woody, the wood occurring in 4 or 6 bundles separated by narrow medullary rays. This woody center is wanting from many pieces, having been removed through a longitudinal incision in the bark. The drug is nearly odorless and at first tasteless, afterward becoming disagreeable and somewhat acrid. The resin of Turpeth root is scarcely half so abundant as that of Jalap, which it closely resembles, only a small part of it (*convolvulin*) being ether-soluble. The remainder ($C_{34}H_{56}O_{16}$) has been called *turpethin*. The use of Turpeth root has been abandoned chiefly because of its great irregularity in strength, but its resin, which can be produced cheaply, has been recommended as a substitute for Jalap resin, than which it is considered rather more active.

Man Root, or *Man-in-the-ground*, *Wild jalap*, *W. scammony*, *W. potato*, or *W. Sweet potato Hog potato*, *Mechoacanna* (the roots of several other species are also called Mechoacanna) or *Mechamech*, is the root of *I. pandurata* (L.) Meyer (*Convolvulus p.* L.). This is a prostrate vine, bearing lance-ovate leaves with a cordate or sometimes hastate base, and grows commonly in sandy soil throughout eastern North America. The root sometimes reaches the size of a man's body, and occurs occasionally in market, cut into irregular pieces which are much more shrivelled and wrinkled than those of either Jalap or Turpeth root. It possesses a rather thin bark, containing laticiferous ducts and exuding milk when wounded in the fresh state. The dried root is brown externally and grayish-white internally. Its resin-cells are massed in a zone near the inner boundary of the bark and are scattered through the medullary rays. Man root yielded to Manz only about 1.5 per cent. of resin, a large amount of starch, some sugar and gum, and a small amount of a tannin-like substance. The glucosidal resin is completely soluble in both ether and alcohol, and is separable into two portions, the one acid, soluble in methyl alcohol and precipitated by lead salts, the other non-acid. Although this resin is quite purgative, the root itself is very feebly so.

Among the numerous other purgative roots of this genus, the following deserve mention: *I. triflora* Velasco, the *Jalap de quercetan* of Mexico; *I. Burmanni* (L.) Chois. (*I. corymbosa* Roth.; *Convolvulus c.* L.), the Mexican *Coaxihgitl*); *I. silvana* Chois. (*Convolvulus ventricosus* Mans.), the tropical American *Purga de cavallo*; *I. mestitlanica* Chois. (*I. batatoides* Benth.), the Mexican *Purgomacho*; *I. emetica* Chois. (*I. sagittata* Moc. et Ses.), the Mexican *Temécatl*; *I. maritima* R. Br. (*Convolvulus Brasiliensis* L.; *C. Pes caprœ* Roth), its root containing saponin and its milk-juice used like scammony; *I. digitata* L. (*Convolvulus paniculata* L.; *Ipomœa p.* R. Br.; *Batatas p.* Chois.; *Convolvulus roseus* H. et B.), the Indian *Bidari-kand*, *Pattana*, etc.

Mirabilis Jalapa L., a *Common four-o'clock* or *Marvel of Peru* of the flower-garden, yields a large tuberous root, known as *False Jalap* or *Metalista*, which is sometimes purgative like Jalap.

The juices of a number of species of the genus are also used as purgatives, for example, *I. Martinicensis* Chois. (*Ipomœa uniflora* R. et Sch.; *Aniseia u.* Chois.; *Convolvulus Rheedii* Walr.), of the East Indies, and *I. carnosa* R. Br., of tropical regions.

In other cases, the portion employed as a purgative is the seed. That of *I. hederacea* (L.) Jacq. (*Convolvulus h.* L.; *C. Nil* L.; *Pharbites N.* Chois.; *Ipomœa N.* Roth.; *I. triloba* Thunb.), the common *Blue morning-glory*, are known in India as *Kaladana* and in Japan as *Kongashi*. The plant is a native of tropical America, and is naturalized in most tropical countries, as well as in the United States. The seeds are similar to morning-glory seeds, and are about 2 to 3 Mm. ($\frac{1}{12}$ to $\frac{1}{8}$ In.) long. They are sometimes prepared by roasting. They contain about 8 per cent. of the resin *pharbitisin*, which appears to be identical with convolvulin, and also considerable fixed oil.

Convolvulaceæ (*the Morning-glory Family*).—The purgative properties of this beautiful and interesting family, of some 40 genera and nearly a 1000 species, are not confined to the genus *Ipomœa*. The herbage of *Convolvulus althœoides* L. (*C. Argyrœus* DC.) was the *Medion* of Galen. The root of *C. arvensis* L., native of Europe but almost everywhere introduced, is the *Hiranpadi* or *Naranji* of India. The root of *Piptostegia Gomesii* Mart. (*Convolvulus operculatus* Gom.; *Ipomœa o.* Mart.) is the *Batata de Purga* of Brazil, and yields the *Tapioca de purga*; while *P. Pisonis* Mart. is known as *Batata purgante*. Several species of *Calystegia* yield roots and herbage which are used as purgatives, and the herbage of *Cuscuta Europœa* L. (*C. major* Bauh.; *C. vulgaris* Pers.), the *Nesselseide* or *Teufelszwirn* of Europe, is thus employed. Various other species of this genus are employed as diuretics. *C. Chinensis* Lam. is the *T'u-sz'tze* of China. *C. Americana* L., of tropical America, is diuretic and poisonous and yields a yellow dyestuff.

Nearly 100 species of the family are medicinally employed in the above or other ways.

JUGLANS.—Butternut Bark.

Écorce de noyer gris, Fr.; *Graue Wallnussrinde*, G.

The dried bark of the root of *Juglans cinerea* L. (*J. cathartica* Mx.; *J. oblonga* Mill.—Fam. *Juglandaceæ*), collected in the autumn.

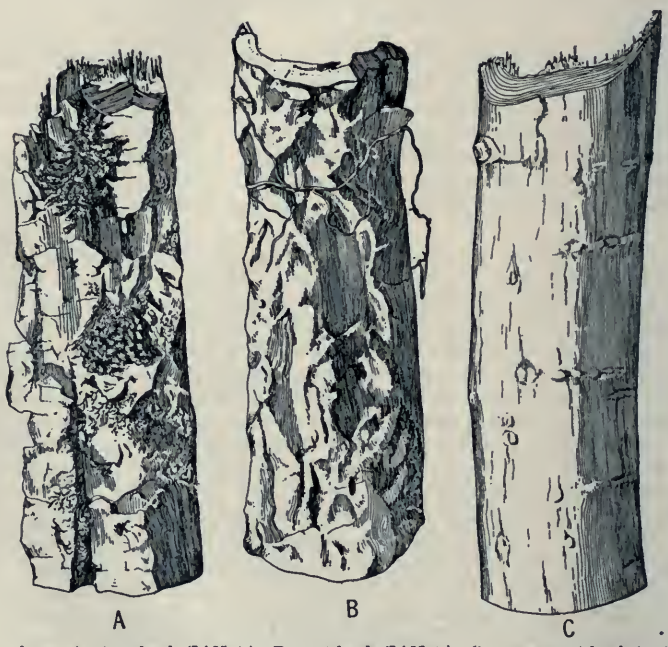
Origin.—A small, widely spreading tree, abundant in rich forest-land, especially in rocky soil, through eastern and central North America. It has a light-gray fissured bark and a soft, but durable brown wood. The foliage is light and graceful, consisting of very long pinnate leaves, which are among the first of our forest-leaves to fall in the autumn. The staminate flowers appear before the leaves, and are in thick green catkins about 10 Cm. (4 In.) long. The pistillate flowers are in little short spikes of about 5 each, and are followed by a cluster of ovoid pointed nuts, enclosed in a thin, green, viscid, bitter and acrid, tough and fibrous-pulpy husk. These nuts (*Butt-nuts*, *Oil-nuts*, *Lemon walnuts*) are very largely collected for eating purposes and are of a peculiarly

mild and delicious flavor and very oily. The bark of the root should be collected in autumn, at which time it is attached to the wood by a thin, stringy, fibrous liber which partly comes away with it and gives to the inner surface of the official bark a ragged, stringy appearance. If collected earlier in the season, it comes away with a smooth shiny surface. In the previous edition of the Pharmacopœia the inner bark was specified, and it still often comes in that form.

Description.—In quills or quilled, rarely flat, strips of variable size, the bark 3 to 10 Mm. ($\frac{1}{8}$ to $\frac{2}{5}$ In.) thick, of a deep chocolate-brown color on both surfaces, or the inner somewhat brown from adhering, ragged strips of liber, the outer surface somewhat smoothish or more or less scaly or warty; fracture short, somewhat fibrous, the transverse surface delicately checkered with white striæ; odor characteristic; taste bitter, slightly pungent, and acrid.

Pieces with a very smooth inner surface are not autumn-collected; those with a gray, fissured bark are from the stem.

FIG. 238.



Juglans: A, stem-bark (¾ Nat.); B, root-bark (¾ Nat.); C, young root-bark (× 2).

The powder is distinguished by its dark-brown color, in connection with large cells containing rosettes of calcium oxalate crystals, many of them attached to bast-fibers, the latter commonly a little narrower than the crystal-cells.

The chief adulterant of Juglans is the stem-bark, detected by the appearance noted above, and by the silver-gray particles, many of them of lichen-tissue, in the powder.

Black Walnut Bark (*J. nigra* L.) closely resembles the above. Its inner surface has more of a brown, less of a chocolate shade, and is much more coarsely striate. On transverse section it displays a brown instead of a greenish-black inner band, and this is coarsely fibrous, and there is less of the checkered appearance. Its powder shows prismatic crystals instead of crystal masses or rosettes.

Constituents.—Truman obtained by extraction with petroleum ether 4.94 per cent. of fixed oil from the trunk-bark, 5.98 per cent. from the root-bark; with strong ether, 2.31 per cent. of (mostly) crystalline resin from the stem-bark, 2.59 per cent. from the root-bark; with absolute alcohol, 6.94 per cent. of (mostly) juglandic acid from the stem-bark, 7.42 per cent. from the root-bark; of dextrin, gum, and sugar, 9.65 per cent. from the stem-bark, 11 per cent. from the root-bark. There are also a little volatile oil and a little tannin. *Juglandic acid, juglone* or *nucin* ($C_{36}H_{12}O_{10}$), is acrid, acid, sparingly soluble in water, more so in alcohol, and readily in ether, chloroform, and carbon disulphide; it crystallizes as orange-yellow needles, and acquires, with alkalies and with the alkali borates and phosphates, a handsome purple color. If the properties of the

bark depend wholly or in part on this principle, it is easily explained why continued boiling should render it less efficacious.

Pharmaceutical Preparation.—Fluidextract of Juglans, N. F.

Action and Uses.—Butternut may be employed as a mild cathartic and slight hepatic stimulant. It is claimed that its administration will produce evacuation of the bowel without causing a subsequent atonic condition of the intestinal tract. The remedy has been recommended in the treatment of acute malarial affections, and is said to be efficacious in both chronic constipation and dysentery. The official extract may be given in doses of from 5 to 15 grains (0.30–1 Gm.) as a laxative, and from 20 to 40 grains (1.3–2.6 Gm.) as a purge.

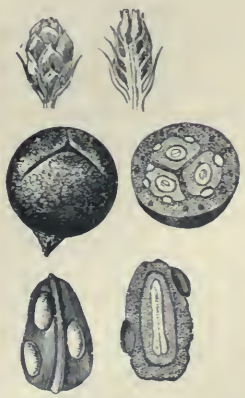
Allied Plants.—Juglans regia, L. *English walnut.*—The green pericarp (*Cortex fructus juglandis*) and the leaves (*Folia juglandis*, P. G.) have a peculiar odor and a somewhat astringent and bitter taste. The young fruit of both species is used for pickles, and when ripe the kernels yield a bland and drying fixed oil known as *nut oil;* it is greenish or pale-yellow, congeals like lard at about —18° C. (0° F.), and acquires a red color with nitric acid and a dark-brown one with a mixture of nitric and sulphuric acids. Similar oils are contained in the nuts of the numerous other nuts of this family (Hickory-nuts, Pecan-nuts, etc.), and the physical characters of their barks and leaves indicate a generally similar composition. The spring-sap of these trees is very sugary. Tanret and Villiers (1877) obtained from the leaves of the European Walnut a crystallizable non-fermentable sugar, *nucit* ($C_6H_{12}O_6.H_2O$), and Tanret (1876) reported having isolated a crystallizable alkaloid. According to Sestini, the root of the European walnut contains *glycyrrhizin*.

JUNIPERUS.—Juniper.

Fructus juniperi, P. G.; *Baccæ* (*Galbuli*) *juniperi.*—*Juniper berries*, E.; *Genièvre, Baie* (*Fruit*) *de genièvre*, Fr. Cod.; *Wachholderbeeren, Kaddigbeeren*, G.; *Enebro*, Sp. The fruit of *Juniperus communis* L. (Fam. *Pinaceæ*).

Origin.—From a large, erect shrub, prostrate in high northern regions, or rarely a small tree, distributed throughout the north-temperate zone and extending into northern Africa. It is distinguished from the common cedar by its widely spreading habit. The numerous leaves are persistent, spreading, in whorls of 3, linear and sharp-pointed; the staminate flowers are arranged in short ovoid catkins; the pistillate form a short cone consisting of about 5 imbricate whorls, each of 3 scales. Three naked ovules are situated at the base of the upper whorl, and, after fructification, these scales enlarge, coalesce, become fleshy, and ultimately enclose the seeds, forming the official berry-like galbulus, which ripens during the second year. The fruits are collected mostly in southern Europe, some in northern Africa, and are chiefly exported from Italy.

Fig. 239.



Juniperus communis L.: *a*, fertile catkin and longitudinal section; *b*, galbulus and transverse section; *c*, seed and longitudinal section, magnified.

Description.—Juniper berries are nearly globular, about 8 Mm. (⅓ In.) in diameter, dark-purplish, and covered with a bluish-gray bloom; the short stalk at the base bears 1 or 2 whorls of the small scales, and the apex is marked by 3 radiating furrows, which are surrounded by ridges, enclosing a triangular space. The 3, or by abortion 1 or 2, bony seeds are ovate in shape, triangular above, have 6 to 10 large oil-sacs on their surface, and are imbedded in a brownish pulp which likewise contains oil-cells. Juniper berries have an aromatic, somewhat balsamic odor, and a sweet, terebinthinate, bitterish, and slightly acrid taste.

Constituents.—The most important constituent of Juniper, from the medicinal standpoint, is its volatile oil (see Oleum Juniperi), the amount of which is variously reported as from 0.5 to 2.5 per cent. It apparently varies greatly in the fruits from different sections and in different samples, but probably averages considerably more than the 1 per cent. commonly stated in text-books. In the distillation of gin, the sugar (dextrose), amounting to from 15 to 30 per cent., is of great importance. There are about 10 per cent. of resin, a yellow coloring-matter, *juniperin*, apparently not active, fat, various acids, and other common plant constituents, with from 2 to 4 per cent. of ash.

Pharmaceutical Preparation.—Fluidextract of Juniper, N. F.

Action and Uses.—Juniper is somewhat stimulant and diuretic, and in the form of an infusion may be employed in the treatment of chronic inflammatory conditions of the genito-urinary tract. It may be given in the treatment of chronic nephritis, pyelitis, and in chronic inflammations of the bladder. The later stages of gonorrhœa may also be benefited by its use. It is said to decrease albuminuria, and to be a valuable adjunct to other remedies in the treatment of subacute Bright's disease. The infusion is prepared by macerating 1 ounce (30 Gm.) of the fruit with 1 pint (480 Cc.) of boiling water, all of which may be taken in 24 hours.

K.

KAMALA, *P. G.*—Kamala.

Rottlera, U. S. 1870; *Glandulæ rottleræ.*—*Kameela, Kamala*, Fr., G., Sp.

The glands and hairs obtained from the capsules of *Mallotus Philippinensis* (Lam.) Muell. Arg. (*Croton P.* Lam.; *Echinus P.* Baill.; *Rottlera tinctoria* Roxb.—Fam. *Euphorbiaceæ*).

Kamala is official in most pharmacopœias. The Russian mentions that it burns in a flame like Lycopodium, and that its aqueous extract is colored brown by ferric chloride. Several mention the chief impurities which are likely to be found in it.

Origin.—From a large evergreen shrub or small tree, common and abundant through tropical Asia and adjacent Africa, the East Indies, and Australia. The hairs and glands are removed by abrasion in baskets, through the bottoms of which they sift out. This powder consists chiefly of the red glands, but many yellowish hairs are mixed with them. The similar hairs which cover the herbage of the plant are also sometimes removed and mixed with the capsular product, reducing the quality of the drug.

Fig. 240.

Kamala (× 180).

Description.—Kamala is a fine granular, mobile powder of a brick-red or brownish-red color and somewhat resinous appearance, inodorous, and nearly tasteless. It is with difficulty mixed with water, imparts to boiling water only a yellow tinge, but a deep-red color to alkaline solutions, alcohol, ether, chloroform, and benzene. When thrown into a flame it burns similarly to, but less rapidly than, Lycopodium, and when heated in a crucible it leaves a small amount of ash, which weighs from pure kamala 1.37 per cent. (Pharmacographia). Examined under the microscope, the glands are seen to be depressed-globular, and to consist of a thin, transparent membrane enclosing a yellowish mass, in which are imbedded many club-shaped vesicles radiating from a common center, and containing a red substance; this structure becomes more apparent after treating the glands with potassa and pressing them between glass. The glands are always mixed with colorless stellately arranged simple hairs, but fragments of leaves and stems should not be present. Very slight amounts of mineral impurities are liable to exist, from adherence to the rough surface of the capsules, but the amount is scarcely sufficient for detection by the microscope.

Adulteration is practised extensively. The addition of the plant-hairs noted above imparts a yellowish or pale color. The chief addition consists of red sand or other earthy matters, and has sometimes been so great as to cause an ash yield of 40 to 50 per cent. Ferric oxide has been similarly used. Other adulterants, which do not thus affect the ash percentage, are dyed starch, broken carthamus, and the related products mentioned at the close of this article. All these are readily detected by microscopical methods.

Constituents.—Kamala contains a small amount of sugar, starch, tannin, citric and oxalic acids, a trace of volatile oil, and about 80 per cent. of a dark brownish-red resinous matter, composed of rottlerin, isorottlerin, wax, a resin freely soluble and one less soluble in alcohol, and a trace of coloring-matter. The ash in the best quality amounts to from 1.5 to 3 per cent. (the P. G. allows 6 per cent.), and contains considerable manganese; if the ash is reddish, ferric oxide is present. The two resins have the formulæ $C_{15}H_8O_4$ and $C_8H_{12}O_5$, and both are brittle, reddish-yellow, and soluble in alkalies. *Rottlerin* (or "kamalin,"—$C_{22}H_{20}O_6$) crystallizes in yellow silky needles or plates, is soluble in ether, alkalies, and boiling alcohol, sparingly soluble in cold alcohol, insoluble in water, and not permanent in air. Fused with potassa, it yields para-oxybenzoic acid. It may be the *mallotoxin* ($C_{18}H_{16}O_5$ or $C_{11}H_{10}O_3$) obtained by Perkin and by Jawein.

Action and Uses.—Kamala is a drastic purgative producing considerable griping. It frequently causes nausea, but seldom vomiting. It was first employed as a tænifuge, and was said to be especially useful in removing *Tænia solium*. It has since been

given also for the removal of round worms. The dose is from 1 to 3 drachms (4–12 Gm.), suspended in water or syrup, to which may be added some hyoscyamus to prevent griping. A tincture made with 6 ounces (180 Gm.) of the drug and 1 pint (480 Cc.) of alcohol may be given in doses of from 1 to 4 fluidrachms (4–16 Cc.). This dose may be repeated in 8 hours if necessary, and followed a few hours later by castor oil.

Allied Substances.—WARS, WARRAS, or WURRUS.—This name, which is the Arabian for saffron, has occasionally been given to kamala, but in eastern Africa is given to a distinct drug of unknown origin, but used for dyeing, and medicinally like kamala. It forms a rather coarse powder of a deep-purple color and slight odor, becomes black at the temperature of a water-bath, yields from 6 to 12 per cent. of ash, and under the microscope is seen to consist of cylindrical or subconical glands enclosing oblong vesicles arranged in 3 or 4 tiers; the glands are mixed with rather long, simple hairs.

KAOLINUM, *U. S., Br.*—Kaolin.

Terra porcellanea.—Porcelain clay, Fullers' earth, E.; *Terre à porcelaine,* Fr.; *Porcellanerde, Porcellanthon,* G.

A native aluminum silicate, consisting largely of the pure silicate ($H_2Al_2Si_2O_8 + H_2O = 257.12$), powdered and freed from gritty particles by elutriation.—U. S. It is found in large deposits in the earth, and is a product of the weathering action of carbon dioxide and water on feldspar, which is a potassium aluminum silicate, $KAlSi_3O_8$. In this action potassium silicate is formed, which is carried off by rain water and, being absorbed by the soil, serves as food for plants, while insoluble kaolin remains. It is used to a large extent in the industries, for clarifying beer, wine, honey, sugar solutions, oils, such as lard and cotton-seed oil and mineral oils. For pharmaceutical purposes, it should be extracted with 5 per cent. hydrochloric acid to remove lime, and levigated to remove sand, etc.

Properties and Tests.—When purified, kaolin is a soft white powder or lumps, having an earthy taste, odorless, insoluble in water and in cold dilute acids and alkalies. Moistened with water, it becomes darker in color and acquires a marked odor of clay. It is used as an absorbent dusting-powder, and as an excipient in pills in the case of substances like silver nitrate, potassium permanganate, etc., which act on organic excipients. If 1 Gm. of kaolin be mixed with 10 Cc. of water and 5 Cc. of sulphuric acid in a porcelain dish, no effervescence should occur, and if the mixture be evaporated and further heated until dense white fumes of sulphuric anhydride appear, then after cooling and adding 20 Cc. of water, boiling for a few minutes and filtering, there should remain on the filter a gray residue of silica. If to one-half of the filtrate ammonia water be added, a gelatinous precipitate of aluminum hydroxide, insoluble in excess, should be obtained. If to the remaining half of the filtrate sodium hydroxide solution be added, it should yield a gelatinous precipitate which is almost or completely soluble in an excess of the alkali. If 2 Gm. of kaolin be rubbed with 10 Cc. of water, the mixture should not acquire more than a slight reddish tint with 0.5 Gm. of sodium salicylate (absence of more than a trace of iron). Not less than 85 per cent. of non-volatile residue should be left when kaolin is ignited at a red heat.—U. S.

Pharmaceutical Preparation.—CATAPLASM OF KAOLIN, U. S. P.

Action and Uses.—Kaolin is never employed in internal medicine, but is occasionally applied locally as a dusting-powder in the treatment of eczema.

KINO, *U. S., Br.*—Kino.

Gummi (or *Resina*) *kino, Indian kino, Malabar kino.—Kino de l'Inde,* Fr. Cod.; *Kino,* G.; *Goma quino,* Sp.; *Tanoma Kino,* Port.

The inspissated juice of *Pterocarpus Marsupium* Roxb. (*P. bilobus* Roxb.—Fam. *Leguminosæ*).

Origin and Collection.—Kino is collected from a large deciduous forest-tree of India and Ceylon, most abundant and most utilized in the north Malabar district of Madras. It appears to present quite a number of distinct forms, which Prain has

arranged in two varieties. The product had become, during the close of the nineteenth century, scarce and costly, but the recent opening of very extensive new districts insures "an unlimited supply at a price that will preclude all competition of other articles of a similar nature" (Watt). The right to tap the trees is let by the government to the highest bidder. The juice flows freely at all seasons, but is chiefly collected in the dry season (February and March), when the tree is in bloom, since the juice is at other times inferior, and artificial drying of the Kino would be required. It runs better at night, and small or middle-sized trees yield better than large ones. If fully tapped, a tree must rest a year before it will again yield. Bleeding may be made so profuse as to kill the tree. A tree ordinarily yields about 1½ pounds of juice, which produces half as much Kino. Incisions are made down to the cambium, and the juice is caught in clay cups, bamboo-joints, or other convenient receptacles, and is boiled soon after collection. The impurities are skimmed off during the boiling, and after reaching the consistency of a thick extract the mass is poured into pans, in thin layers, to dry until it will crumble readily. If kept in the shade, a half-inch layer will dry in 7 or 8 days.

Description.—East India or Malabar Kino is met with in small, angular, dark brownish-red, glistening, and brittle pieces, which in thin layers are transparent and of a ruby-red color, and tinge the saliva deep-red; it softens between the teeth, is inodorous, and has a very astringent and sweetish taste. It is partly soluble in cold water, leaving a flocculent residue, and is entirely soluble in alcohol and nearly insoluble in ether. The solutions have an acid reaction; the aqueous solution is precipitated green-black by ferric salts, gray-purplish by lead acetate, light-brown by tartar emetic, and reddish by mercuric chloride. The solution in diluted alcohol is apt to gelatinize.

The Russian pharmacopœia specifies that Kino has an acid reaction, and it rejects those Kinos which, containing gum, swell in water and alcohol. Several specify that the filtrate, after shaking Kino with water, is turned dark-green by ferric chloride. Dragon's blood, used as an adulterant, is insoluble in water.

Constituents.—Considerable erroneous or doubtful information has been supplied concerning the composition of Kino, as a result of the use, for examination, of products from different botanical sources, these being very numerous. It has been believed to consist chiefly (about 40 to 80 per cent.) of *kinotannic acid*, giving a blackish-green reaction with ferric chloride, and very similar to catechutannin. Kinotannic acid acts like the last-named, from Catechu and Gambir, when fused with potassa, and it yields phlobaphene. It has not yet been obtained in a pure condition, being accompanied by red coloring-matter, and, according to Hennig (1853), by a pectin compound from which it cannot easily be freed. The aqueous solution of the acid gives with pure ferrous salts, when carefully neutralized, a violet color, and with ferric salts a blackish-green one. Mineral acids and many metallic salts produce precipitates; hot nitric acid converts it into oxalic acid. In solution, it is darkened by alkalies. On exposure to air the aqueous solution yields a red precipitate, slowly at the ordinary, more rapidly at the boiling, temperature; this is *kino-red*, an amorphous, tasteless mass, the alcoholic solution of which has a slight acid reaction. Kino-red ($C_{28}H_{22}O_{11}$) is also produced by heating kinoin to 130° C. (266° F.). This compound was obtained by Etti (1879) by boiling supposed kino with diluted hydrochloric acid and agitating the clear liquid with ether; it forms white crystals, the solution of which in water becomes red with ferric chloride. The presence in genuine Kino of the above-described substances has been recently denied by White (*Phar. Jour.*, May, 1903, p. 676), who, following Etti's process with Kino the identity of which had been fully proved, extracted only a fraction of a per cent. of protocatechuic acid. He concluded that Etti's supposed Kino was some one of the numerous similar substances which have gone under that title. Kino contains 13 to 15 per cent. of moisture, and about 1 to 2.5 per cent. of ash.

Pharmaceutical Preparations.—Compound Powder of Kino, Compound Tincture of Kino, N. F.; Tincture of Kino, U. S. P.

Action and Uses.—At present kino is chiefly employed in the treatment of serous diarrhœa, in which condition it is frequently combined with opium or used in conjunction with chalk mixture. It has also been recommended in chronic dysentery and in pyrosis. Its administration in diabetes and in intestinal hemorrhage has been regarded as useful, but the other vegetable astringents are probably equally efficacious.

An infusion made by macerating 2 drachms (8 Gm.) of kino in 8 fluidounces (240 Cc.) of boiling water, and straining, may be beneficially employed as a gargle in sore throat and relaxation of the uvula; as an injection in the treatment of leucorrhœa and the later stages of gonorrhœa; and as an irrigation in epistaxis, intestinal, uterine, and other passive hemorrhages. The powder has been locally employed for the control of hemorrhage and in the treatment of indolent ulcers.

Kino may be prescribed in powder in the dose of from 10 to 20 grains (0.60–1.3 Gm.); in infusion (1 ounce (30 Gm.) to 1 pint (480 Cc.) in the dose of from 1 fluidrachm to 1 fluidounce (4–30 Cc.); and in tincture in the dose of 1 fluidrachm (4 Cc.).

Other Varieties of Kino, and Allied Substances.—The number of substances which have been offered as Kino, or which resemble it in appearance and properties, is very great, and only the more important of them can here be mentioned.

The genus *Pterocarpus*, L., comprises some 20 species, of the Old and New World tropics, and several of them yield Kinos. *African* or *Gambia Kino* is the product of *P. erinaceus* Poir. (*P. echinatus* Pers.?), and has never been an article of commerce to any considerable extent. Its yield of tannin is about 50 per cent. or more. *P. Draco* L., of the West Indies, yields a Kino which is one of the substances which have been known as "West Indian," and has been somewhat confused with Dragon's blood. *P. dalbergioides* Roxb., of India, yields an inferior Kino.

Schaer reports upon an African Kino from *P. Bussei* Harms., which closely resembles Malabar Kino externally, though the fragments are more regularly and sharply angular and there are many adhering particles of bark. Cold water dissolves it slowly and incompletely, and pyrocatechin and kinoin could not be detected. The same author obtained from the same region two similar but inferior Kinos, respectively collected from *Derris Stuhlmannii* and *Berlinia Eminii*.

Palas or Bengal Kino, from *Butea frondosa* Roxb. and several other species of *Butea*, of the same family, is the *Dhak* of India, or *Tsze-kwang* or *Ch'ih-Kiau* of the Chinese. It occurs in dark ruby-colored tears and fragments, of which only about one-half or less is soluble in hot alcohol, the remainder being mucilaginous matter. According to Eissfeldt, it does not contain pyrocatechin, but yields this compound on dry distillation. When incinerated, Butea gum leaves about 1.8 per cent. of ash. It yields only 15 to 35 per cent. of tannin. *Ougeinia dalbergioides* Benth. and *Sesban grandiflora* Poir., of India, also yield Kinos.

Eucalyptus Kino or Gum, *Australian* or *Botany Bay Kino* (*Eucalypti Gummi* of the B. P.), is the most important substitute. It is collected from a number of species of *Eucalyptus*, chiefly from *E. rostrata* Schlecht. Sixteen different species were recorded by von Müller as yielding it, but not all of these products have been examined, and it is only practicable, for the present, to identify it by its properties, not by its sources. It is collected mostly from artificial incisions, the yield being about the same per tree as of ordinary Kino, and is usually dried by artificial heat. Considerable is also collected in a dry state from cavities in the trunk. It occurs in small pieces, usually larger and less angular than those of Kino, which they closely resemble in color and transparency. It is rather dusty, is not so brittle as Kino, adheres to the teeth, tinges the saliva red, and is very astringent. It dissolves almost completely in alcohol, but only 80–90 per cent. of it in cold water, the solution being neutral. It contains about 45 to 50 per cent. of kinotannic acid, with kino-red, catechin, etc. Much, if not all, of the gum of commerce loses its solubility in water on being kept for a long time. Eucalyptus Kino may be employed for the same purposes and in the same doses as *Kino*.

Liquid or Angophora Kino is derived from a tree quite closely related to *Eucalyptus*, the *Angophora intermedia* DC., the so-called *Victorian apple-tree* of Australia. The substance exudes very freely from incisions, from 2 to 10 gallons being obtained from a tree. This juice is quite watery, occasionally quite thick, and varies from colorless to reddish-brown. It is used by fishermen, under the name "Apple-tree juice," for coloring their nets. According to its thickness it yields more tannin, the amount varying from less than 1 to 3 or 4 per cent.

Myristica Kino is obtained in India from *M. gibbosa* Hook. f., *M. Kingii* Hook. f., and some other species. It quite closely resembles the Malabar, and contains about 30 per cent. of kinotannic acid.

Jamaica, West Indian, or Caracas Kino, from *Coccoloba uvifera* L., or *Sea-side grape* (Fam. *Polygonaceæ*), is obtained by boiling the wood and bark and evaporating the decoction. It resembles Malabar Kino in appearance, but is of a brown tint, less glossy, and has a bitterish rather than a sweetish taste; it is soluble in both alcohol and water to the extent of about 90 or 93 per cent. The plant named is a large shrub or tree of the West Indies and southern Florida, and has a heavy, hard, and durable violet-brown wood.

In this connection, reference may be made to the very similar substance, *Quebracho extract*, obtained by boiling the wood of the red Quebracho, derived from two or more species of the genus *Schinopsis*, of Argentina, Paraguay, etc. *S. Balansæ* Eng., *S. Lorentzii* (Griseb.) Eng., and *S. Morongii* (Britton) Rusby, are named as the sources. This extract has an appearance intermediate between Logwood extract and Kino. It is not used in medicine, but is employed upon an enormous scale in the tanning of leather. It contains about 70 per cent. of tannin.

The *Resina d'angelin pedra* is a kino-like extract obtained in Brazil from *Ferreira spectabilis* Allem., also of the *Leguminosæ*. It contains the alkaloid *angeline* or *ratanhine* ($C_{10}H_{13}NO_3$).

Hooper describes an East Indian Kino from *Macaranga Roxburghii* Wright (Fam. *Euphorbiaceæ*), and from other species of *Macaranga*. It is of peculiar consistency, and is used for taking impressions, like sulphur, but is free from the brittleness of the latter substance. From a half to three-fourths consists of insoluble gum, and only about 10 to 15 per cent. of tannin is contained.

Kino-like extracts are also obtained from *Milletia megasperma* Benth., of Australia, and *Machærium fertile* Griseb., and *Iodina rhombifolia*.

KRAMERIA, *U. S.*—Rhatany.

Krameriæ radix, Br.; *Radix ratanhiæ*, P. G.; *Radix ratanhæ*, *Rhatany root*, E.; *Ratanhiawurzel*, G.: *Ratanhia*, Fr.; *Ratania*, It., Port., Sp.; *Crameria*, Sp.

The dried root of *Krameria triandra* Ruiz et Pav. (*K. tomentosa* St. Hil., *Peruvian* or *Payta K.*), of *K. Ixina* L. (*Ixina Granatensis* Tr. et Pl., *Savanilla K.*), or *K. argentea* Mart. (*Para*, *Brazilian*, or so-called *Savanilla K.*).—(Fam. *Krameriaceæ*, or *Leguminosæ*, *fide* Engler et Prantl.)

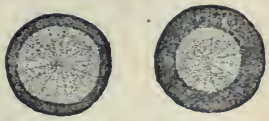
Krameria is official in all pharmacopœias, which differ greatly in the named sources. Those differences, as shown by their accompanying descriptions, are chiefly due to mistakes of identity as to the different varieties (see *Origin*), that adopted in the definition of one, being rejected by that of another, though comprised in its description. Several specify the root-branches, thus excluding the woody crown, a wise precaution. Several specify the exclusion of that deprived of its bark, one excludes the wood (practically impossible except as to the powder), and the Italian requires that it contain 20 per cent. of tannin. The Swiss mentions that the alcoholic tincture gives a red precipitate with alcoholic solution of plumbic acetate and the filtrate retains the red color. Several mention that the aqueous maceration is colored green by ferric chloride and yields a brown precipitate.

Origin.—*K. triandra* is a low, intricately branched, very woody shrub, inhabiting arid localities in the high mountains of Peru, Bolivia, etc. Its short branchlets are sharp and spine-like, its leaves silvery-hairy, its irregularly cross-shaped flowers scarlet or crimson, which endears it to the religious inhabitants. We have ourselves collected

FIG. 241.

Peruvian krameria: small root (Nat.).

FIG. 242.



Rhatany root: *a*, Payta root; *b*, Savanilla root.

this shrub with roots attached, and identified the latter with the commercial article so described below. *K. Ixina* is regarded as a widespread species from Mexico, through northern South America, and into the West Indies, and presenting a number of varieties. When better known, the latter are likely to be regarded as distinct species. The typical article comes from the United States of Colombia and Venezuela. For many years it has been nearly or quite absent from the market, but it is now coming forward sparingly. In the meantime the root of *K. argentea* (*Brazilian*, *Para*, or *Ceara Rhatany*, *Ratani de terra* or *R. des Antilles*), of northern Brazil, has been sold for it. When Savanilla rhatany, the better variety, is called for, the Peruvian is very frequently supplied, and our best dealers are apparently mistaken or uncertain as to their

identity. The name "Ratania da terra" for the Brazilian, means merely "Native Krameria."

Description.—*Peruvian Krameria.*—Root-branches usually occurring with several or many attached to a short, hard, and woody tap-root, which is 1.5 to 4 Cm. (½ to 1½ In.) thick, roughly fissured, and supports a knotty, several- to many-headed crown; of indefinite length, rarely exceeding 50 Cm. (20 In.) and usually less than 1 Cm. (⅖ In.) thick, cylindrical, flexuous or wavy, very flexible; externally light red-brown, more or less marked with dark, scaly patches, especially upward, otherwise smoothish, devoid of transverse fissures; fracture tough and splintery, the pinkish-brown bark occupying less than one-third of the radius, the wood yellowish or pinkish-white, finely radiate; inodorous and of a very astringent taste.

Brazilian Krameria.—Branches usually occurring detached from the tap-root and crown, less flexuous than those last described, externally of a deep purple-brown or chocolate-brown and with numerous transverse cracks or fissures; fracture less tough than that of the last, the bark and wood both darker, the former occupying two-fifths, or even more, of the radius, the taste more astringent than that of the last.

Savanilla Krameria is very similar to the Brazilian, but there is rather more of the red-purple to its color, it is less fissured and its bark not quite so thick, proportionately.

The Russian Pharmacopœia directs that only the bark shall be taken for the powder, but the whole root for the liquid preparations. In a good sample the bark weighs at least 50 per cent. of the whole.

Constituents.—The active constituent is *ratanhia-tannic* or *Krameria-tannic acid*, which is precipitated dark-green with ferric salts and flesh-colored by gelatin, but not precipitated by tartar emetic. By fusion with caustic potash it yields protocatechuic acid and phloroglucin, and with dilute acids forms sugar and *ratanhia-red* ($C_{26}H_{22}O_{11}$), a coloring principle similar to that yielded by the tannins of horse-chestnut and tormentil; on dry distillation, pyrocatechin distils over. On exposure to air, the tannin is slowly changed to an insoluble, non-astringent phlobaphene or anhydride, some of which exists in the plant. The other constituents are starch, uncrystallizable sugar, a trace of gum, wax, and a peculiar acid, *krameric acid.* Of the tannin, Dunwody (1890) obtained 8.4 per cent. from *K. triandra,* and 7.2 per cent. from *K. argentea.* Wittstein extracted 17.8 per cent. from Payta rhatany, and 3.2 per cent. from the Savanilla variety. An amido-acid principle, *ratanhine* or *methyl-tyrosin,* which forms salts with mineral acids or strong bases, has been found in extracts of rhatany, in other plants of Brazil, and to the extent of 86 per cent. in *resina d'angelim pedra* (see under KINO), but its presence in krameria is probably due to adulteration with these latter.

Pharmaceutical Preparations.—EXTRACT OF KRAMERIA, FLUIDEXTRACT OF KRAMERIA, TINCTURE OF KRAMERIA, U. S. P.

Action and Uses.—Krameria is tonic and astringent, and when given to excess produces gastric distress and constipation. It may be employed in serous diarrhœa, and is recommended in chronic diarrhœa, passive hemorrhages (especially from the uterus), and in certain forms of leucorrhœa. Locally applied, a watery solution is said to be advantageous in the treatment of fissured nipples, and rectal injections, made by dissolving from 40 to 90 grains (2.6–6 Gm.) in 5 ounces (150 Cc.) of water have met with favor in the treatment of dysentery and in fissure of the anus.

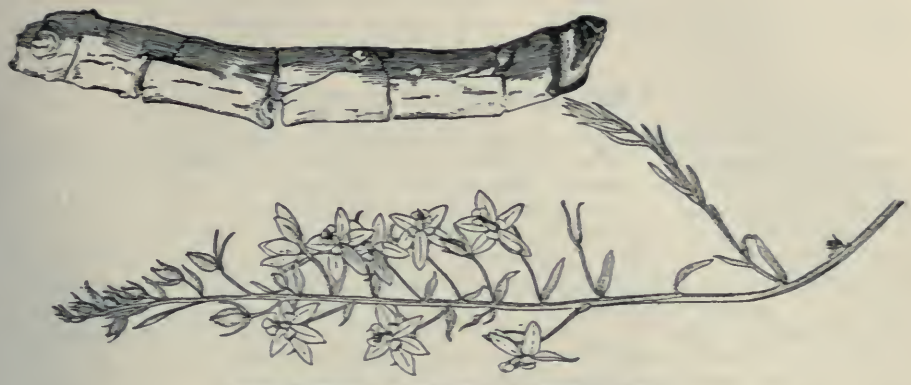
Krameria is administered in the dose of from 10 to 30 grains (0.60–2 Gm.) in powder. The extract, fluidextract, and tincture are given in doses of from 5 to 10 grains (0.30–0.60 Gm.), 5 to 30 minims (0.30–2 Cc.), and ½ to 2 fluidrachms (2–8 Cc.), respectively.

An infusion (krameria 1 ounce (30 Gm.) and boiling water 1 pint (480 Cc.)) may be given in the dose of from 1 to 2 fluidounces (30–60 Cc.).

Other Species, Substitutes, and Allied Drugs.—*Krameria cistoides* Hook. et Arn., a native of Chile, produces a root which, according to Schroff (1869), closely resembles Payta rhatany; the wood of the thick main root is pale-reddish in the outer layer and brown-red in the center.

Texas rhatany has been described by Berg; it is derived from *K. lanceolata* Torr. (*K. secundiflora* DC.), and consists of a roundish root-stock about 2 In. (5 Cm.) thick, from which a number of long roots emanate which have a blackish-brown, internally reddish, bark of the same thickness as the wood. This bark is much more spongy than that of the others and occurs much fissured and broken.

FIG. 243.



Texas krameria: *a*, root (Nat.); *b*, branch (½ Nat.).

The genus *Krameria* is regarded as containing 13 species, all American, and they are probably all more or less uniform as to the constituents and properties of their roots.

Ceanothus is the root, or the bark of the root, of *C. Americanus* L. (Fam. *Rhamnaceæ*), the *Red root*, *New Jersey* or *Walpole tea*, *Sprangles*, *Seckelblume* or *Ceanothe*, a low, densely branching shrub of eastern and central North America. The plant is 2 or 3 feet high, and about as broad, with very many erect, slender branches, alternate oval-ovate, 3-nerved, serrate leaves, downy underneath, numerous short and broad axillary panicles of very small white flowers, followed by 3-lobed pods, somewhat similar to those of the tea-plant. The root is very woody and tough, having a large knotty crown, a stout tapering primary root about an inch thick and 1 to 1½ feet long, with few or many strong branches, mostly from the upper portion. The bark is of a deep brownish-red, more or less streaked with gray or whitish lines. It is a little fissured. The wood has a tough splintery fracture and cuts with a somewhat waxy surface. It is red internally. There is little odor, but a strongly astringent taste. The useful properties of the drug appear due entirely to its tannin, of which there is about 9 per cent. It exists in both the bark and the wood, but chiefly in the bark. There is also 0.2 per cent. or more of an amorphous alkaloidal substance. It has been named Ceanothine, but Gordin finds good reason to believe that it is a mixture. There are also a peculiar coloring-matter, *ceanothus-red*, a little resin, fat, starch, etc. Its uses are purely as an astringent. It is said to have been used as an adulterant of Krameria, and it certainly appears well qualified to subserve such a purpose. The leaves are said to have been used as a substitute for tea during the Revolutionary period, and to make a very good substitute, as far as flavor is concerned.

FIG. 244.

Ceanothus: *a*, branch (¾ Nat.); *b*, fruit (× 6).

The genus *Ceanothus*, L., contains about 40 species, mostly of western North America, where they grow very abundantly. They appear generally to possess the same astringent properties as the above. An alkaloid was found in *C. reclinatus* L'Herit., but it appears different from that of *C. Americanus*.

L.

LABIATÆ.—The Mint Family.

This great family, of more than 150 genera and about 3000 species, is in all respects most uniform and homogeneous. Most of its members are readily distinguishable by the following simple characteristics: In temperate climates herbs, frequently becoming shrubby, or occasionally even small trees, in warm countries; stems or branches square; leaves opposite, without stipules, aromatic; calyx tubular and commonly 2-lipped; corolla tubular and almost always 2-lipped, bearing within 2 stamens, or 4 stamens in 2 pairs; fruit separating into 4 small seed-like nutlets. These plants are distributed over almost the entire globe, chiefly in temperate and subtropical regions.

Constituents.—Alkaloids are wanting, and glucosides are rarely if ever present. The important constituents are volatile oils, amaroids, and tannin, occurring alone or in variable proportion, thus imparting aromatic, bitter, or astringent properties, the last-mentioned rarely (when the tannin amounts to 5 per cent. or more) in important degree. Aromatic properties are pre-eminent, both in degree and frequency, so that our principal study of the properties of the drugs will be found under the title OLEA VOLATILES. For this reason also, the properties of these drugs are highly subject to deterioration with age, resulting from evaporation. Special properties, such as those of menthol or rosemary, occasionally occur, but published statements concerning specific properties in newly proposed drugs of this family should be accepted with great caution. A few are slightly irritant and poisonous. The dose of the herbs of this family is almost always 30 to 60 grains. Tinctures or fluid extracts are usually the best form of preparation. Infusions work fairly well, especially those of astringents, while decoctions are usually inefficient. As aromatics, these drugs act especially as carminatives, and the aromas and flavors are usually pleasant, thus well adapting them for use in perfuming and flavoring.

We give below an artificial structural key to the genera of the more commonly used drugs of the family. The names of those to which separate articles are accorded are printed in capitals. Brief accounts of the others will be found following the key. It is believed that such a key will be found especially useful in this case, since the drugs, with few exceptions, are employed in the form of the flowering herbs:

ARTIFICIAL KEY TO THE PRINCIPAL DRUG-YIELDING GENERA OF THE LABIATÆ.

	Ovary 4-parted. (1)
	Ovary lobed, at most not more than half way. (28)
1	Stamens 4. (2)
	Stamens 2. (8)
2	Stamens declined. (3)
	Stamens erect, divergent or ascending. (4)
3	Stamens exserted. (12)
	Stamens included in the corolla-tube. (13)
4	Calyx-nerves 5 or 10; upper lip of corolla concave. (11)
	Calyx-nerves 13 or fewer; corolla-lobes plane. (5)
	Calyx-nerves 15. (10)
5	Anthers 1-celled. (14)
	Anthers 2-celled. (6)
6	Calyx 5-nerved. (15)
	Calyx 10-nerved. (16)
	Calyx 13-nerved. (7)
7	Calyx equal or slightly 2-lipped. (17)
	Calyx distinctly 2-lipped. (18)
8	Calyx 2-lipped. (19)
	Calyx not 2-lipped. (9)
9	Calyx not hairy in the throat. (20)
	Calyx-throat hairy, at least in fruit. (21)
10	Calyx either open-campanulate and equal, or distinctly 2-lipped. (22)
	Calyx tubular, the mouth merely more or less oblique. (23)

11
- Calyx dorsally flattened, 2-lipped. (24)
- Calyx 10-toothed ; stamens included in corolla-tube. (25)
- Calyx 5- to 10-toothed, the teeth dilated at base, or coherent into an orbicular spreading limb. (26)
- Calyx 5-toothed ; stamens more or less exserted. (27)

12
- Corolla-tube short, the anterior or lower lobe flat or only slightly concave . *Ocimum.*
- Corolla-tube long exserted, the anterior or lower lobe flat or slightly concave . *Orthosiphon.*
- Anterior or lower corolla-lobe saccate, with a narrow stem-like base. *Mesosphærum.* (Hyptis.)

13 . . . . . LAVANDULA.

14 . . . . . *Pogostemon.*

15 . . . . . *Satureia.*

16
- Calyx in flower nearly equally 5-toothed, in fruit greatly enlarged, declined and 2-lipped ; corolla 5-lobed, the lower lobe much the largest and toothed or fimbriate . . . . . *Collinsonia.*
- Calyx as in *Collinsonia ;* corolla 5-lobed, the lower lobe but little larger, entire . . . . . *Perilla.*
- Calyx in flower 2-lipped, the upper lip shortly 3-toothed, the lower slenderly 2-toothed ; corolla 2-lipped . . . . . THYMUS.
- Calyx nearly equally 5-toothed ; corolla 4-lobed . . . . . MENTHA.

17
- Stamens straight or divergent . . . . . *Koellia.* (Pycnanthemum.)
- Stamens ascending at the base, conniving at the summits . . . . . *Micromeria.*
- Stamens ascending at the base, diverging at the summits . . . . . *Origanum.*

18
- Flowers in dense terminal bracted capitate cymes . . . . . *Majorana.*
- Flowers in dense axillary whorls . . . . . *Calamintha.*
- Flowers few in loose axillary whorls . . . . . MELISSA.

19
- Calyx distinctly 2-lipped ; corolla strongly double-curved ; anther-cells widely separated, the lower partly aborted . . . . . SALVIA.
- Calyx shortly toothed, slightly oblique, not distinctly 2-lipped ; lower anther-cell wanting, only a short portion of its connective remaining . *Rosmarinus.*
- Corolla-tube straight ; filaments of the two sterile stamens equalling the others ; anther-cells 2, diverging . . . . . HEDEOMA.

20 . . . . . *Lycopus.*

21
- Calyx 10- to 13-nerved ; anthers 2-celled, the cells distinct and parallel . *Cunila.*
- Calyx 15-nerved ; anthers affixed at the middle, the cells diverging and at length confluently 1-celled . . . . . *Monarda.*

22
- Calyx open-campanulate, equal . . . . . *Hyssopus.*
- Calyx tubular, 2-lipped, the posterior or upper lip much larger than the others . . . . . *Dracocephalum.*

23
- Stamens long-exserted, erect or divergent . . . . . *Lophanthus.*
- Stamens ascending under the upper lip ; anther-cells diverging . . . . *Nepeta.*
- Stamens ascending, the anther-cells parallel . . . . . *Cedronella.*

24
- Upper lip of calyx enlarging in fruit to form a large helmet-shaped erect appendage . . . . . SCUTELLARIA.
- Upper lip of calyx 3-toothed, the lower 2-cleft . . . . . *Prunella.*

25 . . . . . MARRUBIUM.

26 . . . . . *Ballota.*

27
- Nutlets rounded at summit ; corolla-tube cylindraceous ; anther-cells divergent . . . . . *Stachys.*
- Nutlets rounded at summit ; corolla-tube with dilated throat ; anther-cells placed back to back, transversely valved *Galeopsis.*
- Nutlets truncate ; acutely angled ; corolla-tube included ; anther-cells parallel . . . . . *Leonurus.*
- Nutlets truncate, acutely angled ; corolla-tube exserted ; anther-cells divaricate . . . . . *Lamium.*

28
- Upper lip of corolla wanting, the lateral lobes of lower lip almost so . *Teucrium.*
- Upper lip of corolla small, 2-cleft, the lower 3-lobed . . . . . *Ajuga.*

OCIMUM, L., is a genus of about 60 species, 20 or more of which are medicinally employed. *O. Basilicum* L. (*O. majus* Hort. ; *O. medium* Mill. ; *O. minimum* L.) is the *Common*

or *Sweet Basil* (*Basilienkraut*, G.; *Basilic*, Fr.; *Albahaca*, Sp.), a native of southern Asia and adjacent Africa, and very largely cultivated. The stem is branching and more or less pilose; the long petiolate leaves are oblong-ovate, somewhat toothed, smooth, and beneath glandular-punctate; the flowers are in somewhat interrupted spikes, the calyx short and ciliate, and the corolla white or reddish, with a short tube, a broad 4-lobed upper lip, and a descending spatulate lower lip. The herb has a strong and agreeable aromatic odor and a balsamic and cooling taste; it contains volatile oil and a little tannin. *O. gratissimum* L., of the same region, and several other species are quite similar, but inferior.

ORTHOSIPHON STAMINEUS Benth. is the *Java tea*, used to some extent as a substitute for tea in the East Indies.

MESOSPHÆRUM (HYPTIS) is a large genus in tropical America, some Andean species becoming large shrubs or even small trees. They are strongly and delightfully aromatic, and find many uses among the natives.

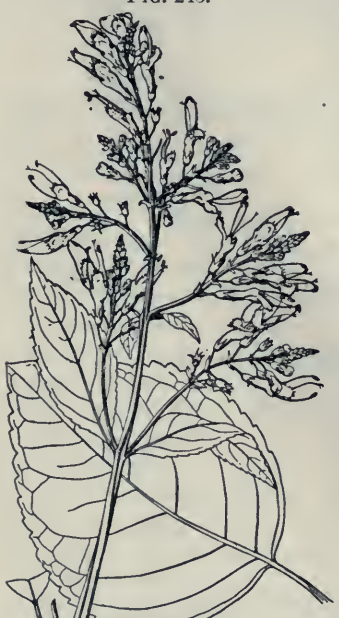
POGOSTEMON HEYNEANUS Benth. (*P. Patchouly* Pelletier; *P. suavis* Tenore), the *Patchouli balm*, native and cultivated in the East Indies, yields oil of patchouli. Since the oil only occurs in commerce to any extent, the herb itself is here of little interest. *Microtœna cymosa* Prain, of Cochin China, is used like patchouli.

SATUREJA HORTENSIS L., or *Summer savory* (*Saturei*, *Pfefferkraut*, *Wurstkraut*, *Bohnenkraut*, G.; *Sarriette*, Fr.), is a native of Europe, and is everywhere cultivated as a medicinal and culinary herb. The stem is much-branched, roughish-pubescent; the leaves are linear-lanceolate or oblong-linear, entire, acute, and tapering into a very short petiole; the cymules are about 3-flowered, with the corolla pale-purplish, and with 4 diverging rather included stamens.

SATUREJA MONTANA L. (*Micromeria m.* Reichenbach) is the *Winter savory*, and is less used. It is suffruticose, retrorsely hairy, and has hairy whitish or reddish flowers in small axillary clusters, and linear-lanceolate, mucronate leaves, pellucid-punctate and rough on the margin. Haller (1882) obtained from it 0.83 per cent. of volatile oil having an orange-yellow color, an odor resembling that of origanum, and the density 0.7394 at 17° C. (62.6° F.); it is lævogyre, and contains 2 hydrocarbons and 2 phenols, one of the latter being identical with *carvacrol*.

COLLINSONIA CANADENSIS L., *Stoneroot*, *Richweed*, *Horse-balm* or *Ox-balm*, *Citronella*, *Knob-root* or *Knot-root* (*Collinsonia*, G.; *Guérut-tout*, *Baume de cheval*, Fr.), is a native of eastern and central United States and extends into Canada. It is a perennial herb, about a meter (a yard) high. It has a nearly horizontal and irregularly branched rhizome, having, together with the branches, a length and width of 7 to 15 Cm. (3 to 6 In.), and on the upper side a very knotty and tuberculated appearance, from the numerous short projecting branches and the many shallow concave stem-scars; the lower surface is much less knotty, and bears many thin nearly simple roots or their remnants. It is externally of a grayish- or yellowish-brown color, has a very thin bark of a slight nauseous taste, and a very hard, whitish wood. The stem is quadrangular and hairy above; the leaves are opposite, petiolate, 7 to 20 Cm. (3 to 8 In.) long, thin, nearly smooth, ovate, pointed, sometimes rather heart-shaped at the base, coarsely serrate, and somewhat dotted beneath. The flowers are in loose racemes, of a lemon- to greenish-yellow color, the lower lip of the corolla fringed and with 2 exserted stamens. The fresh flowering herb has a delightful lemon-like fragrance; when rubbed, a strong and less agreeable odor. Its taste is pungent. Collinsonia is said to possess tonic, astringent, diuretic, and diaphoretic properties. The fresh root produces gastric irritation with nausea and vomiting. Hot infusions have been recommended in the treatment of fevers and muscular rheumatism; and cold decoctions made from the fresh root have been employed in the treatment of leucorrhœa, dropsy, gravel, and vesical catarrh.

FIG. 245.



Collinsonia (leaf, ⅓ Nat.; inflorescence, ⅔ Nat.).

C. ANISATA Sims (*Hypogon a.*—Raf.) is the *Anise-root* of our Southern States.

PERILLA FRUTESCENS (L.) Brit. (*Ocimum f.* L.; *P. ocimoides* L.), native and cultivated in India, is sparingly naturalized in the United States. The seeds, called *Kenia*, *Bhangara*, etc., are used as a food-grain in India. They contain 43 per cent. of fat, 10 per cent. of digestible carbohydrates, and 23 per cent. of albuminoids, and their nutritive ratio is as 1 : 5.

KOELLIA, Moench (*Pycnanthemum* Mx.), is a genus of about 15 species, most of them known as *Mountain mint*, with special prefixes. *K. flexuosa* (Walt.) MacM. (*Origanum f.*

Walt.; *Satureia Thymus-Virginicus* L.; *Pycnanthemum linifolium* Pursh.), the *Narrow-leaved mountain mint*, or *Virginia thyme*, has rigid, narrowly linear sessile crowded leaves, which are entire and 3-nerved; the flowers are in terminal hemispherical clusters, supported by imbricate, rigidly pointed bracts. It has been popularly regarded as useful in hydrophobia, and has been employed in atonic dyspepsia. Its tannin is very similar to, if not identical with caffeo-tannic acid. *K. Virginiana* (L.) MacMillan (*Satureia V.*—L.; *Pycnanthemum lanceolatum* Pursh.), *Virginia mountain mint*, *Virginia thyme*, *Mountain thyme*, *Prairie hyssop*, which extends west of the Mississippi, resembles the preceding, but the leaves are a little broader. Its oil can scarcely be distinguished from that of American Pennyroyal. *K. incana* (L.) Kuntze (*Clinopodium i.* L.; *Pycnanthemum i.* Mx.), the *Hoary mountain mint*, *Wild basil* or *Calamint*, incorrectly called "Horsemint," native of eastern United States, has broader, ovate-oblong, hoary-pubescent leaves.

MICROMERIA CHAMISSONIS (Benth.) Greene (*M. Douglassii* Benth.; *M. barbata* Fisch. et Meyer) is the *Yerba Buena* of the United States Pacific coast. It is a perennial creeping or trailing, sweet-scented herb of the Pacific coast from California to Washington Territory, and is known as *yerba buena*. The leaves are roundish-ovate, thin, sparingly toothed, and short-petioled; the purplish flowers are mostly solitary in the axils on long and filiform peduncles.

ORIGANUM VULGARE L., *Organy*, *Orgament*, *Wild*, *Winter*, or *Bitter marjoram*, *Winter-sweet*, *European mountain mint* (*Wilder Marjoran*, *Dosten*, *Gemeiner Wohlgemuth*, G.; *Origan vulgaire*, Fr.), is a perennial herb growing in dry soil throughout a large portion of Asia, Europe, and northern Africa. It has been introduced into the United States, where in some places it is now quite common. The stem is quadrangular, often purplish, branched above. The leaves are opposite, petiolate, roundish ovate, obtuse, entire, or slightly toothed, hairy on the veins beneath, and pellucid punctate. The flowers are terminal on the branches, forming a corymbose panicle, have a purple, ovate bell-shaped and 5-toothed calyx, a purplish somewhat 2-lipped corolla, and 4 didynamous exserted stamens. The leaves are oval to ovoid, rounded at the summit, 0.75 to 1 Mm. long and about two-thirds as broad, and are finely and harshly papillose. The herb has a strong aromatic, marjoram-like odor and a warm aromatic and bitterish taste. *O. Dictamnus* L., *Cretan dittany* (*Diptamdosten*, *Kretischer Diptam*, G.; *Dictame de Crete*, Fr.), native of the Levant, has woolly-tomentose, obtusely quadrangular branches, roundish ovate tomentose leaves, partly purple-colored bracts, and a dark-purplish corolla. It is pungently aromatic. *O. creticum* L., indigenous to southern Europe, bears the same names, and is known also as *Spanish hop* L., has hairy ovate or nearly cordate and somewhat 5-nerved, pungently aromatic leaves, and whitish flowers. In Europe the volatile oil is distilled from it, and is used like allied oils. The volatile oil of *O. hirtum* Link, which is often sold in place of it, consists, according to Jahns (1879), of 50 to 60 per cent. of *carvacrol* and of several terpenes, besides a volatile acid and a small quantity of a phenol which becomes violet-colored with ferric chloride. Some 20 species of *Origanum* are recorded as being medicinally employed. Wild marjoram has been recommended in the form of a poultice, for the treatment of sprains, bruises, and muscular rheumatism. A hot infusion is occasionally employed by the laity as a diaphoretic and emmenagogue.

FIG. 246.

Origanum (¾ Nat.); flower (× 3).

FIG. 247.

Majorana (¾ Nat.); flower (× 6).

MAJORANA MAJORANA (L.) Rusby (*Origanum m.* L., *M. hortensis* Moench.) yields *Herba majoranæ*, *H. amaraci* or *H. sampsuchi*, and is known as *Sweet*, *Garden*, or *Knotted marjoram* (*Meiran* or *Mayran*, *Majaran*, *Wurstkraut*, G.; *Marjolaine*, Fr.; *Majorana*, *Almoraduz*, Sp.). It is an annual herb, frequently cultivated for culinary purposes, and is indigenous to western Asia and southeastern Europe. The leaves are spatulate or oval, very obtuse, entire, gray-green, soft-hairy, and pellucid punctate. The flowers are aggregated in small heads and have a small whitish corolla. The plant is agreeably and pungently aromatic. The volatile oil (*Oleum majoranæ*) is thin, yellowish, of the specific gravity 0.89, boils above 163° C. (325.4° F.), is readily soluble in alcohol, has the aromatic odor of the herb, and, according to Beilstein and E. Wiegand (1882), contains a terpene boiling at 178° C. (352.4° F.) and forming a liquid compound with HCl; the fraction boiling between 200° and 220° C. (392° and 428° F.) has the composition $C_{15}H_{26}O$, and is not affected by metallic sodium. An ointment of marjoram, *Unguentum majoranæ*, is occa-

sionally employed; it is prepared by softening 2 parts of the cut herb with 1 part of alcohol, then digesting with 10 parts of lard until the alcohol has evaporated, straining and cooling. Sweet marjoram is employed by the laity in hot infusion for the purpose of hastening delayed exanthematous eruptions.

ROSMARINUS OFFICINALIS L. (*Rosemary* or *Old man*, E.; *Meerthau*, *Rosmarin*, G.; *Romarin*, Fr.; *Romero*, Sp.) is a native of southern Europe and cultivated, the drug largely collected and the oil distilled in Spain. It is shrubby, 0.9–1.2 M. (3 or 4 Ft.) high, much branched, evergreen, and has few-flowered axillary clusters of rather large pale-blue flowers. Rosemary leaves are about 25 Mm. (1 In.) long, leathery, linear, entire, sessile, obtuse at both ends, dark-green above, densely woolly and dotted with oil-glands beneath, and revolute on the margin. In drying, the margin becomes more strongly revolute, the leaf narrower and rigid, and the midrib prominent on the lower side. Rosemary has a peculiar aromatic, somewhat camphoraceous odor and a pungently aromatic taste. The principal constituent is the volatile oil. A little tannin, resin, and bitter principle are likewise present. Rosemary was formerly employed in warm infusion as an emmenagogue, galactagogue, and stimulant diuretic. A poultice made by steeping the leaves in hot water may be applied for the relief of local pains. At present it is occasionally employed as a carminative and diuretic, and is thought by some to be useful in functional nervous diseases. An infusion (2 drachms (8 Gm.) in 1 pint (480 Cc.)) may be given in doses of 4 fluidrachms (16 Cc.).

FIG. 248.

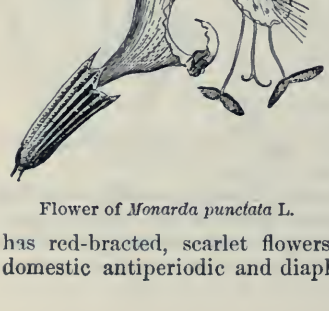
Rosmarinus officinalis L.: branch and flower.

LYCOPUS, L., is a genus of about a dozen species, several of which are largely employed. The principal species is *L. Virginicus* L., the *Virginian* or *Sweet bugleweed*, or *Wood betony* (*Virginische Wolfsfuss*, G.; *Lycope de Virginie*, Fr.), native of the eastern United States, flowering in late summer and fall. The stem is nearly smooth, about 30–45 Cm. (12–18 In.) high, obtusely quadrangular, and with slender runners at the base; the leaves are opposite, short-petioled, elliptic-lanceolate, toothed, wedge-shaped, and entire at the base, and glandular punctate beneath; the flowers are small, in axillary clusters, purplish, and have a calyx with 4 ovate and bluntish teeth. The herb has a somewhat mint-like odor and a bitter and slightly aromatic taste. *L. Europæus* L. (*L. aquaticus* Moench; *L. vulgaris* Pers.; *L. riparius* Salisb.) is the *Water* or *Marsh hoarhound*, *Bitter bugle*, *European bugleweed*, *Gypsy herb*, *Green archangel* (*Wasserandorn*, G.). It has been used in Europe as *Herba marrubii aquatici*. It is indigenous to Europe and North America, and resembles the bugleweed, being mainly distinguished by the often taller, sharply 4-angled stem, the more deeply and sinuate-toothed, at the base often pinnatifid, leaves, and the 5 triangular, sharp-pointed calyx-teeth. It varies somewhat in its foliage, and is not infrequently collected with the preceding. *L. Americanus* Muhl. (*L. sinuatus* Ell.; *L. Europæus sinuatus* A. Gray), *American bitter bugle*, *Paul's betony*, *Cut-leaved water hoarhound*, is very similar, and grows throughou North America.

CUNILA ORIGANOIDES (L.) Britton (*Satureja o.* L.; *Cunila Mariana* L.; *Hedyosmos origanoides* Kuntze) is *American* or *Mountain dittany*, *Wild Basil*, *Sweet horsemint*, *Stone mint*, *High pennyroyal*, native of the eastern United States, where it grows in dry soil, mostly on wooded hillsides. It has a thin, purplish, much-branched stem and nearly sessile, ovate, serrate, smooth leaves, which are rounded or subcordate at the base. The pale-purple flowers are in small pedunculate clusters and have 2 exserted stamens. Cunila may be employed as a diaphoretic for the same purposes as the other members of this family.

MONARDA, L., is a genus of about a dozen species, several of which are used under the name *Horsemint* or *Wild bergamot*. The plants are erect perennials, with toothed leaves and flowers in dense capitate heads terminating the branches, or in some species axillary as well. The calyx is narrowly tubular, 15-nerved, equally 5-toothed or nearly so, the corolla mostly glandular, strongly 2-lipped and ringent, the upper lip arched, the lower spreading. The inferior pair of stamens only bear anthers and are ascending, the thecæ divaricate. The most important is *M. punctata* L., *Common horsemint*, *American origanum* (*Pferdeminze*, G.; *Menthe de cheval*, Fr.), which has pale, spotted flowers, and extends beyond the Mississippi in the southern United States and is the source of *Monarda oil*. *M. didyma* L. (*M. coccinea* Mx.), the *American bee*, *Rose*, *Low*, *Red*, or *Scarlet balm*, *Oswego tea*, *Indian's plume*, is a native of eastern North America. It has red-bracted, scarlet flowers. *M. fistulosa* L. (*M. mollis* L.) is very similar, and is a domestic antiperiodic and diaphoretic in some sections. It has pinkish- or purplish-yellow,

FIG. 249.



Flower of *Monarda punctata* L.

white-bracted flowers. *M. citriodora* Cerv. (*M. aristata* Nutt.), of the southwestern United States, is the *Lemon monarda*, or *Prairie bergamot*. *Monarda punctata* is an aromatic stimulant, diaphoretic, and carminative, and is occasionally employed in domestic practice for the relief of flatulent colic, nausea and vomiting, and diarrhœa resulting from cold. The infusion (½ ounce or 16 Gm. to 1 pint or 480 Cc.) may be administered hot in doses of from 2 to 3 fluidounces (60–90 Cc.). Oil of horsemint may be locally applied to the skin for the relief of neuralgia and muscular rheumatism.

Calamintha is very similar to monarda and at least a dozen of its species are employed.

Hyssopus, *Hyssop*, *Garden hyssop* (*Ysop*, or *Isop*, *Eisering*, G.; *Hysope*, Fr.; *Hissopo*, Sp.), is the herbage of *H. officinalis* L. (*H. canescens* DC.; *H. orientalis* Adam), an herbaceous perennial, indigenous to southern Europe, frequently cultivated and sparingly naturalized in the United States. It is about 30 Cm. (1 Ft.) high, with wand-like simple quadrangular branches and opposite, sessile, linear-lanceolate, entire, and nearly obtuse leaves, which are about 25 Mm. (1 In.) long, nearly smooth, and finely punctate on both sides. The purplish-blue flowers are in small clusters, and have a 15-ribbed calyx, a 2-lipped corolla with a rather short and notched upper lip, and 4 exserted and divergent stamens. Hyssop has an aromatic somewhat camphoraceous odor and a pungent, aromatic, and bitterish taste. Aside from tannin, resin, fat, sugar, mucilage, etc., the most important constituent is *oil of hyssop*, of which the fresh herb yields 0.25 to 0.5 per cent. It is pale-yellow or greenish, limpid, of about the specific gravity 0.94, and freely soluble in alcohol; it contains oxygen, and commences to boil at 142° C. (287.6° F.), the boiling-point rising to 180° C. (356° F.). It has the odor and taste of the herb. The "hyssopin" of Herberger (1829) was found by Trommsdorff to be impure calcium sulphate. Mexican hyssop is *Salvia axillaris* Sesse. Hyssop is an aromatic stimulant and diaphoretic, which may be given in the form of an infusion as a remedy for dyspepsia, amenorrhœa resulting from cold, and muscular rheumatism. It has also been recommended in the treatment of chronic bronchitis, especially in old persons.

Dracocephalum.—Several species of this small genus are employed medicinally, and *D. Moldavica* L. is employed in Siberia as a substitute for tea.

Lophanthus rugosa Fisch. et Mey. is the Chinese aromatic *Hoh-hiang*, or *Hoh-ken*.

Nepeta is represented chiefly by the drug Cataria, elsewhere considered. To the same genus is often referred the *Ground ivy* or *Glechoma*, though it is more properly regarded as of a distinct genus. *Glechoma hederacea* L. (*Nepeta glechoma* Benth.; *N. hederacea* B. S. P.), *Ground ivy*, *Field balm*, *Cat's-foot*, *Alehoof*, *Gill-ale*, *Hove*, *Hay-maids*, incorrectly "Creeping Charlie" (*Gündelreben*, G.; *Lierre terrestre*, Fr.), is a native of Europe and very extensively naturalized in the United States. It is a slender, creeping, pubescent perennial herb, the leaves rather long-petioled, 1 to 4 Cm. (½ to 2 In.) broad, reniform-orbicular and deeply cordate; the flowers blue or violet, in axillary clusters, the calyx oblong, oblique, unequally 5-toothed, 15-nerved, the corolla dilated above, 2-lipped, the upper lip erect, 2-lobed, the lower spreading, 3-lobed, the large middle lobe notched. The taste is bitterish and aromatic.

Cedronella is a small genus, distinguished for the remarkably sweet fragrance of some of its species. *Cedronella triphylla* Moench (*Dracocephalum Canariense* L.), of the Canary Islands, is one of several plants used under the name *Sweet balm*. *C. Mexicana* Benth. and *C. pallida* Lindl. are used as substitutes for *Melissa* in Mexico.

Prunella (incorrectly "Brunella") vulgaris L. (*P. Canadensis* Mill.; *P. officinalis* Cranz) is the *Heal-all* or *Self-heal*, *Sickle-weed*, *Hook-weed*, *Carpenter's-herb*, *Brownwort*, E. (*Braunheil* or *Braunelle* G.; *Paquerette*, Fr.), widely distributed through the north-temperate zone, and common in fields, grassy places, and in woods in North America. Its ascending stem is about 30 Cm. (12 In.) long; the leaves are about 38 Mm. (1½ In.) long, petiolate, oblong-ovate, entire or somewhat toothed, and more or less hairy. The flowers are purplish-blue and form a dense leafy-bracted spike. The herb is nearly inodorous, and has a bitterish and somewhat astringent taste.

Ballota nigra L. (*B. fœtida* Lam.), *Herba ballotæ*, *H. marrubii nigræ*, *H. m. fœtidæ*, *Black*, *Stinking*, or *Bastard hoarhound*, *Black archangel*, *Dunnynettle*, *Henbit*, *Stinking Roger* (*Gemeine Ballote*, *Schwarzer Andorn*, G.; *Marube noir*, *Marube fœtide*, Fr.), is a native of Europe and seen occasionally in the United States. The stem is hairy, often red-brown; the leaves are wrinkled, hairy, ovate, slightly heart-shaped, acute, and crenately toothed. The reddish-purple flowers are in axillary clusters of 5 to 9.

Stachys, L., is a genus of nearly 200 species, a large number of which have been medicinally employed. The most important is *S. palustris* L., the *Hedge* or *Dead-nettle*, *Musk* or *Clown's woundwort*, *Rough-weed* or *Swine arnut* (*Stinknessel*, *Sumpfziest*, G.; *Ortie Rouge*, Fr.), native over a large part of the north-temperate zone, growing in moist places. It is stiff-hairy, and has nearly sessile, ovate-lanceolate, somewhat cordate leaves. *S. Fluminensis* Vell. is the *Catonga do mulata* of tropical America. *S. Betonica* Benth. is more generally known as *Betonica officinalis* L. It is the *Wood betony* or *Lousewort*, *Bishop's-wort*, *Wild hop* (*Betonie*, *Zehrkraut*, G.; *Betonie*, Fr.), native of Europe and occasional in the United States. It is rough-hairy, has cordate-oblong leaves, the cauline ones few, and purplish or whitish soft-hairy flowers in whorls of 6 to 10.

GALEOPSIS TETRAHIT L. (*G. grandiflora* Suter; *G. cannabina* Willd.), *Bee, Blind, Dog, Flowering,* or *Hemp nettle, Bastard hemp* or *Glidewort* (*Hanfnessel, Hohlzahn,* G.; *Chanvre Batard, Galeopside,* Fr.), is a native of the Old World and well established in many places in the United States. It yields the *Herba galeopsidis.* The stem is densely bristly, hairy below the joints; the leaves are ovate, usually acute, rather rounded at the base, coarsely serrate. The flowers are in dense axillary clusters, have long spiny-toothed calyx-teeth, and a white or yellowish corolla, with a purple spot on the lower lip. The allied species *G. ochroleuca* Lam. (*G. grandiflora* Roth.; *G. cannabina* Pollich), *Herba galeopsidis, Yellow hemp-nettle* (*Blankenheimer Thee, Liebersche Kraute, Gesundheitskraüter,* G.), native of Europe, at one time attracted attention as the principal ingredient of "Lieber's Consumption Herbs."

LEONURUS, L., is a genus of some 10 or 12 species of herbs. Most of them bear the name *Motherwort,* and the following are quite largely employed medicinally under that name: *L. Cardiaca* L. (*Cardiaca vulgaris* Moench), *Common motherwort, Lion's tail* or *Lion's ear, Cowthwort* (*Herzgespann, Wolfstrapp,* G.; *Cardiare, Agripanne,* Fr.), is native of temperate and subtropical Asia and Europe and quite commonly naturalized in the United States. It is 0.9 or 1.2 M. (3 or 4 Ft.) high, and has a quadrangular rather rough stem. The lower leaves are roundish, often heart-shaped at the base, and palmately 5- to 7-lobed; the upper ones are oblong, acutely 3-lobed, and have a wedge-shaped base. The pale-purplish flowers have awl-shaped or spiny-toothed calyx-teeth, and are in dense axillary cymules. The plant has a rather unpleasant aromatic odor and a bitter taste. It has been found to contain, besides volatile oil, a bitter principle, a hard and a soft resin, fat, wax, citric, tartaric, and malic acids. *L. Marrubiastrum* L. (*Cardiaca M. Medic.*), the *Hoarhound motherwort* or *Lion's tail,* etc.), has the same range. *Leonurus Sinensis* is the Chinese *Ch'nuy-wei* or *Yih-mu-ts'au.* Several species of *Siderotis* and of *Leonotis* are similar and similarly employed. Also various species of *Leucas,* much, and ignorantly, used for snake-bite.

LAMIUM, L., comprises 40 or 50 species, and a large number of them have been employed. The three following are most important: *L. album* L., *White, Blind, Dumb, Stingless nettle, Dead* or *Flowering nettle,* etc., *White archangel, Suck-bottle* (*Weisser Bienensang, Taubnessel,* G.; *Ortie blanche, Lamier,* Fr.), native of Europe, common in the United States. It has ovate, cordate, coarsely serrate, petioled leaves and white or whitish flowers, in dense axillary clusters. *L. amplexicaule* L. is the *Greater henbit. L. purpurea* L. is the *Red* or *Dead nettle,* etc., *Dry nettle, French nettle, Red* or *Sweet archangel.* The two last have roundish leaves and smaller, purplish flowers.

The genus TEUCRIUM, L., or *Germander,* comprises more than 100 species. The 20 or more of them recorded as in medicinal use have been much confused as to terminology. The genus is characterized by its flowers, which have the lower lip elongated and the upper lip short and deeply divided, the 4 stamens projecting from the cleft. All are aromatic and more or less bitter. The most important is probably *T. Marum* L. (*Herba mari veri, Herba thymi catariæ, Sea germander, Cat-thyme* or *Herb mastich,* E.; *Katzengamander, Amberkraut, Moschuskraut, Theriackraut,* G.; *Germandrée maritime,* Fr.; *Maro cortesso,* Sp.). It is shrubby, about 30 Cm. (12 In.) high and much branched. The leaves are about 8 Mm. (⅓ In.) long, petiolate, oval or lance-ovate, with the margin entire and revolute, and whitish-tomentose beneath. The rose-red flowers are single in the axils of the bracts, forming a 1-sided, spike-like raceme. The odor is strongly camphoraceous, the taste pungent and bitter. *T. Scordium* L. is the *Herba Scordii, Water germander, Wood garlic,* or *English treacle,* E. (*Wasserbathengel, Lachenknoblauch,* G.; *Germandrée aquatique,* Fr.; *Escordio,* Sp.). It is about 30 Cm. (12 In.) high, has sessile, lance-oblong, serrate, and soft hairy leaves about 33 Mm. (1.5 In.) long, and rose-colored flowers in whorls of 2 to 4. In the fresh state it has an alliaceous odor. Very similar is *T. Scordonia* L. (*Scordonia sylvestris* Link.), the *Wood germander, Garlic sage, Ambrose, European mountain sage. T. Polium* L. (*Polymountain,* E.; *Polium,* Fr.; *Bergpoley,* G.; *Zamarilla,* Sp.) has leaves 12 Mm. (0.5 In.) long, tomentose, sessile, lance-linear, obtuse, crenate, and strongly revolute on the margin. The flowers are white. The allied *T. montanum* L. has yellowish flowers. *T. Chamædrys* L., *Herba Chamædryos, H. trixaginis,* is the common *European* or *Wall germander* (*Chamædrys, Ground oak* or *Horse-chire,* E.; *Germanderlein, Edler, Frauenbiss,* G.; *Germandrée Chamædrys, Petit chene,* Fr.; *Camedrios,* Sp.). It is low, suffruticose, and branching. The leaves are about 25 Mm. (1 In.) long, petiolate, hairy, ovate or obovate, obtuse, cuneate at base, and crenately serrate. The flowers are purplish-red. *American germander* or *Wood sage* was formerly regarded as *T. Canadensis* L., but it is now known that several others were used under this name. The drug, as commonly employed, is downy or hairy, of a grayish-green color, and about 60 Cm. (2 Ft.) high. The leaves are about 5 Cm. (2 In.) long, short-stalked, lance-ovate, rounded at the base and serrate on the margin. The pale-purple flowers are in whorls of about 6 and form a terminal spike. The various members of this genus have been employed in the treatment of nervous cough, nervous depression, and functional nervous diseases. The dose of either variety is about 30 grains (2 Gm.), either in substance or in infusion.

AJUGA, L., of some 40 species, is an Old World genus, of which a dozen or more are employed medicinally under the name *Bugle. A. Chamæpitys* (L.) Schreb. (*Teucrium C.* L.),

the *European ground pine*, or *Field cypress*, and one of several plants called "Ground ivy" (*Feldcupresse, Günse*, G.; *Chamæpitys, Ivette*, Fr.; *Pinillo oloroso*, Sp.; *Kamafitus*, Persian), is a European small hairy annual with axillary flowers, having the yellow corolla dotted with purple; the lower leaves are lanceolate, the upper ones 3-cleft with linear lobes; the odor is rosemary-like. *A. Ivy* (L.) Schreb. (*Teucrium I.* L.), the *French ground pine* or *Ground ivy, Herb ivy, Gout ivy* (*Bisamgünsel*, G.; *Ivette musquée*, Fr.), resembles the preceding, but has linear, somewhat toothed, woolly leaves, red flowers, and a musk-like odor. This and the preceding species are official in the French Codex. *A. reptans* L., the *Common* or *Brown bugle, Sicklewort, Dead-man's bellows, Middle comfrey* (*Goldner Günsel*, G.; *Bugle*, Fr.), and *A. pyramidalis* L., the *Mountain* or *Erect bugle*, are small perennials, with obovate, crenate radical leaves, and blue flowers, slightly aromatic and somewhat bitter. The following additional drugs of this family are worthy of note: *Mangerona do campo*, of Paraguay, etc., is *Glechon spathulata* Benth. *Misk-i-trayamana*, of western Asia, is *Zizyphora clinopodioides* Lam. *Misk-i-turamashik* is *Z. tenuior* L. Both are musk-substitutes. *Yokwansa*, of Ceylon, is *Anisomeles ovata* R. Br. (*Nepeta Indica* L.; *N. Amboinica* L. f.). *Gajuban Mogbira*, of the East Indies, is *A. Malabarica* R. Br. (*Nepeta M.* L.; *Ajuga fruticosa* Roxb.). *Eremostachys tuberosa* Bge. (*Molucella t.* Pall.), of Tartary, yields an edible root, and *E. superba* Royle is used in India as a fish poison.

LAC FERMENTATUM.—Fermented Milk.

Kumyss, E.; *Lait fermenté*, Fr.; *Gegohrene Milch, Kumiss*, G.

Preparation.—Cows' milk, fresh, 1000 Cc.; yeast, semiliquid, 5 Cc.; sugar, 35 Gm. Dissolve the sugar in the milk, contained in a strong bottle, add the yeast, cork the bottle securely, and keep it at a temperature between 23° and 32° C. (73.4° to 89.6° F.) for 6 hours; then transfer it to a cold place.

The above formula, taken from the National Formulary, yields a satisfactory product. One-fourth of the quantity given, placed in strong 10-ounce bottles, will be found more desirable for sale and use.

In place of preparing kumyss with sweet milk, and waiting until it turns sour, the casein may be precipitated at once by the addition of one-third of ready kumyss to fresh milk. Yeast is not necessary, but sugar must be added to produce sufficient carbonic acid gas to cause effervescence.

Kumyss may also be made from sour milk, freed from its cream, by breaking up the curd by vigorous stirring, and causing alcoholic fermentation by addition of sugar and yeast. The cream removed may be replaced by sweet cream.

A similar preparation made from mares' milk has long been in use among the nomadic tribes of the Russian steppes. It is made with the aid of a peculiar ferment, occurring in large granules, and known as *Streptococcus kefir*. The resulting fermented liquid is known as *kefir, kephir*, or *kapir*.

Kephir-kumyss may be prepared by adding active kefir grains to fresh cows' milk, kept at a temperature of 70° to 80° F., until the effect of fermentation becomes apparent by the rising of the grains to the surface. The grains may then be strained off, and the milk, which now contains sufficient yeast-cells to insure continuance of the fermentation, left to itself in well-corked bottles.

Action and Uses.—Kumyss contains an altered casein, small quantities of alcohol, lactic acid, and carbon dioxide. This casein, which has been changed by the process of fermentation, is said to be more readily digested than that found in the milk from which this liquid is prepared. The alcohol and lactic acid materially aid digestion and the carbon dioxide is believed to increase the rapidity of absorption. When taken in large quantities, it quenches thirst, relieves hunger, increases nutrition, and slightly stimulates the circulatory, nervous, and respiratory systems. Because of the large quantity of water contained in kumyss, this beverage also increases the flow of the urine and the activity of the sweat-glands. It contains all of the virtues of milk, but as it is more easily digested and more rapidly absorbed, it may be given in larger quantities than the latter without producing the disagreeable sensation of weight in the epigastrium which frequently follows the ingestion of large amounts of other liquids. This preparation is especially useful in all forms of indigestion whether due to either depressions or irritability of the stomach. It is frequently employed as a food in enteric fever, and is useful as such in all typhoid states. As it promotes nutrition in general, it may be given with varying degrees of success in secondary anæmias and in chronic constitutional diseases.

LACCA.—Lac.

Resina lacca.—Lack, Gummi-lack, G.; *Laque, Gomme laque,* Fr.; *Goma laca,* Sp.

A resinous exudation from various plants, caused by punctures made by the hemipterous insect *Coccus lacca* Kerr.

Origin.—The East Indian trees yielding this substance are mostly milky-juiced plants, especially *Croton aromaticus* L. (*C. laccifera* L.; *Aleurites l.* Willd.—Fam. *Euphorbiaceæ*), the principal source, and *Ficus Indica* L. (the *Banyan* or *Indian fig*), *F. religiosa* L. (the *Pipal, Peepul, Bo* or *Sacred fig*), *F. Benghalensis* L., *F. Tájéla* Hamilt., and doubtless other species of Ficus (Fam. *Moraceæ*). Much Lacca is also yielded by *Schleichera trijuga* Willd. (*Cussambium spinosum* Buch-Hamilt.—Fam. *Sapindaceæ*). Other plants said to yield it are *Acacia Arabica* (see ACACIA) and *A. Greggii* A. Gray (Fam. *Mimosaceæ*), of the southwestern United States and Mexico, *Butea frondosa* Roxb. (Fam. *Leguminosæ*) and *Shorea Tálura* Roxb. (*S. laccifera* Heyne —Fam. *Dipterocarpaceæ*).

The impregnated female of the insect becomes imbedded in the exudation, through which the larvæ, if hatched, eat their way. Red Lac is that collected while it still retains the red coloring-matter developed by the body of the insect, and is the more valuable. The branches, bearing their incrustation, are collected.

Description.—The thin branches, almost completely covered with numerous small resin-nodules, constitute the *stick-lac.* The separate nodules or tears are red-brown, and contain in the interior a dark blackish-red powder; after the escape of the young insects the resin is brown. The same resin, after having been detached from the twigs, constitutes the *seed-lac* or *grain-lac.* It is in irregular fragments of the size of a pea and smaller, yellowish-brown or reddish, somewhat shiny, and nearly tasteless. After boiling the stick-lac or seed-lac with water, fusing the resin, and congealing it upon a smooth surface, *shellac* is obtained; it comes in thin, glossy, and more or less transparent fragments. Sometimes *grape-lac* and *lump-lac* have been distinguished, the former of which consists of agglutinated incrustations separated from the twigs; the latter is identical with shellac, except that it has not been congealed in thin layers. When chewed, stick-lac softens and colors the saliva purplish-red, a slight bitterish and astringent taste being perceived; when burned, it gives off a strong and agreeable odor. The water in which red stick-lac has been boiled on being treated with alum yields *lac-dye.*

Shellac is soluble in alcohol, potassa, soda, borax, and hydrochloric and acetic acids, and when digested with ammonia in closed vessels swells to a gelatinous mass. By treating the alkaline solution with chlorine or sulphurous acid, bleached shellac is obtained.

Constituents.—Lac is a complex body, containing, according to Unverdorben, 5 distinct resins, besides wax, fat, and coloring and extractive matter. The resins, which may be separated by their different behavior to alcohol, ether, and alkalies are present in seed-lac, according to Hatchett and John, to the amount of 66 or 68 per cent., but shellac contains fully 90 per cent. of resin. The wax has been found to vary in amount between about 2 and 6 per cent.

Action and Uses.—Lac is rarely employed in internal medicine. It may be combined with astringents and employed in the treatment of indolent ulcers.

LACMUS.—Litmus.

Lacca cærulea, Lacca musica.—Tournesol, Laque bleu, Fr.; *Lackmus,* G.

A blue pigment obtained from various species of lichens, such as *Leconora, Roccella, Variolaria,* and others found on the Azores, Canaries, and Cape Verde Islands, also in East India, Mozambique, Scotland, Sweden, and elsewhere.

Preparation.—The lichens are powdered, made into a soft pasty mixture with potassium carbonate, water, and stale urine, and exposed to the air to undergo fermentation. The liquid gradually acquires a red, purple, and finally blue color, and is then mixed with chalk, gypsum, or sand, to give it consistence, after which the mass is passed through a coarse sieve and moulded into small cakes or cubes, and finally dried. It is chiefly manufactured in Holland, and the best product is said to require about 40 days.

Constituents.—Besides mineral matter, litmus contains several coloring-matters, such as azolitmin, erythrolitmin, erythrolein, and spaniolitmin, the latter only in minute quantity. Of these, azolitmin is the most important. It is a weak acid, and exists in litmus in combination with potassium, insoluble in alcohol but soluble in water. Pure azolitmin is an amorphous brown-red substance. Erythrolitmin is a red crystalline body,

insoluble in ether but soluble in alcohol. The insoluble matter in litmus may range from 46 to 89 per cent., while the moisture present varies from 1.5 to 10 per cent.

D. Rainy Brown (*Pharm. Jour.*, 1896) examined 7 samples of commercial litmus, and found the proportion of azolitmin present to average 4.6 per cent., except in two cases in which it reached 13.3 and 14.1 per cent., respectively. Naturally the richer in azolitmin the more valuable is the litmus. Brown's method for determining the azolitmin content is as follows: "The finely powdered sample is exhausted with boiling water as long as any coloring-matter is extracted; the solution is evaporated to a small bulk, and after acidifying with acetic acid evaporation is continued nearly to dryness. The acetic acid converts the potassium and ammonium carbonates present into alcohol-soluble acetates. A large excess of 85 or 90 per cent. alcohol is added to the acidified solution, which precipitates crude azolitmin; after standing 12 hours the precipitate is collected on a filter, and when dry is dissolved in the smallest possible quantity of boiling water and poured into alcohol. After standing overnight the precipitate is filtered off, dried, and weighed.

Pharmaceutical Uses.—Litmus is used as a reagent or indicator for acids and alkalies, giving a red color with the former and a blue color with the latter. When used by gaslight, the change of color is best seen through green glass. Both litmus solution and litmus-paper are recognized in almost every pharmacopœia, although the directions for preparing the same are not uniform.

Tinctura Laccæ Musicæ.—*Litmus test-solution, Solution of litmus,* E.; *Soluté de laque bleu,* Fr.; *Lakmuslösung,* G.—This is prepared, according to the U. S. P., by exhausting coarsely powdered litmus with three separate and successive portions (representing about 4 times its weight) of boiling alcohol (to remove erythrolitmin), each extraction lasting for about 1 hour, and treating the residue with an equal weight of cold water so as to dissolve the excess of alkali present. Finally, extract the residue with about 5 times its weight of boiling water and filter. The Br. P. gives similar directions. 20 Gm. of litmus, in powder, are boiled for an hour with three portions, 80, 60, and 60 Cc. of 90 per cent. alcohol, after which the washed litmus is digested in 200 Cc. of distilled water and filtered.

Litmus solution should be preserved in wide-mouthed bottles closed with loose plugs of cotton to exclude dust, but to admit air.

Charta Exploratoria Cœrulea et Rubra.—*Blue and red litmus-paper,* E.; *Papier à tournesol bleu et rouge,* Fr.; *Blaues und rothes Lakmuspapier,* G.—Blue litmus-paper is made by impregnating strips of unglazed white paper with solution of litmus, and drying them suspended on clean twine in an atmosphere free from acid and ammoniacal vapors. The P. G. directs that the solution to be used shall be made by macerating litmus with 10 parts of water for 24 hours, occasionally rotating the vessel, then decanting and filtering. This solution is heated to boiling and diluted sulphuric acid added, drop by drop, until a small portion of the liquid diluted with 100 times its volume of water shows just a violet-blue color. Red litmus-paper is made by first changing the color of litmus solution to red by addition of just sufficient sulphuric or hydrochloric acid and then impregnating paper with the same as above directed.

Good sensitive litmus-paper should detect 1 part of sulphuric acid in 40,000 parts of water, 1 part of hydrochloric acid in 50,000, 1 part of potassium hydroxide in 20,000, and 1 part of ammonia in 60,000. It should be preserved in paper boxes or bottles protected against light, dust, and vapors.

Uses.—Litmus may be employed either in the form of an infusion or upon paper. Litmus paper is employed for determining the acidity or alkalinity of various fluids. Its most common use in medicine is in the examination of the urine. Its employment in the examination of the gastric contents is of little value, as it does not indicate either the variety or the amount of free acid present.

Allied Pigments.—Archil or *orchil,* E., *Orseille,* Fr., G., is made from the same lichens which yield litmus. The lichens are heated for a week with diluted ammonia, when sulphuric acid and table-salt are added. Archil is a pasty mass of a deep-purple color.

Persio.—*Cudbear,* E., *Orseille de terre,* Fr., *Persio, Rother Indigo,* G., is made in precisely the same manner, except that, instead of adding acid and salt, the mixture is dried and powdered. It occurs as a purplish-red powder and is used in the form of a hydro-alcoholic solution (see Tinctura Persionis) as a coloring agent in pharmaceutical preparations.

The lichens which are used for the production of the above pigments contain a number of chromogenes, which are ternary compounds, and in the presence of water and ammonia are converted into various nitrogenated red pigments. The most important of these chromogenes, as far as they have been investigated, are—*erythric acid*, $C_{20}H_{22}O_{20}$, *alpha-orsellic acid*, $C_{32}H_{28}O_{14}$, *beta-orsellic acid*, $C_{34}H_{32}O_{15}$, and *evernic acid*, $C_{34}H_{32}O_{14}$. On being boiled for a long time with water or alkaline solutions they yield *lecanoric acid*, $C_{16}H_{14}O_7$, afterward *orsellic acid*, $C_8H_8O_4$, and finally *orcin*, $C_7H_8O_2$, which crystallizes in large colorless needles, has a sweet taste, turns red on contact with air, and yields with ammonia *orcein*, $C_7H_7NO_3$; this is brown, and dissolves in alkalies with a beautiful red color. Orcin is also obtained from aloes by fusing it with caustic potassa.

LACTUCARIUM, *U. S., Fr. Cod.*—Lactucarium.

Lactucarium Anglicum, L. Germanicum.—*Giftlattichsaft*, G.; *Lactucarium*, G., Fr.; *Lactucario*, Sp.

The concrete milk-juice of *Lactuca virosa* L. (Fam. *Compositæ*).

The Lactucarium defined above, or some very similar substance, is official in most pharmacopœias. The French and Italian express the juice from the fresh stems, clarify and inspissate, while the Portuguese extracts the fresh stalks with 65 per cent. alcohol. The French and some others recognize an alcoholic extract of Lactucarium. The Belgian recognizes an alcoholic extract of the juice expressed from the stalks of *Lactuca sativa* L., the common garden lettuce, while some others clarify the same juice by a process of coagulation, expressing and inspissating the remaining juice, which is then called *Thridace*, a name which is also applied to the product of the same plant obtained like Lactucarium. The latter is also called *Lactucarium Gallicum*. Several pharmacopœias specify the product of *L. Scariola* L., the *Prickly lettuce, Horse thistle*, or *Compass plant* of Europe, occasionally found wild in the eastern and central United States.

Origin.—*Latuca virosa*, described below, is abundant in a wild state in western and southern Europe and occurs occasionally in America. It is also cultivated in Europe, mostly in England and Germany, for the production of Lactucarium. Collection is made by cutting off the top of the stalk, just as flowering is about to commence, and scraping off the exuding milk, which is dried by artificial heat, this process being complete in about 5 days. The same plant is cut half a dozen times daily, and the incisions are continued for several weeks. The average yield per plant is said to be from 40 to 50 grains, the juice yielding about 25 per cent. of its weight of Lactucarium. The substance is mostly inspissated in little dishes like evaporating-dishes, resulting in a plano-convex cake, this being cut into quarter segments in removing. Sometimes it is dried in double plano-circular cakes, and occasionally it occurs in irregular fragments.

Description.—In sections of plano-convex circular cakes, or in irregular, angular pieces, externally grayish-brown or dull reddish-brown, internally whitish or yellowish, of a waxy luster when cut; odor heavy, somewhat narcotic; taste bitter.

Lactucarium is partly soluble in alcohol and in ether. When triturated with water it yields a turbid mixture, and when boiled with water it softens and yields a brownish colored liquid which, after cooling, is not colored blue by iodine test-solution.

Tests.—Lactucarium on being treated with boiling water should become soft without melting, and yield a bitter filtrate, which while hot should be clear, and on cooling become turbid; this liquid should not be colored blue by iodine (absence of starch), but should become clear on the addition of ammonia or of alcohol; the ammoniacal liquid should yield a copious precipitate with solution of calcium sulphate (presence of oxalic acid), and the alcoholic solution should not be affected by ferric chloride (absence of tannin, etc.).

Several pharmacopœias place the ash limit at 10 per cent. The Dutch specifies that the drug should be dried over unslaked lime before powdering.

Composition.—*Lactucerin* or *lactucon* ($C_{28}H_{44}O_2$, Massner), the most abundant constituent, forms about one-half of the drug. It occurs in odorless, tasteless, white needles or conglomerates, soluble in hot alcohol, chloroform, ether, benzin, and oils, and insoluble in water. The bitter principles are lactucin, lactucic acid, and lactucopicrin, the rest of the drug including wax, caoutchouc, sugar, gum, pectin, soft resin, volatile oil, oxalic acid, and *alpha-* and *beta-lactucerol* (lactuceryl alcohol, $C_{18}H_{30}O$) in the form of acetates. These lactucerols with acetic acid are yielded on fusing lactucerin with potash. About 50 per cent. of lactucarium is soluble in water. *Lactucin* ($C_{11}H_{14}O_4$?) occurs in odor-

less, white, pearly scales or rhombic plates, soluble in 60–80 parts of water, slightly in ether, and readily in alcohol and acids. It is not a glucoside, but reduces Fehling's Solution. *Lactucic acid* is a light-yellow, very bitter body, crystallizable with difficulty, of acid reaction but without sour taste, and readily soluble in water and alcohol, its aqueous solution turning red with alkalies. *Lactucopicrin* ($C_{44}H_{32}O_{21}$) is brown, amorphous, of weakly acid reaction, very bitter, and easily soluble in water and alcohol.

Lactucarium contains no starch and no hyoscyamine, though the latter has been reported.

Pharmaceutical Preparations.—Fluidextract of Lactucarium, N. F.; Syrup of Lactucarium, Tincture of Lactucarium, U. S. P.

Action and Uses.—Lactucarium was formerly employed quite extensively as a soporific and sedative, but at the present time it is less frequently used. It may be given either in substance or in the form of a syrup for the relief of the nervous manifestations occurring during the course of certain infantile diseases. The dose of the powdered drug is from ½ to 2 grains (0.03–0.12 Gm.).

Allied Products.—Lactuca. Lettuce.—The genus *Lactuca*, L., comprises somewhere near 100 species, well illustrated by the common garden variety (*L. sativa* L.), which, although its physiological action is very mild, is somewhat employed medicinally (see above). It has been said, doubtless incorrectly, to contain a trace of hyoscyamine. As commonly employed in medicine and pharmacy, the name Lactuca or Lettuce (*Herba Lactucæ.—Giftlattich*, G.; *Laitue vireuse*, Fr. Cod.; *Lechuga*, Sp.) applies to the article official in the B. P., the flowering herb of *Lactuca virosa* L., the *Wild, Acrid,* or *Poison lettuce.* This is a biennial herb a yard or two high, the stem erect, somewhat prickly, the radical leaves large, petioled, oblong-obovate, obtuse, irregularly spinose-toothed, the midrib prickly, the stem-leaves gradually smaller, alternate, sessile or clasping, the apex spinose; inflorescence a loose terminal panicle; involucre oblong conical, the scales in about 3 rows, lanceolate, imbricate, the pale-yellow florets all ligulate; akenes oval, flattened, black with a long whitish beak, the pappus of numerous soft white capillary bristles; odor narcotic and disagreeable, and taste bitter and saline. Its constituents appear to be practically the same as those of the Lactucarium derived from it. Some other species have been found similar and probably most of them are so, and there is good reason to believe that related genera of the *Cichoriaceæ* also agree. The principal species which has been employed besides those mentioned above is *L. Scariola* L. Lettuce is rarely employed in medicine at the present time. In ancient times it was given as a soporific for the treatment of insomnia resulting from overstimulation of the mind. The variety grown in this country is practically devoid of soporific effect. In France a water distilled from the leaves is occasionally employed for its sedative effect, in doses of from 2 to 4 fluidounces (60–120 Cc.).

LAMELLÆ.—Disks.

Gelatina medicata in lamellis. Medicated gelatin disks, E.; *Disques de gélatine,* Fr.; *Gelatinlamellen, Gelatinplättchen,* G.

The name is applied to very small gelatin disks containing minute quantities of alkaloidal salts in solution. They may be prepared by dissolving the medicinal agent in an aqueous solution of gelatin to which glycerin has been added, and then pouring the finished solution upon perfectly smooth plates of glass or porcelain, which are set aside in a warm room, protected against dust, so that the moisture may evaporate. When dry, the sheet is divided by means of a suitable cutting apparatus into the required number of disks, each of which is about 1 Mm. ($\frac{1}{25}$ In.) thick and about 2.5 Mm. ($\frac{1}{10}$ In.) in diameter. The glycerin is added to prevent the disks from becoming hard and brittle on keeping.

Medicated gelatin disks are intended chiefly for use in ophthalmic treatment in place of solutions, and are introduced under the eyelid by means of a camel's-hair pencil. The Br. P. recognizes four kinds of medicated disks, and directs that, with one exception, they shall be of 0.0013 Gm. (about $\frac{1}{50}$ grain) weight, but gives no directions for their preparation.

Lamellæ Atropinæ, Br.—*Disks of atropine,* E.; *Disques d'atropine,* Fr.; *Atropinplättchen,* G.—Each disk is to contain 0.000013 Gm. ($\frac{1}{5000}$ grain) of atropine sulphate.

Lamellæ Cocainæ, Br.—*Disks of cocaine,* E.; *Disques de cocaine,* Fr.; *Cocainplättchen,* G.—Each disk is to weigh 0.00217 Gm. ($\frac{1}{30}$ grain) and contain 0.0013 Gm. ($\frac{1}{50}$ grain) of cocaine hydrochloride.

These disks are 4 times as strong as those of the Br. P. of 1885.

Lamellæ Homatropinæ, Br.—*Disks of homatropine,* E.; *Disques d'homatropine,* Fr.; *Homatropinplättchen,* G.—Each disk is to contain 0.0005 Gm. ($\frac{1}{100}$ grain) of homatropine hydrobromide.

Lamellæ Physostigminæ, Br.—*Disks of physostigmine,* E.; *Disques d'ésérine,* Fr.; *Physostigminplättchen,* G.—Each disk is to contain 0.00005 Gm. ($\frac{1}{1000}$ grain) of physostigmine sulphate.

LAMINARIA.—Laminaria.

Sea-girdle, Sea-staff, E.; *Laminaria, Riementang,* G.; *Laminaire digitée,* Fr.

The cylindrical base of the thallus of *Laminaria Cloustoni* Edmonst. and of *L. digitata* Lamour.

Origin.—These plants are very large sea-weeds of the North Atlantic and North Pacific, growing attached to rocks in from 10 to 15 fathoms of water. Their cylindrical base is somewhat rigid, their upper portion foliaceous and digitately lobed. The cylindrical portion is collected and quickly and carefully dried so as to avoid decomposition and the adherence of foreign matter.

Description.—In irregular, cylindrical pieces, about 12 Mm. (½ In.) or less thick, deeply wrinkled, externally brown or gray-brown, internally darker, of horn-like texture, and smooth horn-like fracture; softening and swelling to from 4 to 6 times its usual diameter when immersed in water; transverse section presenting an outer layer which is brownish and contains a zone of somewhat axially elongated large mucilage-cells, and a central portion of lighter or whitish color and composed of larger cells. It is prepared for medicinal use by being turned into evenly cylindrical or conical pieces.

Action and Uses.—Tents made of laminaria are employed principally for dilating the uterine cervix; occasionally, however, bougies are made of this material for the purpose of dilating strictures or sinuses. Their employment, especially in the uterus, is not unattended with danger, however, as they cannot be properly sterilized. Laminaria has largely fallen into disuse, as more efficient and less dangerous procedures have been adopted.

Allied Substances.—The soft spongy wood of *Nyssa grandidentata* Mx. f., the *Large tupelo, Cotton gum, Olivier,* and of *N. capitata* Walt., the *Tupelo gum, Sour gum,* or *Ogeechee lime* (Fam. *Cornaceæ*), both small trees of the southeastern United States, swells to nearly double its size when dry, upon immersion in water, and has been used similarly to Laminaria in gynæcological practice.

LAPPA, *U. S.*—Burdock.

Radix Bardanæ, P. A.—*Bazzies, Beggars' buttons, Cuckoo button, Hare-burr, etc.,* E.; *Klettenwurzel,* G.; *Bardane, Glouteron,* Fr.; *Bardana,* It., Sp.; *Lampazo,* Sp.; *Pegamaco,* Port.

The dried root of *Arctium Lappa* L. (*A. officinalis* All.; *Lappa o.* All.; *L. major* Gærtn.; *L. vulgaris* Neilr.; *L. tomentosa* Lam.) or of other species of *Arctium* (Fam. *Compositæ*), collected from plants of the first year's growth.

Lappa is official in most pharmacopœias, but these differ much as to the botanical names employed.

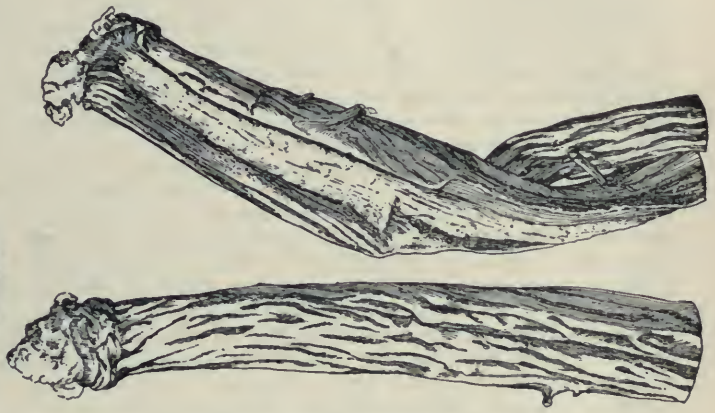
Origin.—The Burdocks are extremely coarse, biennial herbs of Europe and temperate Asia, now most thoroughly naturalized throughout North America and in other countries, in waste places, but in rich soil. The stems are of the second year's growth, are coarse and angular, 1 or 2 yards high, widely branching from the base, and bear enormous triangular-ovate, soft, grayish-white tomentose leaves on very thick, mostly reddish petioles, and racemose-paniculate heads which develop into globoidal burrs from ½ to 1 inch in diameter, clinging readily and tenaciously to passing bodies by their numerous involucral scales, which have recurved, hook-like tips. The florets are tubular, purple or rarely whitish. There has been great confusion regarding the specific and varietal forms and the application of the botanical names, but all forms of the root appear to agree in their almost complete inertness, from a medical standpoint. It is said that in Japan various forms are in cultivation for food, and that some of them reach a great size. For medicinal purposes, the roots are collected between the close of the growth of the first and the beginning of that of the second year. They weigh 6 or 7 times as much when fresh as when dry.

Description.—About 30 Cm. (12 In.) or more long, and 2 Cm. ($\frac{4}{5}$ In.) or less thick, nearly simple, very slenderly fusiform, bearing at the crown a soft, whitish, cottony tuft; or in broken pieces or longitudinal slices of the same, the edges of the longitudinal slices much incurved and usually rounded; externally grayish-brown to deep-brown, rather strongly longitudinally wrinkled; hard and with a short, somewhat fleshy fracture; internally, a dark cambium separates the brown bark from the yellowish wood, and the center is hollow or contains a whitish, pith-like tissue; free from starch; odor slight; taste mucilaginous, sweetish, slightly bitter.

FIG. 250.

Burdock root: transverse section.

FIG. 251.



Burdock: split and outer surfaces (Nat.).

The powder should be free from starch and calcium oxalate crystals.

Burdock root is quite liable to be wormy and mouldy, the latter contingency due to its fleshy nature and the difficulty of drying it.

Constituents.—Burdock root contains inulin, sugar, gum, mucilage, 0.4 per cent. of yellow fixed oil, wax, 0.075 per cent. of phlobaphene (altered tannin), and a very little *lappin*, a bitter crystalline glucoside, soluble in chloroform, alcohol, and water, and decomposed by very dilute acids into sugar and alcohol-soluble resin.

Pharmaceutical Preparation.—FLUIDEXTRACT OF LAPPA, U. S. P.

Action and Uses.—Burdock root may be employed as a diuretic and alterative in the treatment of gouty and rheumatic conditions, and in secondary syphilis and scrofula. It has also been employed as a remedy for chronic diseases of the skin; for example, acne and psoriasis. The fruit may be used as a substitute for the root, and the leaves are occasionally employed both internally and externally in the treatment of chronic skin lesions. Its administration should be continued over a period of several weeks to prove effectual. A decoction prepared by boiling 2 ounces (60 Gm.) of the root in 3 pints (1440 Cc.) of water until only 2 pints (960 Cc.) remain, may be given as the daily dose.

Allied Drugs.—FRUCTUS LAPPÆ, SEMEN BARDANÆ, *Burdock fruit*, is about 6 Mm. ($\frac{1}{4}$ In.) long, obovate-oblong, somewhat curved, angular, and flattened, roughish-wrinkled, brown-gray mottled with black, mostly deprived of the setaceous pappus, the short base of the style projecting from the center of the apical scar; inodorous; taste oily and very bitter. The fruit contains, according to Trimble and Macfarland (*Am. Jour. Phar.*, 1885, p. 127; 1888, p. 79), 15.4 per cent. of drying oil, 5.5 per cent. of resins, and a small quantity of the crystalline glucoside *lappin*. *Tinctura Lappæ Fructus* has been proposed to be made from 4 troyounces of the ground fruit by percolating with a mixture of alcohol 3 parts and water 1 part until a pint of percolate is obtained. Tincture of burdock fruit is frequently employed as a substitute for the preparations made from the root. It may be given in doses of from 1 to 2 fluidrachms (4–8 Cc.).

LAURACEÆ.—The Laurel Family.

This highly aromatic family is elsewhere represented in this work by the important drugs CINNAMOMUM, CAMPHORA, SASSAFRAS, COTO, and LAURUS. Very many of its 39 genera and 900 species possess constituents of equal activity, and are of less importance only because less

well known. Indeed, in the tropical regions of both hemispheres, its members, unknown to scientific medicine, contribute largely to the domestic materia medica. Some of the more important of these secondary drugs of the family are described below:

NECTANDRA BARK.—*Nectandræ cortex* (*Beeberu, Bibiru,* or *Bibiri bark, Green-heart bark,* E.; *Bibirurinde,* G.; *Écorce de bebeeru,* Fr.) is the dried bark of *Nectandra Rodiœi* Schombk., a large tree inhabiting the coast region of Guiana. The wood is strong and durable and highly valued for purposes where other woods are prone to decay; also in shipbuilding, since it is not attacked by marine parasites destructive to timber. It is generally stated in Guiana that wounds inflicted by the splinters of this wood are very apt to produce lockjaw. The bark is in flat or somewhat curved pieces, sometimes 30 to 60 Cm. (1–2 Ft.) long and 10 to 15 Cm. (4–6 In.) wide by 6 Mm. (¼ In.) thick, is heavy, hard, and brittle. The outer surface is gray-brown, with numerous irregular conchoidal depressions, the ridges between consisting of soft cork, sometimes with light reddish-gray patches containing small suberous warts. The inner surface is cinnamon-brown and rather coarsely striate. The bark breaks with a short and rough granular fracture, which is somewhat fibrous in the inner layer. It has no odor; its taste is astringent and persistently bitter.

Besides ordinary plant-constituents, Nectandra bark contains a number of alkaloids, and the wood contains still others. Only two of the alkaloids of the bark have been studied, namely, bebeerine and nectandrine. *Bebeerine* ($C_{18}H_{21}NO_3$) is crystalline, though its salts are not. It melts at 198° C. (388.4° F.), is practically insoluble in water, soluble in alcohol, ether, chloroform, amyl alcohol, and acetone, is colored dirty olive-green by concentrated sulphuric acid and brown by nitric acid. This alkaloid is believed to be identical with *buxine, pelosine,* and *paracine. Nectandrine* ($C_{20}H_{23}NO_4$) is amorphous, melts below 100° C. (212° F.), is insoluble in water, slightly soluble in ether, and soluble in chloroform. It gives a green color, changing to violet, wit hsulphuric acid and manganese dioxide. This alkaloid also occurs in the wood. Sulphate of bebeerine, as it occurs in commerce, is a mixed substance. Besides the two alkaloids above described, Maclagan reported having extracted from it the reddish-brown resin-like alkaloid *sipirine.* Nectandra has been recommended for its tonic, astringent, and antiperiodic properties; but as a tonic and febrifuge it is far inferior to cinchona. Its activity is due principally to the alkaloid beberine, the sulphate of which is most generally employed. Nectandra has been successfully administered in the treatment of malarial fevers, but in many cases it has failed to produce the desired result. It has likewise been recommended as a specific for periodical headache and neuralgias of malarial origin. Atonic dyspepsia, menorrhagia, and leucorrhœa resulting from anæmia are also said to have been benefited by its use. The dose of beberine sulphate is from 3 to 5 grains (0.20–0.30 Gm.). As an antiperiodic, from 20 to 40 grains (1.3–2.6 Gm.) of the powdered drug may be given in divided doses between the paroxysms.

SEMEN (FABÆ or COTYLÆ) PICHURIM (*Pichury* or *Pichurim beans, Brazilian beans, sassafras nuts,* E.; *Pichurimbohnen, Sassafrasnüsse,* G.; *Fève pichurim, noix de Sassafras,* Fr.) occur in two varieties, the large produced by *Nectandra Puchury-major* Nees (*Ocotea P.* Mart.), the small by *N. Puchury-minor* Nees (*Ocotea N.* Mart.), both good-sized trees of Brazil. The drug commonly occurs in the form of the separated cotyledons, which are oblong or roundish-oval, plano-convex, marked near one end with a depressed scar left by the detached caulicle, externally blackish-brown, internally light-brown and exhibiting yellow oil-cells; odor and taste resembling those of a mixture of Nutmeg and Sassafras. Those of the larger variety are about 4 Cm. (1½ In.) long and 1.2 Cm. (½ In.) broad; of the smaller, about half as large. With starch, gum, etc., the drug contains about 30 per cent. of fat, partly butyraceous and partly solid, and about 1 per cent. of a volatile oil, of greenish-yellow color, and apparently containing saffrol. Besides their use as an aromatic, substituting nutmeg, Pichury seeds have been considerably employed in medicine and have been recognized in a number of continental pharmacopœias. They have been chiefly used as stimulants and tonics in mild, subacute, and chronic *diarrhœa* and *dysentery,* and in habitual debility of the intestinal canal tending to produce flatulence and diarrhœa. Pichurim bark, which has an aromatic smell resembling that of nutmegs and an astringent taste, is employed in Panama in the treatment of *typhoid states* of the system, in atonic *dyspepsia, chronic vomiting, intermittent fever,* and *menstrual disorders.* The beans are given in powder in doses of from 10 to 20 grains (0.60–1.30 Gm.), or in an infusion; the bark is used in the same forms, and in doses twice as great as these. The oil from the beans has been employed in Europe in the treatment of gouty and rheumatic affections.

The seeds of *Aydendron Laurel* Nees (*Laurus L.*—W.; *Ocotea Pichurim* Humb.), of Venezuela, are used like Pichury seeds.

Canello preto, of Brazil, is the bark of *Nectandra amara* Meissn. (*N. puberula* Nees), and is used as a general aromatic and an emmenagogue. *Canelo de Mato,* of Venezuela, is the bark of *Nectandra cinnamoides* Nees (*Laurus c.*—H. B.), and is used as a cinnamon-substitute; its unripe fruit, like *Cassia Flores.* The bark of *N. sanguinea* Rottb. (*Laurus c.*—Swz.), of Guiana and the West Indies, is similarly used under the name *Maraguan cinnamon. Pao*

Sassafras, of Brazil, is the root of *N. cymbarum* N. et E. (*Ocotea c.*—Humb.; *O. amara* Mart.), and yields a balsam-like oil known as *Aceite de sassafras*. This may be identical with the Venezuelean Camphor-wood oil obtained by the writer, in eastern Venezuela, from an undetermined tree. The latter wood is rather soft, easily split, somewhat silky-lustrous, and yields a little more than 1 per cent. of oil. The latter is light-yellow, has a specific gravity of 1.155, and forms a crystalline mass at ordinary temperatures. It consists to the extent of 90 per cent. of *apiol*.

Caparrapi oil, of Colombia, is a commercial article, and is said to be the product of *Nectandra Caparrapi*, the bark of which has a cinnamon-like odor, and is called *Canello*. The oil is obtained from holes cut into the trunk. Its important constituent is *caparrapiol* ($C_{15}H_{25}OH$), which by dehydration yields *caparrapene*. It is very closely related to the product last named. Both are used as Copaiba-substitutes.

Benzoin or Lindera (*Spice-bush* or *-wood, Fever-bush* or *-wood, Wild allspice, Snap-wood, Benjamin bush*, E.; *Benzoelerbeer*, G.; *Laurier benzoin*, Fr.) is the dried bark of *Benzoin Benzoin* (L.) Coulter (*Laurus B.*—L.; *Lindera B.*—Blume; *B. odoriferum* Nees), a large, much-branched and widely spreading shrub of swamps and damp woods throughout western North America, and extending westward to Kansas. Its light-yellow flowers are produced before the leaves, in earliest spring, in numerous small, dense fascicles, close against the branches, and are succeeded in summer by small, obovoid, deep-red drupes. All parts of the plant are aromatic. Although the leaves and fruit are sometimes employed, it is the bark which constitutes the drug proper. This is mostly collected in the spring, when it can be easily removed in quills, though there are no data for determining the season which yields the best product. The *bark* forms thin quills, is yellowish or pale-brown and smooth upon the inner surface, blackish-brown and minutely dotted with corky warts upon the outer surface, breaks with a short granular fracture, has an agreeable though not very strong odor, and an aromatic somewhat pungent and astringent taste. Older bark has a brown-gray or dark-ash color and more prominent corky warts. The *fruit* is an obovate red drupe about 8 Mm. (⅓ In.) long, after drying blackish and granular upon the surface, and contains a single large white seed having an oily taste, while the fragile integuments of the fruit have a spicy taste, and when bruised an agreeable odor. The bark owes its activity to an unknown bitter principle, and about 0.5 per cent. of a volatile oil of a specific gravity of about 0.923. About one-tenth of this is methyl salicylate, which imparts the odor of wintergreen. The oil of the fruit has a specific gravity of 0.850 to 0.855 and contains a camphor-like body. The leaves yield about 0.3 per cent. of an oil of a specific gravity of 0.888, the composition of which has not been investigated. An infusion made from the small branches of the spice bush has been used as a stimulant and diaphoretic in the treatment of low fevers. The bark is said to possess vermifuge and antiperiodic properties, and the berries were formerly employed as feeble aromatics.

Lindera sericea Blume, *L. triloba* Br., and several other species, of Japan, possess tonic and stimulating properties, and the former yields a fragrant volatile oil which has been introduced under the Japanese name of *Kuromoji oil*. It is contained in all parts, but is distilled for commerce from the leafy twigs. The commercial oil is dark-yellow, of a specific gravity varying from 0.890 to 0.905. It is of complex composition.

California Laurel (*California bay, California wild olive*) is *Umbellularia Californica* (Arnott) Nutt. This plant becomes a good-sized tree in the Californian coast-region and yields a highly prized timber. Its fruit is said to be eaten by the aborigines. Its leaf is the medicinal portion, and is also used for culinary purposes, like the royal bay. It yields about 4 per cent. of a very active volatile oil, of a bright-yellow color and a specific gravity of 0.947, one of the constituents of which is cineol. This oil is apparently the active constituent. With the usual properties of volatile oils, it appears to possess special powers as an intestinal stimulant, overcoming diarrhœas depending upon sympathetic depression. Its power to relieve neuralgia is apparently of the same general nature. It is also a fairly active counter-irritant. The dose of the leaves is from 10 to 30 grains (0.6 to 2 Gm.); of the oil, 2 to 5 minims.

Alligator Pear (*Midshipman's* or *Vegetable butter, Holy ghost pear*, E.; *Avocado*, E., G.; *Avocatier*, Fr.; *Ahuaca, Aquacata*, Sp.) is the fruit of *Persea Persea* (L.) Cockerell (*Laurus P.*—L.; *L. Indica* Sieb.; *P. gratissima* Gærtn.), and the same names are applied to the seeds, which are somewhat used medicinally. The fruit is pear-shaped, sometimes of the size of a very large pear, the surface green or purplish and of a leathery appearance. The pulp is of buttery consistency, yellowish-white with gray veins, and contains a globoidal seed occupying about two-thirds of its diameter. The juice of the seed is milky, reddening upon exposure to the air and finally blackening, and is used as a substitute for indelible ink. Upon fermentation, the seeds yield hydrocyanic acid, from a glucoside which is probably amygdalin. A fluid extract of this remedy has been recommended in the treatment of rheumatism and neuralgia. Formerly it was thought to possess anthelmintic properties, but it probably has little if any such action.

Several species of *Persea* are used in Paraguay under the name *Aynnaudy*. The acrid juice of the root of one of them is used as a febrifuge. *Casca de Lingue*, of Chile, is the bark of *P. Lingue* Nees (*Laurus Lingue* Miers; *L. Linge* Domb.). The barks of several others are used as aromatics, and the fruits of some are edible.

Cryptocarya moschata Mart. (*Mespilodaphne m.*—Meissner) yields a fruit used in Brazil as a nutmeg-substitute and known as *Brazilian nutmeg*. *C. Guianensis* Meissn. is used similarly. The barks of several other species of this genus are used as aromatics.

Pao pretiosa or *Casca p.*, of Brazil, is *Mespilodaphne pretiosæ* Nees et Mart. (*Cryptocarya p.*—Mart.). The bark of *M. Sassafras* Meissn., also Brazilian, appears to contain saffrol.

Bois de Canelle (East Indies) is the bark of *M. Mauritanica* Meissn. (*Oreodaphne cupularis* Nees; *Ceramophora c.*—Schott.; *Laurus Neesiana* Schott.), and is used as a cinnamon-substitute.

Canello de Cheiro (Southern Brazil, Paraguay, etc.) is the bark of *Ocotea opifera* Mart. (*Oreodaphne o.*—Nees et Mart.). The volatile oil of its fruit is also employed. Several other species of *Ocotea* are reported as being employed medicinally as aromatics.

Various species of *Tetranthera*, mostly of the Old World, are similarly employed. *Maidalakri*, or *Muskaip-pe-yetti* (India), is the bark of *T. laurifolia* Jacq. (*T. sebifera* Pers.; *Sebifera glutinosa* Lour.).

Litsea is a large genus of the Orient. The Chinese drug *Wugoh* is supposed to be the root of *L. Myrrha* Nees (*Laurus M.*—Lour.). *Pisatalia* is the fat of the seed of *L. Stocksii* Hook. f., the leaves of which are employed as an aromatic.

Pao Cravo (Brazil) is the bark of *Dicypellium caryophyllatum* Nees (*Persea c.*—Mart.), and is used as a cinnamon-substitute under the name *Cassia caryophyllata*.

Camaran (Guiana) is the aromatic fruit of *Acrodiclidium Camara* Schombk. *Sassafras de Para* is the bark and wood of *A. chrysophyllum* Meissn., of Brazil.

Ai-uba (Brazil) is the starchy and aromatic seed of *Aydendron permolle* Nees. *Canella Abacate* is the bark of *A. floribundum* Meissn.

Ravensara, *Nux Caryophyllata* or *Quatre épiques* (Madagascar), is the fruit of *Ravensara aromatica* Sonn. (*Agatophyllum a.* Willd.; *Evodia Ravensara* Gærtn.).

A number of species of this family are poisonous, usually owing to the presence of the powerful alkaloid *laurotetanine*, which acts in many respects like strychnine. This alkaloid is crystalline and highly insoluble in most solvents. Ether dissolves a very little, chloroform dissolves it with difficulty, and it is soluble in an excess of caustic alkali. It is precipitated by tannic acid and platinum and gold chlorides, gives a pale rose-red color with concentrated sulphuric acid and a dirty brown with concentrated nitric acid. It has been reported as occurring in the following species: *Notaphœbe umbelliflora* Bl., of the East Indies; *Actinodaphne procera* Nees, of Java; *Litsea latifolia* Bl., of the East Indies; *Cassythe filiformis* Bl. (*Calodium Cochin-chinensis* Lour.), of the East Indies; *Aperula spiceosa* Hort.-Bog.; in a bark known in Java as *Baun-trawus*, believed to be the product of *Tetranthera Brawa* Bl., as well as in *T. intermedia* Bl. Poisonous alkaloids, apparently not laurotetanine, occur in *Haasia firma* Miq., *H. squarrosa* Miq., and *Cryptocarya australis* Benth. (*Cyanodaphne a.*—A. Br.), of Australia.

LAURUS.—Laurel.

Bay, Sweet bay, Bay- or *Noble-laurel, Royal bay*, E.; *Laurier commun*, Fr. Cod.; *Lorbeer*, G.; *Alloro*, It.; *Laurel*, Sp.:

1. Folia Lauri (Laurel Leaves, etc.), the leaves, and,
2. Fructus (or Baccæ) Lauri (Bay Berries), the fruit, of *Laurus nobilis* L. (Fam. *Lauraceæ*).

One or both are official in a number of pharmacopœias.

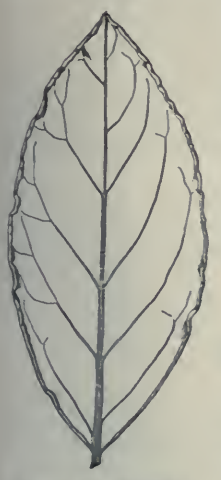
The drug is often confused with Cherry Laurel (*Prunus Laurocerasus*) and with Jamaica Bay or Myrcia, both of which are discussed elsewhere.

Origin.—The Royal Bay is a large evergreen shrub or small tree, native of the eastern Mediterranean region and more or less cultivated in various warm countries. In the northern United States it is often seen growing in tubs for decorative purposes, requiring protection in winter. Its crown is remarkably dense, and of a rich, luxuriant, dark-green appearance. Probably the greatest interest attaching to the Laurel is of a sentimental character, it having been regarded since ancient times as an emblem of victory and success.

Description.—The Leaves.—From 5 to 10 Cm. (2 to 4 In.) long and about one-third as broad, oblong, narrowed and acutish at both ends, very shortly and stoutly petioled, entire but crisped at the margins, very thick and coriaceous, smooth, pale-green or yellowish-green,

the veins finely reticulate and prominent underneath, ending free near the margin; pleasantly aromatic in odor and taste, the latter bitterish, but free from the taste of bitter almond.

Fig. 252.



Royal bay leaf (Nat.).

The Fruit.—About 1.3 Cm. ($\frac{1}{2}$ In.) long, globose-oval, greenish- or brownish-black, more or less wrinkled, the pericarp, inclusive of the brown endocarp, fragile, and brittle, the large oval seed easily separable into its 2 brownish plano-convex cotyledons, and of an oily, aromatic, bitterish taste.

Constituents.—The important constituent of both is the volatile oil (Oleum Lauri), which is also official in several pharmacopœias. The leaves contain about one-third, the fruits about 1 per cent. Besides this, there is an unknown bitter constituent in both. The leaves contain a little tannin, the fruits about 25 per cent. of fat (Oleum Lauri Expressum).

Action and Uses.—Laurel is practically never employed in medicine. The leaves, fruit, and oil, all possess narcotic and stimulant properties; but other more potent remedies have supplanted them. At present the leaves are occasionally used to impart an agreeable flavor to certain articles of diet, and the oil may be employed to overcome the disagreeable odor of various embrocations.

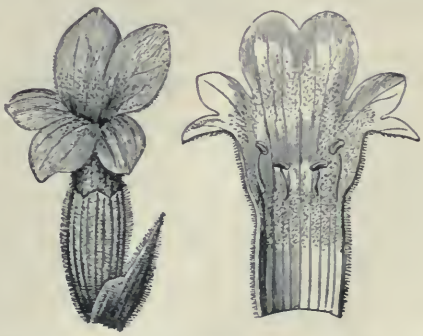
LAVANDULA.—Lavender.

Flores lavandulæ, P. G.; *Flores lavendulæ.—Lavender flowers*, E.; *Lavande officinale*, Fr. Cod.; *Lavendelblüthen*, G.; *Alhucema, Espliego*, Sp.

The carefully dried flowers of *Lavandula angustifolia* (L.) Mill. (*L. spica angustifolia* L.; *L. vulgaris* Lam.; *L. officinalis* Chaix.; *L. vera* DC.—Fam. *Labiatæ*).

Origin.—From a low shrub, native of the Mediterranean basin and everywhere cultivated for ornament or for its perfuming and medicinal properties. The woody portion is short and much branched, the branches densely leafy toward the ends and terminating in long and slender flower-spikes, which have the lower portion naked or nearly so, forming a long, scape-like peduncle, the upper portion becoming densely flowered. The opposite, sessile leaves are 2 or 3 inches long, linear-lanceolate or linear-oblong, thickish, with entire revolute margins and, like the herbage in general, grayish hairy. The flowers, described below, are collected in June and July, before fully expanding, and are carefully dried in the shade. The herbage has a similar odor and composition, and is much used for the same purposes.

Fig. 253.



Lavender flower, with bract, and corolla cut open (× 4).

Description.—Calyx about 4 Mm. ($\frac{1}{6}$ In.) long and half as broad, tubular, slightly contracted at the mouth, which is obscurely 5-toothed, only the upper roundish tooth prominent, 13-nerved, dull-blue and grayish from the dense covering of short roughish hairs and minute glands; corolla nearly twice the length of the calyx, light-blue when carefully dried and fresh, otherwise pale-brown, the tube cylindraceous, enlarged at the throat, glandular-hairy, the limb oblique, 2-lipped, the upper lip erect, of 2 large oval lobes, the lower spreading or declined, of three somewhat smaller lobes; stamens 4, borne at about the middle of the tube, short, not exserted, the lower pair a little the longer; odor strongly aromatic and quite peculiar; taste bitterish, aromatic, somewhat camphoraceous. The nutlets are oval, smooth, rounded at the summit, about 2 to 3 Mm. long by 0.8 to 1.25 Mm. broad.

Constituents.—Besides some tannin, resin, and other widely diffused principles, lavender flowers contain volatile oil, when fresh yielding about 1 per cent. (see Oleum Lavandulæ).

Action and Uses.—Lavender depends upon its volatile oil for its stimulant aromatic properties. It is rarely employed in internal medicine, except in the form of the oil or spirit. Lavender poultices may be applied for the relief of colic, superficial neuralgia, and other local pains. The oil enters into the preparation of certain perfumes.

Allied Plants.—LAVANDULA SPICA Chaix. (*L. latifolia* Ehrhart).—*Spike lavender*, E.; *Spiklavendel*, G.; *Lavande commune*, Fr. Cod.—The plant has spatulate leaves, rather short and dense spikes, and lance-linear bracts. The calyx is finely velvety-hairy, not blue, and about the same length as the calyx-tube. The plant is cultivated in southern France and northern Africa, and volatile oil is distilled from it.

LAVANDULA STŒCHAS L.—*Arabian or French lavender*, E.; *Schopflavendel*, G.; *Stœchas*, Fr.; *Cantuesa*, Sp.—This small shrub grows near the Mediterranean, where the flowering spikes are used. These are short-stalked, and have the small dark-purple flowers in the axils of conspicuous rhombic or obovate, sometimes 3-lobed, purple-colored bracts; the odor is strongly aromatic, camphoraceous.

LECYTHIDACEÆ.—The Brazil-nut Family.

This is a small family of between 100 and 200 species, mostly trees, of tropical regions. Although the seeds of a number of species are used as fish poisons, and some are poisonous to man, the importance of the family is chiefly due to its production of a number of seeds, so-called "nuts," highly nutritious and of delicious flavor. The ordinary Brazil-nut (*Para-, Cream-*, or *Castana-nuts*, or *Nigger-toe nuts*, E.; *Chatiagne du Brésil*, Fr.) is the product of *Bertholletia excelsa* H. et B. The use of these nuts in the North as a luxury, or dessert, gives little idea of their high importance as a food-product in the country of their production. They are rich in oil, for which important uses could doubtless be found. Still more delicious are the *Sapucaja nuts*, *Cream-nuts*, or *Monkey-pot nuts*, produced by various species of *Lecythis*, of tropical America. These nuts are so highly esteemed at home that they are very rare in commerce.

The poisonous seeds of the family belong chiefly to the genus *Barringtonia*, representing both Old and New World species. Apparently, these owe their poisonous properties, chiefly if not wholly, to the presence of saponin. The seeds of *Lecythis minor* Jacq., of the northern part of South America, are narcotic. Other poisonous species belong to the genus *Gustavia*. *Jamparandiva* (Brazil) is the root of *G. Brasiliana* DC. *Chupo* (Colombia) is the fruit of *G. speciosa* DC., and is used in jaundice, The Colombian *Membrillo* or *Baco* is the fruit of *G. superba* Berg. (*Pirigara s.*—H. B. K.; *G. angusta* DC.). *Kayo-umur-ponjang*, of the East Indies, is the leaves of *Grias cauliflora* L., and is drunk as a substitute for tea.

LEGUMINOSÆ.—The Bean Family.

The Leguminosæ comprise the following three subfamilies, or, according to some authors, distinct families: *Papilionaceæ* (the Bean Family proper), distinguished by its butterfly-shaped flowers, their upper petal enclosing the lateral ones in the bud; *Cæsalpiniaceæ* (the Senna Family), distinguished by flower-buds in which the lateral petals envelop the upper one; *Mimosaceæ* (the Acacia Family), distinguished by flower-buds having the petals valvate. The entire family comprises about 450 genera and 6000 species. From a biological standpoint, it represents the highest embryological development as to both structure and nutrition, and its powers of variation and adaptation to environment are second to those of no other family. It ranks in economic importance among the first three or four families of the vegetable kingdom. This preëminence in useful products relates to drugs, foods and fodders, fixed oils, tanning and dyeing materials, and timbers, besides which, the importance of its poisonous products takes high rank.

Many of the tropical trees of the Leguminosæ, especially in the subfamilies Cæsalpiniaceæ and Mimosaceæ, yield timbers of the greatest value, because of their hardness, durability, and polishing properties, and in many cases because of the contained coloring-matters, which give them great beauty in cabinet-work.

The family is rather rich in dyestuffs, many of which, like BAPTISIA, were much employed in former times. A number of these, pertaining to heart-woods of the *Cæsalpiniaceæ*, are mentioned under HÆMATOXYLON. Others, pertaining to herbage, are treated under INDIGO. A few owe their coloring properties to the tannins which they contain, and these are discussed under QUERCUS.

Many members of the Leguminosæ are rich in tannin, and are used both for tanning purposes and as medicinal astringents. These belong chiefly to the subfamily *Mimosaceæ*, are rather common in the *Cæsalpiniaceæ*, and infrequent among the *Papilionaceæ*. The parts so used are usually barks, frequently woods, and occasionally fruits. All these will be found discussed under QUERCUS.

The fixed oils of this family, of which peanut-oil may be regarded as the type, will be found described under OLEA PINGUIA.

Foods and Fodders.—The nutritive properties of the Leguminosæ are of the highest importance, even from the ordinary dietetic standpoint; but they possess, in addition, important medicinal relations. The high nutritive ratio (see GRAMINEÆ) of these food-products is illustrated by the composition of those included in the following table:

NUTRITIVE COMPOSITION OF SOME IMPORTANT HUMAN AND STOCK FOODS OF THE LEGUMINOSÆ.

Food-stuffs.

	Albuminoids.	Fat.	Carbohydrates.	Nutritive ratio
Peas	22	2	52	1 : 2.9
Beans	25	1.6	46	1 : 2.7
Lentils	25	1.85	55	1 : 2.4
Soy beans	35	17.6	6	1 : 1.2
Peanuts	26	47	24	1 : 5.3

Fodders.

Red-clover hay	13.5	3	37	1 : 5
Pea-vines	14	2.6	34	1 : 4
Bean-vines	28	2.5	58	1 : 2.3
Alfafa	16	2.5	32	1 : 2.8
Vetch-hay	20	2.3	29	1 : 2.3
Lupine-hay	17	2.2	31	1 : 3.4

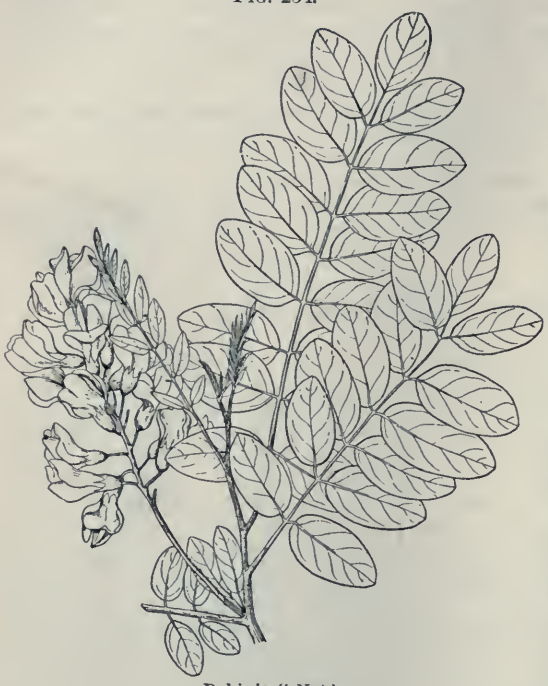
It will be noted that the above substances are not only rich in albuminoids, but also that in some cases their carbonaceous matters are largely fatty; such foods are those peculiarly applicable for use by diabetic subjects. The Soy or Soja Bean has been especially recommended for this purpose, preferably after the removal of its not very agreeable fixed oil, which has distinctly cathartic properties. The residue is then, in Oriental countries, often ground and used for bread-making for such patients. A kind of cheese is also largely prepared from the seed. Soy Bean is also known as *Chinese* or *Sahuca bean*, *White gram*, or (*Japanese*) *Miso*. It is the seed of *Glycine hispida* Maxim. (*Soja h.*—Moench), and of the perhaps distinct species *G. Soja* (L.) Sieb. et Zucc. (*Dolichos S.*—L.), which are climbing herbs, natives of eastern Asia, and largely cultivated there and in other warm countries. The nutritive value of this bean is estimated to be nearly double that of lean meat.

Leguminous foods and fodders, with the above-mentioned advantages, combine some distinctly objectionable characters. Even the best of them, as peas and beans, contain undetermined substances, in all probability albuminous, which may produce injurious results; becoming more or less poisonous when the articles are used upon an extensive scale, as when pea-meal or bean-meal, or even clover-hay, is too freely fed to horses or cattle. MacDougal (*Pharm. Jour.*, 1897, 290) has collected evidence of the poisonous character of such foods, showing that their continued excessive use may produce paralysis of the lower limbs, and that instances have occurred in which their use, on account of these properties, was forbidden by law. The parts most often attacked by these subtle poisons pertain to the epidermal system. In horses, an inflammation (*lamellitis*) is very apt to occur between the foot and the hoof, and the latter may even fall off. In cattle, the horns may become diseased. The hair becomes poorly nourished, and appears dry and rough or even falls out. Thus, in the West Indies, a disease known as "Cigar-tail," in which the tail becomes bare of hair, is said to be the result of eating *Leucæna glauca*.

Poisons.—The poisonous properties of the Leguminosæ are of the highest interest and importance. They very often depend upon the presence of easily determinable compounds, alkaloids or glucosides, as in PHYSOSTIGMA, SCOPARIUS, etc., but probably in a much greater number of cases are due to albuminous substances, well illustrated by those of ABRUS. In the latter class of cases, not only are the constituents extremely difficult to determine and isolate, but the effects are also very obscure in their nature, as well as very severe and intractable. A good illustration of this class of poisons is found in *Robinia Pseudacacia* L. (*Pseudo-Acacia vulgaris* Medic.; *P. odorata* Moench), the *Common*, *White*, *Black*, *Post*, *North American*, or *Pea-flower locust*, *False acacia*, *White laburnum*, *Whya tree* (*Falsche Acazie*, G.; *Robinier*, Fr.), a good-sized tree of the eastern United States, highly prized for its ornamental properties and for its timber, which is exceedingly durable. Its stipules become thorny and persist for some years. The leaves and handsome fragrant white or sometimes slightly purplish flowers are here illustrated. The fruit is a linear, flat, usually 6-seeded legume, about 8 Cm. (3 In.) long and margined on the inner side. The root and inner bark have a sweetish but somewhat offensive or nauseating taste, and have been found poisonous to foraging animals. F. B. Power (1901) isolated from the inner bark a poisonous nucleoproteid *robin*, which has

an acid reaction, is soluble in water and in salt solution, and is precipitated from its solutions by acids. On heating its aqueous solution it becomes coagulated, its poisonous properties being destroyed at water-bath temperature. It is capable of hydrolizing both amygdalin and potassium myronate, with formation of the volatile oils of almond and mustard, respectively, and is capable of coagulating the casein of milk, as also of agglutinating or clotting the red blood-corpuscles of certain animals. Robin possesses strong emetic and purgative properties. The bark furthermore contains one or more substances of an alkaloidal character, easily decomposed and probably representing degeneration-products of the proteid. Dextroglucose, a small amount of tannin, and considerable fatty matter and resin have also been found. (For a full account of the chemical examination of the bark, see *Pharm. Jour.*, Aug., 1901.)

Fig. 254.



Robinia (⅛ Nat.).

Although the leaves of the Robinia have been stated to produce poisonous effects (Blyth, *Poisons*, 3d edit., 1895), careful examination has failed to detect the presence of any soluble proteid, or of alkaloids (Power). By some the leaves have been recorded as even affording wholesome food for cattle.

According to Zwenger and Dronke (1861), the flowers contain a yellow glucoside, *robinin*, which, on being boiled with acids, is resolved into sugar and *quercetin*. Tonic, emetic, and purgative properties have been ascribed to the root and bark of the locust tree, but the plant is rarely if ever prescribed as a therapeutic agent. Occasional cases of poisoning are on record in which boys have chewed the bark and swallowed the juice; the principal symptoms being dryness of the throat, burning pain in the abdomen, dilatation of the pupils, vertigo, and muscular twitching. Excessive quantities occasion, in addition to the above symptoms, great circulatory depression, the heart's action becoming weak and irregular.

Loco.—One of the most notable and curious instances of poisonous properties in plants is that of the group of species known in the grazing regions of the western United States as *Loco* or *Loco-weed*, "loco" being the Spanish word for *crazy*. These species pertain chiefly to the two genera *Astragalus* and *Aragalus* (*Oxytropis*), and many species have been designated by different authors as producing the baneful results. The common *Yellow rattle-box* of the eastern United States (*Crotalaria sagittalis* L.) is said to act similarly. Though many chemists have sought for the constituents, none have been able to locate the active properties, the trace of alkaloids, resins, volatile and fixed oils, having each in turn been found destitute of it. Yet the poisonous properties are fully established by field observations. The destructiveness of these plants to stock is so great as to have probably caused upward of a million dollars loss in the aggregate, and large bounties have been offered by State governments for an effective method of avoiding such losses. It is considered very probable that the poisonous constituent is albuminoidal.

Other members of the family which are of greater interest on account of their poisonous properties than from a medicinal point of view are the following:

Laburnum, *Golden chain* or *Golden shower*, *False ebony*, *Bean-trefoil*, *Ile-broom* (*Goldregen*, *Bohnenbaum*, G.; *Cytise*, *Faux Ebénier*, Fr.), is *Cytisus Laburnum* L. (*Laburnum anagyroides* Medic.; *L. vulgare* Presl.; *L. Cytisus* L.), a tall shrub or low tree of southern Europe, and much planted for decorative purposes. The bark is smooth, the leaves slenderly petioled and trifoliolate, the leaflets sessile, oval-oblong, obtuse, mucronate, about 5 Cm. (2 In.) long and two-thirds as broad, softly grayish-hairy underneath, and of a salty, bitterish, and slightly acrid taste. The golden-yellow flowers are in long drooping racemes, and are followed by linear, obtuse legumes, containing dark-brown, glossy, nearly reniform seeds of a disagreeably bitter and acrid taste. The seeds constitute the principal poisoning agent, though the leaves share their property. The seeds contain the crystalline alkaloid *cytisine* ($C_{11}H_{14}N_2O$), which has a melting-point of 154° C. (309.2° F.), is very soluble in water, alcohol, amyl alcohol, and caustic alkalies, scarcely in ether or chloroform, is precipitated by gold chloride

and picric acid, and is colorless with sulphuric acid. *Laburnic acid* has been isolated, and is supposed to be in combination with the alkaloid. Other bitter principles have been reported (*cystin* and *laburnin*), and are probably glucosides, though little is known of them. Both laburnum and its alkaloid cytisine have been advocated as remedies in the treatment of congestive headache, asthma associated with emphysema, whooping-cough, dyspepsia, and the nausea and vomiting of pregnancy. Its employment in these conditions is rare as it has met with little favor among physicians. In medicinal doses the drug produces a soporific effect and a tendency to constipation. Overdoses cause nausea and vomiting, tetanic convulsions, respiratory depression, and a marked elevation of blood-pressure with a notable increase in the pulse-rate. Dryness of the throat, abdominal pain, weakness of the extremities, vertigo, dilated pupils, and deep sleep are also marked symptoms. The treatment of poisoning by this drug should consist in the prompt evacuation of the stomach, and the administration of alcohol, ammonia, and other stimulants as indicated. An extract prepared from laburnum may be given in doses of from $\frac{1}{10}$ to 1 grain (0.006–0.06 Gm.). The dose of cytisine is from $\frac{1}{20}$ to $\frac{1}{12}$ grain (0.003–0.005 Gm.).

Sophora is a genus which yields a number of poisonous seeds. *S. secundiflora* (Cav.) DC. (*S. speciosa* Benth.) is the *Coral bean* or *Frijolito*, a small evergreen tree of western Texas and southwestward. It has smooth, oddly pinnate leaves, with 3 to 5 pairs of leaflets, which are about 25 Mm. (1 In.) long, ovate in shape, obtuse or somewhat pointed, dark-green and glossy above and pale-green beneath. The flowers are in dense racemes, blue or tinged with white, very fragrant, and have a bell-shaped small calyx and 10 nearly free stamens. The pod is indehiscent, 5 to 8 Cm. (2–3 In.) long, nearly terete, or more or less constricted between the seeds, tough, and covered with a pale brownish-gray pubescence. The seeds are globular-ovate, about 1 Cm. ($\frac{2}{5}$ In.) long, somewhat depressed on the hilum, and of a bright-red color. The active constituent, or at least one of them, is the amorphous alkaloid *sophorine*, which is soluble in nearly all ordinary solvents, gives a dirty deep-purple color with sulphuric and chromic acids, passing through bright-green and bluish into yellowish-brown; and deep-red, after a time orange, with ferric chloride.

S. Japonica L. is the *Pagoda tree*, *Chinese berry tree*, *Waifa* or *Yen-ju*, of China and Japan, and somewhat cultivated for ornamental purposes. The flower-buds are said to be used as a substitute for hops and for dyeing yellow. These buds owe their coloring properties to two substances which have been called, respectively, *sophorin* and *sophoretin*, the latter resembling quercetin.

Wistaria, the highly ornamental cultivated woody twiner of that name, *Kraunhia Chinensis* (Sims) Rusby (*Glycime C.*—Sims; *Wistaria C.*—DC.), is intensely poisonous in all its parts, but especially as to the roots. The poisonous constituent has not been studied, but its effects are said to be similar to those of poisoning by Laburnum. The recorded symptoms are vomiting, intense diarrhœa, convulsions (sometimes tetanic), frothing at the mouth, unequally dilated pupils, and coma. In less severe cases there have been observed great drowsiness, mydriasis, loss of pupillary reflex, and widespread anæsthesia.

Lupinus is a large genus, the poisonous properties of which are apparently very irregularly and unequally distributed. A number of the species are cultivated for fodder, and, if not over-fed, are found highly nutritious and wholesome. If the seeds, at least of certain species, are eaten, in a more or less mature condition, poisoning is liable to occur, great numbers of animals sometimes being fatally affected. These poisoning accidents have occurred in Europe and in the United States, the latter cases sometimes produced by the European species here cultivated, sometimes by our native species. It is very doubtful if the poisonous constituents are the same in all the species, or even if a single species do not contain more than one; thus the identity of the substances reported upon by different investigators is thrown into considerable doubt. The species best known in this connection is the common *White lupine* of cultivation (*Feighbohne*, *Wolfsbohne*, G.; *Lupin*, Fr.; *Altramuz*, *Coochos*, Sp.), the seed of *L. albus* L., native of southern Europe and adjacent Asia. The plant is about 50 Cm. (20 In.) high, and has palmately 5- or 7-foliolate leaves, with the leaflets obovate-oblong, 25–50 Mm. (1 or 2 In.) long, smooth above and white hairy beneath; the flowers are in terminal racemes on short pedicels, white and rather large; the legume is 7–10 Cm. (3–4 In.) long, flattish, and contains 3 to 6 white circular and flattened seeds, which are inodorous and have a somewhat bitter taste. The *Yellow lupine* of the same region is *L. luteus* L., so called from its yellow flowers. The blue-flowered species of the northeastern United States is *L. perennis* L., the *Wild* or *Blue bean*. In the western United States and southward into the Andes the species are very numerous, and their specific relations highly perplexing. The following constituents have been isolated: *lupinin* ($C_{29}H_{32}O_{16}.7H_2O$), a bitter glucoside occurring in yellowish needles, soluble in caustic alkalies and with difficulty in water or alcohol, precipitated by basic lead acetate; the alkaloid *lupinine* ($C_{21}H_{40}N_2O_2$), occurring in rhombic crystals, melting at 67° to 80° C. (152.6° to 176° F.), soluble in cold, less in warm water, soluble in alcohol, ether, and chloroform; the liquid yellow alkaloid *lupinine* ($C_{15}H_{24}N_2O$), agreeing in its solubilities with the last, except that it is with difficulty soluble in alcohol; and *lupinidine* ($C_8H_{15}N$), which is pungent as well as bitter, soluble in

water and alcohol, but with difficulty in ether. Willstater states that the formula given above and accepted by other authors for lupinine is in reality $C_{10}H_{19}NO$, and that it is in nature a primary alcohol.

Derris.—Several species of this genus are employed as fish poisons. Farr has examined *D. uliginosa* Benth., and has traced its poisonous action on fishes to a resin soluble in chloroform or to some substance carried with that resin. The alkaloid present appeared inactive in this direction. An exhaustive study of the chemistry of the stem of this plant has recently been made by F. B. Power (*Proc. Am. Pharm. Assoc.*, 1902, p. 297 et seq.).

Gymnocladus.—The pulp around the seeds of this plant is said to be an effective fly poison. The seeds contain considerable fixed oil.

Enterolobium.—A number of species of this genus contain saponin, and are used as fish poisons. The same may be said of the barks of several species of *Albizzia.*

Drugs.—The more important drugs of this family (Abrus, Acacia, Balsamum Peruvianum, B. Tolutanum, Baptisia, Cassia Fistula, Chrysarobinum, Copaiba, Erythrophlæum, Fœnum Græcum, Glycyrrhiza, Hæmatoxylon, Indigo, Physostigma, Piscidia, Scoparius, Senna, Tamarindus, Tragacantha, etc.) will be found described under these titles. Others have been incidentally discussed above, in connection with the poisons. Less important members of the class are considered below. Very frequently the drugs of this family owe their properties to constituents closely related in physiological and therapeutical activity, if not in constitution, to those of Scoparius, under which title they will be found discussed.

Andira or *Cabbage-tree bark* (*Kohlbaumrinde, Wurmrinde*, G.; *Écorce de geoffrée*, Fr.) presents two varieties, (1) the bark of *Vouacapoua inermis* (Swz.) Lyons (*Geoffræa i.* Swz.; *Andira i.* Kunth), the *Jamaica* variety or *Partridge-wood bark*, also called *Yellow cabbage-tree bark;* and (2) that of *V. retusa* (Poir) Lyons (*Geoffræa r.*—Poir.; *Andira r.*—Kunth), the *Surinam* or *Brown cabbage-tree bark* or *Surinam bark.* The former occurs in long pieces about 3 Mm. ($\frac{1}{8}$ In.) thick, gray or whitish, and fissured externally, upon the inner surface brownish and striate, internally brown or brownish, radially striate, and with yellowish bast-fibers in tangential rows, which cause the laminated fibrous appearance of the bark when broken transversely. It yields a grayish powder, and has a feeble but disagreeable odor and a mucilaginous bitter taste. *Surinam* cabbage-tree bark resembles the preceding, but is internally dark red-brown, has a checkered and glossy appearance on transverse section, yields a cinnamon-colored powder, is nearly inodorous, and has a bitterish-acrid taste. The Surinam variety has been found to contain the alkaloid *ratanhine* ($C_{10}H_{13}NO_3$), having a melting-point of 40° to 45° C. (104° to 113° F.), neutral and tasteless, scarcely soluble in water, alcohol, ether, or chloroform, but soluble in benzene and in an excess of caustic alkalies, and giving a violet reaction with ferric chloride. Ratanhine is regarded as identical with *angeline*, originally extracted from a kino-like exudation from the tree *Ferreira spectabilis* Allem., of Brazil; also with methyl-tyrosin. This variety contains also a large amount of tannin. The Jamaica variety is said to contain berberine. The seeds of *V. vermifuga* (St. Hil.) Kuntze (*Geoffræa v.*—St. Hil.; *Andira v.*—Mart.; *A. anthelmintica* Benth.) are known as *Angelim seeds, A. dolce* or *A. amargosa*, and have been considerably used for their anthelmintic properties. They are of the size of a nutmeg, oblong, somewhat horny, yellowish, internally whitish, almost devoid of odor and taste. They usually occur in transverse or longitudinal sections. This species contains a cathartic and anthelmintic resinous substance.

Bonduc seeds or *nuts*, also known as *Nicker nuts, Benzor nuts*, or *Molucca beans*, are the seeds of *Guilandina Bonduc* L. (*Cæsalpinia B.* Roxb.; *G. glabra* Mill.), the yellow variety; and of *G. Bonducella* L. (*Cæsalpinia B.* Roxb.; *G. aculeata* Salisb.), the gray variety. They are the products of prostrate prickly shrubs growing in nearly all tropical and subtropical countries, especially near the coast. The gray variety occurs 2 or 3 in a pod, this giving them a somewhat angularly spheroidal form, the yellow variety but 1 in a pod, hence nearly spherical. The latter are somewhat smaller, being about 1.2 to 1.5 Mm. ($\frac{1}{2}$ to $\frac{3}{5}$ In.) long, the gray ones 1.8 to 2 Cm. ($\frac{3}{4}$ to $\frac{4}{5}$ In.) long. Both are very smooth and somewhat shining, and about as hard and heavy as an ordinary kidney bean, or possibly of a somewhat higher specific gravity. Their structure is that of the ordinary leguminous seed. Like other leguminous seeds, their composition is largely albuminoidal (20 to 22 per cent.), and there is about 35 per cent. of starch, 5 or 6 per cent. of sugar, 25 per cent. of fixed oil, and about 2 per cent. of a peculiar bitter substance soluble in alcohol and ether and slightly in water, which has not been investigated. The oil is largely used in the East Indies as an embrocation. The seeds themselves, as well as the root-bark, are considerably used in all tropical countries as antiperiodics. Bonduc seeds are employed principally in India in the treatment of intermittent fever and the debility following acute infectious diseases. The dose of the seeds is from 10 to 15 grains (0.60–1 Gm.). Pulvis Bonducellæ Compositus (P. I.), consisting of bonduc and black pepper, is administered in doses of from 15 to 20 grains (1–1.3 Gm.).

Fructus ceratoniæ, Ceratoniæ Fructus, or *Siliqua dulcis* (*St. John's bread, Sweet-pod, Honey-bread, Locust-bean, Carob-tree bean,* E.; *Johannisbrod, Soodbrod, Karobe,* G.; *Caroube, Carouge,* Fr.; *Garrobo, Algarroba de Valenca,* Sp.), is the dried fruit of *Ceratonia Siliqua* L., a good-sized tree, native of the Mediterranean region and cultivated in warm countries. It is said to be the "Locust" which fed St. John the Baptist. The fruit is 10 to 20 Cm. (4 to 8 In.) long, nearly 25 Mm. (1 In.) broad, about 3 or 4 Mm. ($\frac{1}{8}$ or $\frac{1}{6}$ In.) thick, obtuse, linear, much flattened, and with somewhat elevated edges, causing the transverse section to be narrowly and obtusely rectangular. The epicarp is leathery, brown, glossy, finely striate, and encloses a light-brown softer sarcocarp of a pleasantly sweet taste. The seeds, 6 to 12 in number, are flattish ovate and polished brown, and are contained in separate transverse cells formed by the papery inner layer of the pericarp. The fruit contains 40 to 50 per cent. of cane- and grape-sugar, besides mucilage, protein compounds, a little tannin, and butyric acid, to which the odor is due. Aside from its sweetness and edible properties, it is credited with some mild expectorant and demulcent action.

Saman.—The fruit of *Pithecolobium Saman* Benth. (*Calliandra S.*—Griseb.), as well as of *P. dulce* Benth., of the East Indies, and cultivated in all tropical countries, is used as a substitute for St. John's bread. Its seed, as well as those of other species of the genus, contains an alkaloid called *pithecolobine.* The fruits of several species of *Prosopis* are similarly sugary and similarly used.

Galega or *Goat's rue, Herba rutæ capriariæ* (*Geisraute, Pestilenzkraut,* G.; *Rue de Chèvre,* Fr.), is the herb of *Galega officinalis* L., of the Mediterranean region and southern Europe. It has a perennial several-headed root and an erect stem about 90 Cm. (3 Ft.) high; the smooth, oddly pinnate leaves are furnished with 6 or 8 pairs of lanceolate or ovate-lanceolate, obtuse, and finely mucronate leaflets 2–5 Cm. ($\frac{3}{4}$–2 In.) long, and with lanceolate stipules, which are sagittate on one side. The purplish or whitish flowers are in axillary racemes, and produce narrow, almost cylindrical legumes. The herb is inodorous and has a mucilaginous and somewhat bitter and astringent taste. Its constituents have not been investigated.

Melilotus or *Melilot, Herba meliloti* P. G. (*Sweet, King's, Hart's, Tree,* or *Plaster clover, Sweet Lucerne,* or *Wild laburnum,* E.; *Melilotenklee, Steinklee,* G.; *Mélilot officinal,* Fr. Cod.; *Meliloto, Trebol oloroso,* Sp.) is the dried leaves and flowering tops of several species of *Melilotus, M. alba* Desv. (*M. vulgaris* Willd.) being the white variety, and *M. officinalis* (L.) Lam. (*Trifolium Melilotus officinalis* L.; *M. arvensis* Wallr.; *M. diffusa* Koch) and *M. altissimus* Thuill. (*M. officinalis* Willd.; *M. macrorrhizus* Pers.) being the yellow-flowered species. All three are natives of Europe, and are perennial herbs from 2 to 4 feet high, growing in dry fields and along roadsides. The drug of the German Pharmacopœia, and that generally understood, pertains to *M. officinalis* Lam. Its stipules are entire, awl-shaped; the petiolate trifoliolate leaves have oval or obovate-oblong leaflets, the lower ones notched, the upper ones truncate at the apex, entire near the base, and somewhat sharply serrate above, about 2 to 3 Cm. ($\frac{4}{5}$ to $1\frac{1}{4}$ In.) long; the flowers are in spreading or ascending racemes, and the reflexed legumes are brown or blackish. The keel of the flower is much shorter than the other parts, and the obovate, transversely wrinkled legume is 1-seeded. In *M. altissimus,* the keel is as long as the other parts and the obliquely oval, pointed, reticulately wrinkled pod is 2-seeded. *M. alba* is readily distinguished by its white flowers. All the species have a strong, peculiar, and not altogether agreeable odor in the fresh state, but in drying develop cumarin and exhale the pleasant odor of that substance. The taste is somewhat pungent and bitterish. The cumarin is the only important constituent, together with its related compounds (see *Cumarin*), *hydrocumaric* (*melilotic*) acid, *orthocumaric* acid, *melilotic anhydride* or *lactone,* a sort of volatile oil. Melilotus was formerly employed internally in the treatment of flatulent diarrhœa, dysmenorrhœa, and rheumatism. Externally it is occasionally applied in the form of a plaster or ointment for the relief of abdominal and rheumatic pains.

Mucuna or *Cowhage* (*Setæ siliquæ hirsutæ.*—*Kuhkrätze,* G.; *Pica-pica,* Sp.) is the hairs removed from the pods of *Mucuna pruriens* (L.) DC. (*Dolichos p.*—L.; *Stizolobium p.*—Medic.; *Carpopagon p.*—Roxb.; *M. prurita* Hook.), the seeds known as *Sea beans, Ass's* or *Donkey's eyes* (E.); *Kratzbohnen* (G.), *Pois velue, Pois à Gratter* (Fr.), a tall, climbing, bean-like plant of the tropics of both the Old and New Worlds. Similar hairs occur upon the pods of the closely related species *M. urens* Medic. (*Stizolobium u.*—Pers.), of tropical America. Cowhage hairs are about 3 Mm. ($\frac{1}{8}$ In.) long, of a glossy-brown color, straight, quadrangular-prismatic, sharply pointed at the apex, somewhat retrorsely serrate on the upper half, and partly empty, partly filled with a brown granular matter. They easily penetrate the skin, and occasion an intolerable itching, which is greatly increased by washing and rubbing. Those of the second-named species are shorter and darker. The medicinal use of Cowhage depends wholly upon the irritating properties of the hairs. The seeds of these plants are the well-known Sea beans, picked up along the coast of Florida and the West Indies and polished for ornamental purposes. They are credited with diuretic properties, as are the roots.

Psoralea is a genus of more than a hundred species of herbs or shrubs, quite a number of which have been used in medicine under the above name (*Psoralie, Drüsenklee,* G.; *Psorale,*

Fr.). The genus is characterized by a 5-cleft persistent calyx having the lowest lobe longest, by diadelphous or sometimes monadelphous stamens, by a short 1-seeded pod, the pointed end of which projects from the calyx, and by the glandular dots with which the calyx, and frequently also the leaves, are more or less covered. The best known is the East Indian species *P. corylifolia* L., the seeds there used under the name *Bauchee* or *Bawchang seed*, the leaves as *Malay tea*, in indefinite ways as a cutaneous tonic and alterative. In the southeastern United States *P. pedunculata* (Mill.) Vaill. (*Hedysarum p.*—Mill.; *P. melilotoides* Mx.; *P. eglandulosa* Ell.) is used as an aromatic bitter tonic under the names *Samson's snakeroot*, *Bab's root* or *Congo root*. It is a slender, erect, pubescent, and slightly glandular herb, and has a spindle-shaped root, trifoliolate leaves with oblong-lanceolate rather obtuse leaflets, and long-peduncled, oblong, finally elongated spikes of purplish flowers; the legume is nearly orbicular and transversely wrinkled. The plant has a slight aromatic odor and a somewhat spicy and bitterish taste. It flowers in June and July, and should be collected when in full bloom. *P. glandulosa* L. is used in Chile for its aromatic properties, like Rue, and its root as an emetic. *P. pentaphylla* L. is similarly used in Mexico, as well as for the cure of snakebites, under the name *White contrayerba*. The tuberous root of *P. esculenta* Pursh. was an important aboriginal food in the western and central United States, and is known as *Bread root*, *Prairie apple*, *Cree* or *Dakota potato* or *turnip*, *Tipsin* or *Tipsinna* (*Pomme Blanche* or *Pomme de prairie*). A smaller tuber is derived from the closely related species *P. hypogæa* Nutt.

Tephrosia, the herbage of *Cracca Virginiana* L. (*Galega V.*—L.; *Tephrosia V.*—Pers.), is also known as *Goat's rue* (*Turkey pea*, *Hoary pea*, *Catgut plant*, *Devil's shoestrings*, *White sweet pea*, *Rabbit pea*, E.; *Tephrosie*, G., Fr.). It is a perennial herb of eastern and central North America. Its root is many-headed and divided into several nearly horizontal branches which are about 12 Mm. ($\frac{1}{2}$ In.) in diameter, 30–60 Cm. (1 to 2 Ft.) long, somewhat beset with fibers, rather tough and flexible, externally brown-gray and internally whitish. The stems are about 60 Cm. (2 Ft.) long, nearly simple, more or less woolly, and have numerous alternate, odd-pinnate leaves, with about 10 pairs of oblong, mucronate, shortly-stalked, straight-veined, and silky-villous, pale-green leaflets. The flowers are in terminal and axillary racemes, white, rose-colored, and red, and produce a curved silky legume. The root and occasionally the herb have been employed; the root is without odor and has a bitterish and somewhat acrid taste. This species is used as an anthelmintic. Many tropical species of the genus are notoriously poisonous, and *C. piscatoria* (Sol.) Lyons (*Galega p.* Sol.; *G. littoralis* Forst.; *Tephrosia purpurea* Pers.; *T. piscatoria* Hilleb.; *T. leptostachya* DC.), the *Auhuhu* or *Hola*, and *C. toxicaria* (Pers.) Lyons (*Tephrosia t.* Pers.), are used as fish poisons. *C. Apolinea* (Delile) Lyons (*Tephrosia A.* Link; *Galega A.* Delile), of southern Europe, is an indigo-yielder, known as *Egyptian indigo*, and its leaves have been used to adulterate Senna.

The bark of *Albizzia anthelmintica* (Baill.) Courd. (*Acacia a.* Baill.; *Besenna a.* Rich.) is an important anthelmintic in Abyssinia under the names *Mussena*, *Mesenna*, *Bussena*, and *Bisinna*. It also occurs in European commerce, in flat or bent pieces 2 to 5 Cm. (1–2 In.) wide, and 5 Mm. ($\frac{1}{5}$ In.) thick, and 30 Cm. (12 In.) long, gray or yellowish-brown, smooth or somewhat fissured, the middle bark granular and yellowish and the tough bast pale-yellow; it is inodorous, and the inner layers have a nauseous sweet, bitterish, and persistently acrid taste. Thiel (1862) showed the presence of a saponin-like amorphous body, *musenin*, bitter, saccharine, and coloring principles, and about 5.5 per cent. of ash. The infusion is colored yellow by ferric chloride. The Abyssinians are said to take from 3 to 4 ounces (90–120 Gm.) of the powdered bark made into an electuary with honey, after fasting for 24 hours. The parasite is discharged, neither whole nor in fragments, but reduced to a sort of pulp. The medicine thus administered is apt to occasion nausea, but neither colic nor diarrhœa, and its use is followed after several hours by a purgative, usually castor oil. When musenna has been employed in Europe, it has generally failed to produce the results as a tæniacide which are attributed to it in its native country.

Besides its use as a food, the Horse-bean (*Faba vulgaris* L.) is a popular remedy for diarrhœa, and the ash of the burned stalks infused in white wine is a popular diuretic in France. A watery infusion of the flowers has been vaunted as an efficient remedy for attacks of gravel and for the nodosities caused by gout.

Daviesia latifolia R. Br. is a hop-like climber of Australia, where it is known as *Native hop bush*. It has a very bitter taste, and contains an oleoresin and a crystalline amaroid soluble in hot water and weak alcohol, but insoluble in ether. The drug is used as a bitter tonic. In Brazil, the bark of *Stryphnodendron Barbatimao* is used under the name *Barbatimao* as an astringent. The seeds are poisonous. In the Philippines the root-bark of *Clitoria Ternatea* L. is used under the name *Kolokantig* as a sedative diuretic, and the seeds are emeticocathartic. In the same country the bark of *Agati grandiflora* Desv. is used under the name *Katuray* as a bitter tonic, the flowers and leaves as a bitter purgative. *Bowdichia major* Mart. is used in Brazil under the name *Sebipira guacu* in the treatment of fevers and of rheumatic and gouty pains.

Medicago.—The flowers of the common *Lucerne* or *Alfafa* (*Medicago sativa* L.) contain a peculiar odorous principle having the fragrance of Elm bark, and have a considerable domestic use as an ingredient of cough remedies.

Trifolium.—During recent times, the flowers of the common *Red clover* (*T. pratense* L.) have come into use as a constituent of a popular alterative compound, but we have no information to indicate that they possess medicinal properties.

In Sierra Leone a fragrant exudation from *Daniella thurifera* Bennett is used as frankincense. The unripe seeds of *Parkia Africana* R. Br. are used as an aphrodisiac and as a coffee-substitute. Several species of *Hardwickia*, of Africa and the East Indies, yield oleoresins used like *Copaiba*. The root of *Epeiua Isumani* Oliv. is used for toothache. In India, the pith of an aquatic *Æschynomene* is turned into sheets and used for paper and for various decorative purposes. Hat-bodies made from it have a peculiar power for excluding the sun.

Fully a thousand species of this great family have been recorded as of medicinal interest.

LEPTANDRA, *U. S.*—Leptandra.

Culver's root, Culver's physic, Black-root, E.; *Leptandra-Wurzel*, G.; *Racine de leptandra* or *de véronique de Virginie*, Fr.

The dried rhizome and roots of *Veronica Virginica* L. (*Leptandra V.*—Nutt.; *V. Sibirica* L.; *Leptandra purpurea* Raf.—Fam. *Scrophulariaceæ*).

Origin.—From a tall (3 to 6 Ft.) perennial herb, common and abundant in rich woodlands, in eastern and central North America, in the southern section only in the

FIG. 255.

Leptandra (½ Nat.).

elevated regions. It is well distinguished by its simple, slender stems, clothed with whorls of 4 to 6 nearly sessile, lanceolate, serrate leaves and terminal panicles of slenderly lanceolate, acute spikes of white, rarely purplish flowers, the corollas short-tubular, the 2 stamens long-exserted. The drug is collected in the autumn, and should be kept at least a year before being used.

Description.—Rhizome of oblique growth, from 10 to 15 Cm. (4 to 6 In.) long, and 4 to 8 Mm. (⅛ to ⅓ In.) thick, bent and branched, the branches similar to the main rhizome, and readily separating from it; cylindraceous, slightly flattened, dark-gray-brown or sometimes

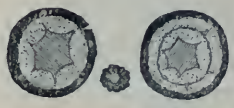
blackish, slenderly annular, bearing few cup-shaped stem-scars upon the upper surface and, upon the sides and underneath, numerous coarse, brittle roots of the same color and articu-

Fig. 256.

Leptandra (½ Nat.).

lated into saucer-shaped cavities of the rhizome; fracture tough and woody, exhibiting a thin, blackish bark, a hard, yellowish wood, and a large purplish-brown pith or partly hollow center; inodorous; taste bitter and somewhat acrid, becoming less acrid upon keeping.

Fig. 257.



Leptandra Virginica: transverse sections of rhizomes and roots.

We know of nothing which resembles Leptandra sufficiently to be mistaken for it.

Constituents.—Culver's root contains the bitter principle *leptandrin*, 6 per cent. of inert (?) resin, a little saponin, volatile oil, tannin, gum, mannit, and glucose. Leptandrin occurs in bitter, yellow or greenish needle-shaped crystals, soluble in hot water, alcohol, ether, and benzol. Exposed for a long time to the action of dilute mineral acid, or boiled with it for a short time, it loses its bitterness and a dark, resinous body is produced. Leptandrin is probably a glucoside. The alcoholic extract is the most active preparation.

Pharmaceutical Preparations.—Extract of Leptandra, Fluidextract of Leptandra, U. S. P.

Action and Uses.—In the recent state, leptandra is a violent cathartic and emetic. When dried, it is milder and more uncertain in its action. The drug is said to increase slightly the flow of bile, and to act as a stimulant to the mucous glands of the intestines. It has been employed as a substitute for mercurials, and is thought by some to be a reliable remedy in the treatment of duodenal indigestion and chronic constipation. The dose of the powdered drug as a cathartic is from 20 to 60 grains (1.3–4 Gm.). The impure resin, improperly called leptandrin, may be employed in doses of from 2 to 5 grains (0.12–0.30 Gm.).

LEVISTICUM.—Lovage.

Lavose or Levose, Sea parsley, E.; *Radix levistici*, P. G.; *Liveche*, Fr. Cod.; *Liebstockel, Badekraut, Barmutterwurz*, G.; *Ache de montagne*, Fr.

The dried rhizome and root of *Levisticum Levisticum* (L.) Lyons (*Ligusticum L.* L.; *Levisticum officinalis* Koch; *L. vulgare* Reichb.—Fam. *Umbelliferæ*).

Origin.—From a perennial, somewhat fleshy or succulent, widely branching herb, the stems ascending, with large decompound leaves on thick sheathing petioles, and bearing terminal umbels of yellow or yellowish-white flowers. It is a native of southern Europe, and is largely cultivated as a condiment and for medicinal purposes, and has become somewhat naturalized in the United States and elsewhere.

Description.—About 30 to 40 Cm. (12 to 16 In.) long, 2.5 to 3.5 Cm. (1 to 1½ In.) thick, several-headed, indistinctly annulate above, shrivelled and heavily wrinkled longitudinally, more or less branched, the branches similar but smaller, deep yellowish-brown externally, bright-yellow within; bark very thick, radiate, the outer portion fissured, exhibiting on transverse section irregular circles of orange-yellow resin-cells; wood-zone soft, with narrow medullary rays, and containing a pith in the upper portion, corresponding to that which is externally annulate and which is in reality rhizome; odor balsamic and resembling Angelica, as does the taste, though the latter is sweeter and more mucilaginous. The drug is readily mistaken for Angelica when in fragments, but is distinguished by its peculiar softness and sponginess, its yellow internal color, and the arrangement of its resin-cells.

Fig. 258.

Levisticum (½ Nat.).

Constituents.—With considerable sugar and gum, lovage contains as its important constituents a peculiar volatile oil (see Olea Destillata) and several resins possessing the general characters of the resins of its family.

Action and Uses.—Lovage has been employed as a stimulant, carminative, diuretic, and emmenagogue; and is said to be of value in the treatment of flatulent dyspepsia, dropsical effusions, and amenorrhœa. The dose in infusion (1 ounce—30 Gm.—to 1 pint—480 Cc.) is from 2 to 4 fluidrachms (4–8 Cc.).

This is the only species of the genus. Several species of the closely related genus Ligusticum will be found considered under Umbelliferæ.

LILIACEÆ.—The Lily Family.

This family, commonly regarded as comprising about 200 genera and nearly 2500 species, is, probably with good reason, divided by some modern botanists into the distinct families *Melanthaceæ*, *Convallariaceæ*, *Smilaceæ*, and *Liliaceæ* proper. For convenience, the entire group is here considered together. The family is pre-eminently ornamental, contributing a large number of the most beautiful and fragrant cultivated flowers, including the lilies, tulips, hyacinths, etc. The important food-plants onion, garlic, and asparagus are also contributed by this family. Of the 300 or so of recorded medicinal species, many will be found described under the titles Allium, Aloe, Asparagus, Colchicum, Convallaria, Sarsaparilla, Scilla, Veratrum, and Veratrina. Others of less importance are here considered. Many species, apart from those medicinally employed, are poisonous. The poisonous and medicinal constituents are of various classes, but usually glucosides, and very frequently of the saponin group.

SAPONIN GROUP.

Soap-root.—*Chlorogalum pomeridianum* (Ker.) Kunth (*Scilla p.* DC.; *Phalangium p.* Sweet; *Ornithogalum divaricatum* Lindl.) is the *Californian soap-root*, *-bulb*, or *-apple*, or *Amole*. Its large bulb, resembling that of squill, is universally used by the Indians of the regions where it grows, as a detergent and as a fish poison. It is especially valued for its stimulating effects upon the scalp. It has other uses dependent upon the action of its saponin, and it is an emetico-cathartic poison. Over the deserts of the southwestern United States and Mexico, the rhizomes of large species of Yucca are called "Soap-root," and have the same uses as those of the California variety. There is probably no better tonic or stimulant treatment for the hair than a free application of a solution of this juice in alcohol, water, or glycerin. Besides the saponin, it contains a great number of acicular raphides, which doubtless add, mechanically, to the stimulation. *Yucca filamentosa* L., of the southeastern United States, the *Adam's needle*, *Eve's thread*, *Thread-and-needle*, *Bear-grass* or *Bear-thread*, has a large rhizome which contains nearly 2 per cent. of saponin, and which is used as a stimulant, obviously due to the action of this constituent.

Trillium.—Various species of this genus, especially *T. erectum* L., of eastern and central North America, are used as uterine stimulants like Caulophyllum, under the names

Birthroot ("Bethroot" or "Bathroot"), *Wake-robin*, or *Indian shamrock*, chiefly for the action of a kind of saponin which they contain. The species named contains about 5 per cent. of this substance. All the species have a simple stem, mostly about 30 Cm. (1 Ft.) high, bearing near the summit a whorl of 3 reticulate-palmately veined and usually broad leaves. Just above these, it terminates in a single trimerous flower, which is followed by a triangular-ovoid, 3-celled, many-seeded dark-purple or red berry. *T. sessile* L., *T. viride* Beck., and *T. recurvatum* Beck. have sessile flowers, the last-named with petioled, the other two with sessile leaves, the first named with purple, the second with green flowers. In the other 5 species of the eastern United States the flower is stalked. *T. nivale* Riddell has obtuse leaves, while those of the others are acuminate. *T. undulatum* Willd. has the leaves petioled, the remaining 3 have them sessile or almost so. *T. grandiflorum* (Michx.) Salisb. (*T. rhomboideum grandiflorum* Mx.), the *Large-flowered birthroot* or *Wake robin* or *White wood lily*, has the flowers 5 to 10 Cm. (2 to 4 In.) or more broad, while those of the others are only about half as large. *T. erectum* has the flower erect and the petals flat or spreading, while *T. cernuum* L., the *Nodding wake robin*, *Cough-root*, *Ground lily*, or *White Benjamin*, has the flower recurved below the leaves and the petals also recurved. The commercial drug consists of a subglobular, oblong, or nearly obconical and oblique rhizome, which is truncate at the lower end and terminates above with a short tuft of sheathing leaf-bases; about 25–38 Mm. (1 or 1½ In.) long, 12–18 Mm. (½ to ¾ In.) in diameter, slightly flattened, finely but distinctly annulate, and, particularly in the upper portion, beset with circular rows of straw-colored or pale-brownish rootlets or with the short remnants of the same; externally of a yellowish orange-brown color, internally whitish or more frequently yellowish or light-brown, and upon transverse section seen to be composed of rather spongy parenchyma and of small scattered fibrovascular bundles, which are circular, elongated, or irregularly curved, and more numerous toward the circumference than near the center. It is inodorous or nearly so, and has a sweetish, astringent, afterward bitter and acrid taste.

Besides the saponin above referred to, Trillium contains resinous and fatty matter, much starch, apparently a little volatile oil, tannin, and coloring-matters.

T. globosum is the Chinese *Ch'ien-li-kwang*, and is in that country believed to have the effect of improving vision.

Muscari comosum Mill. (*Hyacinthus c.* L.), the *Feather hyacinth*, *Purple-* or *Purse-tassels* or *Tuzzimuzzy*, of Europe, as well as other species of *Muscari*, is used for its diuretic and stimulant properties. From the species named has been extracted *comosic acid*, which apparently acts like saponin.

Eriospermum latifolium Jaeg. (*Ornithogalum Capense* L.), of southern Africa, yields a tuber used as an emmenagogue, very much like Trillium, the action apparently due to saponin. The same is apparently true of *Limethis bicolor* Kunth, the *Cournianon* of the Mediterranean region, which is emetic and purgative.

Trillium was formerly employed by the North American Indians for the purpose of controlling uterine hemorrhage and producing uterine contractions during labor. It is said to be astringent, alterative, tonic, and sialagogue. The bruised plant has been locally applied as a stimulant to chronic ulcers. The internal dose of the dried root is stated to be 1 drachm (4 Gm.).

MISCELLANEOUS DRUGS AND POISONS.

Medeola, the *Indian cucumber* or *cucumber root*, is the rhizome of *Medeola Virginiana* L. (*Gyromia V.* Nutt.), a flocculent-woolly perennial herb with slender stem, 30 to 60 Cm. (1 to 2 Ft.) high, bearing above the middle a whorl of 6 or 8 lance-oblong leaves, which are about 7.5 Cm. (3 In.) long, a third as broad, and acute at both ends, and near the top a second whorl of half as many smaller and relatively broader ones, and terminating in 3 or 4 small trimerous, greenish-yellow, recurved flowers which are followed by small purplish-blue berries. The rhizome is horizontal, 25–38 Mm. (1 or 1½ In.) long, about 6 Mm. (¼ In.) thick, pointed at the lower end, beset with hair-like simple roots, pale brown-yellowish externally, white internally, and with a few small wood-bundles. It is without odor, and has a sweetish, in the fresh state somewhat cucumber-like, taste. Its constituents, among which is starch, have not been investigated. Nothing appears to have been added for many years to the scanty knowledge originally possessed of this drug, viz., that it was reputed to be hydragogue and diuretic, and therefore useful in dropsies.

Phormium, the *New Zealand flax* or *hemp*, or *Flax lily* (*Flachslilie, Neuseelandischer Flachs*, G.; *Lin* (or *Chanvre*) *de la Nouvelle Zelande*, Fr.), is the rhizome, roots, and leaf-bases of *Phormium tenax* Forst., of New Zealand and the neighboring islands. This is a Yucca-like plant, producing a basal tuft of linear, tough-fibrous leaves, the fiber of which is used as a flax-substitute, and a flower-stalk 4 or 5 M. (12 to 16 Ft.) long. The fleshy rhizome, roots, and leaf-bases are nsed in making a strong decoction which, with or without the addition of antiseptics, has been claimed to act in checking suppuration in wounds dressed with it.

Lilium candidum L., the *White* or *Meadow lily* of southwestern Asia, is well known in

cultivation. Its scaly bulb is employed medicinally. It has a mucilaginous, slightly bitter and nauseous taste, and contains mucilage and a slight amount of an acrid substance. It is used in uterine disorders but apparently without good reason. About a dozen other species of Lily are similarly employed.

Erythronium, Adder's-tongue, -leaf, or *-violet, Dog's-tooth violet, Trout lily, Yellow snake-leaf* or *Yellow Snowdrop,* is the plant *E. Americanum* Ker. (*E. angustatum* Raf.; *E. bracteatum* Bigel.), a very beautiful and pleasing early spring flower of eastern North America. The plant, which is very smooth, grows from a small ovoid fawn-colored corm, which is quite deeply buried in the soil and is of solid, firm consistence and white and starchy internally. The stem is slender, a few inches high, and bears near the ground a pair of oblong, dark-green, purplish-blotched leaves, and terminates in a handsome, large, pendulous, bright-yellow, trimerous, lily-like flower with the perianth-divisions strongly recurved. Its constituents have not been investigated. All parts, but especially the leaves and corm, are emetic, especially when fresh. It is mostly used in the form of a stimulating poultice, applied to swellings.

Uvularia or *Bellwort* is the rhizome of *U. perfoliata* L., a beautiful smooth herb about a foot high, the stem forking at the summit and bearing a single small, pendulous, yellow, lily-like flower from the end of one of the branches. The leaves are peculiar in the manner in which they clasp the stem at the base, whence the name *perfoliata.* The rhizome is slender, a few inches long, and sparsely provided with roots. It has a slightly acrid and mucilaginous taste somewhat similar to that of *Erythronium,* and the constituents, which have not been investigated, are probably similar. It is used for similar purposes, as well as for erysipelas, ulcerated mouth, etc. *U. latifolia* Sm. is the Chinese *Pei-mi-hiang,* or *Ming.*

Ruscus aculeatus L. (*R. flexuosus* Mill.), the *Ditch-, Sea-,* or *Tassel-grass,* or *Tassel pond-weed,* related to Asparagus, native of the Mediterranean region, is used as a diuretic, diaphoretic, and vulnerary. Its seeds are said to be used as a coffee-substitute.

Camassia esculenta Lindl., of the northwestern United States, produces a starchy bulb which is quite an important food among the Indians, and is probably capable of great improvement by cultivation. A number of species of *Asphodelus* are employed as foods, their roots being mucilaginous, like Salep. Fritillaria is a large genus, producing starchy bulbs, several of which are edible, like those of *Calochortus. F. imperialis* L., of Persia, is said to be there cultivated as a food-plant, its bulb poisonous when raw, but wholesome when cooked. *F. Indica* Spr., of the western United States, is reputed among stockmen to be a Loco-weed (see LEGUMINOSÆ). The large root-stock of *Melanthium Virginicum* L., the *Bunch-flower, Black-flower,* or *Quafodil,* of the eastern and central United States, is poisonous and is used as a parasiticide. *M. Cochin-Chinensis* Lour. (*Anguillaria C.* Spr.) is the Chinese *T'ien-men-tung,* and is there used as an anthelmintic, expectorant, etc. *Paradisia liliastrum* (L.) Bert. (*Anthericum l.* L.) is a heart poison, as is *Bulbine bulbosum* Hassk., of Australia. *Xerophyllum asphodeloides* (L.) Nutt. (*Helonias a.* L.; *H. setifolium* Michx.), of the southern United States, contains the alkaloid *xerophylline. Paris quadrifolia* L., the European *Wolfsberry* (*Einbeere,* G.), contains the poisonous glucoside *paridin* and is emetic. A number of species of *Zigadenus,* of the western United States, are intensely poisonous. *Z. venenosus* Wats., the *Death camas,* destroys great numbers of grazing animals, and is fatal to man when eaten by mistake for the *Camassia esculenta* or *Sweet camas. Chrosperma muscætoxicum* (Walt.) Kuntze (*Melanthium m.* Walt.; *Amianthium m.* Gray) is the *Fly-, Crow-,* or *Fall-poison* of the United States Atlantic coast-region. It is used as an insecticide, and is poisonous to birds.

LIMONIS CORTEX, *U. S., Br.*—Lemon Peel.

Cortex Fructus Citri, P. G.; *Flavido Corticis Citri,* P. A.; *Citronenschale, Limonenschale,* G.; *Écorce* (or *Zeste*) *de citron* (or *de limon*) Fr.; *Scorza do Limone,* It.; *Casca de Limao, Amarello da Casca de Limao,* Port.

The recently separated outer rind of the ripe fruit of *Citrus Limonum* Risso (*C. medica,* var. *B.* L.; var. *Limonum* Hook. f.—Fam. *Aurantiaceæ*).

Lemon Peel is official in nearly all pharmacopœias, though several specify the rind of the *Cedron* or *Cedrat.* The German admits only the outer portion of the rind of the fresh ripe fruit and requires that it be dried. The Russian, on the contrary, requires the retention of the white inner rind.

Origin.—A small tree, native of northwestern India and cultivated, in numerous varieties, in all tropical and subtropical countries. The different varieties vary in size and form, but are, from a medicinal point of view, identical. There is a sweet lemon, believed to be a distinct species (*C. Lumia* Risso), sometimes of gigantic size, sometimes smaller than the ordinary lemon. The Citron, Cedron, or Cedrat is the very large, lemon-like fruit used for making preserved or candied citron. It is the product of *C. medica* Risso, and is totally different in properties from either the lemon or the orange.

Various methods are employed for removing the peel. If removed in broad bands or ribbons, the removal of a considerable portion of the white inner with the oily outer layer is inevitable, and the aromatic constituents are correspondingly decreased in percentage. For this reason, *shredded* lemon peel, that removed in very narrow bands, is preferred. This product is itself, however, often deceptive, since it may be cut in an oblique direction in such a manner as to take away most or the whole of the white portion with the other.

Description.—Lemon peel forms either narrow bands or oblong and curved sections with little of a spongy, white inner layer adhering to them; the outer surface has a deep lemon-yellow color, and is somewhat uneven from numerous oil-glands imbedded in the tissue. This portion has an agreeable odor and an aromatic slightly bitter taste; it is the only part which possesses medicinal value. The Pharmacopœia now directs that the spongy white inner layer adhering to the segments, which is inodorous and nearly tasteless, should be removed before use.

Dried lemon and orange peels often closely resemble one another, and the former is frequently adulterated with the latter. Upon moistening orange peel with strong hydrochloric acid it quickly assumes a rich, dark-green color, while lemon peel is not colored, or merely becomes of a dingy yellowish-brown tint (*Clayton*). Lemon peel of poor appearance is often artificially colored to improve it.

Constituents.—Lemon peel is used wholly for the effect of its volatile oil (see Oleum Limonis). The slight bitterness is due to the same constituents as those described under Aurantii Amari Cortex. The black coloration imparted to the white layer by ferric salts is due to an undetermined constituent.

Action and Uses.—Lemon peel is a stimulant stomachic, and enters into a number of preparations to increase their efficacy and modify their taste.

LIMONIS SUCCUS, *U. S.*—Lemon Juice.

Succus limonis, Br.; *Succus Citro.*—*Limonensaft, Citronensaft*, G.; *Suc de citron* (or *de limon*), Fr.; *Succo de Limone*, It.; *Zumo de Limon*, Sp.

The freshly expressed juice of the ripe fruit of *Citrus Limonum* Risso (*C. medica*, var. *B.* L.; var. *Limonum* Hook. f.)—Fam. *Aurantiaceæ.*

Lemon juice is official in nearly all pharmacopœias. Several specify that the rind and seeds should be removed before the juice is expressed.

Origin (see Limonis Cortex).—The fruit of the lime (*C. acida* Roxb.) is very commonly substituted for lemon juice, and is in every respect its equal if not superior. It has been found far richer in citric acid. It is to be remembered that, as there is a sweet lemon, so there is a sweet lime (*C. Limetta* Risso).

Description.—A slightly turbid, yellowish liquid, usually having an odor of lemon, due to the accidental presence of some of the volatile oil of the rind. Taste acid, and often slightly bitter. Specific gravity 1.030 to 1.040 at 25° C. (77° F.). It reddens blue litmus-paper, and should contain from 7 to 9 per cent. of citric acid.

Ellwood determined the percentage of citric acid in lemon juice, collected during different months, to range from 32 to 42 grains per fluidounce. The U. S. P. demands the absence of acetic, sulphuric, and tartaric acids and sulphates, and also that at least 10 Cc. of normal potassium hydroxide solution shall be required to neutralize 10 Cc. of lemon juice, using phenolphthalein as indicator. The British Pharmacopœia allows only 3 per cent. of ash, and requires from 7 to 9 per cent. of citric acid; also that 110 minims of the juice be neutralized by about 11½ grains of potassium bicarbonate, about 9½ grains of sodium bicarbonate, or about 16½ grains of sodium carbonate.

Constituents.—Besides its 7 to 10 per cent. of citric acid, and the small amount of ash, lemon juice contains from 0.5 to 1 per cent. of gum and sugar. Witt found the principal constituents of the ash to be potash 44.34, lime 7.61, and phosphoric acid 7.56 per cent. Cossa found about 15 per cent. of phosphoric acid.

Action and Uses.—Lemon juice is an excellent refrigerant, and in the form of lemonade affords an agreeable beverage during the course of the acute febrile affections. It is largely employed, and is considered by many as a prophylactic and specific for the treatment of scurvy. Demulcent drinks are frequently flavored by the addition of lemon juice and sugar for the purpose of rendering them more palatable. It may be tried as a remedy for rheumatism, and when topically applied is said to be beneficial in the treatment of uterine hemorrhage.

LINIMENTA.—Liniments.

Embrocations, E., Fr.; *Linimente, Einreibungen*, G.

Liniments are liquid or semiliquid preparations which are intended for external use and are applied to the skin by friction. The vehicle may be oil or alcohol, or sometimes water; many are perfect solutions, others mechanical mixtures which should be well agitated before they are used; a few are of a soft solid consistence at the ordinary temperature, but become liquid when applied to the skin. The U. S. Pharmacopœia since 1880 uses cotton-seed oil in place of olive oil, formerly directed.

The so-called *drying liniments* or *medicated varnishes* consist of mucilage of tragacanth, starch, or dextrin, with egg-albumen, suitably medicated, which when applied to the skin leave a thin varnish or protective film similar to that obtained with collodion.

LINIMENTUM ACONITI, *Br.*—Liniment of Aconite.

Liniment d'aconite, Fr.; *Akonitliniment*, G.

Preparation.—Take of aconite root, in No. 40 powder, 20 ounces; camphor, 1 ounce; alcohol (90 per cent.), a sufficient quantity. Moisten the aconite with 20 fluidounces of the alcohol and set aside in a closed vessel for 3 days, occasionally agitating; transfer to a percolator, and, when the liquid ceases to pass, continue the percolation with more of the alcohol, allowing the liquid to drop into a receiver containing the camphor until 30 fluidounces of the liniment are produced.—Br.

This liniment is about two-thirds as strong as the fluidextract, and differs also from the latter in containing camphor. With proper care and manipulation the aconite root is practically exhausted by the above process.

Action and Uses.—Aconite liniment may be employed for the relief of local pain. It is especially useful in the treatment of superficial neuralgias. (See ACONITUM.)

LINIMENTUM AMMONIÆ, *U. S., Br.*—Ammonia Liniment.

Linimentum ammoniatum, P. G.; *Linimentum volatile, Linimentum ammoniacale.—Volatile liniment*, E.; *Liniment ammoniacal (volatil), Savon ammoniacal*, Fr.; *Flüchtiges Liniment, Flüchtige Salbe*, G.

Preparation.—Ammonia water, 350 Cc.; alcohol, 50 Cc.; oleic acid, 30 Cc.; cotton-seed oil, 570 Cc.; to make 1000 Cc. Mix them.—U. S.

To make a quart of official ammonia liniment, mix 11¼ fluidounces of ammonia water, 1½ fluidounces of alcohol, 1 fluidounce of oleic acid, and 18¼ fluidounces of cotton-seed oil, and shake well.

Take of solution of ammonia, 1 fluidounce; almond oil, 1 fluidounce; olive oil, 2 fluidounces. Mix together with agitation.—Br.

The German Pharmacopœia directs 3 parts of olive oil and 1 part of poppy-seed oil, and the French Codex 9 parts of expressed oil of almonds to 1 part of ammonia water. The fixed oil is partly decomposed, with the formation of an ammonia soap, by means of which the water and oil are kept well mixed, forming an opaque emulsion. Ammonia liniment may be prepared by shaking together in a bottle 3½ fluidounces of ammonia water, ½ fluidounce of alcohol, 3 fluidrachms of oleic acid, and 5⅝ fluidounces of cotton-seed oil. The addition of alcohol in the official formula is intended to preserve the fluidity of the liniment, as the latter has a tendency to thicken considerably if kept on hand for some time.

LINIMENTUM AMMONIATO-CAMPHORATUM, P. G.—*Linimentum ammoniæ camphoratum.—Camphorated volatile liniment*, E.; *Liniment ammoniacal camphré*, Fr.; *Flüchtiges Kampferliniment*, G.—The French Codex and German Pharmacopœia direct it to be made precisely like volatile liniment, except that camphor liniment is substituted for the almond and olive oil, respectively.

Uses.—This preparation is employed as a stimulant and rubefacient. As a rule it should be applied by rubbing, but if it be applied to the skin upon flannel and evaporation prevented, vesication may occur. The remedy is employed for the relief of rheumatic and neuralgic pains, and for the purpose of aborting beginning inflammations such as pharyngitis and bronchitis. If too severe in its action, it may be diluted with oil.

LINIMENTUM BELLADONNÆ, *U. S., Br.*—Belladonna Liniment.

Liniment de belladone, Fr.; *Belladonnaliniment*, G.

Preparation.—Camphor, 50 Gm.; fluidextract of belladonna root, a sufficient quantity to make 1000 Cc. Dissolve the camphor in about 800 Cc. of the fluidextract, and then add sufficient of the latter to make the product measure 1000 Cc.—U. S.

To make 1 pint of the official liniment, dissolve 365 grains of camphor in 12 ounces of fluidextract of belladonna root, and add sufficient fluidextract to bring the volume up to 16 fluidounces.

Liquid extract of belladonna, 10 fluidounces; camphor, 1 ounce; distilled water, 2 fluidounces; alcohol (90 per cent.), a sufficient quantity. Dissolve the camphor in 6 fluidounces of alcohol; add the liquid extract of belladonna, the distilled water, and sufficient alcohol to produce 20 fluidounces. Set aside for 24 hours and filter.—Br.

Owing to the difference in alkaloidal strength of the U. S. and Br. fluidextracts of belladonna, the former liniment will be about one-third stronger than the last named.

Uses.—Belladonna liniment is a useful preparation for the relief of rheumatic and neuralgic pains.

LINIMENTUM CALCIS, *U. S., Br.*—Lime Liniment.

Liniment of lime, Carron oil, E.; *Liniment calcaire, Savon calcaire*, Fr.; *Kalkliniment*, G.

Preparation.—Take of solution of lime, linseed oil, each 500 Cc. Mix them.—U. S.

Take of solution of lime, olive oil, each 2 fluidounces. Mix together, with agitation.—Br.

A lime soap is formed by this process, which keeps the excess of the oil emulsionized for a short time, the two separating together from the aqueous liquid.

The French Codex directs the separation of the soft saponaceous mass resulting from the agitation of 9 parts of lime water with 1 part of expressed oil of almonds, and its preservation for use.

Uses.—Carron oil when thickly spread upon lint or cotton forms an efficient application for the treatment of recent burns or scalds. It should be frequently renewed in order to prevent the dressings from adhering to the burned area.

LINIMENTUM CAMPHORÆ, *U. S., Br.*—Camphor Liniment.

Oleum camphoratum, P. G.; *Linimentum camphoratum.—Camphorated oil*, E.; *Liniment camphré, Huile camphré*, Fr.; *Kampherliniment*, G.

Preparation.—Take of camphor, in coarse powder, 200 Gm.; cotton-seed oil, 800 Gm.; to make 1000 Gm. Introduce the camphor and the cotton-seed oil into a suitable flask, and apply a gentle heat, by means of a water-bath, loosely stoppering the flask during the operation. Agitate from time to time, until the camphor is dissolved.—U. S.

To make about 1 pint of camphor liniment, dissolve 2 avoirdupois ounces of camphor in 14½ fluidounces of cotton-seed oil.

Take of camphor, 1 ounce; olive oil, 4 fluidounces. Dissolve the camphor in the oil.—Br.

Dissolve camphor 1 part in olive oil, 9 parts.—Fr. Cod., P. G. Oleum Camphoratum Forte of the German Pharmacopœia contains twice as much camphor as the preceding.

A simple solution of camphor in oil, which is best obtained by employing the camphor as a fine powder or by digesting the mixture in a closed bottle at a moderate heat.

Souley's *Carbolized Camphor Liniment* is made by dissolving pure carbolic acid 9 parts and camphor 25 parts in absolute alcohol 9 parts and adding oil 35 parts.

Uses.—Camphor liniment may be employed for the relief of sprains, bruises, and rheumatic pains, and as a mild counterirritant in bronchitis, especially of children. As an absorbent it has been successful when applied to glandular enlargements.

LINIMENTUM CAMPHORÆ AMMONIATUM, *Br.*—Ammoniated Liniment of Camphor.

Linimentum camphoræ compositum.—Compound camphor liniment, E.; *Liniment ammoniacal camphré anglais*, Fr.; *Ammoniak- und Kampherliniment*, G.

Preparation.—Take of camphor, 2½ ounces; oil of lavender, 1 fluidrachm; strong solution of ammonia, 5 fluidounces; alcohol (90 per cent.), a sufficient quantity. Dis-

solve the camphor and oil of lavender in 12 fluidounces of alcohol; add the strong solution of ammonia gradually, shaking them together, until after adding sufficient alcohol to produce 20 fluidounces of the liniment a clear solution is formed.—Br.

Uses.—This preparation combines the properties of both a rubefacient and an anodyne. It may be used for the relief of rheumatic and neuralgic pains.

LINIMENTUM CHLOROFORMI, *U. S., Br.*—Chloroform Liniment.

Liniment au chloroforme, Fr.; *Chloroformliniment*, G.

Preparation.—Take of chloroform, 300 Cc.; soap liniment, 700 Cc.; to make 1000 Cc. Mix them.—U. S.

Take of chloroform, liniment of camphor, each 2 fluidounces. Mix.—Br.

Chloroform 1 part, expressed oil of almond 9 parts.—Fr. Cod.

The preparations bearing the same name in the three pharmacopœias differ essentially in composition as well as in the proportion of chloroform.

Uses.—Chloroform liniment forms an efficient local application for the relief of many painful affections. Its full anodyne effect can only be obtained by preventing the evaporation of the chloroform. This may be accomplished by the use of oiled silk or waxed paper.

Allied Preparation.—Linimentum Aconiti et Chloroformi, *Liniment of Aconite and Chloroform*, N. F.—Tincture of aconite, 125 Cc.; chloroform, 125 Cc.; soap liniment, 750 Cc. Mix. This liniment is largely used under the name of Compound Chloroform Liniment.

LINIMENTUM CROTONIS, *Br.*—Liniment of Croton Oil.

Linimentum tiglii, N. F.—*Liniment crotoné*, Fr.; *Krotonöllinimeut*, G.

Preparation.—Take of croton oil, 1 fluidounce; oil of cajuput, alcohol, 90 per cent., each 3½ fluidounces. Mix.—Br.

Croton oil, 12 Cc.; oil of cajuput, 44 Cc.; alcohol, 44 Cc. Mix.—N. F.

This is simply a solution of croton oil in alcohol and oil of cajuput, and has the odor of the latter.

Uses.—This preparation is an active rubefacient and counterirritant, producing pustulation in a short time. From 20 to 30 minims (1.3–2 Cc.) may be rubbed upon a limited area and repeated at intervals of 8 hours until pustulation takes place, when its use should be stopped.

LINIMENTUM HYDRARGYRI, *Br.*—Liniment of Mercury.

Linimentum mercuriale.—Liniment mercuriel, Fr.; *Quecksilberliniment*, G.

Preparation.—Take of ointment of mercury, 1 ounce; strong solution of ammonia, 160 minims; liniment of camphor, a sufficient quantity. Add the strong solution of ammonia to sufficient liniment of camphor to produce 1½ fluidounces; triturate the ointment of mercury with sufficient liniment of camphor to produce 1½ fluidounces; mix the two liquids.—Br.

Uses.—Mercury liniment may be employed to promote the absorption of fluids, and to aid in the resolution of syphilitic tumors and chronic enlargements of joints and glands. Care should be exercised in its employment as it frequently produces salivation.

LINIMENTUM OPII, *Br.*—Liniment of Opium.

Anodyne liniment, E.; *Liniment opiacé*, Fr.; *Opiumliniment*, G.

Preparation.—Take of tincture of opium, soap liniment, each 2 fluidounces. Mix.—Br.

The *Liniment savonneux opiacé* of the French Codex was made by triturating 5 parts of powdered soap with 90 parts of expressed oil of almonds, and adding 5 parts of tincture of opium; it must be well agitated.

Uses.—Opium liniment may be used as an anodyne for the relief of sprains and rheumatic pains.

LINIMENTUM POTASSII IODIDI CUM SAPONE, *Br.*—Liniment of Potassium Iodide and Soap.

Liniment savonneux ioduré, Fr.; *Jodkalium-Seifenliniment*, G.

Preparation.—Take of curd soap, cut small, 2 ounces; potassium iodide, 1½ ounces; glycerin, 1 fluidounce; oil of lemon, 1 fluidrachm; distilled water, 10 fluidounces. Reduce the soap to fine shreds, and mix this with the water and glycerin in a porcelain dish over a water-bath. When the soap is dissolved, pour the liquid into a mortar in which the potassium iodide has previously been powdered. Mix briskly, and continue the trituration until the mixture is solid. Set aside for an hour; then rub well the oil of lemon into the cream-like product.—Br.

Uses.—This liniment is intended to be employed in conjunction with massage for the purpose of producing the systemic effect of the iodide.

LINIMENTUM SAPONIS, *U. S., Br.*—Soap Liniment.

Spiritus nervinus camphoratus; Liquid opodeldoc, E.; *Liniment savonneux camphré*, Fr.; *Flüssiger Opodeldok*, G.

Preparation.—Soap, dried and granulated, 60 Gm.; camphor, in small pieces, 45 Gm.; oil of rosemary, 10 Cc.; alcohol, 725 Cc.; water, a sufficient quantity to make 1000 Cc. Add the soap to 200 Cc. of boiling water, heat the mixture on a water-bath until a clear gelatinous mass results. Mix this, while yet warm, with 500 Cc. of alcohol, and stir it until solution is effected. Dissolve the camphor and oil of rosemary in 225 Cc. of alcohol by agitation in a bottle; add this solution to the warm soap mixture; mix thoroughly, and, if necessary, add enough water to make the product measure 1000 Cc. Set it aside in a cool place for 24 hours, then filter.—U. S.

To prepare 2 pints of soap liniment will require granulated dried soap, 885 grains, camphor 663 grains, oil of rosemary 154 minims, alcohol 24 fluidounces, and sufficient water to make the solution measure 32 fluidounces.

Take of soft soap, 2 ounces; camphor, 1 ounce; oil of rosemary, 3 fluidrachms; alcohol (90 per cent.), 16 fluidounces; distilled water, 4 fluidounces. Dissolve the soap in the distilled water; dissolve the camphor and oil of rosemary in the alcohol; mix the solutions; set aside for one week and filter.—Br.

The U. S. P. directions for making soap liniment are a great improvement over those of the last pharmacopœia, and a perfect solution can be effected in comparatively short time. The object of setting the liniment aside in a cool place for 24 hours, is to get rid of the sodium palmitate always present in Castile soap, and which is but sparingly soluble in the menstruum when cold. Since the Br. formula directs the use of soft soap, separation will not occur in the cold, potassium soap being soluble in alcohol cold or warm.

Uses.—Soap liniment is a mild anodyne and absorbent, but is principally used as a vehicle for other remedies.

Allied Preparations.—Linimentum Saponato-Camphoratum, P. G.—*Camphorated soap liniment, Solid opodeldoc*, E.; *Opodeldok*, G.—Medicinal soap, 40 parts; camphor, 10 parts; alcohol, 420 parts; oil of thyme, 2 parts; oil of rosemary, 3 parts; ammonia water, 25 parts. Dissolve the soap and camphor in the alcohol with the aid of a gentle heat, and filter the solution while still warm; add the oils of thyme and rosemary, and finally the ammonia water. Cool the mixture quickly.—P. G.

This preparation is practically identical with that of the National Formulary, the chief difference being that the latter directs a little more camphor and the use of stronger ammonia water in place of the 10 per cent. solution. Solid opodeldoc is better known as Steer's Opodeldoc, and is usually put up in wide-mouth vials, which are filled while the solution is still warm and fluid. It is white or yellowish in color, opalescent, and somewhat translucent, and readily liquefies at the temperature of the body.

LINIMENTUM SAPONIS MOLLIS, *U. S.*—Liniment of Soft Soap.

Tinctura saponis viridis, U. S., 1880. *Spiritus saponis kalinus Hebra.—Teinture de savon vert*, Fr.; *Hebra's Seifenspiritus*, G.

Preparation.—Soft soap, 650 Gm.; oil of lavender, 20 Cc.; alcohol, a sufficient quantity to make 1000 Cc. Mix the oil of lavender with 300 Cc. of alcohol, dissolve in

this the soft soap by stirring or agitation, and set the solution aside for 24 hours. Then filter it through paper, and pass sufficient alcohol through the filter to make the product measure 1000 Cc.—U. S.

To make 1 pint of liniment of soft soap will require soft soap $10\frac{3}{4}$ avoirdupois ounces, oil of lavender 3 fluidrachms, and alcohol sufficient to make the solution measure 16 fluidounces.

Uses.—Liniment of soft soap has been employed as a local remedy for chronic skin affections, such as psoriasis, lichen, and prurigo.

LINIMENTUM SINAPIS, *Br.*—Liniment of Mustard.

Liniment sinapisé, Fr.; *Senfliniment*, G.

Preparation.—Volatile oil of mustard, $1\frac{1}{2}$ fluidrachms; camphor, 120 grains; castor oil, 5 fluidrachms; alcohol (90 per cent.), 4 fluidounces. Dissolve the camphor in the alcohol; add the oil of mustard and castor oil. Mix.—Br.

The solution is readily effected by agitation in a vial.

The Compound Liniment of Mustard (*Linimentum Sinapis Compositum*), of the U. S. P. 1890, was made by dissolving camphor 60 Gm. in alcohol 500 Cc.; then adding to this solution fluid extract of mezereum 200 Cc., volatile oil of mustard 30 Cc., and castor oil 150 Cc., and finally sufficient alcohol to make the product measure 1000 Cc.

Uses.—This liniment is a powerful rubefacient and counterirritant, and affords a convenient method for applying volatile oil of mustard. It may be employed as a substitute for mustard plaster. Its uses are described under SINAPIS (which see).

LINIMENTUM TEREBINTHINÆ, *U. S., Br.*—Turpentine Liniment.

Linimentum terebinthinatum.—Liniment térébenthiné, Fr.; *Terpentinliniment*, G.

Preparation.—Resin cerate, 650 Gm.; oil of turpentine, 350 Gm.; to make 1000 Gm. Add the oil to the cerate, previously melted, and mix them thoroughly. —U. S.

Take of soft soap, 2 ounces; camphor, 1 ounce; oil of turpentine, 13 fluidounces; distilled water, 5 fluidounces, or a sufficient quantity. Mix the soft soap with 2 fluidounces of distilled water; dissolve the camphor in the oil of turpentine; gradually add the latter solution to the former, triturating until the mixture becomes a thick, creamy emulsion; lastly mix with sufficient distilled water to produce 20 fluidounces.—Br.

The first formula yields what is known as *Kentish liniment;* the cerate should be melted at a low heat, and then the oil gradually added, with continued stirring. The second process is a considerable modification of the first.

Uses.—Linimentum terebinthinæ is not frequently employed at the present time. It may be applied as a soothing and protective dressing to burns and scalds, and is considered by some as an efficient remedy in the treatment of superficial erysipelas and frost-bite.

LINIMENTUM TEREBINTHINÆ ACETICUM, *Br.*—Liniment of Turpentine and Acetic Acid.

Linimentum album.—Acetic turpentine liniment, Stokes' Liniment, St. John Long's Liniment, E.; *Liniment térébenthiné acetique*, Fr.; *Terpentin- und Essigliniment*, G.

Preparation.—Take of oil of turpentine, 4 fluidounces; glacial acetic acid, 1 ounce; liniment of camphor, 4 fluidounces. Mix.—Br.

The National Formulary gives the following directions: Oil of turpentine, 100 Cc.; fresh egg, albumen and yolk, 1; oil of lemon, 4 Cc.; acetic acid (36 per cent.), 20 Cc.; rose-water, 85 Cc. Triturate or beat the contents of the fresh egg with the oil of turpentine and the oil of lemon in a mortar until they are thoroughly mixed. Then incorporate the acetic acid and rose-water. Shake the mixture whenever any of it is to be dispensed.

The latter preparation, which differs materially from the former, is extensively used in this country, especially by the laity. If properly made, it will not separate, and increases in whiteness as it becomes older. The use of oil of lemon is quite superfluous, since its odor is masked by that of the oil of turpentine, and the albumen of the egg can be reduced to one-half with decided benefit. It will be found advantageous to pour the

oil and egg mixture into a bottle and add the water and acid mixture in divided portions, shaking well after each addition until a thick, creamy emulsion is formed.

Uses.—This preparation has been largely employed in the past as a stimulating liniment in the treatment of chronic rheumatic complaints. At present it is rarely prescribed by the medical profession.

LINUM, *U. S., Br.*—Flaxseed.

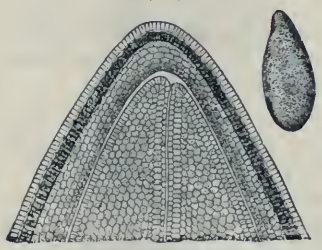
Semen Lini, P. G.; *Linseed*, E.; *Leinsamen, Flachssamen*, G.; *Semence (Graine) de lin*, Fr.; *Linaza*, Sp.; *Linhaca, Sementes de Linho*, Port.; *Semi di Lino*, It.

The ripe seed of *Linum usitatissimum* L. (*L. sativum* Blackw.)—Fam. *Linaceæ*.

Linum is official in all pharmacopœias, several of which require that it be renewed annually.

Origin.—From a slender annual of cultivation, about 2 feet high, little if at all branched, with alternate, exstipulate, linear-lanceolate leaves, and regular and symmetrical 5-merous blue flowers. The 5-celled or imperfectly 10-celled capsule contains 10 seeds. The original home of the flax is uncertain, but is probably the Mediterranean basin. It is cultivated in nearly all temperate and in some tropical regions, and is everywhere naturalized. Cultivation has developed a number of strong forms sometimes regarded as species. The principal source of flax and flaxseed is Russia.

Fig. 259.



Flaxseed, and transverse section near edge (× 65).

Description.—From 4 to 6 Mm. ($\frac{1}{6}$ to $\frac{1}{4}$ In.) long and a little more than half as broad, ovate, obtusely and obliquely pointed, flattened, the edges subacute, the base rounded; anatropous, the hilum and micropyle upon one edge, near the point; light-brown to dark-brown, smooth and shining, finely pitted under a strong lens. Structurally, the thickish testa possesses a layer of gum-cells, forming an abundance of mucilage under the action of water; the kernel consists of 2 white or yellowish oily cotyledons enclosed in a very thin perisperm. The odor should be none, or very faint; the testa bland, oily, and mucilaginous.

Ground flaxseed should be recently prepared, of a gray-brown color, yielding to carbon disulphide not less than 30 per cent. of fixed oil, the oil readily saponifiable, free from starch and fibre, and of but slight and not rancid or unpleasant odor. If 0.1 Gm. of ground linseed be mixed with 20 Cc. of water and the mixture heated to boiling, then cooled and diluted with cold water to 100 Cc., the addition of 0.5 Cc. of iodine test-solution should not produce more than a pale-blue color (limit of starch). By exposure to heat, light, and a damp atmosphere, or otherwise carelessly preserved, flaxseed, especially when ground, is apt to become rancid and foul-smelling. It is also subject to insect attack. It is generally regarded as unfit for use after the lapse of more than a year.

Constituents.—The seeds contain fixed oil, wax, resin, tannin, gum, gluten, and albumen. Only the young seeds are said to contain starch. The integuments contain much gum ($C_{12}H_{20}O_{10}$), about 15 per cent. of the seed, which swells with water to make a viscid, odorless, and almost tasteless mucilage, which is precipitated by alcohol and lead subacetate, but not by tannin. Dilute acids split it into gum, sugar, and cellulose, and, boiled with nitric acid, it yields *mucic acid*. Analyses of seeds from different sources (Dey and Cowil, 1895) gave the following yields of oil: English, 29.5; Dutch, 34.5; Turkish, 36.5; Canadian (also contained starch), 27; Russian (also contained starch), 39; South American, 39.5; and Bombay, 40 per cent. The ash amounted to from 2 to 4 per cent. The young plant yields a glucoside, *linamarin*, in odorless, bitter colorless needles, soluble in water and alcohol, but not in ether, and with dilute acids decomposed into sugar, hydrocyanic acid, and a volatile acetone. A ferment (zymase), contained in linseed meal, is said to cause the same decomposition.

Varieties and Adulterants.—In commerce, a number of geographical varieties of flaxseed are recognized, but, aside from the presence of impurities, there is no great difference in their qualities. The tropical varieties are usually larger and paler, and are less highly esteemed. To a certain extent the source can be determined by the accompanying weed-seeds.

Damaged flour and other starchy material is often introduced in grinding, and is at once detected by the microscope or the iodine test. The commonest sophistication is the

substitution, in whole or in part, of the linseed meal used as cattle-food, made by grinding up the linseed cake (*Placentis Seminæ Lini*) left after expression of the oil. This is detected by the less oily appearance of the mass and by the reduced percentage-yield of oil (less than 25 per cent.). To restore the appearance, mineral oil has been then added, but its saponification properties are thus lost or impaired.

In commerce, the percentage of impurities is roughly determined by shaking in a conical muslin bag, the impurities settling into the point. Foreign seeds and earthy impurities should not exceed 2 or 3 per cent., and are often less than 1 per cent. Occasionally they amount to 25 per cent. or more. Such seeds consist chiefly of mustard and rape and their relatives. By imperfect cleansing, sand and small stones are often present.

Actions and Uses.—Infusions of flaxseed are used as demulcents in cases of acute inflammation of the gastro-intestinal tract. They act as soothing agents, and by forming a protective coating over the mucous membrane tend to prevent farther irritation. They have also been recommended in acute bronchitis and cystitis, and in inflammatory conditions of the entire genito-urinary tract; but their value in these conditions is probably limited. An infusion made by macerating 3 drachms of flaxseed and 30 grains of extract of licorice with 10 ounces of boiling water, to which has been added a small quantity of lemon juice and sugar, is the most palatable form of administration. Flaxseed meal moistened with boiling water was formerly employed as a poultice, but is now almost entirely supplanted by hot antiseptic fomentations.

Allied Plants.—The genus *Linum*, L., contains nearly a hundred species, and several of them possess distinct properties. The herbage of *L. catharticum* L. (*Cathartolinum pratense* Reichb.), of Europe, is used as a purgative. *L. Chamissonis* Schied. (*L. aquilinum* Mol.), of Chile, is there employed under the names *Ratamilla* and *Yanga* as a stomachic and febrifuge, as are *L. ramossissimum* Gay and *L. selaginoides* Lam., of the same region. The root and bark of the related *Hugonia Mystax* L., of India, are employed as an anthelmintic, diuretic, and diaphoretic.

LIQUOR ACIDI ARSENOSI, *U. S.*—Solution of Arsenous Acid.

Liquor arsenici hydrochloricus, Br.; *Liquor arsenici chloridi*, U. S., 1870; *Hydrochloric solution of arsenic*, E.; *Liqueur arsénicale hydrochlorique*, Fr.; *Chlorarsenik-lösung*, G.

Preparation.—Arsenic trioxide, in small pieces, 10 Gm.; diluted hydrochloric acid, 50 Cc.; distilled water, a sufficient quantity to make 1000 Cc. Boil the arsenic trioxide with the hydrochloric acid and 250 Cc. of distilled water until solution has been effected. Filter the liquid, and pass sufficient distilled water through the filter to make the solution measure 1000 Cc.—U. S.

To make 1 pint of the official solution of arsenous acid, boil 73 grains of arsenic trioxide and 384 minims of diluted hydrochloric acid with 4 ounces of distilled water until dissolved; filter and add sufficient distilled water to make 16 fluidounces.

The solution of the Br. P. is identical with the above, except that 12½ Cc. of hydrochloric acid are directed in place of 50 Cc. of diluted hydrochloric acid, the latter being equal to about 14.3 Cc. of the stronger acid.

The hydrochloric acid simply facilitates solution of the arsenic trioxide in water, whereby the latter is converted into arsenous acid, thus: $As_2O_3 + 3H_2O = 2H_3AsO_3$, and does not enter into chemical reaction with it. Hence the solution contains simply the two acids, and the name solution of arsenic chloride, formerly used, was wrongly applied, since arsenous chloride, As_2Cl_6, is at once decomposed in contact with water.

Properties.—The solution is colorless, has an acid reaction and an acidulous taste. Hydrogen sulphide yields at once a bright-yellow precipitate of arsenic sulphide. In arsenic strength it corresponds with Fowler's Solution, containing 1 per cent. of arsenous acid, or 4.56 grains to the fluidounce, or 4.35 grains to the Imperial fluidounce; Valangin's Solution contained 0.38 per cent. of arsenous acid, or 1¾ grains to the fluidounce.

The strength is determined as follows: If to 24.6 Cc. of solution of arsenous acid 2 Gm. of sodium bicarbonate and 100 Cc. of water be added, and mixed with a little starch test-solution, it should require not less than 50 Cc. of tenth-normal iodine volumetric solution until the blue tint of iodide of starch makes its appearance (corresponding to 1 Gm. of arsenic trioxide in 100 Cc. of the solution.—U. S. 25 Cc. diluted with

water should discharge the color of 50.8 to 50.9 Cc. of volumetric solution of iodine, the presence of a slight excess of sodium bicarbonate being maintained throughout the operation.—Br.

Action and Uses.—This preparation may be employed for the same purpose as Fowler's Solution. It has no apparent advantage over the latter remedy. The beginning dose is from 2 to 5 minims (0.10–0.30 Cc.), largely diluted with water.

LIQUOR ACIDI CHROMICI, *Br.*—Solution of Chromic Acid.

Soluté d'acide chromique, Fr.; *Chromsäurelösung*, G.

An aqueous solution containing the equivalent of 25 per cent. of chromic anhydride, CrO_3, or 29.5 per cent. of chromic acid, H_2CrO_4.

Preparation.—Chromic anhydride, 25 Gm.; distilled water, 75 Cc. Dissolve.—Br.

Properties.—Solution of chromic acid is an orange-red liquid, without odor, and having a caustic, strongly acid character. Its specific gravity is 1.185.

Chromic acid should be weighed in glass or porcelain vessels and all contact with organic matter carefully avoided. The solution should be preserved in glass-stoppered bottles.

Action and Uses.—The employment of this solution is described under CHROMII TRIOXIDUM (which see).

LIQUOR AMMONII ACETATIS, *U. S.*, *Br.*—Solution of Ammonium Acetate.

Liquor ammonii acetici, P. G.; *Spiritus Mindereri.—Spirit of Mindererus*, E.; *Acétate d'ammoniaque liquide, Esprit de Mindérérus*, Fr.; *Ammoniumacetatlösung*, G.

An aqueous solution of ammonium acetate, containing not less than 7 per cent. of the salt, together with small amounts of acetic and carbonic acids.

Preparation.—Ammonium carbonate, 5 Gm.; diluted acetic acid, 100 Cc. Add the ammonium carbonate (which should be in translucent pieces, free from white pulverulent bicarbonate) gradually to the cold diluted acetic acid, and stir until it is dissolved. This preparation should be freshly made when wanted.—U. S.

Each fluidounce of diluted acetic acid, U. S. P., would require about 23 grains (22.84) of official ammonium carbonate in the preparation of Spirit of Mindererus, as directed above.

The solution of the Br. P. is of about the same strength, but prepared in a different manner. 50 Gm. of ammonium carbonate are dissolved in 500 Gm. of distilled water, neutralized with acetic acid, and sufficient distilled water added to make the solution measure 1000 Cc.

The official formula insures a definite amount of ammonium acetate, together with an excess of acetic acid; in following the pharmacopœial directions the dispenser will be sure that no excess of alkali can possibly be present. The 100 Cc. of diluted acetic acid ordered in the above formula contain 6.048+ Gm. of absolute acetic acid, of which 5.728+ Gm. will be required to neutralize the 5 Gm. of official ammonium carbonate (consisting of ammonium acid carbonate and carbamate), as may be seen from the equation $NH_4HCO_3NH_4NH_2CO_2 + 3HC_2H_3O_2 = 3NH_4C_2H_3O_2 + H_2O + 2CO_2$ — 156.01 : 178.74 : : 5 : x, $x = 5.728+$.

Solution of ammonium acetate should never be kept on hand for dispensing purposes, as it absorbs ammonia from the air, and finally acquires an alkaline reaction.

Properties.—It is a "clear colorless liquid, free from empyreuma, of a mildly saline taste and acid reaction. It is wholly volatilized by heat. When heated with potassium hydroxide it evolves vapors of ammonia. If to 5 Cc. of the solution 1 Cc. each of sulphuric acid and alcohol be added, and the mixture boiled, the odor of ethyl acetate will be developed.—U. S.

Action and Uses.—Solution of ammonium acetate is employed as a diuretic and diaphoretic. When given internally, it is of value in the early stages of acute tonsillitis, acute bronchitis, and in the exanthematous diseases where the eruption is delayed. It is also said to be of value in the treatment of epidemic influenza, menstrual disorders, acute alcoholic intoxication, and chronic skin affections. It has been employed as a

lotion in the treatment of bruises, beginning abscesses, glandular enlargements, and impetigo capitis. The internal dose of the U. S. P. preparation is from 4 to 8 fluidrachms (16–30 Cc.). The British preparation may be given in practically the same dose.

LIQUOR AMMONII CITRATIS, *Br.*—Solution of Ammonium Citrate.

Citrate d'ammoniaque liquide, Fr.; *Ammoniumcitratlösung*, G.

Preparation.—Ammonium carbonate, 1¾ ounces or 87.5 Gm.; citric acid, 2½ ounces, or 125 Gm.; distilled water, a sufficient quantity. Dissolve the citric acid in 5 times its weight of distilled water; neutralize with ammonium carbonate, and sufficient distilled water to produce 1 Imperial pint or 1000 Cc.—Br.

This solution contains about 72 grains of ammonium citrate in each fluidounce. It should be preserved in green-glass bottles, to avoid solution of the lead contained in flint glassware.

Action and Uses.—This preparation possesses the same properties and uses as Liquor Ammonii Acetatis. The dose is from 4 to 8 fluidrachms (16–30 Cc.).

LIQUOR ANTISEPTICUS, *U. S.*—Antiseptic Solution.

Liqueur Antiseptique, Fr.; *Antiseptische Lösung*, G.

Preparation.—Boric acid, 20 Gm.; benzoic acid, 1 Gm.; thymol, 1 Gm.; eucalyptol, 0.25 Cc.; oil of peppermint, 0.50 Cc.; oil of gaultheria, 0.25 Cc.; oil of thyme, 0.10 Cc.; alcohol, 250 Cc.; purified talc, 20 Gm.; water, a sufficient quantity to make 1000 Cc. Dissolve the boric acid in 700 Cc. of water, and the benzoic acid in 150 Cc. of alcohol, and pour the aqueous solution into the alcoholic solution. Then dissolve, in a mortar, the thymol in the eucalyptol and oils of peppermint, gaultheria and thyme; thoroughly incorporate the purified talc, and add, with constant trituration, the solution first prepared. Allow the mixture to stand, with occasional agitation, during 48 hours, filter, add 100 Cc. of alcohol to the clear filtrate, and a sufficient quantity of water to make the finished product measure 1000 Cc.—U. S.

To make a pint of the official antiseptic solution, 155 grains of boric acid should be dissolved in 11½ ounces of water, and 7 grains of benzoic acid in 2½ ounces of alcohol, and the two liquids then mixed. After dissolving 7 grains of thymol in a mixture of 8 drops of oil of peppermint, 4 drops each of eucalyptol and oil of gaultheria, and 1 drop of oil of thyme, triturate with 155 grains of purified talc, and add the solution of benzoic and boric acids. Shake occasionally during 48 hours, filter, and add to the clear filtrate first 1½ ounces of alcohol, and then sufficient water to bring the volume up to 1 pint.

Antiseptic solution prepared by the above formula is a colorless liquid, having a pleasant odor, which improves after the solution has stood for some time. When freshly made the odor of oil of peppermint predominates, but is gradually blended with that of the oil of wintergreen and the eucalyptol and thymol.

Action and Uses.—This is a mildly antiseptic solution with an agreeable odor and taste, and may be employed as a substitute of many proprietary preparations possessing a similar formula. Diluted with from 2 to 8 parts of water it is used as a general antiseptic, and is particularly serviceable in inflammations of the mouth, throat, ear, and nose.

It is extensively employed as a dentifrice.

In the treatment of pelvic inflammatory diseases of women, the solution may be applied both as a douche, in the strength of 1 to 2 tablespoonfuls (16–30 Cc.) to the pint (480 Cc.) of hot water, and by means of a tampon saturated with a mixture of 1 part of the solution with 4 parts of glycerin. In the dose of from ½ to 2 drachms (2–8 Cc.), it is administered internally to arrest decomposition of the contents of the stomach and intestines.

LIQUOR ARSENI ET HYDRARGYRI IODIDI, *U. S., Br.*—Solution of Arsenous and Mercuric Iodide.

Solutio Donovani.—Donovan's Solution, E.; *Soluté d'iodo-arsénite de mercure, Liqueur de Donovan*, Fr.; *Jodquecksilber-Arseniklösung, Donovansche Tropfen*, G.

Preparation.—Arsenous iodide, 10 Gm.; red mercuric iodide, 10 Gm.; distilled

water, a sufficient quantity, to make 1000 Cc. Triturate the iodides with 150 Cc. of distilled water until they are dissolved. Filter the liquid, and pass sufficient distilled water through the filter to make the solution measure 1000 Cc.—U. S.

The Br. P. preparation is of exactly the same strength as the preceding.

A fluidounce of Donovan's Solution contains 4.56 grains each of arsenous iodide and red mercuric iodide; the liquid should be kept in a dark place, and should not be dispensed if the color has changed to yellowish-red and the odor of iodine become apparent.

This is a solution of the two iodides in very nearly the proportion of their molecular weights, and containing them mixed, but not chemically combined.

Properties.—It is a clear, colorless, or pale-yellowish liquid, has a metallic taste, and gives precipitates with solutions of silver, alkalies, and salts of the alkaloids.

Action and Uses.—Donovan's Solution is employed as an alterative. It is thought by some to cause the speedy resolution of skin lesions occurring in advanced syphilis, and to afford relief from the night pains resulting from the same disease. It has also been employed in the treatment of many chronic skin affections, such as lupus, lepra, psoriasis, and impetigo. The beginning dose is from 1 to 5 minims (0.05–0.3 Cc.), well diluted with water.

LIQUOR ATROPINÆ SULPHATIS, *Br.*—Solution of Atropine Sulphate.

Soluté de sulfate d'atropine, Fr.; *Schwefelsaure Atropinlösung*, G.

Preparation.—Take of atropine sulphate, 17½ grains; salicylic acid, 2 grains; distilled water, 4 fluidounces. Dissolve the atropine sulphate and salicylic acid in sufficient boiled and cooled distilled water to produce 4 fluidounces of solution.—Br.

110 minims of this solution contain 1 grain of atropine sulphate.

Action and Uses.—The uses of this preparation are fully described under ATROPINE (which see). The internal dose is from 1 to 2 minims (0.05–0.10 Cc.).

LIQUOR BISMUTHI ET AMMONII CITRATIS, *Br.*—Solution of Bismuth and Ammonium Citrate.

Liquor bismuthi.—Solution of bismuth, Liquid bismuth, E.; *Soluté de citrate de bismuth ammoniacal*, Fr.; *Wismuth-Ammoniakcitratlösung*, G.

Preparation.—Bismuth oxynitrate, 613 grains; potassium citrate, 613 grains; potassium carbonate, 175 grains; nitric acid, 1 fluidounce; solution of ammonia and distilled water, of each, a sufficient quantity. Dissolve the bismuth oxynitrate in the nitric acid diluted with an equal volume of distilled water; add distilled water with constant stirring until the liquid is very faintly opalescent; add the potassium citrate and carbonate dissolved in a little distilled water; heat the liquid to the boiling-point; cool; separate the precipitate; wash it with distilled water until free from nitrates. Gradually add solution of ammonia to the moist precipitate until it is just dissolved; dilute with distilled water to 1 pint. Filter.—Br.

This preparation is described as a colorless solution of alkaline reaction, and having a specific gravity of 1.070. It has a slightly metallic taste, is freely soluble in water, and yields a white precipitate upon addition of alkalies. When heated with the latter, ammonia is evolved. Each fluidrachm represents 3 grains of bismuth oxide.

Tests.—Evaporated to dryness and the product ignited, a residue with a yellow edge results, which, when suitably treated, should not yield any reaction characteristic of silver, lead, copper, arsenic, iron, selenium, or tellurium. If 10 Cc. of the solution be mixed with 40 Cc. of water and treated with hydrogen sulphide in excess, a black precipitate is obtained, which, when washed and dried, should weigh at least 0.55 Gm. —Br.

The reactions involved in making the above solution are the formation of normal bismuth nitrate, which is subsequently decomposed by the potassium citrate, forming bismuthous citrate and potassium nitrate, potassium carbonate being added to neutralize the excess of nitric acid present. The insoluble bismuth citrate is finally brought into solution by means of ammonia water. The exact character of the compound in the finished product is an open question, some authorities contending that the ammonia liberates bismuthous hydroxide, which is kept in solution by aid of the newly formed ammonium

citrate, while others assert that a compound having the composition $BiC_6H_5O_7NH_3$ is formed.

Action and Uses.—This solution is employed as an astringent in the treatment of diarrhœa resulting from a relaxed condition of the mucous membrane of the bowel. It should not be used if any irritation is present. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

LIQUOR CALCIS, *U. S., Br.*—Solution of Calcium Hydroxide; Lime Water.

Aqua calcariæ, P. G.; *Aqua calcariæ ustæ, Aqua calcis, Calcaria soluta.—Solution of lime*, E.; *Eau (Liqueur) de chaux*, Fr.; *Kalkwasser*, G.

A saturated aqueous solution of calcium hydroxide ($Ca(OH)_2 = 73.56$), containing not less than 0.14 per cent. of the pure hydroxide.

The percentage of calcium hydroxide varies with the temperature, being somewhat over 0.17 per cent. at 15° C. (59° F.), and diminishing as the temperature rises.

Preparation.—Lime, 12 Gm.; distilled water, a sufficient quantity. Slake the lime by the gradual addition of 70 Cc. of the water, then add 360 Cc. of water, and stir occasionally during half an hour. Allow the mixture to settle, decant the liquid, and throw this away. Now add to the residue 3600 Cc. of distilled water, stir well, wait a short time for the coarser particles to subside, and pour the liquid, holding the undissolved lime in suspension, into a glass-stoppered bottle. Pour off the clear liquid when wanted for use.—U. S.

Wash calcium hydroxide 2 ounces with distilled water until free from chlorides; then shake it with 1 gallon of distilled water contained in a stoppered green-glass bottle for 2 or 3 minutes; set aside for 12 hours. The clear solution may be drawn off with a siphon as it is required for use, or transferred to a green-glass bottle furnished with a well-ground stopper.—Br.

When water is added to burned lime or calcium oxide, this is converted into *calcium hydroxide*, $Ca(OH)_2$, which dissolves in the excess of water. If used for this purpose, the lime should be prepared from marble, when it will be nearly pure; but if made from ordinary limestone, it usually contains alkalies which are readily soluble in water, hence it should be treated with a portion of the water, and this rejected to remove the impurities mentioned. The water should be kept, at a low temperature, upon the lime to retain the solution saturated, and this should be drawn off as needed.

Properties.—Lime water is a clear, colorless, inodorous solution of a slightly alkaline, disagreeable taste, but of a strongly alkaline reaction to test-paper; its specific gravity is 1.0015 at 15° C. (59° F.). When exposed to air, it becomes covered with a pellicle of calcium carbonate; the same compound is formed with loss of the alkaline reaction if carbon dioxide is passed through the solution and the solution heated to expel the excess of the gas (absence of alkalies or alkali carbonates). If lime water is heated to boiling, it becomes turbid from the separation of calcium hydroxide, which dissolves again on cooling. On the addition of test-solution of oxalic acid, lime water yields a white precipitate of calcium oxalate, which is insoluble in acetic, but soluble in hydrochloric, acid.

Tests.—Since at 15° C. (59° F.) lime requires about 780 parts of water for solution, 1 fluidounce (U. S. measure) of lime water contains 0.57 grain of lime or 0.75 grain of calcium hydroxide, which is equal to 0.125 and 0.165 per cent., respectively. At 21° C. (70° F.) 800 parts of water are required for solution, indicating 0.125 per cent. of calcium oxide or 0.166 per cent. of calcium hydroxide. According to Thomas Maben (1883), 1 part of CaO is soluble.

at	10°	20°	30°	40°	60°	80°	99° C.
in	770	791	862	932	1136	1362	1650 parts of water.
equal to	0.129	0.126	0.116	0.107	0.088	0.073	0.06 per cent. CaO.

50 Cc. of lime-water should require, for complete neutralization, not less than 19 Cc. of tenth-normal sulphuric acid (corresponding to about 0.14 per cent. of calcium hydroxide), using phenolphthalein as indicator.—U. S. 24 Cc. should require for neutralization 10 Cc. of tenth-normal solution of sulphuric acid. It should yield no characteristic reaction with the tests for lead or for chlorides.—Br.

Lime-water is a very important article in pharmacy, and should receive careful

attention, as it is chiefly used as an antacid for infants. The supply should be kept in tightly corked bottles, preferably made of green glass, in a cool place, as carbon dioxide is readily absorbed and heat is unfavorable to solution of the lime. Lime water is best decanted from the sediment, or, if filtered, this must be done under cover. It must not be supposed, however, that even the best lime will furnish unlimited quantities of good lime water, and the supply should be tested from time to time, either volumetrically, as directed by the Pharmacopœia, or empirically by breathing into a small quantity of it through a glass tube or boiling a little of it in a test-tube—in either case a turbid liquid should result, due to the separation of calcium carbonate in the first place, or calcium hydroxide in the second.

Action and Uses.—Lime water is an antacid and feeble astringent. It stimulates the flow of the gastric secretion and materially aids in the digestion of milk by preventing too rapid coagulation of the casein. Mixed with an equal quantity of milk and given in small quantities at short intervals, it frequently relieves nausea and vomiting resulting from gastric irritability. It is also useful in the treatment of diarrhœa and diabetes when these conditions are associated with a uric acid diathesis. When given to infants or nursing mothers, it is probably utilized by the organism in the formation of bone.

Externally it is employed as a wash in the treatment of parasitic skin diseases and sluggish ulcerations. Mixed with an equal part of linseed oil, it forms an excellent application for recent burns and scalds. Lime water has also been employed as an injection in the treatment of leucorrhœa and chronic inflammation of the urethra. In the form of a spray it is said to be valuable as a solvent for the false membrane occurring in diphtheria. The dose is from 4 fluidrachms to 4 fluidounces (16–120 Cc.), the smaller amount being preferable for the relief of vomiting.

Allied Preparation.—Liquor Calcis Saccharatus, Br., *Saccharated Solution of Lime.*—Calcium hydroxide, 50 Gm. (or 1 ounce); refined sugar, in powder, 100 Gm. (or 2 ounces); distilled water, 1000 Cc. (or 20 fluidounces). Mix the calcium hydroxide with a solution of the sugar in the distilled water. Set aside in a stoppered green-glass bottle for a few hours, shaking occasionally; separate the clear solution with a syphon, avoiding unnecessary exposure to air.—Br.

It is well known that sugar materially increases the solubility of lime in water, the amount taken up depending upon the temperature and the concentration of the sugar solution. The above preparation contains nearly 2 per cent. of lime (calcium oxide), or about 8 grains in 1 fluidounce. "The specific gravity of saccharated solution of lime is 1.055; 10 Gm. should require for neutralization 6.3 Cc. of volumetric solution of sulphuric acid."—Br.

LIQUOR CALCIS CHLORINATÆ, *Br.*—Solution of Chlorinated Lime.

Chlorure de chaux liquide, Fr.; *Chlorkalklösung*, G.

Preparation.—Take of chlorinated lime, 1 pound; distilled water, 1 gallon. Mix well the water and the chlorinated lime, and, having transferred the mixture to a stoppered bottle, let it be well shaken several times for the space of 3 hours. Pour out now the contents of the bottle on a calico filter, and let the solution which passes through be preserved in a stoppered bottle.—Br.

The solution has the odor, taste, and general properties of chlorinated lime (see page 349). Its specific gravity is about 1.055, and when fresh it should yield about 3 per cent. of available chlorine. The Br. P. requires that the brownish-red solution obtained by adding 1 Cc. of hydrochloric acid to a mixture of 1 Gm. of the solution and 0.5 Gm. of potassium iodide dissolved in water, shall require not less than 5.6 Cc. of decinormal solution of sodium thiosulphate for complete decoloration, which corresponds to 2 per cent. of available chlorine.

Action and Uses.—This solution is employed for the removal of foul odors arising from putrefaction. Applied to the skin it acts as a stimulant, and may be employed as a remedy for chronic cutaneous affections. Internally it is said to be an antidote for hydrocyanic acid. The internal dose is from $\frac{1}{2}$ to 1 fluidrachm (2–4 Cc.), largely diluted with water.

LIQUOR CALUMBÆ CONCENTRATUS, *Br.*—Concentrated Solution of Calumba.

Preparation.—Calumba root, in No. 5 powder, 10 ounces; alcohol (90 per cent.), 4½ fluidounces; distilled water, 20 fluidounces or a sufficient quantity. Macerate the calumba for 24 hours with 10 fluidounces of distilled water; press strongly; again macerate the residue for 24 hours with 10 fluidounces of distilled water; press strongly. Mix the expressed liquids, and heat for 5 minutes to 82.2° C. (180° F.). When cold add the alcohol; set aside; decant or filter, adding sufficient distilled water to produce 1 pint (Imperial measure).—Br.

This is a new preparation in the Br. P., and is in reality a concentrated cold-water infusion, preserved by alcohol, and intended to be used for making infusion of calumba by simple dilution with water. The use of a coarse powder (No. 5, as directed) is necessary to avoid the formation of a thick mucilaginous fluid. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

Action and Uses.—This solution is employed as a bitter tonic. Its uses are mentioned under CALUMBA (which see).

LIQUOR CAOUTCHOUC, *Br.*—Solution of India-rubber.

Preparation.—India-rubber, 1 ounce; benzene and carbon disulphide, of each, 10 fluidounces (Imperial measure). Cut the India-rubber into fine shreds, and place it in a well-stoppered bottle containing the previously mixed benzene and carbon disulphide. Set aside in a cool place, and agitate occasionally until solution is effected.—Br.

This preparation closely resembles the solution of gutta-percha, formerly official in the U. S. P.; the formula is given in the National Formulary, as follows:

LIQUOR GUTTA-PERCHÆ. *Solution of Gutta-percha.*—Gutta-percha, in thin slices, 15 Gm.; commercial chloroform, 100 Cc.; lead carbonate in fine powder, 17 Gm. Add the gutta-percha to 75 Cc. of the chloroform, contained in a bottle, cork it well, and shake it occasionally until the gutta-percha is dissolved. Then add the lead carbonate previously mixed with the remainder of the chloroform, and, having several times shaken the whole together, at intervals of half an hour, set the mixture aside until the insoluble matters have subsided and the solution has become perfectly clear. Lastly decant the liquid and preserve it in small, cork-stoppered vials.—N. F.

The chief use of these solutions is as adhesive agents in the preparation of mustard leaves, although they may also be used in place of collodion as coverings for abraded surfaces. Although the British solution may be more quickly prepared, the disagreeable odor of the carbon disulphide renders it objectionable for many purposes.

Action and Uses.—Solution of gutta-percha is a protective covering to the skin in cases of abrasion or localized superficial inflammation. It is thought by some to be superior to collodion, being non-irritating, more elastic, and less contractile. It may be applied by means of a camel's-hair brush or a glass rod.

LIQUOR CHIRATÆ CONCENTRATUS, *Br.*—Concentrated Solution of Chiretta.

Preparation.—Chiretta, in No. 40 powder, 10 ounces; alcohol (20 per cent.), 25 fluidounces or a sufficient quantity. Moisten the chiretta with 5 fluidounces of the alcohol; pack in a closed percolator; set aside for 3 days; percolate with the remaining alcohol, added in 10 equal portions at intervals of 12 hours; continue percolation with more alcohol until the product measures 1 pint (Imperial measure).—Br.

In the same manner are prepared the following:

LIQUOR CUSPARIÆ CONCENTRATUS, Br.—*Concentrated Solution of Cusparia.*

LIQUOR KRAMERIÆ CONCENTRATUS, Br.—*Concentrated Solution of Krameria.*

LIQUOR SERPENTARIÆ CONCENTRATUS, Br.—*Concentrated Solution of Serpentary.*

These concentrated solutions may be looked upon as weakly alcoholic 50 per cent. tinctures. By some they are considered as concentrated infusions. They are miscible with water and contain sufficient alcohol to preserve them. The dose is from ½ to 1 fluidrachm.

Action and Uses.—The therapeutic value of these preparations is described under the respective drugs from which they are prepared.

LIQUOR CHLORI COMPOSITUS, *U. S.*—Compound Solution of Chlorine.

Soluté de chlore composé, Fr.; *Zusammengesetzte Chlorlösung*, G.

An aqueous solution containing, when freshly prepared, about 0.4 per cent. of chlorine, with some chlorinated products and potassium chloride.—U. S.

Preparation.—Potassium chlorate, granulated, 5 Gm.; hydrochloric acid, 18 Cc.; distilled water, a sufficient quantity to make 1000 Cc. Add the hydrochloric acid, diluted with 20 Cc. of distilled water, to the potassium chlorate contained in a flask of the capacity of about 2000 Cc. Insert in the flask a stopper perforated to admit a funnel of the capacity of about 100 Cc., containing about 10 Gm. of purified cotton, well wetted with cold water; place the flask in a water-bath containing boiling water for a period of from 2 to 3 minutes; when the flask is completely filled with a greenish-yellow gas, remove it from the bath and add cold distilled water through the cotton in the funnel, in four separate portions of 250 Cc. each. After the addition of each separate portion of cold distilled water, stopper the flask securely and thoroughly agitate the contents. This solution should be freshly made when wanted.—U. S.

Although the Pharmacopœia includes the name Chlorine Water among the official titles of this preparation, the latter by no means corresponds to the chlorine water of the 1890 Pharmacopœia, and should not be used when chlorine water is intended as a chemical reagent, since it contains other compounds in solution which might interfere with the reaction desired. Compound solution of chlorine is intended for internal administration of chlorine, and the official formula makes the extemporaneous preparation of the solution an easy task. When moderately dilute hydrochloric acid is allowed to act upon potassium chlorate as directed above, a greenish-yellow gas is formed, which has been called *euchlorine*, and is a mixture of chlorine and chlorine dioxide. The reaction occurring may be shown by the following equation: $2KClO_3 + 4HCl = 2KCl + 2H_2O + 2ClO_2 + Cl_2$. Care is necessary in adding the distilled water, in divided portions, to guard against the loss of chlorine gas when inserting the stopper prior to agitating the flask. The finished solution is a liquid of almost golden-yellow color and a strong chlorine odor. It retains its color for some time, but is best preserved in small bottles, well-stoppered and paraffined.

Physicians will be satisfied to use the above solution in place of chlorine water, as the accompanying impurities are not injurious; but whenever pure chlorine water is desired, the solution mentioned under AQUA CHLORATA (page 215) should be used.

Action and Uses.—As mentioned above, this preparation affords a convenient and efficient substitute for aqua chlorata, to be used as a disinfecting gargle in the putrid sore throat of scarlet fever, diphtheria, smallpox, etc. For this purpose it should be diluted with from 2 to 4 parts of water.

Although better disinfectants are at our disposal, this solution is of value as a local application to suppurating wounds, sloughing ulcers, and gangrene. Its internal administration in typhoid and typhus fever and other diseases is attended with little or no beneficial result; however, in the dose of from ½ to 1 drachm (2–4 Cc.), well diluted, it may correct decomposition in the alimentary canal and correct the fetor of the evacuations.

LIQUOR CRESOLIS COMPOSITUS, *U. S.*—Compound Solution of Cresol.

Liquor cresoli saponatus, P. G.—*Soluté de crésol composé*, Fr.; *Kresolseifenlösung*, G.

Preparation.—Cresol, 500 Gm.; linseed oil, 350 Gm.; potassium hydroxide, 80 Gm.; water, a sufficient quantity to make 1000 Gm. Dissolve the potassium hydroxide in 50 Gm. of water in a tared dish, add the linseed oil, and mix thoroughly. Then add the cresol, and stir until a clear solution is produced, and, finally, sufficient water to make the finished product weigh 1000 Gm.—U. S.

If avoirdupois weight is preferred, 1.6 ounces of potassium hydroxide may be dissolved in 1 ounce of water, 7 ounces of linseed oil added, and finally 10 ounces of

cresol; the weight of the finished product is to be brought up to 20 ounces by addition of water.

The process of solution will be materially expedited if the potassium hydroxide solution be warmed on a bath of hot water during the addition of the linseed oil, in order to effect perfect saponification, and then adding the cresol in divided portions while continuing the heat and stirring constantly.

The directions of the P. G. are almost identical with the above, except that crude cresol is to be used and mixed with an equal weight of soft linseed-oil-potash soap on a water-bath.

Properties.—Compound cresol solution is a clear brownish-yellow liquid, of oil-like consistence, and slippery to the touch. It is apt to become darker with age, and froths considerably when mixed with water and shaken. It has a decided cresol odor, and an alkaline reaction. Prepared with crude cresol, it is of darker, almost brown, color, and has been marketed under such names as *lysol, phenolin, sapocresol,* etc.

Action and Uses.—Compound solution of cresol corresponds in composition to several proprietary preparations which are largely employed as disinfectants and antiseptics in surgical and obstetric practice and household sanitation. Solutions varying in strength of from 1 to 5 per cent. are used as vaginal and intrauterine douches following labor and in acute and chronic inflammations of the pelvic organs; as urethral and vesical irrigations in urethritis and cystitis, as callyrid in gonorrhœal ophthalmia, as general antiseptic applications to wounds, abscesses, ulcers, etc., and to sterilize surgical instruments, the hands of the operator, and the field of operation.

In operations upon the vagina it possesses the advantage over bichloride of mercury solutions in that it renders the parts soft and pliable instead of harsh and rough.

LIQUOR EPISPASTICUS, *Br.*—Blistering Liquid.

Liqueur vésicant, Fr.; *Blasenziehende Flüssigkeit,* G.

Preparation.—Take of cantharides, in powder, 10 ounces; acetic ether, a sufficient quantity. Mix the cantharides with 5 fluidounces of acetic ether; pack in a percolator, and at the expiration of 24 hours pour acetic ether over the contents of the percolator; allow the solution to pass slowly through until 1 pint (Imperial measure) is obtained. —Br.

This preparation is of double the strength of the last (1885) Blistering Liquid. It is chiefly used for making Blistering Collodion. At one time it was known in Great Britain as *Liniment of Cantharides.*

Action and Uses.—Because of the acetic acid present, this solution produces vesication more rapidly than the other preparations of cantharides. It should be thoroughly rubbed into the skin with a brush or mop, and should be applied only over a limited area.

LIQUOR ETHYL NITRITIS, *Br.*—Solution of Ethyl Nitrite.

Solutê de nitrite d'éthyle, Fr.; *Aethylnitritlösung,* G.

Preparation.—Ethyl nitrite made by interaction of 90 per cent. alcohol, sodium nitrite, and diluted sulphuric acid, at a low temperature, is added to a mixture of 95 volumes of absolute alcohol and 5 volumes of glycerin, in the proportion of 3 parts by weight to 97 parts by weight of the glycerin-alcohol mixture.—Br.

Properties and Tests.—Solution of ethyl nitrite is a limpid liquid, practically colorless, of characteristic apple-like odor and taste. It is highly inflammable. Specific gravity 0.823 to 0.826. When solution of ethyl nitrite is poured on an acidulated strong solution of ferrous sulphate contained in a test-tube, a deep olive-brown coloration is produced at the surface of contact of the two liquids, widening as the tube is gently shaken. The solution should not effervesce when shaken carefully with sodium bicarbonate (absence of acid). 10 Cc. of the solution mixed with 5 Cc. of volumetric solution of sodium hydroxide and 5 Cc. of water should not assume a yellow color (absence of aldehyde). 1 volume of solution, agitated briskly at intervals during 5 minutes in a brine-charged nitrometer with 1 volume of solution of potassium iodide and 1 volume of diluted sulphuric acid, should yield, at the ordinary temperature, 15.5° C. (60° F.), and pressure, and when freshly prepared, at least 7.6 volumes of nitric oxide gas; and even after the solution of ethyl nitrite has been kept for some time, and the vessel con-

taining it has occasionally been opened, it should possess at least five-sixths of the strength just indicated.—Br.

Solution of ethyl nitrite was introduced into the last edition of the British Pharmacopœia evidently for the purpose of providing a more stable preparation than the well-known spirit of nitrous ether, from which latter it differs but slightly in strength. It is well known that the presence of water predisposes ethyl nitrite to decomposition, and hence the spirit of that name has often been found unsatisfactory. By dissolving freshly made ethyl nitrite in absolute alcohol the tendency to deteriorate is very materially lessened. Owing to its low boiling-point, solution of ethyl nitrite should be preserved in small vials in a cool place.

Action and Uses.—This solution may be employed for the same conditions and in the same doses as SPIRITUS ÆTHERIS NITROSI (which see).

LIQUOR FERRI ACETATIS, *Br.*—Solution of Ferric Acetate.

Acétate ferrique liquide, Fr.; *Ferriacetatlösung*, G.

Preparation.—Solution of ferric sulphate, 2½ fluidounces; solution of ammonia, 4 fluidounces; glacial acetic acid, liquefied, 1½ fluidounces; distilled water, a sufficient quantity. Mix the solution of ammonia with 1 pint (Imperial measure) of distilled water; gradually add to this the solution of ferric sulphate diluted with 1 pint (Imperial measure) of distilled water; stir well together, taking care that ammonia is, even finally, in slight excess, as indicated by the odor of the mixture; let the whole stand for 2 hours, stirring occasionally; transfer to a calico filter; wash the precipitated ferric hydroxide with distilled water until free from sulphates; let drain; squeeze it to remove superfluous moisture; dissolve it in the glacial acetic acid; make the volume up to 1 pint (Imperial measure) with distilled water; allow any insoluble matter to subside; pour off the clear solution.—Br.

Properties.—Solution of ferric acetate, made as above, is a red liquid, having the specific gravity 1.031, and is miscible in all proportions with water and 90 per cent. alcohol. It has an acetous odor and a sour, styptic taste. The Br. P. demands the absence of lead, copper, arsenic, zinc, calcium, sodium, ammonium, potassium, ferrous salts, and nitrates, and permits only very slight reactions with the tests for sulphates.

Solution of ferric acetate has been dropped from the U. S. and German pharmacopœias. The former (1890) gave the following directions for preparing a solution of about 1.160 specific gravity, which is very much stronger than the above, containing about 33 per cent. of anhydrous ferric acetate, $Fe_2(C_2H_3O_2)_6$, and representing about 7.5 per cent. of metallic iron. Solution of ferric sulphate, 1000 Gm.; glacial acetic acid, 260 Gm.; ammonia water, 850 Cc.; water, distilled water, each a sufficient quantity to make 1000 Gm. Mix the ammonia water with 3000 Cc. of cold water, and the solution of ferric sulphate with 10,000 Cc. of cold water. Add the latter solution slowly to the diluted ammonia water, stirring constantly. Let the mixture stand until the precipitate has subsided as far as practicable, and then decant the supernatant liquid. Add to the precipitate 6000 Cc. of boiling water, mix well, and set the mixture aside, as before. Repeat the washing with successive portions of boiling water, in the same manner, until the washings are no longer affected by sodium cobaltic nitrite test-solution (showing the removal of ammonia and its salts). Transfer the mixture to a wet muslin strainer, allow the precipitate to drain completely, and press it, folded in the strainer, until its weight is reduced to 700 Gm. or less. Now add the precipitate gradually to the glacial acetic acid contained in a jar provided with a glass stopper, stirring the mixture after each addition until each portion added is nearly dissolved before adding another portion. Finally, add sufficient distilled water to make the product weigh 1000 Gm.; mix thoroughly; allow it to become clear by subsidence, and decant the clear solution. Keep the product in well-stoppered bottles, in a cool place, protected from light.

To make 1 pint of this solution 14 fluidounces of solution of ferric sulphate should be diluted with 10 pints of water, and then poured slowly into a mixture of 15¼ fluidounces of ammonia water and 4 pints of water. The well-washed and drained precipitate, free from ammonium salts, should be dissolved in 4 fluidounces of glacial acetic acid, as directed above, and finally sufficient distilled water added to bring the volume of finished product up to 16 fluidounces.

Action and Uses.—This solution combines the properties of a chalybeate and astringent. It may be employed for the same purposes as the other astringent preparations of iron, but for internal use is probably of less value than the tincture of ferric acetate. The dose is from 5 to 10 minims (0.3–0.6 Cc.).

LIQUOR FERRI CHLORIDI, *U. S.*—Solution of Ferric Chloride.

Liquor ferri perchloridi fortis, Br.; *Liquor ferri sesquichlorati*, P. G.; *Liquor ferri muriatici oxydati.—Solution of chloride of iron, Strong solution of ferric chloride*, E.; *Solution de perchlorure de fer, Chlorure ferrique liquide*, Fr.; *Eisenchloridlösung, Flüssiges Eisenchlorid*, G.

The specific gravities of the official solutions of ferric chloride are—1.315 U. S., 1.42 Br., 1.280 to 1.282 P. G., and they contain not less than 29 per cent. U. S. (with some free hydrochloric acid), about 46 per cent. Br., 29.02 per cent. P. G., of anhydrous ferric chloride, representing, respectively, 10, 15.84, and 10 per cent. of metallic iron.

Preparation.—Iron, in the form of fine wire and cut into small pieces, 125 Gm.; hydrochloric acid, 680 Gm.; nitric acid, distilled water, each a sufficient quantity to make 1000 Gm. Put the iron wire into a flask capable of holding double the volume of the intended product. Pour upon it 420 Gm. of hydrochloric acid previously diluted with 250 Cc. of distilled water, and heat upon a water-bath for not less than 1 hour and 15 minutes or until effervescence ceases; then boil the liquid, filter it through paper, and, having rinsed the flask and iron wire with a little boiling distilled water, pass the washings through the filter. To the filtered liquid add 220 Gm. of hydrochloric acid, and pour the mixture, slowly and gradually, in a stream, into 65 Gm. of nitric acid contained in a capacious porcelain vessel, and warm gently. After effervescence ceases apply heat, by means of a sand-bath, until the liquid is free from nitric acid. If the solution has acquired a black color, continue the addition of nitric acid, drop by drop, until red fumes are no longer evolved, and the solution assumes a clear reddish-brown color. Finally, add the remaining 40 Gm. of hydrochloric acid, and sufficient distilled water to make the whole weigh 1000 Gm.—U. S.

To prepare 1 pint of solution of ferric chloride would require 1550 grains of iron wire, 105 fluidrachms of hydrochloric acid (divided into three portions of 64, 34, and 7 fluidrachms, respectively), and $6\frac{1}{2}$ fluidrachms of nitric acid. The first portion of hydrochloric acid should be diluted with 6 fluidounces of distilled water.

Liquor Ferri Perchloridi Fortis, Br.—Mix iron wire, 4 ounces; hydrochloric acid, $12\frac{1}{2}$ fluidounces; and water, 7 fluidounces; when effervescence ceases, heat to boiling, filter, rinse the flask and contents with a little water, and pour this over the filter; add to the filtrate hydrochloric acid, 7 fluidounces; then pour the solution in a slow continuous stream into $1\frac{1}{2}$ fluidounces of nitric acid, the evolution of red fumes being promoted, if necessary, by a slight application of heat. Evaporate the product until no more nitrous fumes escape and a precipitate begins to form; then add hydrochloric acid 1 fluidounce and sufficient water to produce $17\frac{1}{2}$ fluidounces of the solution.—Br.

Liquor Ferri Perchloridi, Br.—Mix strong solution of ferric chloride 1 fluidounce with distilled water sufficient for 4 fluidounces. Its specific gravity is 1.11.

The reactions which take place in the preparation of solution of ferric chloride result first in the formation of ferrous chloride, and subsequently in the conversion of this salt into ferric chloride with escape of nitric oxide, as shown by the following equations: $Fe + 2HCl = FeCl_2 + H_2$; $6FeCl_2 + 2HNO_3 + 6HCl = 6FeCl_3 + 2NO + 4H_2O$. The U. S. P. solution contains about 1.6 per cent. of uncombined HCl.

Properties.—Solution of ferric chloride is a reddish-brown liquid, which has a faint odor of hydrochloric acid, an acid reaction, and a strongly styptic taste. It may be mixed with water and alcohol in all proportions without producing a precipitate. Diluted with water, it gives a brown precipitate with ammonia or potassium hydroxide, a white one with silver nitrate (chloride), and a dark-blue precipitate of Prussian Blue with potassium ferrocyanide. It is not altered by exposure to the sunlight, except in the presence of various organic matters, by which the salt is partly reduced to ferrous chloride; and it remains clear when heated to boiling unless ferric oxychloride be present, when it becomes turbid, a slight turbidity being best observed in reflected light. On being evaporated

to dryness a reddish-brown salt is left, which at a red heat is partly decomposed and partly volatilized.

Tests.—The same reactions which are used for determining the purity of the salt (see FERRI CHLORIDUM, page 620) are likewise employed for this solution. On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the solution (1 in 10), the crystal should not become colored brown, nor should a brownish-black color develop around it (absence of nitric acid). A freshly prepared solution of potassium ferricyanide should color the solution olive-brown, but not blue (ferrous salt). If the iron be completely precipitated from a portion of the solution by an excess of ammonia water, the filtrate should be colorless, and should not yield a precipitate with hydrogen sulphide test-solution (absence of zinc or copper); nor should it leave a fixed residue on evaporation and gentle ignition (absence of salts of the fixed alkalies). If to 3 drops of solution of ferric chloride 10 Cc. of tenth-normal sodium thiosulphate test-solution be added, and then slowly heated to boiling, no brown precipitate of ferric hydroxide should separate (absence of oxychloride). If 10 Gm. of the solution be diluted to measure 100 Cc., and 11.1 Cc. be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 10 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), then cooled and mixed with a few drops of starch test-solution, it should require not less than 20 Cc. of tenth-normal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution consumed corresponding to 0.5 per cent. of metallic iron).—U. S. 5 Cc. of the solution, diluted with 80 Cc. of water, and mixed with an excess of ammonia water, should yield a reddish-brown precipitate which, when washed and incinerated, weighs 1.6 Gm.—Br.

Action and Uses.—Because of its astringent properties this solution is employed as a hæmostatic agent. It causes immediate coagulation of the blood when injected into veins or applied to an open wound. For this reason it has been employed as an injection for the cure of varices, hemorrhoids, and aneurisms. It has been injected into fatty tumors with the object of effecting their removal, but the procedure is attended with danger. Diluted with water and locally applied, it is sometimes useful in reducing the size of nasal polypi and erectile tumors. When sufficiently diluted (1 : 32), it may be employed in the treatment of post-partum hemorrhage. Internally it is usually employed in the form of TINCTURA FERRI CHLORIDI (which see). The dose of the solution is from 2 to 10 minims (0.10–0.6 Cc.), largely diluted and taken through a glass tube.

Allied Preparations.—FERRUM DIALYSATUM. *Liquor ferri dialysatus; Liquor ferri oxychlorati*, P. G.; *Dialyzed iron, Solution of oxychloride of iron*, E.; *Fer dialysé*, Fr.; *Eisenoxychloridlösung, Flüssiges Eisenoxychlorid*, G.

Dialyzed iron is made by saturating an aqueous solution of ferric chloride with ferric hydroxide, putting the liquid into a dialyzer, and suspending this in water which is often renewed—as long, indeed, as it acquires an acid reaction. Very little iron will pass through the parchment septum; when dialysis is completed, the ferric solution is diluted, so that 100 grains of it, when evaporated and dried at a temperature not exceeding 100° C. (212° F.), will leave a solid residue weighing 5 grains.

Similar solutions were obtained by Ordway (1858) and Béchamp (1859) by leaving pure ferric hydroxide in contact with ferric chloride for a prolonged time. Th. Graham (1861) subjected this to dialysis, and succeeded in removing the acid until chlorine corresponding to 1.5 per cent. of HCl was left. Such a solution, however, which would correspond to $Fe_2Cl_6.95Fe_2O_3$, gelatinized ultimately.

E. Scheffer (1878) showed that by precipitation with ammonia very basic oxychlorides of iron may be obtained, which, after having been thoroughly washed, will slowly dissolve in distilled water. The limits at which a soluble precipitate is obtained appear to have been reached on mixing 150 volumes of the official solution of ferric chloride with 91.5 volumes of ammonia water. The washed precipitate contained 97.83 per cent. Fe_2O_3 to 2.17 per cent. Fe_2Cl_6, and required over 7 weeks for effecting solution in distilled water.

The German Pharmacopœia does not direct dialysis, but has adopted the following process: Dilute solution of ferric chloride (specific gravity 1.281) 35 parts with water 160 parts, and pour the mixture slowly into ammonia water 35 parts, previously diluted with water 320 parts; wash the precipitate, express, and add hydrochloric acid (specific gravity 1.124) 3 parts; agitate occasionally for 3 days, then warm gently until solution has been effected, and dilute with water until the liquid has the specific gravity 1.050.

Owing to the retention of ammonia by ferric hydroxide, solutions of the latter in acid

or ferric chloride must vary somewhat in character, and therefore are properly subjected to dialysis for separating ammonium chloride and increasing the basic character of the ferric oxychloride.

Liquid oxychloride or dialyzed iron is perfectly transparent in thin layers of a deep brown-red color, inodorous, and almost destitute of styptic taste. It is miscible with alcohol, glycerin, syrup, and distilled water, but not with spring water or other, even dilute, saline solutions. A small quantity of tannin merely darkens the liquid; a larger quantity causes a deep-brown gelatinous precipitate. A minute quantity of silver nitrate will not disturb the liquid; a larger quantity will cause a gelatinous brown precipitate, which is again soluble in distilled water; but on adding first a slight excess of ammonia, filtering from the ferric hydroxide, acidulating with nitric acid, and then testing with silver nitrate, a white precipitate of silver chloride is formed. If to 1 Cc. of the liquid, diluted with 19 Cc. of distilled water, 1 drop each of nitric acid and 5 per cent. silver nitrate solution be added, the mixture should be clear in transmitted light.—P. G. This test indicates the thorough washing of the ferric hydroxide and the absence of ammonium chloride from the solution; a few drops more of either the acid or test-solution will cause a turbidity or precipitate. Prepared by the P. G. process, it has the specific gravity 1.050, and contains nearly 3.5 per cent. of iron or about 7 per cent. of oxychloride, having approximately the composition $Fe_2Cl_6.8Fe_2(OH)_6$. A solution which, when evaporated on a water-bath until the residue is pulverulent and weighs 5 per cent., has, according to E. B. Shuttleworth (1877), the specific gravity 1.034. If 5 per cent. of residue is left after completely drying on a water-bath, the specific gravity is 1.040, and if the same amount of residue is left after ignition, the specific gravity of the solution is 1.046.

Liquor Ferri Albuminati, P. G. *Solution of iron albuminate*, E.; *Eisenalbuminatlösung*, G.—This is prepared as follows: 35 parts of dry egg-albumen are dissolved in 1000 parts of water, the solution strained and poured slowly and in a thin stream, under constant stirring, into a mixture of 120 parts of oxychloride of iron solution and 1000 parts of water; the precipitate is well washed with water until all chlorine is removed, and then dissolved in a mixture of 3 parts of 15 per cent. sodium hydroxide solution and 50 parts of water. To the solution are added 150 parts of alcohol, 100 parts of cinnamon water, 2 parts of aromatic tincture, and sufficient water to make the finished product weigh 1000 parts. It contains about 0.4 per cent. of metallic iron and mixes clear with alcohol. (See Ferri Albuminas.)

Liquor Ferri Peptonati. *Solution of iron peptonate*, E.; *Eisenpeptonatessenz*, G.—The supplement of the 1890 P. G. directs the preparation as follows: Dry peptone, 8 Gm., are dissolved in 100 Gm. of hot water, and to the solution, when cold, are added 174 Gm. of solution of oxychloride of iron (specific gravity 1.050), gradually and with constant stirring. The fluid is exactly neutralized by means of dilute sodium hydroxide solution and the resulting precipitate washed by decantation with distilled water until the washings are no longer affected by silver nitrate solution. The precipitate is drained on a muslin strainer, mixed with 200 Gm. of simple syrup, warmed, and dissolved by the careful addition of dilute (1.5 per cent.) sodium hydroxide solution. To this solution are finally added alcohol, 100 Gm.; tincture of orange peel, 3 Gm.; aromatic tincture and tincture of vanilla, of each 1.5 Gm.; acetic ether, 5 drops, and sufficient distilled water to make the total product weigh 1000 Gm. It is a clear reddish-brown liquid, containing about 0.6 per cent. of metallic iron, and should be protected against light. (See Ferri Peptonas.)

These so-called *indifferent iron preparations* are very sensitive to carbon dioxide and sodium chloride, and hence they must be prepared as rapidly as possible and with distilled water previously boiled and cooled again.

LIQUOR FERRI ET AMMONII ACETATIS, *U. S.*—Solution of Iron and Ammonium Acetate.

Mistura ferri et ammonii acetatis, U. S. P., 1880.—*Basham's Mixture.*

Preparation.—Tincture of ferric chloride, 40 Cc.; diluted acetic acid, 60 Cc.; solution of ammonium acetate, 500 Cc.; aromatic elixir, 120 Cc.; glycerin, 120 Cc.; water, a sufficient quantity to make 1000 Cc. To the solution of ammonium acetate (which should not be alkaline) add, successively, the diluted acetic acid, the tincture of ferric chloride, the aromatic elixir, and the glycerin, and lastly, sufficient water to make the product measure 1000 Cc. This preparation should be freshly made when wanted. —U. S.

To prepare 1 pint of Basham's Mixture would require 308 minims of tincture of ferric chloride, 460 minims of diluted acetic acid, 8 fluidounces of solution of ammonium acetate, 2 fluidounces of aromatic elixir, 2 fluidounces of glycerin, and sufficient water to bring the volume up to 16 fluidounces.

Basham's Mixture, as prepared by the present official formula, is about twice as strong as that of the 1890 Pharmacopœia.

This preparation was at one time the cause of much annoyance to the pharmacist on account of its instability. As now made, it keeps perfectly; although the Pharmacopœia directs that it shall be freshly made when wanted, this is scarcely necessary; we have found it to remain unchanged for a period of 75 days, exposed to diffused light at summer temperature. The use of glycerin in place of simple syrup was first suggested by H. R. LeValley (*Drugg. Circ.*, 1887).

Ferric chloride and ammonium acetate mutually decompose each other, forming ferric acetatic and ammonium chloride, some of the ammonium acetate remaining unchanged. The deep-red color of the liquid is due to the newly formed ferric acetate.

Action and Uses.—This astringent chalybeate is largely employed in the treatment of chronic nephritis. It produces diuresis, decreases albuminuria, and is considered the best preparation of iron to employ for combating the anæmia of Bright's disease. The dose is from 2 to 8 fluidrachms (8–30 Cc.).

LIQUOR FERRI PERNITRATIS, *Br.*—Solution of Ferric Nitrate.

Solution of nitrate of iron, E.; *Azotate de fer liquide*, Fr.; *Eisennitratlösung, Ferrinitratlösung*, G.

Preparation.—Iron, 1 ounce; nitric acid, 4½ fluidounces; distilled water, a sufficient quantity. Dilute the nitric acid with 16 ounces of the distilled water; introduce the iron; set aside until the metal is dissolved, taking care to moderate the action, should it become too violent, by the addition of a little more distilled water; filter the liquid; add sufficient distilled water to produce 30 fluidounces (Imperial measure).—Br.

Properties.—Solution of ferric nitrate is a clear, reddish-brown liquid, of 1.107 specific gravity, and having a distinctly acid and astringent taste. It remains unaltered on exposure to light and air except in the presence of organic compounds, by many of which it is deoxidized. It affords the reactions characteristic of ferric salts and of nitrates.

Tests.—Potassium ferricyanide, silver nitrate, and barium nitrate should not disturb the solution, proving the absence of ferrous salt, chloride, and sulphate. If precipitated with an excess of ammonia, the filtrate evaporated to dryness, and the salt heated to redness, no residue should be left (showing the absence of other metals). The Br. P. requires that 5 Cc. treated with an excess of solution of ammonia shall give a precipitate which, when washed, dried, and incinerated, weighs 0.23 Gm. Such a residue would correspond to the presence of about 12.6 per cent. of anhydrous ferric nitrate, representing 2.98 per cent. of metallic iron.

The U. S. P. no longer recognizes this preparation. That of 1890 directed it to be made by dissolving the well-washed and drained ferric hydroxide, obtained from 180 Gm. of solution of ferric sulphate by means of diluted ammonia water, in nitric acid 71 Gm., and finally adding sufficient distilled water to make the finished product weigh 1000 Gm. This solution was weaker than the above, having a specific gravity of 1.050 and containing only 6.2 per cent. of anhydrous ferric nitrate.

Following the directions of the Br. P., ferric nitrate is formed with the evolution of red vapors, according to the equation $Fe_2 + 8HNO_3 = 4Fe_2(NO_3)_6 + 2NO + 4H_2O$. Considerable heat is produced, and the reaction must be closely watched, and moderated if necessary by the addition of cold water. If the acid is somewhat in excess in the finished product, the color will be much lighter, and a colorless solution may even result. Ferric nitrate has been obtained in deliquescent colorless crystals containing 12 or 18 molecules of water, and yielding colored solutions.

Action and Uses.—This solution is more astringent than the vegetable salts of iron, and less so than those prepared with sulphuric or hydrochloric acid. It may be employed in the treatment of chronic diarrhœa, dysentery, mucous diarrhœa, and in leucorrhœa and menorrhagia occurring in feeble and anæmic individuals. In the latter conditions it is employed internally and also in the form of an injection containing from 10 to 30 minims (0.6–2.0 Cc.) to 1 ounce (30 Cc.) of water. The internal dose is from 5 to 10 minims (0.3–0.6 Cc.), well diluted.

LIQUOR FERRI SUBSULPHATIS, *U. S.*—Solution of Ferric Subsulphate.

Solution of basic ferric sulphate, Solution of persulphate of iron, Monsel's Solution, E.; *Liqueur hémostatique de Monsel,* Fr.; *Basisch-schwefelsaure Eisenoxydlösung, Monselsche Eisenlösung,* G.

An aqueous solution of basic ferric sulphate (of variable chemical composition), representing not less than 13.57 per cent. of metallic iron.

Preparation.—Ferrous sulphate, in clear crystals, 675 Gm.; sulphuric acid, 65 Gm.; nitric acid, distilled water, each a sufficient quantity to make 1000 Gm. Add the sulphuric acid to 500 Cc. of water in a capacious porcelain dish, heat the mixture to nearly 100° C. (212° F.), and then add 70 Gm. of nitric acid, and mix well. Divide the coarsely powdered ferrous sulphate into four equal portions, and add one of these portions, at a time, to the hot liquid, stirring after each addition, until effervescence ceases. When all the ferrous sulphate has been dissolved, add a few drops of nitric acid, and if this causes a further evolution of red fumes, continue to add nitric acid, a few drops at a time, until it no longer causes red fumes to be evolved; then boil the solution until it assumes a ruby-red color and is free from nitrous odor. Lastly, add sufficient distilled water to make the product weigh 1000 Gm. Keep the product in well-stoppered bottles, in a moderately warm place (not under 22° C. or 71.6° F.), protected from the light.—U. S.

Note.—Solution of subsulphate of iron is to be dispensed when solution of persulphate of iron is prescribed by the physician.

To prepare 1 pint of Monsel's Solution would require 1 pound and 650 grains of ferrous sulphate, 736 grains each of sulphuric and nitric acids, and a sufficient quantity of distilled water, 12 fluidounces being used to dilute the acids in the first instance.

This process is a slight modification of that proposed by Dr. Squibb (1860). On introducing the ferrous sulphate in small portions into the heated acids, a black color is produced from the union of nitric oxide with ferrous sulphate, which disappears with the copious evolution of red nitrous vapors as fast as the sulphate dissolves in the hot liquid. The mixture foams most toward the end of the process, and after the liquid has again subsided, a little of it should be tested with nitric acid to insure its complete oxidation. The amount of sulphuric acid used is insufficient for forming the normal ferric sulphate. A basic or oxysulphate is the result, which has the composition $Fe_4O(SO_4)_5 + Aq$, or $5Fe(SO_4)_3.Fe(OH)$. The mineral *copiapite* is a crystallized hydrate of the same combination. Other more basic ferric sulphates are known, some being soluble, others insoluble, in water.

Properties.—Monsel's Solution is a deep red-brown liquid, being nearly of a syrupy consistence, and of specific gravity 1.548 at 25° C. (77° F.). It is almost inodorous, has a very astringent but not caustic taste, and an acid reaction, and mixes with water and alcohol in all proportions without decomposition. On dropping sulphuric acid into it the color becomes lighter, and with a larger quantity (½ volume) of the acid a separation of whitish anhydrous ferric sulphate takes place (difference from solution of tersulphate). Diluted with distilled water, it yields a red-brown precipitate with ammonia or potassa, a dark-blue one with potassium ferrocyanide, and a white one insoluble in nitric or hydrochloric acid with barium chloride. When evaporated at a moderate heat upon a glass or porcelain plate, it yields transparent, deliquescent scales, and at a somewhat higher temperature is converted into a yellowish powder which is less deliquescent.

Tests.—The solution, diluted with 20 parts of water, should be colored a pure brown with freshly prepared solution of potassium ferricyanide, and it should not at once turn green or greenish blue (absence of ferrous salt). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the solution, the crystal should not become brown, nor should there be a brownish-black zone developed around it (absence of nitric acid). If 10 Gm. of the solution be diluted to measure 100 Cc., and 11.1 Cc. of this liquid be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 10 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), and then cooled, and mixed with a few drops of starch test-solution, it should require not less than 27.2 Cc. of tenth-normal sodium thiosulphate solution to discharge the blue or

greenish color of the liquid (each Cc. of the volumetric solution consumed corresponding to 0.5 per cent. of metallic iron).—U. S.

Action and Uses.—Monsel's Solution is a very powerful styptic, and because of its deficiency in sulphuric acid, is less irritating than ferric sulphate. This renders it useful in the control of hemorrhage from incised wounds, the nasal cavities, etc., in which it is desirable to produce as little irritation as possible. Diluted with water, it has been used in the form of a spray in the treatment of epistaxis and hæmoptysis. It may be locally applied to bleeding cavities after the extraction of teeth, and when given internally is said to control hemorrhage from the stomach. The internal dose is from 5 to 10 minims (0.3–0.6 Cc.), largely diluted with water. When used in the atomizer, the solution should contain 10 minims (0.6 Cc.) to 1 ounce (30 Cc.) of water.

LIQUOR FERRI TERSULPHATIS, *U. S.*—Solution of Ferric Sulphate.

Liquor ferri persulphatis, Br.; *Solution of normal ferric sulphate*, E.; *Persulfate de fer liquide*, Fr.; *Ferrisulfatlösung, Schwefelsaure Eisenoxydlösung*, G.

An aqueous solution of normal ferric sulphate, $Fe_2(SO_4)_3$, containing about 36 per cent. of the salt, and representing not less than 10 per cent. of metallic iron.

Preparation.—Ferrous sulphate, in clear crystals, 500 Gm.; sulphuric acid, 96 Gm.; nitric acid, distilled water, each a sufficient quantity to make 1000 Gm. Add the sulphuric acid to 250 Cc. of water in a capacious porcelain dish, heat the mixture to nearly 100° Cc. (212° F.), then add 56 Gm. of nitric acid, and mix well. Divide the coarsely powdered ferrous sulphate into four equal portions, and add these portions, one at a time, to the hot liquid, stirring after each addition until effervescence ceases. When all the ferrous sulphate has been dissolved, if the solution has acquired a black color, add nitric acid, a few drops at a time, heating and stirring until it no longer causes red fumes to be evolved, and the solution assumes a clear reddish-brown color; then boil the liquid until it is free from nitric acid. Lastly, add sufficient distilled water to make the product weigh 1000 Gm. Filter if necessary.—U. S.

To prepare 1 pint of solution of ferric sulphate would require 11 avoirdupois ounces of ferrous sulphate, 940 grains of sulphuric acid, 540 grains of nitric acid, and a sufficient quantity of distilled water, of which 4½ fluidounces should be used for dilution of the acids.

Take of ferrous sulphate, 8 ounces; sulphuric acid, nitric acid, of each, 6 fluidrachms; distilled water, a sufficient quantity. Add the sulphuric acid to 10 ounces of the water, and dissolve the ferrous sulphate in the mixture with the aid of heat. Mix the nitric acid with 2 ounces of the water, and add to this acid, warmed, the solution of ferrous sulphate. Concentrate the whole by boiling until, by the sudden disengagement of ruddy vapors, the liquid ceases to be black and acquires a red color. If any ferrous salt remains in the solution, add a few drops of nitric acid, and boil again. When the solution is cold, make the quantity 11 fluidounces (Imperial measure) by the addition, if necessary, of distilled water.—Br.

The reaction which takes place in these processes is precisely the same as in making the subsulphate of iron, the only difference being that the sulphuric acid is used in sufficient quantity to form normal ferric sulphate, $Fe_2(SO_4)_3$. The reaction is explained by the equation $6FeSO_4 + 3H_2SO_4 + 2HNO_3 = 3Fe_2(SO_4)_3 + N_2O_2 + 4H_2O$. From 100 parts of ferrous sulphate, 200 parts, U. S. (198.14 parts, Br.) of the solution are prepared.

Properties.—Solution of normal ferric sulphate is a dark, reddish-brown liquid, having no odor, a very astringent and at the same time acid taste, and an acid reaction. It is miscible in all proportions with alcohol and water without causing decomposition. Its behavior to ammonia, potassium ferrocyanide, and barium chloride is the same as that of the subsulphate, but for the precipitation of the anhydrous salt about 3 volumes (instead of ½ volume) of sulphuric acid are required. On slowly mixing 2 volumes of the solution with 1 volume of concentrated sulphuric acid, in a beaker, no solid white mass will separate on standing (difference from subsulphate). The pharmacopœial solution contains 36 per cent. U. S., 36.3 per cent. Br., of anhydrous ferric sulphate, and has the specific gravity 1.432 at 25° C. (77° F.) U. S., 1.441 at 15.5° C. (60° F.) Br. Hager gives the following densities for solutions containing the anhydrous salt—

25	26	27	28	28.5	29	29.5	30	31	32 per cent.
1.271	1.284	1.297	1.310	1.316	1.323	1.330	1.337	1.351	1.365

Tests.—The absence of ferrous salt, chloride, nitric acid, and foreign salts is determined in precisely the same manner as for the subsulphate (which see). If 1.11 (1.1176) Gm. of the solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), then allowed to cool, and mixed with a few drops of starch test-solution, it should require not less than 20 Cc. of tenth-normal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution consumed corresponding to 0.5 per cent. of metallic iron).—U. S. 5 Cc. of the solution diluted with 80 Cc. of water and mixed with an excess of ammonia water should yield a precipitate which, when washed and ignited, weighs 1.04 Gm.—Br.

Action and Uses.—This preparation may be substituted for Liquor Ferri Subsulphatis. It should be remembered, however, that the latter is less irritating and more astringent. The principal employment of the tersulphate is in the preparation of the arsenic antidote.

LIQUOR FORMALDEHYDI, *U. S.*—Solution of Formaldehyde.

Formaldehydum solutum, P. G.—*Formol, Formalin*, E., G.; *Soluté d'aldéhyde formique*, Fr.; *Formaldehydlösung*, G.

An aqueous solution containing not less than 37 per cent., by weight, of absolute formaldehyde (CH_2O or HCHO = 29.79), a product of the partial oxidation of methyl alcohol. It should be kept in well-stoppered bottles, in a cool place, protected from light.—U. S.

Preparation.—Formaldehyde solution is prepared by passing heated vapors of methyl alcohol mixed with air over heated copper spirals, or coke, or by passing methane (marsh gas) over a heated mixture of copper, pumice, and asbestos fibres, and then passing the products of the resulting oxidation into water and removing undecomposed methyl alcohol by subsequent distillation. The solution thus obtained is finally adjusted to the proper strength either by dilution or by concentration.

Properties.—The official solution is a clear, colorless liquid, having a specific gravity of 1.075–1.078 at 25° C. (77° F.), a pungent odor, a caustic taste, and an irritating action upon mucous surfaces. It is miscible with water and alcohol in all proportions, but is not miscible with ether. On standing, the solution sometimes becomes milky in appearance, due to the separation of paraformaldehyde. The aqueous solution shows a neutral reaction with litmus, but owing to slow oxidation of the formaldehyde by the air, resulting in the formation of formic acid, its reaction is frequently slightly acid. If 1 volume of the solution be mixed with 5 volumes of distilled water and then treated with an ammoniacal solution of silver nitrate, a gray precipitate of metallic silver, in finely divided form, will be produced, which often adheres as a metallic mirror to the sides of the test-tube. Formaldehyde solution added to an alkaline cupric tartrate solution and then heated, causes the separation of red cuprous oxide, the liquid becoming colorless. If the aqueous solution of formaldehyde be evaporated over sulphuric acid, or in a vacuum, white solid paraformaldehyde is rapidly formed, which is insoluble in water, and which sublimes at about 100° C. (212° F.) and melts at 153°–172° C. (307.4°–341.6° F.), and is resolved into ordinary gaseous formaldehyde. The same result is obtained if the solution be evaporated to dryness on a water-bath; but if the solution, previous to evaporation, be made alkaline by addition of ammonia water, a white crystalline residue is obtained, known as hexamethylenetetramine, which is readily soluble in water.

Tests.—If 5 Cc. of sulphuric acid (specific gravity 1.34) be placed in a test-tube and a little salicylic acid be dissolved in it, and 2 drops of formaldehyde solution be added and the liquid be very gently warmed, a permanent deep-red color should immediately appear. If 20 Cc. of the solution be evaporated to dryness on a water-bath, a white amorphous mass should remain, which upon ignition should not leave a residue (absence of mineral matter). If 20 Cc. of formaldehyde solution, to which a couple of drops of phenolphthalein test-solution have been added, be titrated with normal potassium hydroxide solution, not more than 0.5 Cc. of the normal solution should be required for neutralization (absence of more than 0.1 per cent. of formic and other acids). If 20 Cc. of the solution be diluted with 60 Cc. of distilled water and the liquid be divided

into approximately four equal portions, no turbidity or precipitate should be produced on the addition to one portion of silver nitrate test-solution (absence of chloride); barium chloride test-solution to the second portion (absence of sulphate); hydrogen sulphide or potassium ferrocyanide test-solution to the third portion (absence of metals); ammonium oxalate test-solution to the fourth portion (absence of calcium).—U. S. If 100 Cc. of formaldehyde solution be treated with 100 Cc. of ammonia water, and allowed to stand at least 6 hours and then distilled until 25 Cc. of distillate have been collected, and to the distillate thus obtained, a quantity of salicylic acid about the size of a pea, and sulphuric acid equal to about one-third the volume of the distillate be added, and the whole heated for a few minutes, no odor of oil of wintergreen should be observed in the cooled liquid (absence of methyl alcohol). If 10 Cc. of the solution be mixed with 10 Cc. of iodine test-solution, and potassium hydroxide test-solution be added drop by drop until the yellow color of the liquid disappears, no milky turbidity should be produced, nor should the odor of iodoform be developed (absence of acetone).

Assay of Formaldehyde Solution.—The U. S. P. prescribes the following method for determining the percentage of formaldehyde present: Transfer 3 Cc. of solution of formaldehyde to a well-stoppered Erlenmeyer flask, and weigh accurately. Add 50 Cc. of normal solution of sodium hydroxide, and follow this immediately, but slowly, through a small funnel, with 50 Cc. of solution of hydrogen hydroxide, to which a drop of litmus test-solution has been added, and which has been neutralized with normal sodium hydroxide solution. After the reaction has ceased and the foaming has subsided, rinse the funnel and sides of the vessel with distilled water, and, after allowing it to stand 10 minutes, titrate back with normal sulphuric acid, using litmus test-solution as indicator. Subtract the number of cubic centimeters of normal sulphuric acid used from 50 (the number of Cc. of normal sodium hydroxide solution employed), multiply the remainder by 2.979, and divide the product by the weight of the solution taken; the quotient represents the percentage of absolute formaldehyde in the liquid.

This method of estimating formaldehyde quantitatively was suggested by Blank and Finkenbeiner in 1898, and involves the oxidation of formaldehyde to formic acid at the expense of the hydrogen dioxide added, the acid being neutralized by the alkali hydroxide and hydrogen being eliminated according to the following reaction: $2H.CHO + H_2O_2 + 2NaOH = 2H.COONa + 2H_2O + H_2$. Since 59.58 Gm. of formaldehyde will yield by oxidation sufficient formic acid to neutralize 79.52 Gm. of sodium hydroxide, as shown by the equation above, each cubic centimetre of normal sodium hydroxide solution neutralized by the newly formed formic acid, in the official test, corresponds to 0.02979 Gm. of formaldehyde.

Action and Uses.—This preparation is employed in medicine for its powerful antiseptic properties. By heat it may be converted into a gas, which latter is employed for the purpose of disinfecting rooms previously exposed to contagion. One pint of the solution when converted into vapor is considered sufficient to disinfect a room containing 500 cubic feet. It has been largely, but unlawfully, used for preserving milk and other foods which are prone to deteriorate. When largely diluted, it may be employed intravenously for the purpose of combating septicæmia. Diluted with from 3 to 10 parts of water, it is said to retard the growth of uterine cancer, but its employment is quite painful and not wholly unattended with danger.

Formaldehydum. *Formic aldehyde, Methyl aldehyde*, E.; *Formaldehyd, Ameisenaldehyd*, G. HCHO or CH_2O.—This compound, which was discovered by A. W. Hofmann in 1868, is at ordinary temperature a colorless gas possessing a strong, pungent, irritating odor. It is condensable to a colorless liquid which boils at —21° C. (5.8° F.), and which if kept at —20° C. (—4° F.) readily changes to the solid insoluble polymeric form. Aqueous solutions of formaldehyde containing 50 per cent. of the gas are obtainable, but polymerize readily, and hence commercial solutions are made of 35 or 40 per cent. strength. Formaldehyde is a strong reducing agent, readily reducing silver, gold, and copper from aqueous alkaline solutions. It gives the reactions common to aldehydes and forms many condensation-products. It enters into direct combination with albumin, casein, gelatin, agar-agar, starch, dextrin, acids, and alkali hydroxides, and enters into quantitative reaction with ammonia, forming hexamethylenetetramine, according to the equation $6CH_2O + 4NH_3 = (CH_2)_6N_4 + 6H_2O$. Heated with dilute sodium hydroxide solution, formaldehyde is converted into formic acid. Dilute solutions of formaldehyde shaken with calcium hydroxide produce formose, which is convertible into isoformose on continued boiling of the solution in the presence of tin.

Formaldehyde is a powerful disinfectant, antiseptic, and preservative. Commercially it is extensively used for these purposes, and lately has been found useful in the tanning of hides and skins. Besides the properties of formaldehyde already mentioned above under

Liquor Formaldehydi, the following reactions are available for its recognition in very dilute solutions: To the solution add a few drops of a weak solution of phenylhydrazine hydrochloride and a few drops of a fresh solution of sodium nitroprusside, then a few drops of concentrated solution of sodium hydroxide, when in the presence of formaldehyde a blue color will be developed (Rimini). About 0.05 Gm. of resorcin is added to the suspected solution and the latter then mixed with an equal volume of 50 per cent. sodium hydroxide solution and the mixture heated to boiling, when a permanent red color develops in the presence of formaldehyde (Lebbin). Hehner's test for formaldehyde in milk is a very delicate reaction: Dilute the milk with an equal volume of water and superimpose it upon 94 per cent. sulphuric acid containing a trace of ferric chloride. A violet-blue coloration will appear at the point of contact of the two liquids.

Derivatives of Formaldehyde.—Amyloform.—A white, odorless, innocuous, non-irritant powder, insoluble in water, not decomposed by heat under 180° C. (356° F.), but decomposed by acids and alkalies with liberation of formaldehyde. It is prepared by making a dilute mixture of starch in water, and then adding a strong solution of formaldehyde. After allowing the mixture to stand for some time it is heated to boiling, then evaporated to dryness, and the residue pulverized. Recommended as a substitute for iodoform.

Glutoform.—*Glutol, Formaldehyde-gelatin, Collaform.*—A white insoluble powder prepared by the action of formaldehyde upon a solution of gelatin. Various methods are employed. Schroeder directs 50 parts of gelatin to be dissolved in 50 parts of boiling water, and when the solution is complete, to add 2 Cc. of formaldehyde, to stir thoroughly the agglutinated mass, transfer it to a cold dish, and to pour over it a solution of formaldehyde. After allowing it to react for some hours the solid residue is dried and pulverized. Recommended as a germicidal dusting-powder.

Geoform.—*Kreoform.*—A condensation-product from the action of formaldehyde upon guaiacol. A colorless, tasteless, non-irritant powder, insoluble in water, soluble in alcohol and ether, and in aqueous alkali hydroxide solutions, from which last it is reprecipitated by acids. Recommended as a germicidal dusting powder.

Paraform.—*Paraformaldehyde, Triformol, Trioxymethylene.* $(CH_2O)_3$.—A white, amorphous to crystalline powder, insoluble in cold water, soluble in boiling water and in solutions of fixed alkali hydroxides. With calcium hydroxide it yields formic acid and a fermentable sugar, formose. It combines with the haloid acids. It is slowly sublimable at 100° C. (212° F.), but does not melt below 152° C. (305.6° F.). The sublimed paraform melts at 172° C. (341.6° F.) (Tollens). At higher temperatures it is decomposed into formaldehyde. Employed in surgery for its antiseptic properties.

Thymoform. $[C_6H_3(CH_3).C_3H_7O]_2.CH_2$.—A yellowish, almost tasteless powder, of a slight thymol odor, insoluble in water, glycerin, and petroleum ether. Soluble in alcohol, ether, chloroform, carbon disulphide, and fixed oils. Iodothymoform is prepared by iodizing thymoform. It is a yellow powder melting at 150° C. (302° F.), insoluble in water and glycerin, but soluble in alcohol, ether, chloroform, and fixed oils.

Protogen.—*Ovoprotogen.*—A yellow powder, used as a food-product, and obtained by the action of formaldehyde upon white of egg.

LIQUOR HYDRARGYRI NITRATIS, *U. S.*—Solution of Mercuric Nitrate.

Liquor hydrargyri nitratis acidus, Br.; *Liquor hydrargyri nitrici oxydati.—Acid solution of nitrate of mercury, Solution of pernitrate of mercury*, E.; *Azotate (Nitrate) mercurique liquide, Nitrate acide (Pernitrate) de mercure*, Fr.; *Mercurinitratlösung, Quecksilberoxydnitratlösung*, G.

A liquid containing about 60 per cent. of mercuric nitrate, $Hg(NO_3)_2$, together with about 11 per cent. of free nitric acid.—U. S.

Preparation.—Red mercuric oxide, 40 Gm.; nitric acid, 45 Gm.; distilled water, 15 Gm.; to make 100 Gm. Mix the nitric acid with the distilled water, and dissolve the red mercuric oxide in the mixture. Keep the solution in glass-stoppered bottles.—U. S.

The foregoing formula will yield a little over 1½ fluidounces (1.61 +) of solution.

Take of mercury, 4 ounces; nitric acid, 5 fluidounces; distilled water, 1½ fluidounces. Mix the nitric acid with water in a flask, and dissolve the mercury in the mixture without the application of heat. Boil gently for 15 minutes, cool, and preserve the solution, which should weigh about 3 times the quantity of the mercury employed, in a stoppered bottle not exposed to the light.—Br.

Mercury, 100 parts; nitric acid, 150 parts; water, 50 parts. Dissolve and evaporate to 225 parts.—Fr. Cod.

The mercury is dissolved in the last two processes by the action of nitric acid, with elimination of red nitrous vapors, to form mercuric nitrate; $3Hg_2 + 16HNO_3$ yields $6Hg(NO_3)_2 + 4NO + 8H_2O$. It is necessary to apply some heat, particularly at the close of the reaction, to convert into mercuric any mercurous salt which may be present. The United States process yields the same solution more rapidly, and involves simply a combination of the mercuric oxide with nitric acid, water being liberated; $HgO + 2HNO_3$ yields $Hg(NO_3)_2 + H_2O$. The three solutions do not differ materially from one another, representing respectively 35 (Br.), 40 (U. S.), 43 (Fr.) per cent. of mercuric oxide.

Properties.—The solution is colorless, and has a slight odor of nitric acid, a strong acid reaction, and a caustic and metallic taste. Its specific gravity is about 2.086 at 25° C. (77° F.) U. S. P., about 2.0, Br. A crystal of ferrous sulphate dropped into it soon becomes surrounded with a dark-colored liquid (nitrate). Dropped upon copper, a deposit of mercury is at once produced, and the diluted solution gives a yellow precipitate with sodium or potassium hydroxide solution and a scarlet-red precipitate with potassium iodide; this latter precipitate is soluble in an excess of the precipitant. Nearly one-fourth of the nitric acid is uncombined, and prevents the separation of a basic salt on dilution with water. Evaporated by heat on a glass or porcelain dish, a white salt is left, which on the further application of heat is decomposed, assuming a yellow, red, and brown color, and is finally completely volatilized. The solution, mixed with alcohol and heated, produces *fulminating mercury*, which is very explosive.

Tests.—The characters given are sufficient to determine the quality of the preparation. On the addition of water no precipitation should occur (free nitric acid). Diluted hydrochloric acid should occasion no precipitate, potassa solution a yellow (not black), and potassium iodide a scarlet-red (not yellow or green) precipitate (absence of mercurous salt).

Action and Uses.—This solution is employed locally only when a powerfully caustic action is desired. It destroys the parts with which it comes in contact, and produces a zone of inflammation around the cauterized area. It may be applied to chancres, cancers, lupus, small boils, acne, and erosions of the uterine cervix. If accidentally taken in overdose, it produces burning pain in the mouth, œsophagus, and gastro-intestinal tract, with nausea, vomiting, purging, and collapse followed by death. Poisoning by this solution should be treated by the administration of mild alkalies, demulcent drinks, opium, and stimulants as needed.

Allied Preparations. MILLON'S TEST SOLUTION.—Dissolve with a gentle heat mercury in an equal weight of strong nitric acid, dilute the solution with twice its bulk of water, and decant from the precipitate; the liquid must contain some free nitric and nitrous acid. A solution of nearly the same mercury strength, but containing no nitrous acid, is obtained by diluting the pharmacopœial (U. S.) solution of mercuric nitrate with an equal bulk of water. Millon's reagent is used as a reagent for proteids, the mixture, as well as the precipitate, acquiring a red color on boiling.

HYDRARGYRI PROTONITRAS. *Nitras (azotas) hydrargyrosus*, Fr. Cod.—*Mercurous nitrate*, E.; *Azotate mercureux*, Fr.; *Mercuronitrat, Salpetersaures Quecksilberoxydul*, G.—Mercury, 4 parts; nitric acid, 3 parts; water, 1 part. After 24 hours collect the crystals, wash them with a little diluted nitric acid, and dry.—Fr. Cod. The salt forms colorless monoclinic plates or prisms having the composition $Hg_2(NO_3)_2 2H_2O$, molecular weight 559.4; it melts at 70° C. (158° F.), is completely soluble in a little warm water, but is by more water decomposed into a soluble acid and an insoluble basic salt; the solution imparts to the skin a purplish-red color, turning black.

LIQUOR HYDRARGYRI NITRICI OXYDULATI, S. HYDRARGYRUM OXYDULATUM SOLUTUM, S. LIQUOR BELLOSTII.—*Solution of mercurous nitrate*, E.; *Liqueur de Belloste*, Fr.; *Mercuronitratlösung*, G.—Dissolve without heat mercurous nitrate 100 parts in nitric acid 15 parts and water 885 parts. On exposure to the air oxidation to mercuric nitrate takes place.

LIQUOR HYDRARGYRI PERCHLORIDI, *Br.*—Solution of Mercuric Chloride.

Liquor hydrargyri bichloridi.—Solution of corrosive sublimate, E.; *Soluté de bichlorure de mercure*, Fr.; *Sublimatlösung*, G.

Preparation.—Take of mercuric chloride, 10 grains; distilled water, 1 pint (Imperial measure). Dissolve.—Br.

This is a colorless solution having the metallic taste of the salt from which it is made. It contains ½ grain of corrosive sublimate to the (Imperial) fluidounce.

Liqueur de Van Swieten, Fr. Cod., Van Swieten's Solution, is a solution of 1 part of corrosive sublimate in 100 parts of alcohol and 900 parts of water.

Action and Uses.—This solution may be taken in doses of from ½ to 2 fluidrachms (2–8 Cc.).

LIQUOR IODI COMPOSITUS, *U. S.*—Compound Solution of Iodine.

Lugol's Solution, E.; *Soluté iodurê de Lugol*, Fr.; *Lugolsche Jodlösung*, G.

An aqueous solution, which should contain not less than 5 per cent. of iodine and 10 per cent. of potassium iodide.—U. S.

Preparation.—Iodine, 5 Gm.; potassium iodide, 10 Gm.; distilled water, 85 Gm.; to make 1000 Gm. Dissolve the iodine and potassium iodide in the distilled water. Keep the solution in well-stoppered bottles.—U. S.

To prepare 4 fluidounces of Lugol's Solution 108 grains of iodine and 216 grains of potassium iodide should be dissolved in 4 ounces of distilled water.

Solutions of potassium iodide dissolve iodine in different proportions, weak solutions taking up 1 atom of I for each molecule of KI, or 76.5 parts for 100 parts of the salt. The dissolved portion therefore has the composition KI_3.

Properties.—The solution is of a dark brown-red color, having the caustic taste of iodine and imparting to starch-paste a dark-blue color. When boiled, iodine is given off, but the whole of it does not volatilize until the liquid is evaporated to dryness and the residuary mass heated nearly to redness. When agitated with chloroform, ether, or carbon disulphide, the solution is decolorized. If 3 Gm. of the solution be diluted with about 20 Cc. of distilled water and boiled until colorless, and then allowed to cool, after adding 2 drops of potassium chromate test-solution, not less than 18 Cc. nor more than 18.4 Cc. of decinormal silver nitrate solution should be required to produce a permanent red color of silver chromate. If 6.3 Gm. of the solution be mixed with a few drops of starch test-solution, it should require for complete decoloration not less than 24.75 Cc. of tenth-normal sodium thiosulphate solution.

Action and Uses.—The medical properties of this solution depend principally upon the free Iodine (which see) which it contains. It may be employed in the treatment of constitutional syphilis, and is thought to be very servicable in those cases which fail to respond to potassium iodide. The ordinary dose is 5 minims (0.3 Cc.), corresponding to ¼ grain (0.015 Gm.) of iodine.

Allied Preparations.—Liquor Iodi Fortis, Br.—*Strong solution of iodine.*—This solution, which is almost identical with the liniment of iodine of the 1885 Br. P., is made by dissolving iodine, 1¼ ounces, and potassium iodide, ¾ ounce, in 1¼ fluidounces of distilled water, adding 90 per cent. alcohol 9 fluidounces, and shaking the mixture.

Liquor Iodi Causticus, N. F.—*Caustic solution of iodine; Churchill's iodine caustic.*—Iodine, 480 grains; potassium iodide, 960 grains; distilled water, 4 fluidounces.

Causticum Iodi.—*Lugol's Caustic.*—Iodine and potassium iodide, of each, 1 part; water, 2 parts. By substituting glycerin for the water, *Hebra's iodine caustic* is obtained.

LIQUOR MAGNESII CARBONATIS, *Br.*—Solution of Magnesium Carbonate.

Aqua magnesio-effervescens.—Fluid magnesia, E.; *Eau magnésienne, Magnésie liquide*, Fr.; *Magnesiawasser, Kohlensaure Magnesialösung*, G.

Preparation.—Take of magnesium sulphate, 2 ounces; sodium carbonate, 2½ ounces; distilled water, a sufficiency. Dissolve the two salts separately, each in ½ pint of water. Heat the solution of magnesium sulphate to the boiling-point, then add to it the solution of sodium carbonate, and boil them together until carbon dioxide ceases to be evolved. Collect the precipitated magnesium carbonate on a calico filter, and wash it with distilled water until the filtrate is free from sulphate. Mix the washed precipitate with a pint of distilled water, and, putting them into a suitable apparatus, pass into it pure washed carbon dioxide. Let the mixture remain in contact with excess of carbon dioxide, retained there under a pressure of about 3 atmospheres, for 24 hours or

longer; decant the solution, into which again pass carbon dioxide. Finally, keep the solution in bottles securely closed to prevent the escape of carbon dioxide. The solution contains about 10 grains of magnesium carbonate in a fluidounce.—Br.

The first part of the above process embraces the preparation of magnesium oxycarbonate, $4(MgCO_3).Mg(OH)_2$, which is the official Magnesii Carbonas. By the subsequent operation this is dissolved in water by the aid of carbon dioxide in excess, whereby magnesium carbonate, $MgCO_3$, and bicarbonate, MgH_2CO_3, are formed.

Properties and Tests.—It is a colorless solution, which should effervesce on opening the vessel, carbon dioxide escaping, and has a slightly acidulous taste, free from bitterness. When the solution is exposed to cold, prismatic crystals of magnesium carbonate, $MgCO_3.5H_2O$, appear, which on exposure to the air lose water and become $MgCO_3.3H_2O$. It should yield no characteristic reaction for sulphates. 20 Cc. evaporated to dryness afford a white residue of pure hydrous magnesium carbonate, which after being calcined weighs between 0.16 and 0.19 Gm. This residue is insoluble in water, and when dissolved in dilute acid responds to the tests for magnesium. —Br.

Action and Uses.—This slightly effervescent solution is employed as an antacid and laxative. Its taste is disagreeable, and it has no advantages over extemporaneous mixtures containing magnesia. The dose is from 1 to 2 fluidounces (30–60 Cc.).

LIQUOR MAGNESII CITRATIS, *U. S.*—Solution of Magnesium Citrate.

Liquor magnesii citrici.—Limonade au citrate de magnésie, Limonade purgative citro-magnésienne, Fr.; *Magnesiumcitratlösung, Magnesiumlimonade,* G.

Preparation.—Magnesium carbonate, 15 Gm.; citric acid, 33 Gm.; syrup of citric acid, 60 Cc.; potassium bicarbonate, in crystals, 2.5 Gm.; water, a sufficient quantity. Dissolve the citric acid in 120 Cc. of water, and, having added the magnesium carbonate, stir until it is dissolved. Filter the solution into a strong bottle of the capacity of 360 Cc., containing the syrup of citric acid. Then add sufficient water to nearly fill the bottle, drop in the potassium bicarbonate, and immediately close the bottle with a cork, which must be secured with twine. Lastly, shake the mixture occasionally until the potassium bicarbonate is dissolved.—U. S.

Effervescent solution of magnesium citrate has been the source of frequent annoyance to the pharmacist. The present official directions are an improvement on those of 1890 in ordering an increased quantity of citric acid, which will produce a solution less liable to deposit if kept on hand for some time, although of decidedly more acid taste. When magnesium carbonate and citric acid are brought together in the presence of water, carbon dioxide is generated and magnesium citrate is formed; the exact composition of the latter salt depends upon the amount of base or acid present. Normal magnesium citrate of the composition $Mg_3(C_6H_5O_7)_2$ is but slightly soluble in water, and crystallizes from its solutions with 14 molecules of water; it is formed whenever 10 molecules of citric acid are allowed to react with 3 molecules of official magnesium carbonate, as follows: $3[4(MgCO_3).Mg(OH)_2.5H_2O] + 10H_3C_6H_5O_7.H_2O = 5Mg_3(C_6H_5O_7)_2 + 12CO_2 + 43H_2O$. The acid magnesium citrate, $MgHC_6H_5O_7$, is very soluble in water, and is the compound aimed at by the formula of both pharmacopœias; it is produced by the following reaction: $4(MgCO_3).Mg(OH)_2.5H_2O + 5H_3C_6H_5O_7.H_2O = 5MgHC_6H_5O_7 + 4CO_2 + 16H_2O$, which shows that each molecule of official magnesium carbonate requires 5 molecules of citric acid. The 15 Gm. of magnesium carbonate ordered in the official formula require 21.61+ Gm. of citric acid to form the normal, or 32.43 Gm. to form the acid salt; the Pharmacopœia orders 33 Gm. of acid, of which only 31.85 Gm. are available for the magnesium salt, as the quantity of official syrup of citric acid ordered does not contain sufficient acid to decompose the 2.5 Gm. of potassium bicarbonate subsequently added. The official solution must contain, therefore, a mixture of acid and normal salts, the former largely predominating. If a solution of acid magnesium citrate only is desired which will not deposit in the course of time, the quantity of citric acid in the official formula must be increased to 33.58 (32.43 + 1.15) Gm., which includes the necessary amount of acid to supply the deficiency in the syrup stated above; this, however, produces a very acid liquid, and may be objected to by many persons on that account. A solution of normal magnesium citrate is admirably adapted for extemporaneous prepara-

tion, but it does not keep well for any length of time; the following formula, in which the quantity of magnesium carbonate directed by the Pharmacopœia has been retained, but the amount of citric acid has been reduced to five-sixths, will be found to yield a very satisfactory solution for use within 24 hours, and contains just sufficient excess of citric acid (2.24 Gm.) to make the taste agreeably acidulous: Mix 25 Gm. of citric acid in powder with 15 Gm. of magnesium carbonate, and add 180 Cc. of water; stir well until dissolved, and filter the solution into a strong bottle of 360 Cc. capacity containing 60 Cc. of syrup of citric acid. Add sufficient water to nearly fill the bottle, and drop in 2.5 Gm. of potassium bicarbonate in crystals; the bottle should be immediately closed with a perfect soft cork, which is to be secured with wire or twine. Finally, shake the bottle until all crystals are dissolved.

The Pharmacopœia orders plain water to be used, but if the solution is to be kept on hand, distilled, or, better yet, recently boiled and filtered, water will be found preferable, so as to avoid the formation of fungi. The potassium bicarbonate added is converted into neutral potassium citrate, the carbon dioxide which is eliminated remaining in solution. Magnesium carbonate is preferable to the oxide, as it is less apt to vary in composition; but if the latter is chosen, 6.23 Gm. of magnesium oxide may be used in place of 15 Gm. of the official carbonate.

To prepare the solution, 10 times (or any other convenient multiple) of the quantities of citric acid and magnesium carbonate are weighed out and mixed with the corresponding quantity of water; after the magnesia is dissolved, the liquid is passed through a paper filter, divided equally among the requisite number of bottles, each containing the necessary quantity of syrup; sufficient water is then added to each bottle, after which the potassium bicarbonate in crystals is dropped in. The corks are then inserted and securely fastened by twine, and the bottles laid upon their sides in a cool place. Prepared in this way, the crystals gradually dissolve in the syrup, and this slowly mixes with the lighter saline solution; if it be wanted for immediate use, by slight agitation the syrup and bicarbonate are dissolved in the aqueous fluid.

The solution is colorless, free from sediment, and of a pleasant acidulous taste, free from bitterness.

Action and Uses.—Solution of magnesium citrate is largely employed as a mild refrigerant cathartic. As a laxative it may be given in doses of from 4 to 6 fluidounces (120–180 Cc.). In order to obtain its full purgative effect an entire bottle (12 fluidounces—360 Cc.) should be administered either at once or in divided doses.

Allied Preparations.—LIQUOR MAGNESII ACETATIS.—*Solution of magnesium acetate*, E.; *Soluté d'acétate de magnésie*, Fr.; *Magnesiumacetatlösung*, G.—Renaud proposed a solution made by dissolving 40 parts of magnesium carbonate in sufficient acetic acid (137 parts), filtering, and evaporating to 100 parts. It is a colorless, syrupy liquid, having a bitterish taste less pleasant than the citrate, and containing nearly 60 per cent. of the dry acetate, $Mg(C_2H_3O_2)_2$ (molecular weight, 142.02). The dry salt is white, gum-like, very deliquescent, and freely soluble in water and alcohol.

ELIXIR MAGNESII ACETATIS.—Solution of magnesium acetate, 66 parts; alcohol, 14 parts; syrup of orange peel (or of lemon peel), 70 parts. This contains 25 per cent. of the dry salt, but less alcohol than directed by Garot's formula.

LIQUOR MORPHINÆ ACETATIS, *Br.*—Solution of Morphine Acetate.

Soluté d'acétate de morphine, Fr.; *Essigsaure Morphinlösung*, G.

Preparation.—Take of morphine acetate, 17½ grains; diluted acetic acid, 38 minims; alcohol (90 per cent.), 1 fluidounce; distilled water, a sufficient quantity. Mix the alcohol with an equal volume of distilled water, adding the diluted acetic acid; dissolve the morphine acetate in the mixture; dilute with sufficient distilled water to produce 4 fluidounces of solution.—Br.

The addition of diluted acetic acid is for the purpose of preventing dissociation of the morphine acetate; the alcohol likewise is intended to preserve the solution. 110 minims of the solution contain 1 grain of the morphine salt.

Uses.—See MORPHINA. Dose, from 15 to 30 minims (1–2 Cc.).

LIQUOR MORPHINÆ HYDROCHLORIDI, *Br.*—Solution of Morphine Hydrochloride.

Soluté de hydrochlorate de morphine, Fr.; *Salzsaure Morphinlösung*, G.

Preparation.—Take of morphine hydrochloride, 17½ grains; diluted hydrochloric acid, 38 minims; alcohol (90 per cent.), 1 fluidounce; distilled water, a sufficient quantity. Mix the alcohol with an equal volume of distilled water, adding the diluted hydrochloric acid; dissolve the morphine hydrochloride in the mixture; dilute with sufficient distilled water to produce 4 fluidounces of solution.—Br.

Although the presence of alcohol is essential for the prolonged preservation of the solution, the addition of diluted hydrochloric acid seems unnecessary. 110 minims of the solution contain 1 grain of morphine hydrochloride.

Uses.—See MORPHINA. Dose, from 15 to 30 minims (1–2 Cc.).

LIQUOR MORPHINÆ TARTRATIS, *Br.*—Solution of Morphine Tartrate.

Soluté de tartrate de morphine, F.; *Weinsteinsaure Morphinlösung*, G.

Preparation.—Take of morphine tartrate, 17½ grains; alcohol (90 per cent.), 1 fluidounce; distilled water, a sufficient quantity. Mix the alcohol with an equal volume of distilled water; dissolve the morphine tartrate in the mixture; add sufficient distilled water to produce 4 fluidounces.—Br.

This is a new preparation, morphine tartrate having been introduced on account of its greater solubility and stability. 110 minims of the solution contain 10 grains of the salt.

Action and Uses.—See MORPHINA. Dose, 15 to 30 minims (1–2 Cc.).

LIQUOR PANCREATIS, *Br.*—Pancreatic Solution.

Liquor Pancreaticus.—Soluté de pankreatine, Fr.; *Pankreatinlösung, Pankreasessenz*, G.

A liquid preparation containing the digestive principles of the fresh pancreas of the pig.

Preparation.—Pancreas, freed from fat and external membrane, and finely divided by trituration with washed sand or powdered pumice-stone, 5 ounces; alcohol (20 per cent.), 20 fluidounces. The pancreas should be added to the alcohol and digested in a closed vessel for 7 days, and then filtered. The preparation is most active when the animal from which it is obtained has been fed shortly before being killed.—Br.

Properties and Tests.—Pancreatic solution is a pale-yellowish liquid, 1 volume of which should completely peptonize 40 volumes of milk, as shown by the following test given in the Br. P.: If 2 Cc. of the solution, together with 0.2 Gm. of sodium bicarbonate and 20 Cc. of water, be added to 80 Cc. of milk, and the mixture be kept at a temperature of 45° C. (113° F.) for 1 hour, coagulation should no longer occur on the addition of nitric acid.

The *Liquor Pancreaticus* of the National Formulary differs from the preceding, being made as follows: pancreatin (U. S. P.), 17.5 Gm.; sodium bicarbonate, 50 Gm.; glycerin, 250 Cc.; compound spirit of cardamom, 35 Cc.; alcohol, 35 Cc.; purified talcum, 15 Gm.; water, a sufficient quantity to make 1000 Cc. Triturate the pancreatin and the sodium bicarbonate gradually with 650 Cc. of water; add the alcohol, compound spirit of cardamom, and purified talcum; mix them thoroughly by shaking, and pour the mixture upon a wetted filter, returning the first portions of the filtrate until it runs off clear. Wash the filter with sufficient water to obtain 750 Cc. of filtrate. To this add the glycerin. Each fluidrachm represents 1 grain of pancreatin.

Action and Uses.—See PANCREATINUM. Dose, 1 to 4 fluidrachms (4–16 Cc.).

LIQUOR PICIS CARBONIS, *Br.*—Solution of Coal Tar.

Soluté de goudron de houille, Fr.; *Kohlentheerlösung*, G.

Preparation.—Take of prepared coal tar, 4 ounces; quillaia bark, in No. 20 powder, 2 ounces; alcohol (90 per cent.), a sufficient quantity. Moisten the powdered quillaia bark with 1 fluidounce of the alcohol, and set aside for 24 hours in a closed vessel. Pack the mixture in a percolator, and pour over the contents, at intervals, further portions of alcohol, until 20 fluidounces of tincture have been obtained. To the tincture add the prepared coal tar, and digest at 48.9° C. (129° F.) for 2 days, occasionally stirring. Cool and decant or filter.—Br.

In the above process the saponin extracted from the soap bark by the alcohol is intended to keep the alcohol-soluble constituents of the coal tar in proper suspension when the solution is mixed with water for use. The prepared coal tar of the Br. P. is made by placing commercial coal tar in a shallow vessel, and maintaining it at a temperature of 48.9° C. (120° F.) for 1 hour, stirring frequently.

Action and Uses.—This preparation is employed externally in the treatment of many chronic skin affections.

LIQUOR PLUMBI SUBACETATIS, *U. S.*—Solution of Lead Subacetate.

Liquor Plumbi Subacetatis Fortis, Br.; *Liquor Plumbi Subacetici*, G.—*Acetum Plumbi, Acetum Saturni, Plumbum hydrico-aceticum solutum. Strong solution of lead subacetate, Goulard's Extract*, E.; *Sous-acétate de plomb liquide, Extrait de Saturne, Extrait de Goulard, Vinaigre de plomb*, Fr.; *Bleiessig*, G.

An aqueous liquid containing in solution not less than 25 per cent. of lead subacetate (approximately, $Pb_2O(C_2H_3O_2)_2$, 543.74), U. S. Specific gravity, 1.235 at 25° C. (77° F.), U. S.; 1.275, Br.; 1.235 to 1.240, P. G.; 1.32, Fr. Cod.

Preparation.—Lead acetate, 180 Gm.; lead oxide, 110 Gm.; distilled water, a sufficient quantity to make 1000 Gm. To the finely pulverized lead oxide contained in a mortar or porcelain dish, of about 1 liter capacity, add slowly and in portions, with constant trituration, the lead acetate, which has been previously dissolved in 700 Cc. of boiling distilled water, and boil the liquid for ½ hour, with occasional stirring. Finally, when cool, filter the solution, and add sufficient distilled water, which has been previously boiled and cooled, to make the finished product weigh 1000 Gm. Keep the solution in well-stoppered bottles.—U. S.

Take of lead acetate, 5 ounces; lead oxide, in powder, 3½ ounces; distilled water, a sufficient quantity. Boil the lead acetate and the lead oxide in 20 fluidounces of distilled water for half an hour, constantly stirring, and maintaining the volume of the liquid by occasional additions of distilled water; filter; when the liquid is cold, add sufficient distilled water to produce 1 pint (Imperial measure).—Br.

Lead acetate, 3 parts; lead oxide, 1 part; distilled water, 8 parts. Boil and preserve the weight.—Fr. Cod.

Lead acetate, 3 parts; lead oxide, 1 part; water, ½ part. Mix at the heat of a water-bath until the mixture has become white or nearly so; then add 9½ parts of water, set aside to settle, and filter.—P. G.

The slight increase in the quantities of lead acetate and oxide ordered in the U. S. P. formula was necessary to insure the presence of 25 per cent. of lead subacetate in the finished product. The solution may also be prepared by the process suggested by Haussmann, which is admirably adapted to the pharmacist's needs, and has the advantage of keeping the solution protected against atmospheric influences during its preparation: Pour 710 Cc. of distilled water, heated to boiling, into a strong bottle previously warmed and graduated at 710 Cc.; add quickly 180 Gm. of pure crystallized lead acetate in small pieces or granules, cork the bottle, and dissolve by gentle agitation. After solution of the salt, add in divided small portions 110 Gm. of lead oxide (97–99 per cent. pure), previously sifted, shaking the bottle after each addition. In about 10 minutes the yellow color of the lead oxide will disappear, and after 2 hours all reaction will have ceased. The mixture may then be filtered under cover. The resulting solution will measure about 810 Cc., or very nearly 27½ fluidounces.

Several basic lead acetates are known, the composition of which depends upon the

proportions in which the lead acetate and oxide are employed; thus the United States and British pharmacopœias, using the acetate and oxide in the proportion of their molecular weights, obtain in solution the basic compound indicated by the formula $Pb_2O(C_2H_3O_2)_2$, according to the equation $(Pb(C_2H_3O_2)_2 + 3H_2O) + PbO = Pb_2O(C_2H_3O_2)_2 + 3H_2O$; while the German and French pharmacopœias, directing the use of 3 parts of lead acetate to 1 of lead oxide, cause the production of a less basic compound, as shown by the equation $2(Pb(C_2H_3O_2)_2 + 3H_2O) + PbO = Pb_3O(C_2H_3O_2)_4 + 6H_2O$.

In the preparation of this solution other basic lead acetates, such as $Pb_3O_2(C_2H_3O_2)_2$, are also formed in small quantities in addition to those mentioned, and an insoluble white residue is always left, consisting of a very basic compound, probably having the composition $Pb_6O_5(C_2H_3O_2)_2$.

Properties.—Solution of lead subacetate is a colorless liquid having a sweet, astringent taste, and an alkaline reaction to test-paper. On exposure to air, or on being mixed with water containing air in solution, it yields a white film, and finally a white precipitate of basic lead carbonate. It unites readily with liquid and solid fats, and may be mixed with an equal volume of alcohol without precipitation. Added to a solution of acacia, it produces a dense white precipitate. In other respects the solution conforms to the reactions of lead acetate.

Tests.—After acidulating the solution with acetic acid, potassium ferrocyanide should produce a white precipitate free from any blue (iron) or red (copper) tint. When completely precipitated by an excess of sulphuric acid, the filtrate, on being evaporated to dryness, should leave no residue or only a very slight one (absence of other salts). When precipitated by an excess of ammonia, the filtrate should not have a blue color (absence of copper). "If 10 Gm. of the solution be diluted with distilled water, which has been previously boiled and cooled, to measure 100 Cc., and 13.6 (13.594) Cc. of this are added to 35 Cc. of tenth-normal oxalic acid solution, contained in a graduated cylinder, and after thorough shaking, the mixture is diluted with distilled water to measure 50 Cc., and again well shaken; then after the precipitate has settled, 10 Cc. of the clear solution, after diluting with about 50 Cc. of water and adding 5 Cc. of sulphuric acid, should not require more than 2 Cc. of tenth-normal potassium permanganate solution to produce a permanent pink tint. Each Cc. of tenth-normal oxalic acid solution required for the precipitation of the 13.6 Cc. of the diluted solution corresponding to 1 per cent. of lead subacetate present."—U. S. Each Gm. should require for complete precipitation 17 Cc. of tenth-normal sulphuric acid solution.—Br.

The reaction occurring in the official process of assay may be shown by the following equation: $Pb_2O(C_2H_3O_2)_2 + 2(H_2C_2O_4 + 2H_2O) = 2Pb(C_2O_4) + 2HC_2H_3O_2 + 5H_2O$. Hence each Cc. of tenth-normal oxalic acid will precipitate 0.013327 Gm. of lead subacetate, which corresponds practically to 1 per cent. of 1.36 Gm., the weight of the original solution taken. The number of Cc. of tenth-normal potassium permanganate required to produce a pink tint, multiplied by 5 (as only $\frac{1}{5}$ of the clear supernatant liquid is used), and then subtracted from 35 will indicate the exact quantity of tenth-normal oxalic acid required for precipitation of 1.36 Gm. ($\frac{1}{10}$ of 13.6 Cc.) solution used.

Action and Uses.—Goulard's Extract is employed locally as a sedative astringent in the treatment of sprains and bruises. As a rule, it should not be applied to incised wounds or abrasions of the skin. This solution is entirely too strong and requires dilution before applying. From ½ to 1 fluidounce (16–30 Cc.) added to 1 pint (480 Cc.) of water is usually sufficient.

LIQUOR PLUMBI SUBACETATIS DILUTUS, *U. S.*, *Br.*—Diluted Solution of Lead Subacetate.

Aqua Plumbi, P. G.; *Aqua Saturnina.—Lead Water*, E.; *Eau de Saturne, Eau blanche*, Fr.; *Bleiwasser, Kühlwasser*, G.

An aqueous liquid, which should contain about 1 per cent. of lead subacetate.—U. S.

Preparation.—Solution of lead subacetate, 40 Gm.; distilled water, a sufficient quantity to make 1000 Gm. Mix the solution of lead subacetate with sufficient distilled water, previously boiled and cooled, to make the product weigh 1000 Gm.—U. S.

To prepare a pint of lead water, 260 minims of solution of lead subacetate should be mixed with sufficient distilled water, previously boiled, to make 16 fluidounces.

Take of strong solution of lead subacetate, 2 fluidrachms; alcohol (90 per cent.), 2 fluidrachms; distilled water, a sufficient quantity. Mix the alcohol with 19½ fluidounces of recently boiled and cooled distilled water; add the strong solution of lead subacetate and shake.—Br.

The use of distilled water does not prevent the mixture from becoming turbid at once, the carbon dioxide held in solution or contained in the atmosphere producing lead carbonate; this gas is therefore expelled by the previous boiling of water. Since, however, the decomposition will again take place when exposed to the atmosphere, it is best to prepare lead water only in small quantities; for preparing 4 fluidounces of it 65 minims of Goulard's Extract are required; the French and German Pharmacopœias order 2 per cent.

The solution should be kept in well-stoppered bottles.

The terms *Aqua Plumbi Goulardi; Goulard's Lead Water, Goulard's Lotion, Goulard Water*, E.; *Eau de Goulard*, Fr.; *Goulard'sches Wasser*, G.; are applied to dilute solution of lead subacetate containing alcohol, as in the case of the British formula above.

Action and Uses.—This solution possesses the same properties as Goulard's Extract, but in a milder degree. As a rule it is too weak to be of any material benefit.

LIQUOR POTASSII ARSENITIS, *U. S.*—Solution of Potassium Arsenite.

Liquor arsenicalis, Br.; *Liquor kalii arsenicosi*, P. G.; *Solutio arsenicalis Fowleri, Kali arsenicosum solutum.—Arsenical Solution, Fowler's Solution*, E.; *Liqueur (solution) arsenicale de Fowler*, Fr.; *Fowlersche Tropfen*, G.

An aqueous solution, which should contain potassium arsenite corresponding to 1 per cent. of arsenic trioxide.—U. S.

Preparation.—Arsenic trioxide, in fine powder, 10 Gm.; potassium bicarbonate, 20 Gm.; compound tincture of lavender, 30 Gm.; distilled water, a sufficient quantity to make 1000 Gm. Boil the arsenic trioxide and potassium bicarbonate with 100 Cc. of distilled water, in a tared dish, until solution has been effected. Then add sufficient distilled water to make the solution, when cold, measure 970 Gm., and lastly, add the compound tincture of lavender. Filter through paper.—U. S.

To prepare ½ pint of Fowler's Solution, 37 grains of arsenic trioxide and 74 grains of potassium bicarbonate should be boiled with 6 fluidrachms of distilled water until dissolved; when cool, sufficient distilled water should be added to bring the volume up to 7¾ fluidounces, and finally ¼ fluidounce of compound spirit of lavender is to be added.

Take of arsenious anhydride, in powder, and potassium carbonate, each, 87½ grains; compound tincture of lavender, 5 fluidrachms; distilled water, a sufficient quantity. Heat the arsenious anhydride and the potassium carbonate with 10 fluidounces of distilled water in a 1 pint flask until a clear solution is obtained, cool; add the compound tincture of lavender and sufficient distilled water to produce 1 pint (Imperial measure) of the solution.—Br.

The U. S. P. very properly directs the mixture of potassium bicarbonate and arsenic trioxide to be boiled in a small quantity of water, whereby combination and solution are readily effected. The solution is most conveniently prepared in a test-tube of sufficient capacity or a small flask having a long neck, so as to lessen evaporation of the water. The exact nature of the compound in solution is somewhat in doubt, some authorities believing that when 1 molecule of arsenic trioxide and 4 molecules of acid potassium carbonate are brought together with water, as in the official process, secondary potassium ortho-arsenite, K_2HAsO_3, is formed; others claim that primary potassium ortho-arsenite, KH_2AsO_3, is produced; while still others assert that potassium meta-arsenite, $KAsO_2$, only is formed, as in the preparations of the British and German pharmacopœias made with equal weights of arsenic trioxide and normal potassium carbonate. Some authorities even claim that the solution is not that of a definite arsenical compound at all, but simply a solution of the arsenous acid in the alkaline liquid, and that the U. S. P. solution will likewise be changed to this condition by the absorption of carbon dioxide from the atmosphere. Solution of potassium arsenite is likely to develop fungi in the course of time, and if an excess of alkali be present, as in the

British and German preparations, the arsenous acid is gradually converted into arsenic acid; it is, therefore, better not to keep the solution on hand in large quantities. While the preparations of the United States and British pharmacopœias are colored reddish by the compound tincture of lavender added, those of the German and French pharmacopœias are colorless.

The amount of arsenic trioxide represented in the solution may be conveniently ascertained by means of iodine, using starch paste as an indicator. The official tests are as follows: If 24.6 Cc. of the solution of potassium arsenite be diluted with water to 100 Cc., the mixture very slightly acidified wtih diluted hydrochloric acid, and then made alkaline with 2 Gm. of sodium bicarbonate, it should require not less than 50 Cc. of tenth-normal iodine solution to produce a permanent yellow tint (corresponding to 1 Gm. of arsenic trioxide in 100 Cc. of the solution).—U. S. 25 Cc. of the solution, neutralized with hydrochloric acid and diluted with water, should discharge the color of 50.8 to 50.9 Cc. of volumetric solution of iodine, the presence of a slight excess of sodium bicarbonate being maintained throughout the operation.—Br.

The addition of sodium bicarbonate in the official tests is for the purpose of neutralizing the newly formed arsenic and hydriodic acids, thus preventing decomposition of the latter by the former, which would vitiate the results by constantly liberating iodine.

Uses.—The employment of this solution is fully discussed under ARSENI TRIOXIDUM (which see). The beginning dose is from 1 to 5 minims (0.05–0.3 Cc.), which amount may be gradually increased until its physiological effects are observed.

LIQUOR POTASSII CITRATIS, *U. S.*—Solution of Potassium Citrate.

Mistura potassii citratis; Liquor kali citrici.—Citrate de potasse liquide, Fr.; *Kaliumcitratlösung*, G.

An aqueous liquid, containing in solution not less than 8 per cent. of anhydrous potassium citrate, with small amounts of citric and carbonic acids.—U. S.

Preparation.—Citric acid, 6 Gm.; potassium bicarbonate, 8 Gm.; water, a sufficient quantity. Dissolve the citric acid and the potassium bicarbonate each in 40 Cc. of water. Filter the solutions separately, and wash the filters with sufficient water to obtain in each case 50 Cc. of solution. Finally, mix the two solutions, and when effervescence has nearly ceased, transfer the liquid to a bottle. This preparation should be freshly made when wanted.—U. S.

To make 4 fluidounces of the official solution use 112 grains of citric acid and 154 grains of potassium bicarbonate, dissolving each separately in 2 ounces of water.

This solution of potassium citrate differs from Mistura Potassii Citratis, U. S. 1880, in the absence of the yellowish color and the agreeable lemon flavor. It has a mildly saline and pleasant acidulous taste. "If 10.14 Gm. of solution of potassium citrate be evaporated to dryness and then thoroughly carbonized at a temperature not exceeding a low red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange test-solution, the filtrate should require for complete neutralization not less than 16 Cc. of half-normal sulphuric acid, methyl-orange test-solution being used as indicator (each Cc. of the half-normal sulphuric acid consumed representing 0.5 per cent. of anhydrous potassium citrate)."—U. S.

The direction to make the solution fresh as wanted is a commendable one, since aqueous solutions of citric acid undergo decomposition.

POTIO RIVERI, P. G., is less than one-third the strength of the preceding; it is made from citric acid 4 parts, water 190 parts, and crystallized sodium carbonate 9 parts.

POTIO DE RIVIERE, Fr. Cod. Dissolve citric acid and potassium bicarbonate, of each 2 Gm., separately in water 50 Gm., and syrup 15 Gm.; the solutions are often dispensed in separate vials.

Action and Uses.—This excellent refrigerant diaphoretic is largely employed in the treatment of fevers when the skin is hot and dry. It is largely used in treating the fevers of infants, and its efficacy is frequently increased by the addition of small doses of spirit of nitrous ether and tincture of aconite. Neutral mixture, which is prepared by substituting a solution consisting of equal parts of water and lemon-juice for the solution of citric acid, is much more agreeable to the taste. The dose is from $\frac{1}{2}$ to 1 fluidounce (16–30 Cc.).

LIQUOR POTASSII HYDROXIDI, *U. S.*—Solution of Potassium Hydroxide.

Liquor potassæ, Br. (U. S., 1890); *Liquor kali caustici*, P. G.; *Lixivium causticum.—Solution of potassa, Solution of potash*, E.; *Potasse caustique liquide, Lessive caustique*, Fr.; *Kalilauge, Ætzkalilauge*, G.

An aqueous solution of potassium hydroxide, KOH; molecular weight, 55–74—containing about 5 per cent. U. S., 5.85 per cent. Br., 15 per cent. P. G., of the hydroxide. Specific gravity, about 1.046 at 25° C. (77° F.) U. S., 1.058 Br., 1.126 to 1.130 P. G.

Preparation.—Potassium hydroxide, 60 Gm.; distilled water, 940 Gm. Dissolve the potassium hydroxide in the distilled water.

The potassium hydroxide used in this process should be of the full strength and quality directed by the Pharmacopœia (85 per cent.). Potassium hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken; the proper amount for the above formula being ascertained by dividing 5100 by the percentage of absolute potassium hydroxide contained therein. Solution of potassium hydroxide should be kept in bottles made of green glass, and provided with glass stoppers coated with paraffin or petrolatum.—U. S.

To prepare 1 pint of solution of potassa 450 grains of the official potassium hydroxide may be dissolved in sufficient distilled water to obtain 16 fluidounces of finished product.

The Br. P. no longer gives a method of preparation for this solution.

Solution of potassium hydroxide is prepared on a large manufacturing scale by gradually adding a boiling dilute solution of pure potassium carbonate to boiling milk of lime and boiling the mixture for 10 or 15 minutes to insure complete decomposition of the potassium salt. The mixture is strained through linen, the liquid set aside in well-closed vessels until clear, and then decanted and concentrated. The reaction occurring is between equal molecules of potassium carbonate and calcium hydroxide, 140 parts of the former requiring about 75 parts of the latter.

Properties.—Solution of potassium hydroxide is a clear and colorless liquid of the specific gravity stated above, and has a strong alkaline reaction and a very caustic taste. The slight peculiar odor which it usually has is due to its action upon organic bodies which may have been derived from the atmosphere. It dissolves wool, skin, and other animal and many vegetable substances, and decomposes fats, forming therewith soluble soaps. It attracts carbon dioxide from the air with great avidity, and must therefore be preserved in well-stoppered bottles. Green glass free from lead is best adapted for the purpose, but it is likewise somewhat decomposed by alkalies, which cause the stopper to become firmly fastened into the bottle unless protected by a thin layer of paraffin. Potassium hydroxide solution decomposes the salts of ammonium, of the metals, and of all the alkaloids, and induces the decomposition of tannin and its derivatives; a drop taken by a platinum loop and held in a non-luminous flame imparts to it a violet tint. As a test of identity, and considering the strong yellow color given by sodium compounds, the flame may be examined through blue glass to cut off the color of sodium. It differs from soda solution in yielding a white crystalline precipitate with excess of concentrated solution of tartaric acid, and a yellow one on the addition of hydrochloric acid and platinic chloride.

Spec. gravity at 15° C.	Percent. of KOH.	Spec. gravity at 15° C.	Percent. of KOH.	Spec. gravity at 15° C.	Percent. of KOH.	Spec. gravity at 15° C.	Percent. of KOH.
1.009	1	1.166	19	1.374	37	1.604	55
1.017	2	1.177	20	1.387	38	1.618	56
1.025	3	1.188	21	1.400	39	1.630	57
1.033	4	1.198	22	1.411	40	1.641	58
1.041	5	1.209	23	1.425	41	1.655	59
1.049	6	1.220	24	1.438	42	1.667	60
1.058	7	1.230	25	1.450	43	1.682	61
1.065	8	1.241	26	1.462	44	1.695	62
1.074	9	1.252	27	1.475	45	1.705	63
1.083	10	1.264	28	1.488	46	1.718	64
1.092	11	1.278	29	1.499	47	1.729	65
1.101	12	1.288	30	1.511	48	1.740	66
1.111	13	1.300	31	1.527	49	1.751	67
1.119	14	1.311	32	1.539	50	1.768	68
1.128	15	1.324	33	1.552	51	1.780	69
1.137	16	1.336	34	1.565	52	1.790	70
1.146	17	1.349	35	1.578	53		
1.155	18	1.361	36	1.590	54		

The table on page 913 by Gerlach shows the specific gravity at 15° C. (59° F.) of solutions containing from 1 to 70 per cent. of potassium hydroxide.

Tests.—Solution of potassium hydroxide should conform to the reactions and tests given under POTASSII HYDROXIDUM for an aqueous solution of the same. The U. S. P. demands that 28 (27.9) Gm. of solution of potassium hydroxide shall require about 25 Cc. of normal sulphuric acid for complete neutralization, methyl orange being used as an indicator, each Cc. of the acid corresponding to 0.2 per cent. of absolute potassium hydroxide. According to the Br. P., 9 Cc. of the solution should require for neutralization 10 Cc. of normal sulphuric acid, corresponding to 0.557 Gm. of KOH, which is equivalent to 5.85 per cent.

Action and Uses.—For the employment of this solution see POTASSII HYDROXIDUM.

LIQUOR POTASSII PERMANGANATIS, *Br.*—Solution of Potassium Permanganate.

Soluté de permanganate de potasse, Fr.; *Kaliumpermanganatlösung*, G.

Preparation.—Potassium permanganate, 87½ grains; distilled water, a sufficient quantity. Dissolve the potassium permanganate in sufficient distilled water to produce 1 pint (Imperial measure) of the solution.—Br.

The solution, which contains 1 per cent. of potassium permanganate, is of a deep-purple color and shows the chemical behavior of the salt.

Action and Uses.—For the employment of this solution see POTASSII PERMANGANAS.

LIQUOR QUASSIÆ CONCENTRATUS, *Br.*—Concentrated Solution of Quassia.

Preparation.—Quassia wood, in No. 40 powder, 2 ounces; alcohol (20 per cent.), 22 fluidounces. Mix the quassia with 2 fluidounces of the alcohol; pack in a closed percolator; set aside for 3 days; percolate with the remaining alcohol, added in 10 equal portions at intervals of 12 hours; continue percolation with more alcohol until the product measures 1 pint (Imperial measure).—Br.

Concentrated solution of quassia is 8 times as strong as the infusion of quassia of the 1885 British Pharmacopœia, and keeps much better on account of the alcohol present.

Action and Uses.—This preparation is employed as a simple bitter (see QUASSIA).

LIQUOR RHEI CONCENTRATUS, *Br.*—Concentrated Solution of Rhubarb.

Preparation.—Rhubarb, in No. 5 powder, 10 ounces; alcohol (20 per cent.), 25 fluidounces. Moisten the rhubarb with 5 fluidounces of the alcohol; pack in a closed percolator; set aside for 3 days; percolate with the remaining alcohol added in 10 equal portions at intervals of 12 hours; continue percolation with more alcohol until the product measures 1 pint (Imperial measure).—Br.

This preparation, which may be looked upon as a weakly alcoholic 50 per cent. tincture of rhubarb, is about 20 times as strong as the former infusion of rhubarb, and is a decidedly more elegant looking preparation. It will precipitate upon standing.

Action and Uses.—The uses of solution of rhubarb are mentioned under RHEUM (which see).

LIQUOR SARSÆ COMPOSITUS CONCENTRATUS, *Br.*—Concentrated Compound Solution of Sarsaparilla.

Preparation.—Sarsaparilla, cut transversely and bruised, 20 ounces; sassafras root, in shavings, 2 ounces; guaiacum wood, in shavings, 2 ounces; dried liquorice root, bruised, 2 ounces; mezereon bark, cut small, 1 ounce; alcohol (90 per cent.), 4½ fluidounces; distilled water, a sufficient quantity. Infuse the sarsaparilla in 3 successive portions of 5 pints of the distilled water, for 1 hour each, at 71.1° C. (160° F.). Boil the other solid ingredients with distilled water until exhausted. Rapidly concentrate the mixed infusion and decoction until, when cold, the liquid measures 16 fluidounces;

add the alcohol; set aside for at least 14 days; filter. The product should measure 1 pint (Imperial measure).—Br.

Concentrated compound decoction of sarsaparilla would seem to be a more appropriate name for this preparation. It contains the same ingredients as the compound decoction of the preceding Br. P. and is 8 times as strong. The addition of alcohol causes the precipitation of some inert matter and subsequently preserves the liquid. The dose is from 2 to 8 fluidrachms (8–30 Cc.).

LIQUOR SENEGÆ CONCENTRATUS, *Br.*—Concentrated Solution of Senega.

Preparation.—Senega root, in No. 20 powder, 10 ounces; a mixture of 2 parts of alcohol (20 per cent.) and 1 part of alcohol (45 per cent.), 25 fluidounces. Moisten the senega with 4 fluidounces of the menstruum; pack in a closed percolator; set aside for 3 days; percolate with the remaining menstruum, added in 10 equal portions at intervals of 12 hours; continue percolation with more menstruum until the product measures 1 pint (Imperial measure).—Br.

Concentrated solution of senega is no doubt intended as a concentrated infusion of the drug, being 10 times as strong as the infusion of the 1885 British Pharmacopœia, made with boiling water. While the alcohol (about 28 per cent. in the finished product) is intended to preserve the solution, it cannot prevent the tendency to gelatinize caused by the presence of the pectin, which will even occur in much more strongly alcoholic preparations of the drug unless an alkali has been added. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

LIQUOR SENNÆ CONCENTRATUS, *Br.*—Concentrated Solution of Senna.

Preparation.—Senna, in No. 5 powder, 20 ounces; tincture of ginger, 2½ fluidounces; alcohol (90 per cent.), 2 fluidounces; distilled water, a sufficient quantity. Divide the senna into 3 equal portions; slightly moisten one portion with distilled water; pack in a percolator; set aside for 24 hours; pass distilled water through it until 5 fluidounces are obtained. Slightly moisten the second portion of senna with this liquid; pack in a percolator; set aside for 24 hours; percolate with the remainder of the liquid obtained from the first portion, and also with an additional 5 fluidounces obtained by passing more distilled water through the first portion. Repeat the process with the third portion of the senna, and continue successive percolation through the 3 portions, until a quantity of 16 fluidounces has been collected from the third percolator. Heat the liquid to 82.2° C. (180° F.) for 5 minutes; cool; set aside for 7 days; filter. Add the alcohol and tincture of ginger, previously mixed; set aside for 7 days; filter. The product should measure 1 pint (Imperial measure).—Br.

This concentrated infusion of senna is prepared by repercolation with cold water instead of boiling water, as directed for the infusion of 1885, and is 10 times as strong as the latter. Heating the watery percolate causes coagulation of albuminous matter, any mucilaginous matter taken up by the aqueous menstruum being precipitated by the alcoholic mixture afterward added. The ginger is intended as a corrective, to prevent griping. The dose is from ½ to 1 fluidrachm (2–4 Cc.).

LIQUOR SODÆ CHLORINATÆ, *U. S., Br.*—Solution of Chlorinated Soda.

Liquor sodæ chloratæ, U. S., 1890; *Liquor natri chlorati, Liquor natri hypochlorosi. Labarraque's Solution, Bleaching Solution*, E.; *Chlorure de soude liquide, Liqueur de Labarraque*, Fr.; *Chlornatronlösung, Bleichflüssigkeit*, G.

An aqueous solution of several chlorine compounds, chiefly NaClO and NaCl, and containing at least 2.4 per cent. by weight of available chlorine. The official solutions of the U. S. and Br. pharmacopœias are practically of the same strength, but that of the French Codex is less than one-third as strong.

Preparation.—Monohydrated sodium carbonate, 65 Gm.; chlorinated lime, 90 Gm.; water, a sufficient quantity to make 1000 Gm. Triturate the chlorinated lime (which should contain not less than 30 per cent. of available chlorine) with 200 Cc. of water,

gradually added, until a uniform mixture results. Allow the heavier particles to subside, and transfer the thinner, supernatant portion to a filter.. Then triturate the residue again with 200 Cc. of water, transfer the whole to the filter, and when the liquid has drained off, wash the filter and contents with 100 Cc. of water. Dissolve the monohydrated sodium carbonate in 300 Cc. of hot water, and add this solution to the previously obtained filtrate contained in a suitable vessel. Stir or shake the mixture thoroughly, and, if it should become gelatinous, warm the vessel until the precipitate subsides. Then transfer the mixture to a new filter, and, when no more liquid drains from it, wash the filter and contents with sufficient water to make the product weigh 1000 Gm. Keep the solution in well-stoppered bottles, protected from the light.—U. S.

To prepare 1 gallon of Labarraque's Solution, 9 avoirdupois ounces of monohydrated sodium carbonate, dissolved in 44 fluidounces of hot water, should be added to a solution of 13 avoirdupois ounces of chlorinated lime in 64 fluidounces of water (prepared as directed above); after the mixture has been well shaken and filtered, sufficient water should be passed through the filter to bring the volume of the solution up to 8 pints.

Take of chlorinated lime, 16 ounces; sodium carbonate, 24 ounces; distilled water, 1 gallon. Dissolve the sodium carbonate in 2 pints of the distilled water; thoroughly triturate the chlorinated lime with 6 pints of the water; mix the two liquids; filter. Keep the solution in a stoppered bottle in a cool and dark place.—Br.

Dry chlorinated lime, 100 Gm.; crystallized sodium carbonate, 200 Gm.; distilled water, 4500 Gm. Triturate the chlorinated lime in a porcelain mortar with a portion of the water, and separate by decantation the finest portion; triturate the residue, add more of the water, and decant as before; repeat this operation until two-thirds of the water has been used. Dissolve the sodium salt in the remaining water, mix the two liquids, let settle, and filter.—Fr. Cod.

The above processes yield the chlorinated soda by double decomposition of chlorinated lime with sodium carbonate, whereby calcium carbonate is precipitated, the chlorinated soda remaining in solution, together with the sodium chloride resulting from the decomposition of calcium chloride present in the lime compound and with the excess of sodium carbonate employed. The solution of sodium carbonate should be boiling hot when added to the mixture of chlorinated lime and water, the object being the precipitation of a dense calcium carbonate. If no heat is employed, the precipitate will be very light and retain a large proportion of the liquid. But heat should not be applied after the mixture has been made, since the solutions of chlorinated alkalies are decomposed thereby into chloride and chlorate, oxygen being at the same time evolved; in the presence of much free alkali the decomposition takes place less readily.

Properties.—The solution is clear and colorless, not pale-greenish, as described by the U. S. Pharmacopœia. Its specific gravity is 1.050 at 25° C. (77° F.). It has a feeble odor of chlorine, and a saline, somewhat styptic and sharp alkaline taste, and bleaches indigo, litmus, and vegetable colors like chlorine, but less energetically. With solution of ferrous sulphate it produces a brown precipitate of ferric hydroxide, and with solution of lead salt a brown one of lead dioxide; the color of both precipitates is lighter, from carbonate present, if an excess of the metallic salts be used. On the addition of hydrochloric acid, effervescence takes place, the gas consisting of carbon dioxide and chlorine, the latter resulting from the mutual reaction of the hydrochloric and hypochlorous acids; thus, $NaCl.NaClO + 2HCl = 2NaCl + HCl + HClO$, and $HCl + HClO = Cl_2 + H_2O$. It is upon the amount of this available chlorine that the value of this preparation depends.

Tests.—Solution of chlorinated soda is not precipitated by ammonium oxalate (absence of calcium). "If 7.04 Gm. of the solution be mixed with 50 Cc. of water, then 2 Gm. of potassium iodide and 10 Cc. of hydrochloric acid added, it should require not less than 48 Cc. of tenth-normal sodium thiosulphate solution to discharge the yellow color of the liquid (each Cc. of the volumetric solution corresponding to 0.05 per cent. of available chlorine)."—U. S. The chlorine set free liberates an equivalent quantity of iodine, which imparts a blue color to the solution containing starch, and this color disappears on the addition of the thiosulphate. The same process is used by the British Pharmacopœia, 3.5 Gm. of the chlorinated solution being mixed with a solution of 1 Gm. of potassium iodide in 100 Cc. of water and acidulated with 3 Cc. of hydrochloric acid; the brown color should be discharged by not less than 25 Cc. of the volumetric solution of sodium thiosulphate (2½ per cent. Cl).

Action and Uses.—This solution has been employed as a gastro-intestinal antiseptic and as a topical application to external ulcers of all kinds. The internal dose is 30 to 40 minims (2–2.6 Cc.), well diluted, repeated every 2 or 3 hours.

LIQUOR SODII ARSENATIS, *U. S., Br.*—Solution of Sodium Arsenate.

Soluté d'arséniate de soude, Fr.; *Arsensaure Natronlösung*, G.

An aqueous solution, which should contain sodium arsenate corresponding in amount to not less than 1 per cent. of exsiccated sodium arsenate.—U. S.

Preparation.—Exsiccated sodium arsenate, 1 Gm.; distilled water, a sufficient quantity to make 100 Gm. Dissolve the sodium arsenate in the distilled water. —U. S.

The above formula yields nearly 3½ fluidounces of solution, and hence each fluidrachm contains about ½ grain of the anhydrous salt.

Take of sodium arsenate, recently rendered anhydrous, 17½ grains; distilled water, a sufficient quantity. Dissolve the anhydrous sodium arsenate in sufficient distilled water to produce 4 fluidounces of solution.—Br.

The object of using anhydrous sodium arsenate in making this solution is to insure uniformity of strength in the finished product. The commercial salt may contain variable proportions of water of crystallization, ranging from 53 per cent. to less than 20 per cent., depending upon the care with which the salt has been preserved. The temperature used for desiccation should not be carried beyond 149° C. (300° F.) in order to avoid conversion of the ortho-arsenate into pyro-arsenate.

The solutions are colorless, and give the reactions of SODIUM ARSENATE (which see).

The Liqueur arsenicale de Pearson of the French Codex is made by dissolving 1 part of crystallized sodium arsenate in 600 parts of distilled water, which makes the product about one-tenth as strong as the above solutions. Pearson's Solution may therefore be readily prepared as directed in the National Formulary, by diluting the official solution of sodium arsenate with 9 times its volume of distilled water.

Action and Uses.—The value of this preparation is fully described under ARSENI TRIOXIDUM (which see). Dose, from 1 to 5 minims (0.05–0.3 Cc.).

LIQUOR SODII ETHYLATIS, *Br.*—Solution of Sodium Ethylate.

Solution of sodium alcoholate, E.; *Soluté d' ethylate de soude*, Fr.; *Natriumethylatlösung, Natriumalkoholatlösung*, G.

Preparation.—Sodium, clean and bright, 22 grains; absolute alcohol, 1 fluidounce. Cautiously dissolve the sodium in the absolute alcohol contained in a flask, the latter being kept cool by a stream of cold water.—Br.

Properties and Tests.—Solution of sodium ethylate is a colorless liquid of 0.867 specific gravity and syrupy consistence. It turns brown on keeping. When slightly heated, it boils and gives off alcoholic vapors, leaving a white residue which, on being strongly heated, becomes charred. If the white residue be mixed with water and heated, it yields ethyl alcohol, and the solution, on evaporation, leaves a white residue consisting almost wholly of caustic soda. The solution contains 18 per cent. of the solid sodium ethylate, and should be recently prepared.

When metallic sodium is brought in contact with absolute alcohol hydrogen is liberated and sodium ethylate is formed, as shown by the following equation: $C_2H_5OH + Na = C_2H_5ONa + H$. Ordinary alcohol cannot be used, since the water present will at once react with the sodium, forming sodium hydroxide or caustic soda.

Action and Uses.—This preparation is employed externally as a caustic. It is said to destroy tissue without the production of very much pain.

LIQUOR SODII HYDROXIDI, *U. S.*—Solution of Sodium Hydroxide.

Liquor sodæ, U. S., 1890.—*Liquor natri caustici*, P. G.; *Solution of soda, Solution of caustic soda*, E.; *Soude caustique liquide, Lessive des savonniers*, Fr.; *Natronlauge, Ätznatronlauge*, G.

An aqueous solution of sodium hydroxide, NaOH = 39.76, containing about 5

per cent. U. S., 15 per cent. P. G., 23 per cent. Fr. Cod., of the true hydroxide. Specific gravity of the official solutions: 1.056 at 25° C. (77° F.) U. S., 1.33 Fr. Cod., 1.168 to 1.172 P. G.

Preparation.—Sodium hydroxide, 56 Gm.; distilled water, 944 Gm. Dissolve the sodium hydroxide in the distilled water.

The sodium hydroxide used in this process should be of the full strength and quality directed by the Pharmacopœia (90 per cent.). Sodium hydroxide of any other strength, however, may be used if a proportionately larger or smaller quantity be taken; the proper amount for the above formula being ascertained by dividing 5040 by the percentage of absolute sodium hydroxide contained therein.—U. S.

To prepare 1 pint of solution of sodium hydroxide, 432 grains of the official sodium hydroxide may be dissolved in sufficient distilled water to obtain 16 fluidounces of solution.

Solution of sodium hydroxide may also be prepared by adding a boiling solution of sodium carbonate gradually to boiling milk of lime and boiling the mixture for a short time. When cold, the mixture is strained through muslin and set aside in well-stoppered vessels to become clear.

Properties.—Sodium hydroxide solution is a clear and colorless liquid of the density given above, and has a strong alkaline reaction and a very caustic taste; the peculiar slight odor which it usually has is solely due to the accidental presence of organic matters, which are likely to impart also a yellowish color. It dissolves various organic matters and tissues, and decomposes fats, forming soaps. It has a great affinity for carbon dioxide, and should be preserved in well-stoppered bottles made of glass free from lead, the stopper being protected by a thin layer of paraffin. In its chemical behavior it closely resembles potassa solution, but, unlike the latter, it does not yield a crystalline precipitate with excess of tartaric acid, except in concentrated solutions; with hydrochloric acid and platinum chloride it does not yield a yellow precipitate, and when, by means of a platinum wire, a drop of it is held in a non-luminous flame, an intense yellow color is imparted to the latter.

The following table by Gerlach shows the specific gravity at 15° C. (59° F.) of solutions containing from 1 to 70 per cent. of sodium hydroxide:

Spec. gravity at 15° C.	Percent. of NaOH.	Spec. gravity at 15° C.	Percent. of NaOH.	Spec. gravity at 15° C.	Percent. of NaOH.	Spec. gravity at 15° C.	Percent. of NaOH.
1.012	1	1.213	19	1.405	37	1.591	55
1.023	2	1.225	20	1.415	38	1.601	56
1.035	3	1.236	21	1.426	39	1.611	57
1.046	4	1.247	22	1.437	40	1.622	58
1.059	5	1.258	23	1.447	41	1.633	59
1.070	6	1.269	24	1.456	42	1.643	60
1.081	7	1.279	25	1.468	43	1.654	61
1.092	8	1.290	26	1.478	44	1.664	62
1.103	9	1.300	27	1.488	45	1.674	63
1.115	10	1.310	28	1.499	46	1.684	64
1.126	11	1.321	29	1.508	47	1.695	65
1.137	12	1.332	30	1.519	48	1.705	66
1.148	13	1.343	31	1.529	49	1.715	67
1.159	14	1.353	32	1.540	50	1.726	68
1.170	15	1.363	33	1.550	51	1.737	69
1.181	16	1.374	34	1.560	52	1.748	70
1.192	17	1.384	35	1.570	53		
1.202	18	1.395	36	1.580	54		

Tests.—Solution of sodium hydroxide should conform to the reaction and tests given under SODII HYDROXIDUM, for an aqueous solution of the same. The U. S. P. demands that 20 (19.9) Gm. of solution of sodium hydroxide shall require for complete neutralization about 25 Cc. of normal sulphuric acid, methyl orange being used as an indicator, each Cc. of the acid corresponding to 0.2 per cent. of absolute sodium hydroxide.

Action and Uses.—The employment of this preparation will be found under SODII HYDROXIDUM (which see). Dose, 10 to 30 minims (0.60–2 Cc.), well diluted.

LIQUOR SODII PHOSPHATIS COMPOSITUS, *U. S.*—Compound Solution of Sodium Phosphate.

Solutê de phosphate de soude composé, Fr.; *Zusammengesetzte Natriumphosphatlösung*, G.

Preparation.—Sodium phosphate, uneffloresced crystals, 1000 Gm.; sodium nitrate, 40 Gm.; citric acid, 130 Gm.; distilled water, a sufficient quantity to make 1000 Cc. Triturate the sodium phosphate and sodium nitrate in a mortar, with the citric acid, until completely liquefied, then add sufficient distilled water to make the product measure 1000 Cc. Filter the liquid. Keep the solution in well-stoppered bottles, in a moderately warm place.—U. S.

To make 1 pint of compound solution of sodium phosphate, 1 pound and 303 grains of sodium phosphate, and 293 grains of sodium nitrate should be triturated with 914 grains of citric acid until liquefied, after which sufficient distilled water is added to produce exactly 1 pint of liquid.

It is essential that the sodium phosphate be used in the form of uneffloresced crystals, otherwise perfect liquefaction will not result. Although official sodium phosphate requires about 6 times its own weight of water for solution at ordinary temperature, when liquefied in its own water of crystallization by the aid of sodium nitrate and citric acid, but little water need be added to produce the official solution, which remains liquid even when exposed for some time in a moderately cold room. If some of the salt should crystallize out, it may be brought into solution again by placing the bottle in hot water and agitating the contents. The official solution contains 1 Gm. of crystallized sodium phosphate in each cubic centimetre, or a trifle over 57 grains in a fluidrachm.

Compound solution of sodium phosphate is a colorless liquid having the density of a thin syrup, and a not disagreeable acid taste. The presence of phosphoric, citric, and nitric acids may be demonstrated by the following reactions given in the Pharmacopœia: If to 1 Cc. of the solution, diluted with an equal volume of water, a slight excess of ammonia water, followed by 1 Cc. of magnesium mixture test-solution, be added, a white crystalline precipitate will be obtained (caused by phosphoric acid); if 1 Cc. of the solution, diluted with 5 Cc. of water, be mixed with an equal volume of sulphuric acid, and to the cooled mixture a crystal of ferrous sulphate be added, a dark-brown zone will appear around the crystal (caused by nitric acid); if 5 Cc. of the solution be neutralized with ammonia water, an excess of calcium chloride test-solution added, and the mixture filtered, the filtrate, upon boiling, should deposit a white precipitate (caused by citric acid).

Action and Uses.—Although this solution is an elegant pharmaceutical preparation, there is no good reason for its introduction into the Pharmacopœia. The addition of a small amount of lemon juice to an ordinary aqueous solution of sodium phosphate forms a more palatable and an equally efficacious method of administering the salt. The dose of the solution is from ½ to 2 fluidrachms (2–8 Cc.).

LIQUOR SODII SILICATIS.—Solution of Sodium Silicate.

Liquor natrii silicici, P. G.; *Vitrium solubile.—Liquid glass, Soluble glass*, E.; *Silicate de soude liquide, Verre soluble, Verre liquide*, Fr.; *Natriumsilikatlösung, Wasserglas, Natronwasserglaslösung*, G.

Origin.—The element *silicon* or *silicium* (Si; atomic weight, 28.2) is an important constituent of many minerals and rocks. *Rock-crystal* is pure silica or silicic oxide, SiO_2, and *quartz, sand, amethyst, chalcedony, agate, flint*, and other minerals are chiefly composed of the same oxide. A combination of this oxide with alkali and other bases became known at an early date with the discovery of glass; and about 1640, Van Helmont noticed that the compound of silex and salt of tartar (potassium carbonate) would liquefy in a damp atmosphere. This liquid became known as *Liquor silicum—Liquor of flints*, E.; *Liqueur des cailloux*, Fr.; *Kieselfeuchtigkeit*, G. The usefulness of such a solution for rendering inflammable substances incombustible was proved by J. N. Fuchs (1818). In its preparation soda was soon substituted for potash, and the designation "liquid" or "soluble glass" applied indiscriminately to both compounds, which are used in calico-printing, as an addition to cheap soaps, in fresco-painting, for manufacturing artificial stone, for cements, and for other purposes. In 1900, 65,302,901 pounds of

sodium silicate were manufactured in the United States, in addition to which 1,306,782 pounds were imported.

Preparation.—Sodium silicate is usually made by fusing together a mixture of 1 part of fine sand or powdered flint and 2 parts of exsiccated sodium carbonate, dissolving the product in boiling water, filtering, and evaporating; or 8 parts of exsiccated sodium carbonate, 15 parts of fine sand, and 1 part of charcoal are used, the latter merely serving as a means for facilitating the decomposition of the carbonate, the gas evolved being partly carbonic oxide. A mixture of soda and potash with silica is more rapidly fusible than the former. The proportion of the ingredients, however, is varied according to the use to be made of the compound, and a more glass-like and less readily soluble mass is obtained by the fusion of 2 parts of silica and 3 parts of calcined soda.

Properties.—Sodium silicate is a transparent, glass-like mass, which may be obtained in crystals, Na_2SiO_3, with variable amounts of water of crystallization. On exposure the salt becomes superficially opaque, and it is slowly soluble in boiling water; but the alkaline solution may be evaporated to a thick syrupy consistence without separating a deposit on cooling. The solution, as met with in commerce, usually contains about 10 to 12 per cent. of soda (NaOH), and 20 to 24 per cent. of silica (SiO_2), and is a transparent or semitransparent, colorless or yellowish, viscid liquid, which is inodorous, and has a saline and sharp alkaline taste and an alkaline reaction to test-paper. Its specific gravity varies between 1.30 and 1.40. On acidulating the solution with hydrochloric acid the mixture remains transparent, but the colorless silicic acid forms gradually a dense jelly. If the solution be previously diluted with 10 to 15 parts of water, the silicic acid liberated by the hydrochloric acid will remain dissolved or suspended until the liquid is boiled or evaporated. Alcohol added to the solution produces a gelatinous precipitate of sodium silicate. A drop of the liquid held in a non-luminous flame by means of a loop of platinum wire burns with the intense yellow color of sodium compounds.

Solution of sodium silicate should be preserved in glass or stone vessels, securely stoppered with cork or caoutchouc to prevent access of air and decomposition by carbon dioxide gas. Stoppers of glass or stone may be used, but should be well coated with paraffin to prevent their becoming cemented to the neck of the vessel.

Tests.—When mixed with an equal bulk of alcohol any caustic alkali present will remain in solution, and may be recognized by test-paper or estimated by volumetric solution of oxalic acid. On adding excess of hydrochloric acid to the solution, only a moderate effervescence should take place, showing that it has not been injuriously affected by exposure; and on evaporating the acid mixture to dryness a residue partly soluble in water should be left, which is not colored dark by hydrogen sulphide. Should the solution of sodium silicate be strongly alkaline, it may be boiled with gelatinous silicic acid, which will be dissolved by the free alkali.

Action and Uses.—This solution is employed by surgeons in the preparation of fracture-dressings and other mechanical appliances.

LIQUOR STRYCHNINÆ HYDROCHLORIDI, *Br.*—Solution of Strychnine Hydrochloride.

Liquor strychniæ.—Soluté de chlorhydrate de strychnine, Fr.; *Salzsaure Strychninlösung*, G.

Preparation.—Take of strychnine hydrochloride, 17½ grains; alcohol (90 per cent.), 1 fluidounce; distilled water, a sufficient quantity. Dissolve the strychnine hydrochloride in the alcohol mixed with sufficient distilled water to produce 4 fluidounces of solution.—Br.

110 minims of the solution contain 1 grain of strychnine hydrochloride. The presence of alcohol serves to keep the solution better.

Action and Uses.—For the employment of this preparation see STRYCHNINA.

LIQUOR THYROIDEI, *Br.*—Thyroid Solution.

Thyroid essence, Thyroid extract, E.; *Schilddrüsenessenz, Schilddrüsenextrakt*, G.

A liquid prepared from the fresh and healthy thyroid gland of the sheep.—Br.

The Br. P. gives the following directions for its preparation: Remove the external fat and connective tissue from thyroid glands taken from sheep immediately after kill-

ing; cut the glands across, and reject any that contain cysts, are hypertrophied, or are otherwise abnormal. Count the healthy glands that remain; slice them and bruise them thoroughly in a mortar; for each entire gland (consisting of two lobes) add 34 minims of glycerin and 34 minims of a 0.5 per cent. solution of phenol in distilled water; transfer the mixture, well stirred, to a flask, and close the neck with a plug of cotton-wool; allow it to stand for 24 hours; strain then through linen, with strong pressure; add to the strained liquid sufficient of the 0.5 per cent. solution of phenol to make 100 minims of the solution for each gland used.

Properties.—Thyroid Solution is a pinkish, turbid liquid, entirely free from odor of putrescence. It must be freshly prepared, and kept in well-stoppered, sterilized bottles.

In order that a perfectly satisfactory preparation may be obtained it is essential that every precaution be taken to avoid contamination with dirt, and that the glands are absolutely free from disease. The lobes of the thyroid gland frequently occur separate, and it should be borne in mind that 2 lobes constitute 1 gland. Carbolated water is used as a preservative, but according to White and Humphrey is inferior to chloroform water of the same strength for the purpose desired.

Action and Uses.—The value of this preparation is described in the article on THYROID GLAND (which see).

LIQUOR ZINCI CHLORIDI, *U. S., Br.*—Solution of Zinc Chloride.

Chlorure de zinc liquide, Solution de Burnett, Fr.; *Chlorzinklösung, Flüssiges Chlorzink,* G.

An aqueous solution of zinc chloride, $ZnCl_2$—containing about 50 per cent. by weight of the salt.

Preparation.—Zinc, granulated, 240 Gm.; hydrochloric acid, 840 Gm.; nitric acid, 12 Gm.; precipitated zinc carbonate, 12 Gm.; distilled water, a sufficient quantity. To the zinc, contained in a glass or porcelain vessel, add 150 Cc. of distilled water; then gradually add the hydrochloric acid, and digest, until the acid is saturated. Pour off the solution, add the nitric acid, evaporate the solution to dryness, and heat the dry mass to fusion at a temperature not exceeding 115° C. (239° F.). Let it cool, and dissolve it in a sufficient amount of distilled water to make the product weigh 1000 Gm. Then add the precipitated zinc carbonate, agitate the mixture occasionally during twenty-four hours, and then set it aside until it has become clear by subsidence. Finally, separate the clear solution by decantation or by means of a syphon.—U. S.

The above formula will yield about 22 fluidounces of solution.

The Br. P. directs that granulated zinc 1 pound be added to a mixture of 44 fluidounces of hydrochloric acid and 20 fluidounces of water, and a gentle heat applied as long as gas is evolved. The mixture is then boiled for one-half hour, supplying the water lost by evaporation, and allowed to cool. If upon testing a few drops of the liquid iron or lead be found present, the liquid is to be filtered and solution of chlorine added by degrees, with frequent agitation until the liquid acquires a permanent odor of chlorine; zinc carbonate is then added in small quantities at a time, with renewed agitation, until a brown sediment appears and the whole of the iron or lead is thus precipitated. Finally the liquid is filtered and evaporated to the bulk of 2 pints (Imperial measure).

Zinc dissolves in hydrochloric acid with the evolution of hydrogen gas, $Zn_2 + 4HCl$ yields $2ZnCl_2 + 2H_2$. The iron contained in the solution is first oxidized in the one case by nitric acid and in the other by chlorine gas. To avoid contamination with nitrate, the former solution is evaporated to dryness, redissolved in water, and then treated with zinc carbonate, whereby ferric oxide is precipitated. The process of the British Pharmacopœia arrives at the same result in a similar manner, except that an evaporation of the liquid to dryness is not necessary. 1 pound of zinc yields about 33½ ounces of zinc chloride, which are contained in 40 (Imperial) fluidounces of the solution. The specific gravity is stated to be 1.548 at 25° C. (77° F.) U. S., 1.530 Br.

Properties.—The solution is a colorless and inodorous liquid which has the disagreeable metallic taste of zinc salts, and an acid reaction, and is miscible with alcohol and water without producing a precipitate. It should conform to the reactions and tests given under ZINCI CHLORIDUM.

The French Codex directs 1 part of fused zinc chloride to be dissolved in 2 parts of

water, the solution to be of specific gravity 1.33. Burnett's liquid contained 200 grains of zinc in the Imperial fluidounce, and was stated to have the specific gravity 2.0 and to contain about 50 per cent. of $ZnCl_2$.

Action and Uses.—This solution is not employed in internal medicine. It was formerly used for disinfecting hospitals, ships, cesspools, etc.; but at present it is seldom employed.

LIQUORES.—Solutions.

Solutés, Fr.; *Lösungen*, G.

With the exception of infusions, decoctions, and syrups, and of those aqueous liquids containing volatile oils or gases, all aqueous solutions are, by the U. S. Pharmacopœia, designated *Liquores;* the British and some other pharmacopœias embrace under the same head also aqueous solutions of gases. The German Pharmacopœia is inconsistent in its designation, lime water, chlorine water, and lead water being placed among *Aquæ*, while ammonia water is regarded as a *liquor*. Gutta-percha solutions and blistering liquids alone have a menstruum other than water. Many saline solutions develop a cryptogamic vegetation altering the nature and properties of the dissolved compounds; this is particularly the case with phosphates in the presence of organic substances. through the rapid growth of an alga, *Hygrocrocis phosphaticus*, which, according to Jacquemaire (1888), is prevented by the presence of carbon dioxide in excess.

LITHII BENZOAS, *U. S.*—Lithium Benzoate.

Lithium benzoicum. — *Benzoate de lithine*, Fr.; *Lithiumbenzoat, Benzoesaures Lithium*, G.

Formula $LiC_7H_5O_2$. Molecular weight, 127.11.

It should contain not less than 98.5 per cent. of pure salt, and be kept in well-stoppered bottles.—U. S.

Preparation.—This salt is made by decomposing lithium carbonate with benzoic acid, and according to Shuttleworth (1875), it is most advantageous to add the acid to the carbonate. 100 grains of the latter are heated with 900 grains (2 fluidounces) of distilled water, when 330 grains of benzoic acid or a sufficient quantity of it is added in small portions until effervescence is no longer produced. The filtrate is evaporated to dryness with constant stirring, and the salt rubbed to powder, or the hot somewhat concentrated solution may be set aside to crystallize on spontaneous evaporation. The yield will be 346 grains.

Properties.—Lithium benzoate is a white salt, forming either a light crystalline powder or small glistening pearly scales, which feel greasy to the touch and are sometimes aggregated to moss-like forms. Berzelius stated the salt to be hygroscopic, but Shuttleworth, and afterward Raskowsky (1886), showed it to be permanent in the air. It has a slight odor, like that of medicinal benzoic acid, or if free from aromatic compounds is inodorous; its taste is alkaline, somewhat cooling and sweetish; its reaction to test-paper is slightly acid. It dissolves at 25° C. (77° F.) in 3 parts of water and in 13 parts of alcohol, and at the boiling temperature in 2.5 parts of water and 10 parts of alcohol (U. S.). The presence of sodium benzoate increases the solubility in water and lessens that in alcohol. When heated, the salt melts, and at a higher temperature chars and emits aromatic inflammable vapors of benzene and other decomposition-products of benzoic acid, a portion of the latter subliming unaltered; the black residue left contains charcoal and lithium carbonate. The aqueous solution of the salt is decomposed by mineral acids, but not by carbon dioxide, and yields with ferric chloride a flesh-colored precipitate soluble in hydrochloric acid and in alcohol.

Tests.—If an excess of hydrochloric acid be added to a concentrated aqueous solution of 0.6 Gm. of the salt, and the white precipitate of benzoic acid be filtered, thoroughly washed, and dried, it should respond to the tests of purity given under ACIDUM BENZOICUM. If the filtrate and washings from this precipitate be evaporated almost to dryness on a water-bath in a 50 Cc. flask, and 10 Cc. of amyl alcohol (boiling-point 132° C.) be added, and the mixture cautiously heated until the lower aqueous layer has evaporated, which may be facilitated by passing a current of air through the hot solution, then, after the addition of 3 drops of hydrochloric acid and boiling for 3 minutes, the

resulting insoluble residue should weigh not more than 0.004 Gm. (limit of other alkalies). This test and separation depends upon the fact that lithium chloride is soluble in amyl alcohol, while the chlorides of the other alkali metals are insoluble. If the benzoic acid be precipitated from 1 Gm. of the salt in 20 Cc. of water by an excess of hydrochloric acid, a portion of the filtrate, after rendering alkaline with ammonia water, should produce neither a turbidity nor precipitate, either before or after boiling (absence of iron, aluminum, etc.). Another portion of the filtrate should not be colored or made turbid by an equal volume of hydrogen sulphide solution, after standing corked at 35° C. (95° F.) for at least half an hour, either before or after rendering alkaline with ammonia water (absence of heavy metals). If 0.5 Gm. of the salt be thoroughly mixed with about 1 Gm. of powdered anhydrous ammonium sulphate, and cautiously ignited in a porcelain crucible, until of constant weight, the residue should weigh not less than 0.210 Gm., nor more than 0.216 Gm.—U. S.

In the last-mentioned test, lithium sulphate, Li_2SO_4, is formed, which is non-volatile, while ammonium benzoate volatilizes. Theoretically, 254.22 parts of pure lithium benzoate should leave a residue of 109.31 parts of sulphate, or 43 per cent.; hence 0.5 Gm. of the pure salt should leave a residue of 0.215 Gm. of sulphate. This figure falls between the minimum and maximum residue allowed by the Pharmacopœia. A residue greater than the theoretical may be caused by the presence of alkali metals, whose atomic weights are higher than those of lithium, as sodium or potassium.

Action and Uses.—Lithium benzoate has been employed as a substitute for Benzoic Acid (which see) in the treatment of gouty and rheumatic affections and calculous disorders. The dose is from 15 to 30 grains (1–2 Gm.), in solution.

LITHII BROMIDUM, *U. S.*—Lithium Bromide.

Lithium bromatum.—Bromure de lithium, Fr.; *Bromlithium, Lithiumbromid*, G.

Formula, LiBr. Molecular weight, 86.34.

Lithium bromide should be kept in well-stoppered bottles, and should contain not less than 97 per cent. of pure salt when well dried.—U. S.

Preparation.—Yvon (1875) prepared the salt by dissolving lithium carbonate in hydrobromic acid and evaporating; or, 37 Gm. of the carbonate are converted into neutral sulphate, dissolved in a small portion of water, and mixed with a concentrated aqueous solution of 119 Gm. of potassium bromide; the mixture is well stirred, the liquid separated by filtration, evaporated to dryness, and treated with alcohol, which leaves potassium sulphate undissolved; the alcoholic solution is evaporated to dryness. A convenient method for preparing the salt consists in forming, first, ferrous bromide by gradually adding 399 grains of bromine to 300 grains of iron and 900 grains (2 fluidounces) of water; the green solution is filtered, heated, and in a flask agitated with 186 grains of lithium carbonate; when cool, the liquid is filtered and evaporated, yielding 434 grains of lithium bromide. Lithium bromide may be obtained in crystals by evaporating its syrupy solution over sulphuric acid. The anhydrous salt contains nearly 92 per cent. of bromine.

Properties.—Lithium bromide is a very deliquescent salt, and on this account not readily obtainable in crystals, but is usually kept in the form of a white powder more or less granular. It is inodorous, and has a somewhat pungent (sharp, U. S.) and bitterish taste and a neutral reaction. It imparts a crimson color to flame, melts at a dull-red heat, and at a white heat is slowly volatilized. It is freely soluble in alcohol, also in ether, and dissolves at 25° C. (77° F.) in 0.6 part and at 100° C. (212° F.) in 0.3 part of water (U. S.). The concentrated, but not the largely diluted, aqueous solution yields a white precipitate with ammonium carbonate, On the addition of a few drops of chlorine water bromine is liberated, which dissolves in carbon disulphide with a brown-yellow or yellowish-brown color without a violet tint (absence of and difference from iodide).

Tests.—If 0.5 Cc. of sodium cobaltic nitrite test-solution be added to 5 Cc. of an aqueous solution of the salt (1 in 20), no precipitate or turbidity should occur within 10 minutes (limit of potassium). If to 0.4 Gm. of the salt in a 50 Cc. flask an excess of hydrochloric acid be added, and the mixture evaporated nearly to dryness on a water-bath, and if 10 Cc. of amyl alcohol (boiling-point 132° C.) be added and the mixture cautiously heated until the lower aqueous layer has evaporated, which may be facilitated by passing a current of air through the hot solution, then, after the addition of 3

drops of hydrochloric acid and boiling for 3 minutes, the resulting insoluble residue should weigh not more than 0.007 Gm. (limit of other alkalies). This test and separation depends upon the fact that lithium chloride is soluble in amyl alcohol while the chlorides of the other alkali metals are not. The addition of a slight excess of ammonia water to the previously acidified aqueous solution of the salt (1 in 20) should produce neither a turbidity nor a precipitate, either before or after boiling (absence of iron, aluminum, etc.). An aqueous solution of the salt (1 in 20), acidified with hydrochloric acid, should give neither a color nor a turbidity when mixed with an equal volume of hydrogen sulphide solution and kept corked at 35° C. (95° F.) for at least half an hour, either before or after adding ammonia water to slight alkalinity (absence of heavy metals). If 1 Gm. of the dry salt be dissolved in water to the volume of 100 Cc., then 20 Cc. of the solution, with 2 drops of potassium chromate test-solution, should require not less than 23.2 Cc. nor more than 24.4 Cc. of tenth-normal silver nitrate solution to produce a permanent red color.—U. S. Since 1 Cc. of the silver solution corresponds to 0.008634 Gm. of pure dry lithium bromide, 0.2 Gm. of such a salt would require 23.16 Cc. of the silver solution for precipitation, which practically coincides with the lower pharmacopœial figure, 23.2 Cc., the slight excess of the latter being required to give color to the indicator. But the pharmacopœial figure does not allow for the permissible limit of "other alkalies" present in the lithium bromide, which in the form of bromides would cause the titration figure to fall below the theoretical figure for a pure salt. It is possible for the salt to be contaminated with chloride, which would tend to throw the titration figure above the theoretical one, and chloride and "other alkalies" may be present in such proportion as to counteract each other and cause the titration to yield a figure identical with that for a pure salt. If the lithium bromide as found on the market always contains some chloride, then the pharmacopœial figure, 23.2 Cc., corresponding to a pure salt, is compatible with the permissible "other alkalies." The higher figure of the official assay, 24.4 Cc. of silver solution, limits the amount of chloride in the lithium bromide.

Action and Uses.—The employment of lithium bromide is practically the same as that of POTASSIUM BROMIDE (which see). It is thought by S. Weir Mitchell to be more hypnotic than the other bromides, but there is no experimental evidence to justify this claim. The dose is from 10 to 30 grains (0.6–2 Gm.), in solution.

LITHII CARBONAS, *U. S., Br.*—Lithium Carbonate.

Lithium carbonicum, P. G.; *Carbonate of lithia*, E.; *Carbonate de lithine, Carbonate lithique*, Fr.; *Lithiumkarbonat, Kohlensaures Lithium*, G.

Formula, Li_2CO_3. Molecular weight, 73.51.

Lithium carbonate should contain not less than 98.5 per cent. of the pure salt.

Preparation.—Lithium carbonate is prepared by various processes from *lepidolite*, a silicate mineral containing lithium. One of these is as follows: The mineral is heated with sulphuric acid; the aqueous solution, containing impure lithium sulphate, may be freed from most of the sulphates of aluminum and the alkalies by crystallizing them as alum, or it is treated with lime to separate metallic oxides and earths, and then precipitated by barium chloride to remove sulphate, and by ammonium oxalate to remove calcium. After evaporating to dryness, lithium chloride is dissolved by a mixture of alcohol and ether, and thus freed from the chlorides of rubidium, cæsium, sodium, and potassium, with which metals it is associated in the lepidolite. The concentrated aqueous solution of lithium chloride, treated with ammonium carbonate, yields a precipitate of lithium carbonate, which is washed with alcohol; the filtrate from the precipitate on being evaporated to dryness and ignited yields as chloride the lithium which had remained in solution. Lithium carbonate can only be prepared on a large scale, and it is the source from which all other lithium compounds are obtained.

Properties.—Lithium carbonate is a light white amorphous powder or is in minute crystalline grains. It has the specific gravity 2.11, is permanent in the air, inodorous, has a mild alkaline taste and a distinct alkaline reaction, and imparts a carmine color to flame. It is insoluble in alcohol, but soluble in 140 parts of boiling water and in 75 parts at 25° C. (77° F.); much more soluble in water saturated with carbon dioxide (U. S.), 70 parts of cold water (Br.). The solution has an alkaline reaction, precipitates the salts of the heavy metals, and on boiling decomposes ammonium salts. On heating the salt to dull redness it melts to a transparent liquid, loses a portion of its

carbon dioxide, and congeals on cooling to pearly oxycarbonate, which is permanent in the air; the fused salt corrodes glass, silver, and platinum. It dissolves with effervescence in dilute hydrochloric acid, and the solution, evaporated to dryness, leaves a residue of lithium chloride, which is soluble in spirit of ether, and the neutral solution of which yields a white precipitate with sodium phosphate.

Tests.—If 1 Gm. of lithium carbonate be dissolved in 40 Cc. of diluted acetic acid, no insoluble residue should remain. If 1 part of the salt be added to 20 parts of water and just sufficient hydrochloric acid be added for solution, then boiled and cooled, separate portions of the solution should respond to the tests for iron, aluminum, and heavy metals given under LITHII BROMIDUM. 0.2 Gm. of the salt dissolved in a slight excess of hydrochloric acid, and further treated as described under LITHII BROMIDUM, should leave a residue of not more than 0.003 Gm. (limit of other alkalies). If 0.5 Gm. of the salt be dissolved in 20 Cc. of normal sulphuric acid, it should require not more than 6.6 Cc. of normal alkali to neutralize the excess of acid in the solution, using methyl-orange test-solution as indicator.—U. S.

In this titration, 1 Cc. of normal acid represents 0.036755 Gm. of pure lithium carbonate, hence 13.4 Cc. (20–6.6 Cc.) represents 0.4925 Gm., or 98.5 per cent. The Br. P. requires the same per cent., which is determined by converting the carbonate into sulphate and weighing after heating to redness.

Action and Uses.—Lithium carbonate was formerly employed with the idea that it combined with the uric acid in the body and formed soluble urates which were eliminated by the kidneys. It was supposed that its administration not only prevented the formation of uric acid deposits in the joints, kidneys, and bladder, but also caused their solution. It is now known that this salt has a greater affinity for the acid sodium phosphate in the blood than for uric acid, and that the large quantity of water ingested during its administration is largely responsible for the removal of the latter substance. Lithium carbonate taken internally does not dissolve gouty deposits in the tissues, but it may be employed for the purpose of rendering the urine alkaline. When given in conjunction with copious draughts of water, it is sometimes beneficial in the treatment of rheumatoid arthritis and diabetes due to a gouty diathesis. It is, moreover, thought by some to be a valuable remedy in gout and chronic rheumatism. The dose is from 5 to 15 grains (0.30–1 Gm.), 3 times daily.

LITHII CITRAS, *U. S.*, *Br.*—Lithium Citrate.

Lithiæ citras, Lithium citricum.—Citrate of lithia, E.; *Citrate de lithine,* Fr.; *Lithiumcitrat, Citronsaures Lithium,* G.

Formula, $Li_3C_6H_5O_7 + 4H_2O$. Molecular weight, 280.08.

Lithium citrate should be kept in well-stoppered bottles, and, when carefully dried, should contain not less than 98.5 per cent. of the pure salt.

Preparation.—No official method is given in the pharmacopœias. Lithium citrate can be prepared by adding lithium carbonate to a solution of citric acid until the latter is neutralized, and evaporating the liquid to dryness, gradually raising the temperature to 115° C. (239° F.). As shown by the equation, $2H_3C_6H_5O_7.H_2O + 3Li_2CO_3 = 2Li_3C_6H_5O_7 + 3CO_2 + 4H_2O$, 419 parts of citric acid requires 221.61 parts of lithium carbonate, the yield of citrate being equal to the weight of acid used.

This method gives the anhydrous salt which was official in the U. S. P., 1890. If the above-mentioned solution be concentrated and allowed to crystallize, the resulting salt will have the formula, $Li_3C_6H_5O_7 + 4H_2O$, and contain 25.5 per cent. of water of crystallization, one-fourth of which cannot be eliminated at the temperature of a boiling water-bath; this is the salt recognized in the Br. P. and the present U. S. P. (1900).

Both the anhydrous salt in powder-form and the crystallized occur in commerce. For dispensing in solution the salt may well be prepared extemporaneously, the proportion of citric acid to lithium carbonate being 1000 : 528.6 (or 10 : 5.3), with a yield of 1000 (or 10) parts; on triturating in a mortar with a small quantity of hot water the decomposition is readily effected. Hager recommends precipitation of the concentrated slightly acid solution with alcohol, when the normal salt, containing 2 molecules, or 14.63 per cent., of water, is precipitated.

Properties and Tests.—Lithium citrate is a white powder or colorless crystals, dissolves in 2 parts of water at 25° C. (77° F.), and in 1.5 parts of boiling water (U. S.),

and may be obtained crystallized from a concentrated solution on standing. It is almost insoluble in alcohol or ether, and deliquesces in moist air (U. S.).

Investigation has shown that the commercial lithium citrate offered in this country is by no means uniform in composition, varying from an anhydrous salt to one containing one or more molecules of water; moreover, according to L. F. Kebler, the anhydrous salt is more or less hygroscopic, but becomes non-hygroscopic after a certain amount of moisture has been absorbed.

The salt has a neutral reaction to test-paper, is inodorous, has a saline, somewhat cooling taste, is soluble in glycerin, and insoluble or nearly so in alcohol. When heated, it blackens, gives off inflammable gases of a pungent odor, and finally a white residue is left, which, if neutralized with hydrochloric acid, is soluble in alcohol, and the solution, ignited, burns with a carmine color. The salt is recognized as a citrate by mixing its aqueous solution with calcium chloride, filtering if necessary, and heating the clear liquid, when a precipitate of calcium citrate will be deposited.

If the residue obtained by igniting 0.2 Gm. of the salt at a red heat be treated with a slight excess of diluted hydrochloric acid, and the filtrate and washings be further treated as described under LITHII BROMIDUM, the insoluble residue obtained should weigh not more than 0.002 Gm. (limit of alkalies). The solution of the salt (1 in 20) acidulated with hydrochloric acid, should not be colored or rendered turbid by an equal volume of hydrogen sulphide solution, when kept corked for at least half an hour at 35° C. (95° F.), either before or after making slightly alkaline with ammonia water (absence of heavy metals). If 0.5 Gm. of the anhydrous salt be cautiously ignited in a porcelain crucible, and the residue when cold be moistened with a few drops each of nitric and sulphuric acids and again cautiously ignited, and this repeated until the residue becomes white and constant in weight, the lithium sulphate thus obtained should be not less than 0.387 Gm., nor more than 0.394 Gm., and after dissolving in 10 Cc. of boiling water and acidifying with hydrochloric acid, then adding ammonia water in excess, it should not give a turbidity or precipitate, either before or after boiling (absence of iron, aluminum, etc.).—U. S.

417.12 parts of pure anhydrous lithium citrate would yield 327.93 parts of lithium sulphate, or 0.5 Gm. would yield 0.39308 Gm. of sulphate; hence 0.387 Gm. of sulphate in the test above represents 98.45 per cent. of pure salt. A residue of sulphate greater than the theoretical would indicate presence of other alkalies or impurities. The Br. P. requires that when 2 Gm. of the crystallized salt are dried at 100° C. (212° F.), it should lose about 6.38 Gm., and at 115.5° C. (240° F.) an additional 0.13 Gm., and on incinerating to whiteness 0.77 Gm. residue should remain, corresponding to 98.5 per cent. of pure citrate. F. B. Power (1900) calls attention to the fact that constant weight cannot be obtained at 100° C. (212° F.), and that all the water is not expelled at 115.5° C. (240° F.), but that a temperature of 140° C. (284° F.) is necessary.

Action and Uses.—The employment of this salt is the same as that of LITHIUM CARBONATE (which see). It is given in doses of from 10 to 20 grains (0.60–1.3 Gm.), in solution.

LITHII CITRAS EFFERVESCENS, *U. S.*, *Br.*—Effervescent Lithium Citrate.

Limonade sèche au citrate de lithine, Fr.; *Brauselithiumcitrat*, G.

Preparation.—Lithium citrate, 50 Gm.; sodium bicarbonate, dried and powdered, 570 Gm.; tartaric acid, dried and powdered, 300 Gm.; citric acid, uneffloresced crystals, 195 Gm. Powder the citric acid and mix it intimately with the lithium citrate and tartaric acid, then thoroughly incorporate the sodium bicarbonate. Place the mixture on a plate of glass or in a suitable dish, in an oven heated between 93° and 104° C. (199.4° and 219.2° F.). When the mixture, by the aid of careful manipulation with a wooden spatula, has acquired a moist consistence, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles.—U. S.

To prepare 4 avoirdupois ounces of the effervescent salt, use 87½ grains of lithium citrate, 987½ grains of sodium bicarbonate, 525 grains of tartaric acid, and 341 grains of citric acid in uneffloresced crystals, and proceed as directed above.

The formula of the present Pharmacopœia differs materially from that of 1890, since lithium citrate is used in place of a corresponding quantity of lithium carbonate and citric acid, and all sugar is omitted. The amount of lithium salt in the finished product is also considerably less than formerly, being equal to about 5 instead of 13.2 per cent. As the sodium bicarbonate will lose part of its carbonic acid during the heating, the weight of the final product will be reduced to that extent, and therefore amount to about 1000 Gm. The quantity of citric and tartaric acids ordered are just sufficient to neutralize the prescribed amount of alkali, the liberated carbonic acid, when the salt is dissolved in water, rendering the taste agreeably acidulous. The following formula of the British Pharmacopœia is almost identical with the preceding: Take 58 parts of sodium bicarbonate, 31 parts of tartaric acid, 21 parts of citric acid, and 5 parts of lithium citrate. The lithium citrate and citric acid are mixed, the tartaric acid is then added, and finally the sodium bicarbonate, the whole being thoroughly triturated and dried at 93.3°–104.4° C. (200°–220° F.) to granular form. The granules are dried at a temperature not exceeding 54.4° C. (130° F.); weight of product about 100 parts.

Action and Uses.—This combination forms an agreeable method for the administration of lithium citrate. The dose is from 1 to 2 drachms (4–8 Gm.).

LITHII SALICYLAS, *U. S.*—Lithium Salicylate.

Lithium salicylicum, P. G.; *Salicylate de lithine*, Fr.; *Lithiumsalicylat*, G.

Formula, $LiC_7H_5O_3$. Molecular weight, 142.99.

Lithium salicylate should contain not less than 98.5 per cent. of the pure salt.

Preparation.—This salt may be prepared by warming on a water-bath at 60° C. (140° F.) a mixture of 10 parts of lithium carbonate, 38 parts of salicylic acid, and 70 parts of water. After reaction is over, the liquid should be slightly but distinctly acid; if not so, more acid should be added. The liquid is then filtered through an iron-free paper and evaporated at 60° C. (140° F.). The mass is finally thoroughly dried in a drying-oven. The above conditions must be observed if a colorless product is desired. Keep in well-stoppered bottles. The pure salt of weakly acid reaction is not affected by light.

Properties.—The salt may be obtained crystallized in needles, but is usually met with as a white powder, deliquescent on exposure to air, odorless or nearly so, having a sweetish taste and a faintly acid reaction; very soluble in water and alcohol. When heated, the salt is decomposed, emitting the odor of phenol, and finally leaves a black residue having an alkaline reaction, which imparts a crimson color to a non-luminous flame. On supersaturating the dilute aqueous solution with hydrochloric acid a bulky white precipitate of salicylic acid is obtained which is soluble in boiling water, from which it crystallizes on cooling; also soluble in ether, and producing an intense violet color with ferric salts. On adding to a small portion of the salt, in a test-tube, about 1 Cc. of concentrated sulphuric acid, and then, cautiously, about 1 Cc. of methyl alcohol in drops, on heating the mixture to boiling the odor of oil of gaultheria will be evolved.

Tests.—The aqueous solution should be colorless (absence of iron and organic coloring-matters) and not effervesce on the addition of an acid (absence of carbonate). If copper sulphate test-solution be added to an aqueous solution of the salt (1 in 20), the mixture should have a bright-green color. If an excess of hydrochloric acid be added to a concentrated aqueous solution of 0.7 Gm. of the salt, the precipitate, when thoroughly washed and dried on a filter, should conform to the reactions and tests given under ACIDUM SALICYLICUM; the filtrate and washings, if treated further as described under LITHII BENZOAS, should yield an insoluble residue weighing not more than 0.005 Gm. (limit of other alkalies). If 1 Gm. of the salt be dissolved in 20 Cc. of water, and the salicylic acid precipitated by a sufficient quantity of hydrochloric acid, the filtrate should respond to the tests for iron, aluminum, heavy metals, etc., given under LITHII BENZOAS. When assayed by the method given for the latter salt, 0.5 Gm. of dry lithium salicylate should yield not less than 0.188 Gm., nor more than 0.192 Gm., of lithium sulphate.—U. S.

285.98 parts of pure dry lithium salicylate would yield 109.31 parts of the sulphate,

or 0.5 Gm. would yield 0.19111 Gm. of the sulphate; hence 0.188 Gm. of sulphate in the assay represents 98.37 per cent. of pure salicylate.

Action and Uses.—The medicinal properties and untoward effects of lithium salicylate differ in no particular from those of sodium salicylate (see Sodii Salicylas), except that it is said not to irritate the stomach. The average daily dose is from 40 to 60 grains (2.6–4 Gm.), best administered in aqueous solution.

LITHIUM.—Lithium.

Lithium, Fr., G.

Symbol, Li. Atomic weight, 6.98. Univalent in nearly all of its compounds.

Lithium is a member of the family of elements known as the alkali metals. It occurs in nature very widely distributed, but in small quantities. As silicate it is found in the minerals petalite, triphane, lepidolite, spodumene, and tourmaline, as phosphate in triphyline and amblygonite. It is found in minute quantities in the ashes of some plants, as sea-tangle and tobacco, and in many mineral springs, often as carbonate; the waters of the Mur spring at Baden-Baden and of a hot spring at Wheel-Clifford, in Cornwall, are the richest known, the latter, according to W. A. Miller (1864), containing 26.05 grains of LiCl in the Imperial gallon. Lithium is said to occur in the mother-liquors of tartaric acid manufacture in sufficient quantity to justify extraction. Lithium was discovered by Arfvedson (1817) in petalite and other Swedish minerals, and by Berzelius (1822) in the mineral waters of Carlsbad, Marienbad, and Franzensbrunn. It is obtained from the minerals (usually lepidolite, which contains 3.6 per cent.) in the form of carbonate (see this), which is the mother-substance for preparing all other salts. The metal was first isolated by Bunsen and Matthiessen, 1855. It is now obtained by electrolysis of the molten chloride.

Lithium is silver-white, shining, much harder than potassium or sodium, but softer than lead. It melts at 186° C. (366.8° F.), but is not volatile at red heat, has the specific gravity 0.59, is the lightest of all metals, burns when heated in air or in oxygen to lithium oxide, Li_2O, and like sodium decomposes water at the ordinary temperature, forming hydrogen and lithium hydroxide. It has a remarkable affinity for nitrogen, combining with it slowly in the cold; but when heated, it burns in nitrogen energetically, forming lithium nitride, Li_3N.

Contrary to the other alkali metals, lithium forms an infusible, stony, white oxide, Li_2O, which dissolves in water only slowly. Lithium hydroxide, LiOH, is less hygroscopic and less soluble in water than sodium hydroxide and sparingly soluble in alcohol.

Lithium nitrate, $LiNO_3$, is much more deliquescent than sodium nitrate. **Lithium sulphate** forms glistening prisms, $Li_2SO_4.H_2O$, soluble in 3 parts of ice-water and in 3.5 parts of hot water. Lithium salts are as a rule freely soluble in water, but the carbonate and phosphate are striking exceptions, and in this respect lithium shows a marked contrast to the other alkali metals and exhibits an approach to the alkaline earth metals. The carbonate is official and has been described. The **phosphate,** $Li_3PO_4 + \frac{1}{2}H_2O$, formed by addition of disodium phosphate to a lithium salt in solution, is a heavy, white, granular powder, which loses its crystal-water at 100° C. and requires 2540 parts of pure water, or 3920 parts of ammoniacal water for solution. **Lithium fluoride,** like calcium fluoride, is insoluble in water. **Lithium chloride,** LiCl, crystallizes in cubes, is easily fusible, salty, and deliquescent. It forms crystalline compounds with alcohol and many other organic bodies, and absorbs ammonia gas with great energy; in these respects it behaves remarkably much like calcium chloride. If a mixture of the chlorides of lithium, sodium, and potassium is treated with alcohol, only the lithium chloride is dissolved, and thus can be separated from the other chlorides. Besides the official salts, various other salts of lithium have been put on the market as remedies for various ills. Some of these are the following: Lithium bitartrate (tartarlithin), L. formate, L. glycerophosphate, L. hippurate, L. iodate, L. sulphoichthyolate, and L. theobromine-salicylate (uropherin). For details in reference to the last-named compound, see under Sodii Salicylas.

LOBELIA, *U. S., Br.*—Lobelia.

Herba lobelia, P. G., P. A.—*Indian or Wild tobacco, Asthma-weed, Puke-weed, Bladder pod*, E.; *Lobelienkraut*, G.; *Lobélie enflée*, Fr.; *Tobaco Indiano*, Port.

The dried leaves and tops of *Lobelia inflata* L. (Fam. *Campanulaceæ*), collected after a portion of the capsules have become inflated.

Lobelia is official in all pharmacopœias, though they differ considerably in the wording, and to some extent in the meaning of their definitions. The British says merely "The dried flowering herb"; the German, "The dried upper portion of the flowering plant." The drug is probably somewhat more active in the state required by the U. S. P., since it then bears some seeds.

Fig. 260.

Lobelia (¾ Nat.).

Origin.—The plant is an annual herb, growing usually in open, somewhat grassy and rather dry locations throughout eastern and central North America. Flowering commences in early to middle

Fig. 261.

Lobelia-seed, magnified.

Fig. 262.

Flower, and section through stamens and pistil (× 5).

summer and continues till fall, the plant branching continuously until destroyed by cold weather. Although growing abundantly in pastures, it is not eaten by grazing animals.

Description.—More or less, usually sparsely, clothed on the stems and leaves, especially on the veins of the lower leaf-surfaces, with stout, spreading, white hairs; stems coarsely angled, often purplish; leaves alternate, exstipulate, sessile or very shortly petioled, rarely exceeding 5 Cm. (2 In.) long and about half as broad, ovate or oval, usually obtusish, irregularly and shortly serrate-dentate, the teeth usually with whitish tips; mostly pale- or yellowish-green; racemes terminating the branches, elongated, loosely flowered; flowers bracted, short-pedicelled, about 6 to 8 Mm. (¼ to ⅓ In.) long, the calyx-tube adherent, ovoid, and shorter than the 5 slender teeth, becoming much larger, globular, and inflated after flowering; corolla blue, tubular, with the tube cleft along the upper side, 2-lipped and irregular, the 5 stamens having both filaments and anthers coherent; capsule inflated, 2-celled, containing numerous seeds; odor narcotic, irritating; taste becoming burning and acrid.

The drug is not adulterated, but often contains an undue amount of the stemmy portion, or even the root.

Constituents.—Lobelia contains gum, resin, fixed oil, the alkaloid *lobeline* combined with *lobelic acid*, *lobelacrin*, *inflatin*, and *lobelianin*, a pungent, odorous volatile oil with but little taste. The seeds contain the most lobeline, and 30 per cent. of a nearly odorless, bland, drying, fixed oil. *Lobeline* ($C_{18}H_{23}O_3$?) has been always considered a yellowish oily liquid, lighter than water, of somewhat aromatic odor and persistent acrid taste, and forming crystalline salts with mineral acids. But Lloyd (1886) claims to have separated from this the pure lobeline as a colorless, odorless, amorphous, non-hygroscopic body, soluble in alcohol, ether, chloroform, benzene, and carbon disulphide, slightly soluble in water, easily decomposable by heat, and not forming crystallizable salts. *Lobelacrin* forms brown warty tufts soluble in ether and chloroform, and only slightly in water. Boiled with dilute acids or alkalies it splits into sugar and lobelic acid. *Inflatin* is a colorless, tasteless, odorless, neutral principle, insoluble in water or glycerin, but soluble in chloroform, ether, benzol, and carbon disulphide, and slightly in alcohol.

Pharmaceutical Preparations.—Ethereal Tincture of Lobelia, N. F.; Fluid-extract of Lobelia, Tincture of Lobelia, U. S. P.; Vinegar of Lobelia, N. F.

Action and Uses.—Overdoses of lobelia produce violent nausea and vomiting, muscular relaxation, intense prostration, respiratory and circulatory depression, a cold, clammy skin, and subnormal temperature. If the dose is sufficiently large, collapse with coma and occasionally convulsions precede death. The drug depresses the motor nerve-trunks, the peripheral vagi, and the respiratory centre. The heart and peripheral circulation are at first depressed, but secondarily blood-pressure is increased because of the asphyxia which it produces. Cases of poisoning should be treated by the application of external heat, the administration of rapidly acting diffusible stimulants, such as ammonia, to support the circulation, and the employment of opium to relieve pain and vomiting. Lobelia may be employed in the treatment of spasmodic asthma, unless due to cardiac disease, when its administration is contraindicated. It has also been employed for croup, catarrh, whooping-cough, and chronic bronchial affections, but has never been highly esteemed in these conditions. Given in small doses it is thought to be valuable in the treatment of atonic constipation when the feces are hard and dry.

As an expectorant the dose is from 10 to 20 minims (0.6–1.3 Cc.) of the tincture. As an emetic it may be given in doses of from 1 to 2 fluidrachms (4–8 Cc.). Vinegar of lobelia, a 10 per cent. preparation made by maceration with dilute acetic acid, may be employed in the same doses.

Allied Products.—The genus *Lobelia*, L., comprises some 200 species, distributed through temperate and tropical regions of almost the entire world. Almost wherever found they are in bad repute for their poisonous properties. Some 20 species are recorded as being medicinally employed or of importance as poisons. *L. nicotianifolia* Heyne (*Dhvala, Adavi-pokaku, Bokenul*, etc.), of India, is employed like *L. inflata*, as is *L. Delisseana* Gaud., of the Sandwich Islands.

L. cardinalis L., the *Cardinal flower* or *Scarlet lobelia* of the eastern United States, is somewhat used as an anthelmintic. *L. syphilitica* L., the *Great lobelia* or *Blue cardinal flower*, abundant in swampy grounds of eastern and central North America, is an old-time remedy for syphilis, and its seeds are employed like those of *L. inflata*. It is a rather stout, very leafy perennial, 1 to 3 feet high, slightly hairy upon the stem. The leaves are 5 to 15 Cm. (2 to 6 In.) long, and about a third as wide, oblong-ovate, narrowed at both ends, and mostly acute at the apex, coarsely and irregularly crenate-dentate, the lower tapering into a petiole. The flowers are short-pedicelled, racemose, varying from bright blue to nearly white, about an inch in length. In the size of the blue flowers it differs from all other east-American species. *L. pinifolia* L., of southern Africa, is used as a diuretic and antirheumatic. Other species noted for their poisonous properties are *L. splendens* Willd. and *L. fulgens* Willd., both of Mexico; *L. urens* L., and *L. Dortmanni* L., of Europe, the latter also in the United States; *L. cirsiifolia* Lam. (*Tupa c.* DC.), *L. stricta* Swz. (*Tupa s.* DC.), and *L. coccinea* Stockes, of tropical America; *L. purpurascens R.* Br., of Australia; *L. decurrens* Cav., of Peru; *L. laxiflora angustifolia* DC. (*Xochipipile*), of Mexico, and especially *L. Tupa* L. (*Tupa Feuillei* Don.), of tropical America.

Isotoma longiflora (L.) Presl. (*Lobelia l.* L.; *Hippobroma l.* Don), of tropical America, is regarded as one of the most violently poisonous of known plants. Its action is much like that of official Lobelia. It is used externally as an epispastic and internally as an anti-syphilitic.

Tupa Berterii DC. (*Lobelia serrata* Meyer), of Chile, acts much the same, and is used as a fish poison. The large Andean genus *Siphocampylos*, many of its species of great beauty, possesses many poisonous species. Several species of this genus are said to yield rubber.

LORANTHACEÆ.—The Mistletoe Family.

A small family of about 500 species of plants of very curious habits and peculiar appearance, being true parasites, for the most part upon trees, the bark and wood of which are penetrated by absorbing organs which take the place of roots. For the purpose of better attaching themselves to the bark in falling, the seeds and fruits are often enclosed in exceedingly viscid substances, and the latter have been considerably used in the manufacture of bird-lime. Owing to the peculiar parasitical habits of the plants, well illustrated by the common mistletoe (*Viscum album* L.; *Mistel, Eichenmistel*, G.; *Gui de chêne, Gillon*, Fr.; *Visco, Muerdago*, Sp.), they have always been objects of superstition and occasions for religious fanaticism. Most of their medicinal use has probably no better basis, although many species apparently possess some power as uterine stimulants.

Viscum or Mistletoe (see above).—This species is indigenous to Europe, and is chiefly found upon apple, pear, plum, and similar trees, but grows upon others as well. The plant constitutes a well-known Christmas decoration. The stems are greenish and brittle, the

leaves opposite, estipulate, lanceolate to spatulate, obtuse and entire; the flowers obscure and monœcious or dicœcious, sessile in small clusters or short spikes; the fruit a small, whitish, 1-seeded berry. The odor is rather weak, but heavy and unpleasant, and the taste sweetish, bitter, somewhat astringent and mucilaginous. The constituents are mucilage, sugar, resin, volatile and fixed oil, and a little tannin, together with the peculiar glutinous substance *viscin*, soluble in ether and oil of turpentine, insoluble in water, alcohol, and fixed oils. In the living plant it appears to be in very slight amount, but apparently forms under the action of some enzyme. Viscum appears to be very uncertain in its effects. It has been employed as a powerful nervine in the treatment of hysteria, chorea, and epilepsy, but is probably of little value in these conditions. Cases are on record in which the ingestion of large quantities of the berries of American mistletoe have produced grave symptoms, and even death, the most prominent symptoms being great thirst, vomiting, purging, and collapse. American mistletoe has been recommended as an oxytocic, but is considered quite uncertain in its action. The drug has been employed during labor and in the treatment of post-partum hemorrhage. The dose of either variety is from ½ to 1 fluidrachm (2–4 Cc.) of a fluidextract made from the leaves and stems.

American mistletoe or *Golden bough* is the somewhat similar stems and herbage of *Phoradendron flavescens* (Pursh) Nutt. (*Viscum f.* Pursh), native of the southern United States. It is a somewhat stouter plant, occasionally slightly pubescent, the leaves oblong to obovate, 1.5 to 3 Cm. (⅗ to a little more than 1 In.) long, entire, rounded at the summit, 3- to 5-nerved, and of a yellowish-green color. The constituents, so far as known, are identical with those of the European. It is somewhat employed for the same purposes.

Loranthus Europœus Jacq. is used similarly to the European Mistletoe, as are many species of *Phoradendron*, *Loranthus*, and related genera of the tropics of both the Old and New Worlds.

LOTIO HYDRARGYRI FLAVA, *Br.*—Yellow Mercurial Lotion.

Lotio flava, N. F.; *Aqua phagedœnica flava.—Yellow Wash, Yellow Lotion*, E.; *Eau phagédénique, Eau divine de Fernel*, Fr.; *Phagedänisches Wasser, Altschadenwasser*, G.

Preparation.—Take of mercuric chloride, 20 grains; solution of lime, 10 fluidounces. Mix.—Br.

Take of corrosive chloride of mercury, 3 Gm.; boiling water, solution of lime, of each a sufficient quantity to make 1000 Cc. Dissolve the corrosive chloride of mercury in 35 Cc. of boiling water, and add the solution to a sufficient quantity of solution of lime to make 1000 Cc.—N. F.

A double decomposition takes place, resulting in the formation of calcium chloride and finely divided yellow mercuric oxide. The mixture should be well agitated whenever any of it is to be dispensed.

Action and Uses.—Yellow wash is somewhat stimulating and may be used with advantage in the treatment of sluggish venereal sores.

LOTIO HYDRARGYRI NIGRA, *Br.*—Black Mercurial Lotion.

Lotio nigra, N. F.; *Aqua phagedœnica nigra.—Aqua nigra, Aqua mercurialis nigra, Black Lotion, Black Wash*, E.; *Eau phagédénique noir*, Fr.; *Schwarzes Wasser*, G.

Preparation.—Take of mercurous chloride, 30 grains; glycerin, ½ fluidounce; mucilage of tragacanth, 1¼ fluidounces; solution of lime, a sufficient quantity. Triturate the mercurous chloride with the glycerin and mucilage of tragacanth; transfer to a bottle; add 2 fluidounces of the solution of lime; shake well; add sufficient solution of lime to produce 10 fluidounces.—Br.

Take of mild chloride of mercury, 7.5 Gm.; water, solution of lime, of each a sufficient quantity to make 1000 Cc. Triturate the mild chloride of mercury with 35 Cc. of water, and gradually add a sufficient quantity of solution of lime to make 1000 Cc.—N. F.

The chemical reaction between the mercurial salt and solution of lime results in producing calcium chloride and black mercurous oxide. The presence of glycerin and tragacanth mucilage in the British preparation serves to keep the oxide in better suspension. The mixture should be well agitated whenever any of it is to be dispensed.

Action and Uses.—Black wash is employed locally as a mild sedative astringent in the treatment of venereal sores.

LUPULINUM, *U. S., Br.*—Lupulin.

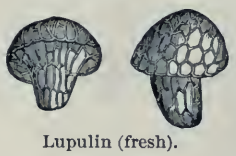
Glandulæ lupuli, P. G.—*Lupuline*, Fr. Cod.; *Lupulite*, E.; *Hopfenmehl, Lupulin*, G.; *Lupulina*, Sp.; *Luppolina*, It.

The glandular trichomes separated from the fruit of *Humulus Lupulus* L. (Fam. *Moraceæ*).

Lupulin is official in nearly all pharmacopœias, which variously specify the following requirements: It burns in a flame like Lycopodium; becomes plastic when triturated in a mortar with strong pressure; not more than 40 per cent. is insoluble in ether; it should be renewed annually, being rejected when dark-brown or cheesy-smelling; should be kept protected from light. The ash allowance in different pharmacopœias ranges from 10 to 20 per cent. Lupulin is said to have ignited spontaneously.

Origin and Description. (For an account of its origin and for botanical synonyms, see HUMULUS.)—On handling dry hops, the glandular powder becomes detached, and is freed from fragments of the bracts, etc., by sifting; about 10 per cent. of the weight of the hops can be obtained.

FIG. 263.



Lupulin (fresh).

A bright, light brownish-yellow (becoming yellowish-brown) mobile, granular resinous powder, having a strong odor of hops and a strongly aromatic and bitter taste; of low specific gravity, floating lightly on water. Under the microscope it is seen to consist of two hemispheres, the lower and firmer of which is somewhat obtusely conical or top-shaped, the upper one rounded, the surface of both reticulate. In the dry state the lower one nearly retains its shape, but the more delicate upper part collapses and forms a flattish hood. The glands contain a brown-yellow liquid which dries to a resinous mass. Not less than 60 per cent. of lupulin is soluble in ether. Lupulin should be free from sand, which readily subsides from it when agitated with water, and, on incineration, should yield not more than 10 per cent. of ash.

A granular powder of this sort is peculiarly amenable to adulteration, and this has been largely practised. The substances employed are chiefly sand and other earthy matter, which increase the ash percentage. Starch and all powdered vegetable tissue are very readily detected by microscopical examination.

Constituents.—The composition of lupulin is similar to that of hops, but it contains no alkaloid. Lupulin yields a tasteless resin, myricin (myricylic palmitate), and bitter *lupamaric* or *hop-bitter acid*. This forms white crystals, which on exposure to air turn yellow. They are soluble in water, and, boiled with dilute sulphuric acid, yield crystalline lupulic acid, and lupuliretin. On distilling with water, the glands yield valerianic acid and a volatile oil.

Pharmaceutical Preparations.—FLUIDEXTRACT OF LUPULIN, OLEORESIN OF LUPULIN, U. S. P.

Action and Uses.—Lupulin, like HUMULUS (which see), is employed as an antispasmodic and nervous sedative in the treatment of hysteria, insomnia, and nervousness. It may be given in doses of from 2 to 5 grains (0.12–0.30 Gm.), which amount may be increased if needed.

LYCOPODIUM, *U. S., P. G.*—Lycopodium.

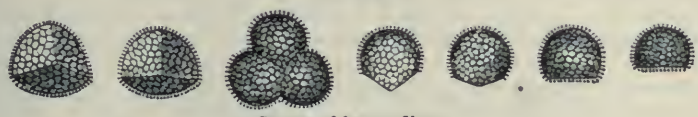
Semen lycopodii, Pulvis lycopodii, Sulphur vegetabile.—*Vegetable sulphur*, E.; *Bärlappsamen, Streupulver, Hexenmehl, Blitzpulver*, G.; *Lycopode, Soufre végétal*, Fr.; *Licopodia*, Sp.

The spores of *Lycopodium clavatum* L. and of other species of *Lycopodium* (Fam. *Lycopodiaceæ*).

Origin.—The common *Club-mosses* are prostrate and creeping evergreen perennials, found in dry woods over most of the globe, but especially in northern countries. The powder is mostly collected in central Europe. The spores are contained in sporangia borne in the axils of bracts which form dense, erect, long-peduncled spikes, 1 to 4 inches in length. The spikes are collected entire, just before maturity, and after drying, during which the spores ripen, the latter are shaken and sifted out.

Description.—A fine, very mobile, pale-yellow, odorless and tasteless powder, floating upon water, and wetted by it with difficulty, and only after continued trituration, unless the surface of the spores has been cleansed of the oily coating contained in the subepidermal or endosporial layer, by washing with alcohol, ether, or chloroform. After boiling, it sinks in water. Trituration imparts a darker tint and renders it more coherent and greasy. Slowly heated, it burns quietly, but thrown into a flame, the spores explode with a hissing noise. The spores are about 25 mikrons in diameter, and exhibit a short, 3-sided pyramid, the fourth side being nearly hemispherical, the surface reticulate with 5- or 6-sided meshes, and the edges beset with projecting points. There is no blue coloration with iodine. The ash should not exceed 5 per cent.

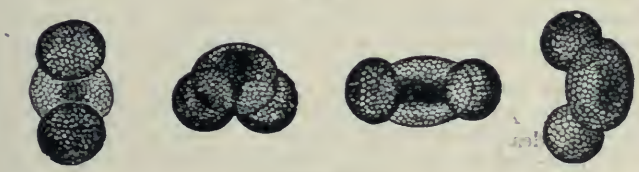
FIG. 264.



Spores of lycopodium.

Constituents.—Lycopodium yields about 50 per cent. of a neutral, odorless, non-drying oil, similar to expressed oil of almonds. This is composed of 3 to 8.2 per cent. of glycerin, 0.3 of phytosterin, 2 of lycopodic acid, 80 of oleic acid, and 3 of arabic, palmitic, stearic, and myristic acids (Langer says also *decyliso-propylacrylic* acid). The ash is under 4 per cent. Lycopodic acid ($C_{18}H_{36}O_4$) crystallizes in fine silky needles.

FIG. 265.



Pollen of pine.

Adulteration.—Lycopodium is subjected to extensive adulteration. 25 per cent. of starch has been reported as detected by sinking in carbon bisulphide and being colored blue by iodine. Pine pollen has been used largely, and is seen to be always in 3's, forming a large plano-convex body with a globular one attached to either end of the flat side. Mineral substitutes sink in carbon bisulphide and increase the yield of ash. Dextrin is dissolved by water, rosin by alcohol. All these substitutes are readily distinguished from the spores by microscopical examination.

Action and Uses.—Lycopodium is practically never administered internally. At one time a decoction of the moss was employed in rheumatic, pulmonary, and renal complaints, but it has fallen into disuse. The spores are employed in medicine only as a dusting-powder, and may be used with advantage in the prevention of excoriations, especially about the genitals of infants.

Allied Products.—The genus Lycopodium contains more than 100 species, the herbage of several being employed in domestic medicine. Thus, *L. Selago* L. (*Kolbenmoos, Purgierbärlapp*), of Europe, is used to poison animals and as a drastic and emmenagogue. Similar properties are attributed to *L. Saururus* Lam., of the Argentine, from which the alkaloid *piliganine* was extracted, 2 grains killing a dog, and $\frac{1}{6}$ to $\frac{1}{3}$ grain of the hydrochloride being purgative, as are 6 grains of the alcoholic extract of the plant. Larger doses are emetic. *L. polytrichoides* Kaufl., of the Sandwich Islands, and *L. cernuum* L., of the tropics, act similarly, and in Venezuela *L. rubrum* Cham. is used in elephantiasis. The alkaloid *lycopodine* is reported in *L. complanatum* L.

Small doses of the poisonous species are used as tonics.

Equisetum.—Closely related to the *Lycopodiaceæ* is the family *Equisetaceæ*, or Scouring Rush Family, several species of which have been used medicinally to a slight extent, though without important constituents or, apparently, definite physiological properties. *Equisetum* or *Horse tail* (*Pferdeschwanz, Schachtelhalm, Zinnkraut, Scheurkraut*, G.; *Prêle*, Fr.; *Coda di cavallo*, It.; *Cola de caballo*, Sp.), as commonly understood, is the perennial herb *Equisetum arvense* L., also known as *Cat's tail*, and which grows almost throughout the central portion of the north-temperate zone, mostly in sandy, though somewhat damp soil. It propagates by slender tuberiferous rhizomes, and produces fertile and sterile shoots, which do not at

all resemble one another and are destitute of true leaves. The fertile shoots are brownish, simple, erect, a few inches high, thick and somewhat succulent, ribbed, scale-bearing at the nodes, and each terminating in an ovoid spike which bears the abundant green spores on the under side of horizontal lamellæ. The sterile shoots, which are alone employed in medicine, appear a little later, are a foot or two long, more slender than the fertile, green, furrowed, slenderly and widely branched, the branches somewhat quadrangular and bearing 4 scales at each node. They are slightly harsh to the touch, owing to their siliceous covering. The herb contains a peculiar acid which has been called *equisetic acid*, but is claimed to be identical with aconitic acid. There is yielded 4 or 5 per cent. of ash, nearly half of it silica. The drug has been used indefinitely, chiefly in domestic practice.

E. hiemale L., the *Scouring* or *Polishing rush* or *Dutch rush*, *Shave grass*, *Horse pops* or *Rough horse-tail* (*Tischlers* or *Polir Schachtelhalm*, G.), having the same range, is much taller (up to 3 feet), darker, with about 20 narrow scales at each joint, black-girdled at their bases and summits, and much rougher than the former, on which account it has been largely used for polishing. It yields two or three times as much ash, most of it silica, together with a little resin, sugar, and various salts. This species is used in China, in ophthalmic practice, under the name *Muh-ts'ih*. In South America, *E. Bogotense* Kunth and *E. giganteum* Thunb. (*E. ramosissimum* Desf.; *E. elongatum* Willd.) are used as intestinal and urethral astringents. It is claimed that *E. palustre* L. and *E. limosum* contain alkaloidal substances which are poisonous to animals, and *E. arvense* is numbered among the suspicious stock-poisoning plants of the northwestern United States.

LYTHRACEÆ.—The Loosestrife Family.

A small family of some 400 or 500 species, most abundant in warm countries, and of little economic importance except for its ornamental properties. Many of the species contain bitter, acrid, and irritant principles which appear worthy of investigation.

Henna or *Alhenna* (also called *Alkhanna* or *Alcanna*) is a yellow or orange coloring-matter obtained from the leaves of *Lawsonia inermis* L. (*L. alba* Lam.; *L. spinosa* L.), the *Henna plant*, *Egyptian privet*, or *Jamaica mignonette*, a fragrant white flowered shrub of southern Asia and adjacent regions. Although somewhat used as an astringent and in the treatment of jaundice, which latter idea probably depends upon the yellow color, it is chiefly employed for staining the hair, finger-nails, etc. The astringent principle has been named *henotannic acid*.

Ammania.—This genus of about 30 species of annual herbs, besides being somewhat aromatic, is noted for the acrid and counterirritant properties of its herbage. A number of species (*A. Indica* Lam., *A. vesicatoria* Roxb., etc.) are employed in the East Indies for blistering purposes, the fresh leaves being used and producing a blister in about half an hour.

Lythrum or *Loosestrife* (*Purple* or *Milk willow-herb*, *Willow-weed* or *Willowwort*, *Purple loosestrife*, *Purple grass* or *Long purples*, *Sage willow*, *Red Sally* or *Rainbow weed*, E.; *Rotherweiderich*, G.; *Salicaire*, Fr.) is the *Herba salicariæ*, derived from *L. Salicaria* L. (*Salicaria vulgaris* Moench), a tall downy perennial herb of Europe and Asia, abundantly naturalized in the northeastern United States, where it flowers from midsummer to early fall. The leaves are opposite or whorled in 3's, about 75 Mm. (3 In.) long, lanceolate, sessile, clasping by the heart-shaped base. The flowers are apparently whorled, form a long, interrupted, wand-like spike, and have 6 showy purple or sometimes whitish petals and 12 stamens. The herb has a mucilaginous, mildly astringent taste. The blackish-brown, branching, and fibrous root is astringent. The principal constituents of Loosestrife are mucilage and tannin. Several species of this genus are used in Mexico under the name *Yerba del cancer*. Similarly employed in tropical America, in the ignorant treatment of supposed syphilitic disorders, are various species of the related genus *Parsonsia*, P. Br. (*Cuphea*). In Mexico the purgative and diuretic herbage and juice of *Heimia salicifolia* (H. B. K.) Link et Otto (*Nesæa s.* H. B. K.), containing the amaroid *nessin*, is used under the name *Hanchinol* or *Abrosol*, as also is *H. syphilitica* DC. (*Nesæa s.* Steud.). Lythrum possesses astringent and demulcent properties. A decoction (1 ounce [Gm. 30] to a pint [Cc. 480]), has been recommended in the treatment of dysentery, chronic diarrhœa, leucorrhœa, and passive uterine *hemorrhage*.

M.

MAGNESII CARBONAS, *U. S., Br.*—Magnesium Carbonate.

Magnesium carbonicum, P. G.; *Magnesiæ carbonas, Magnesia alba.—Carbonate of magnesia*, E.; *Carbonate de magnésie, Magnésie blanche*, Fr.; *Magnesiumkarbonat, Weisse Magnesia*, G.; *Carbonato di magnesia*, It.; *Carbonato de magnesia*, Sp.

Formula approximately, $(MgCO_3)_4.Mg(OH)_2.5H_2O$ (U. S.). $(MgCO_3)_3.Mg(OH)_2.4H_2O$ (Br.). Molecular weight, 482.26 (U. S.).

It should yield, upon ignition, not less than 40 per cent. of residue, of which not less than 96 per cent. should consist of pure magnesium oxide.—U. S.

Preparation.—Only one form of the carbonate is official in the U. S. P., *light magnesium carbonate*, but no process for preparing it is given. The Br. P. gives processes for preparing, and recognizes two forms, namely, *Magnesii Carbonas Levis* or *light magnesium carbonate*, and *Magnesii Carbonas Ponderosus* or *heavy magnesium carbonate*.

The British formula for the light magnesium carbonate consists in dissolving 10 parts of magnesium sulphate, 12 parts of crystallized sodium carbonate, each in 80 parts of cold water, mixing the two solutions and boiling the mixture for 15 minutes, filtering and washing with boiling water until the filtrate gives no precipitate with barium chloride. The product is dried at 100° C. (212° F.).

The process for the heavy carbonate differs from the above in the fact that one-fourth as much water is used for solution of the salts, and the mixture is evaporated to dryness, the residue digested for half an hour with 40 parts of water, filtered, washed, and dried as above.

It is improbable that the two forms of the carbonate have the same composition, as given in the Br. P., and, moreover, the same criticism holds as in the case of bismuth subcarbonate in regard to assigning a definite formula, which varies with conditions, depending upon the concentration of the solutions employed, and the temperature at which the decomposition is effected and the precipitate dried. Pure normal magnesium carbonate is never obtained when a solution of the sulphate or chloride is mixed with an alkali carbonate, but always a basic carbonate, the proportion of normal carbonate present in the precipitate being greatest when dilute solutions are used at ordinary temperature.

If solutions of magnesium sulphate and sodium carbonate be mixed in the cold, no carbon dioxide is eliminated, a voluminous precipitate of basic magnesium carbonate being thrown down, while an acid magnesium carbonate, $MgH_2(CO_3)_2$, remains in solution; but if the solution be mixed warm or hot, carbon dioxide is evolved. The reaction producing the official magnesium carbonate of the U. S. P. is probably as follows: $5(MgSO_4 + 7H_2O) + 5(Na_2CO_3 + 10H_2O) = (MgCO_3)_4.Mg(OH)_2.5H_2O + 5Na_2SO_4 + CO_2 + 79H_2O$; dilute solutions being used and mixed at a temperature not above 55° C. (131° F.); the precipitate is washed to remove sodium sulphate and dried without heat. Potassium carbonate is not so good as sodium carbonate in the preparation of magnesium carbonate, as it is not so pure, and the potassium sulphate formed is more difficult to wash out, in consequence of which the precipitate is apt to be gritty and to have a slightly saline taste.

Magnesium carbonate may be obtained from the mother-liquors or bittern of saltworks, but it is then contaminated with calcium carbonate. It is made in large quantities in England, Germany, and this country by Pattinson's method from *dolomite*, a native magnesium limestone, by ignition and treatment with water and carbon dioxide under pressure; acid magnesium carbonate is formed and readily dissolved, and the solution, separated from the calcium carbonate, is treated with steam, whereby the basic carbonate is precipitated.

Light magnesium carbonate is often prescribed as *Magnesia alba*. In German-speaking countries the term magnesia is understood to refer to the light carbonate, while in English-speaking countries it refers to the oxide or calcined magnesia.

Properties.—The heavy and light magnesium carbonates differ chiefly in the degree of aggregation of their molecules, the former being slightly granular, the latter a smooth

and less dense powder, both being inodorous, and of a slight earthy taste. They are almost insoluble in water, requiring, according to Fyfe, 2500 parts of cold and 9000 parts of boiling water for solution, and when it is moistened with water and applied to turmeric paper a brown color is gradually produced. When heated to dull redness water and carbon dioxide are given off, and magnesia remains. They dissolve with copious effervescence in dilute sulphuric, hydrochloric, and other acids, and the solutions have the chemical behavior of magnesium salts.

Tests.—Magnesium carbonate may be contaminated with calcium compounds, and from incomplete washing also with the acidulous radicals contained in the mother-liquor, more particularly with chlorides, bromides, and sulphates. These impurities are detected by dissolving the carbonate in dilute nitric acid, and this solution should not be precipitated by silver nitrate (chloride and bromide) or barium nitrate (sulphate); neutralized with ammonia, it should not be precipitated by ammonium oxalate (calcium). On the addition of ammonia or ammonium carbonate a white precipitate is produced, which should be completely soluble in an excess of the precipitant and in ammonium chloride (an insoluble portion would indicate alumina), and the ammoniacal solution should not yield a white precipitate with hydrogen sulphide (zinc).

The following tests have been adopted by the United States Pharmacopœia: 1 Gm. of the salt, heated with 50 Cc. of water to boiling and cooled, should yield a filtrate leaving, when evaporated to dryness on a water-bath, not more than 0.001 Gm. of residue (limit of foreign soluble salts). 10 Cc. of a solution of the salt (1 in 50) made by the aid of acetic acid, should not give more than a slight opalescence with ammonium oxalate test-solution within 5 minutes (limit of calcium). A solution of 1 Gm. of the salt in 20 Cc. of diluted hydrochloric acid should be colorless and not give an immediate blue coloration with potassium ferrocyanide solution (limit of iron), nor should another solution of the same strength be colored or made turbid by an equal volume of hydrogen sulphide solution, when kept corked at 35° C. (95° F.) for at least half an hour, either before or after rendering alkaline with ammonia water (absence of heavy metals). 1 Gm. of the salt when ignited in a porcelain crucible should leave a residue of not less than 0.4 Gm. If 0.400 Gm. of the recently ignited and cooled salt be dissolved in 25 Cc. of normal sulphuric acid, not more than 5.8 Cc. of normal alkali should be required to neutralize the excess of acid, methyl-orange test-solution being used as indicator (each Cc. of the acid consumed being equivalent to 0.02003 Gm. of MgO, or 5 per cent.).—U. S. 5 Gm. heated to redness should leave 2.1 Gm. of residue of oxide, corresponding to 42 per cent. (Br.). The theoretical per cent. of oxide obtainable from the U. S. formula is 41.53, from the Br. formula 41.9.

Action and Uses.—Magnesium carbonate is employed internally as an antacid in the treatment of gastric acidity and sick headaches. When the stomach or intestines are excessively acid, the drug is probably converted into a laxative salt. It is considered by some inferior to calcined magnesia because of the flatulence which may result from the liberation of carbon dioxide. Heavy magnesium carbonate may be given internally in doses of from 30 to 60 grains (2–4 Gm.); but if employed constantly there is danger of its accumulation in the intestines. Because of its bulk light magnesium carbonate is never employed in internal medicine. It is, however, largely used as a dusting-powder in intertrigo and similar conditions, and as a cosmetic.

Magnesium Carbonate Normal or Crystallized, $MgCO_3.3H_2O$, is formed when freshly precipitated basic carbonate is dissolved in water by the aid of carbon dioxide or potassium or sodium bicarbonate, and the solution is allowed to stand a day or two exposed to the air. It forms small, hard white crystals which lose a part of their carbon dioxide in the air. It is used principally in the preparation of mineral waters, and also as a substitute for the official carbonate when a very pure carbonate is desired; $1\frac{1}{2}$ parts of the crystallized salt are equal to 1 part of the ordinary carbonate.

MAGNESII CITRAS EFFERVESCENS.—Effervescent Magnesium Citrate.

Magnesium citricum effervescens, P. G.—*Limonade sèche au citrate de magnésie*, Fr.; *Brausemagnesia, Magnesiumcitrat in Körnern*, G.

Preparation.—Magnesium carbonate, 10 Gm.; citric acid, 46 Gm.; sodium bicarbonate, 34 Gm.; sugar, in No. 60 powder, 8 Gm.; alcohol, distilled water, each a sufficient quantity. Mix the magnesium carbonate intimately with 30 Gm. of citric acid and

4 Cc. of distilled water, so as to make a thick paste; dry this at a temperature not exceeding 30° C. (86° F.), and reduce it to a fine powder. Then mix it intimately with the sugar, the sodium bicarbonate, and the remainder of the citric acid, previously reduced to a very fine powder. Dampen the mass with a sufficient quantity of alcohol, and rub it through a No. 6 tinned-iron sieve, to form a coarse granular powder. Lastly, dry it in a moderately warm place, and keep in well-closed bottles.—U. S. (1890).

To prepare 1 pound of effervescent magnesium citrate the following quantities should be used: magnesium carbonate, 714 grains; citric acid, 7 avoirdupois ounces and 223 grains; 4 avoirdupois ounces and 390 grains of the citric acid should be used together with 5 drachms of distilled water to form the thick paste of acid magnesium citrate.

The formula of the German Pharmacopœia is like the preceding. The French Codex uses calcined magnesia 65, magnesium carbonate 60, citric acid 300, and sugar 600 parts.

In order to obtain a granular salt which is readily and completely soluble, it is important that the official directions be closely followed. The first step is the preparation at as low a temperature as possible of an acid magnesium citrate, a little less than one-half the citric acid ordered for this manipulation being sufficient for the formation of the normal salt. If the prescribed quantity of water and the temperature of 30° C. (86° F.) are exceeded, the far less soluble salt is likely to be produced, causing trouble in the finished product. The remainder of the citric acid should be powdered separately and then mixed, without pressure, with the sodium bicarbonate and sugar; lastly the finely powdered magnesium citrate is added. The citric acid necessary for complete decomposition of the alkali bicarbonate is derived in part from the acid magnesium salt; although this changes the character of the latter compound, its ready solubility is nevertheless preserved by the newly formed sodium citrate.

The addition of alcohol to the mixed powder should be made cautiously, only sufficient being used to enable the operator to form a mass which will permit of being rubbed through the meshes of the sieve. The subsequent drying of the granules must also be conducted with care, as the use of too high a heat will cause effervescence to take place, and thus destroy the granular condition of the salt. All granular effervescent salts containing sugar are apt to become discolored if made by the process recommended by the British Pharmacopœia, unless the heat necessary be carefully controlled.

Sieves of different degrees of fineness are usually used so as to obtain granules nearly uniform in size.

Properties.—This preparation forms white granules or a white granular inodorous powder having an acid reaction and a pleasantly saline and mildly acidulous refreshing taste. On exposure to air it attracts moisture, resulting in decomposition of the bicarbonate and the evolution of carbon dioxide, and afterward becomes damp without, however, completely deliquescing. It is nearly insoluble, or rather only partly soluble, in alcohol, but dissolves slowly and with copious, long-continued but not violent effervescence in 2 parts of water at 15° C. (59° F.); this solution is rarely perfectly clear, but usually is more or less opalescent from traces of impurities contained in the magnesium carbonate, and in the course of several days deposits crystals of magnesium citrate. Boiling water dissolves more rapidly a larger amount of the granules, and this solution separates on cooling a portion of the magnesium citrate in crystals. The total amount of citric acid ordered in the above formula is somewhat in excess (about 3.28 Gm.) of that required for the production of normal salts; this renders the taste pleasantly acidulous and the solution more permanent. The aqueous solution shows the reactions of citric acid and of magnesium salts; on boiling with test-solution of calcium chloride a white precipitate is produced; and the cold solution, on being rendered alkaline with ammonia water, yields with test-solution of sodium or ammonium phosphate a white precipitate which is readily soluble in acetic acid.

Action and Uses.—The properties of this salt are practically the same as those of its solution (see LIQUOR MAGNESII CITRATIS); but as it contains less acid than the latter, its taste is not so agreeable. It may be given in doses of from 1 to 3 drachms (4–12 Gm.), which should be dissolved in water and drunk during effervescence.

MAGNESII OXIDUM, *U. S.*—Magnesium Oxide; Magnesia.

Magnesia, U. S., 1890; *Magnesia levis*, Br.; *Magnesia usta*, P. G.; *Magnesia calcinata.*—*Calcined magnesia*, E.; *Magnésie, Magnésie calcinée*, Fr.; *Gebrannte Magnesia*, G.

Formula, MgO. Molecular weight, 40.06.

It should be kept in well-closed vessels, and contain, after ignition, not less than 96 per cent. of pure oxide.—U. S.

Preparation.—No detailed method is given in the pharmacopœias. Magnesia is prepared by exposing magnesium carbonate to low red heat in a covered crucible.

The Br. P. recognizes two varieties of magnesia—the heavy as *Magnesia ponderosa*, made from the heavy magnesium carbonate by the process just given, and *Magnesia levis* or *light magnesia*, which is made in precisely the same manner from the light magnesium carbonate. In the United States both kinds are extensively used, but when the heavy variety is desired, it is usually designated in prescriptions as *Magnesia ponderosa*, under which title it was recognized in the 1890 Pharmacopœia, while the light magnesia is designated simply as *Magnesia.*

The official magnesium carbonate consists of magnesium carbonate and hydroxide. On heating it, water and carbon dioxide are given off and magnesium oxide remains behind: $4(MgCO_3).Mg(OH)_2.5H_2O$ yields $5MgO + 4CO_2 + 6H_2O$. The magnesium carbonate is pressed somewhat firmly into a crucible, and this is placed in a suitable furnace, loosely covered with a lid, and then heated to dull redness. The expulsion of the water and carbon dioxide keeps the surface of the powder continually in motion, and there is no necessity of testing it as long as that motion is present; when the motion ceases a small quantity of the powder is taken from beneath the surface and near the center, mixed with sufficient water to displace the air, and then poured into an excess of dilute sulphuric acid. If no evolution of carbon dioxide takes place, the product is finished, and may be dipped out with a ladle, and the crucible filled with a fresh portion of magnesium carbonate without removing it from the furnace. The carbonate should not be raised to full red heat unless it be stirred constantly, otherwise the oxide will soon become dense and granular and with difficulty soluble in dilute acids. The yield is between 40 and 43 per cent. Magnesia of both kinds is now extensively made in this country, so that importation from England has very materially decreased.

Properties.—Magnesia is a white, very bulky, and very fine powder, without odor, and of an earthy, but destitute of a saline, taste. Exposed to a high heat, it becomes more compact, but does not fuse except before the oxyhydrogen blowpipe. According to Fresenius, it requires 55,000 parts of water for solution, and the liquid, like the moistened magnesia, has a distinct alkaline reaction. Its specific gravity varies between 2.3 and 3.3. When mixed with water it unites with it, forming a hydroxide having the composition $Mg(OH)_2$. Exposed to the atmosphere, a similar change takes place, but carbon dioxide is also absorbed and a corresponding quantity of oxycarbonate is formed. It should therefore be preserved in well-stoppered bottles. On stirring 1 part of magnesia with 15 parts of water in a beaker, and allowing the mixture to stand for about half an hour, it will form a gelatinous mass of sufficient firmness to prevent it from falling out when the glass is inverted; hence in suspending magnesia, sufficient water should be used to overcome this tendency, and the magnesia should always be added to the water, and not *vice versa.* Light magnesia should always be used for dispensing in water suspension. Heavy magnesia is smoother and denser than the light, and is preferred for use in powder mixtures. An ounce of light magnesia fills a 4-ounce bottle, while a like weight of heavy magnesia occupies about one-fourth the space.

Several proprietary articles, such as Henry's, Husband's, and others, consisting of heavy magnesia, were extensively used formerly. This magnesia was generally characterized by freedom from grittiness and ready miscibility with water, but it is not superior to a dense magnesia obtainable by careful manipulation from a properly prepared magnesium carbonate.

Tests.—A filtered solution of magnesia in diluted sulphuric acid, mixed with ammonium chloride test-solution and an excess of ammonia water, yields with sodium phosphate test-solution a white crystalline precipitate (ammonium-magnesium phosphate). If a mixture of 1 Gm. of magnesium oxide with 50 Cc. of water be heated to boiling, and, after cooling, filtered, the filtrate should not impart more than a faintly alkaline reaction

to red litmus-paper, and when evaporated to dryness should not leave more than 0.005 Gm. of residue (limit of foreign soluble salts). If a mixture of 0.1 Gm. of magnesium oxide, with 5 Cc. of water, be heated to boiling, and, after cooling, be poured into 5 Cc. of acetic acid, solution should take place without the evolution of more than a few isolated gas bubbles (limit of carbonate). 10 Cc. of a solution of magnesium oxide (1 in 50) prepared by the addition of sufficient acetic acid for solution, should not be rendered more than slightly opalescent within 5 minutes by ammonium oxalate test-solution (limit of calcium). If 1 Gm. of magnesium oxide be dissolved in 50 Cc. of diluted hydrochloric acid, the solution should be colorless and not give an immediate blue coloration upon the addition of potassium ferrocyanide test-solution (limit of iron), and a solution of magnesium oxide (1 in 20) in diluted hydrochloric acid, and warmed to about 50° C. (122° F.), should not be colored or rendered turbid by the addition of an equal volume of freshly prepared hydrogen test-solution, after standing, well-stoppered, in a warm place, 35° C. (95° F.) for at least half an hour, nor should the further addition of ammonia water to this solution cause a coloration therein (absence of heavy metals). If magnesium oxide be exposed to a low red heat in a porcelain crucible, it should not lose more than 15 per cent. of its weight (limit of water of hydration). If 0.400 Gm. of recently ignited and cooled magnesium oxide be dissolved in 25 Cc. of normal sulphuric acid, not more than 5.8 Cc. of normal potassium hydroxide solution should be required for neutralization, phenolphthalein test-solution being used as indicator (each Cc. of the normal sulphuric acid consumed being equivalent to 5 per cent. of pure magnesium oxide).—U. S.

Action and Uses.—Magnesia may be employed as a feeble laxative and antacid. It is thought by some to be beneficial in the treatment of gouty and dyspeptic conditions when attended with constipation and excessive gastric acidity. It may also be employed as an antidote to arsenic, and it enters into the official Ferri Oxidum Hydratum cum Magnesia. Under the name of Husband's Magnesia it is largely employed by the laity to overcome the excessive gastric acidity and constipation of infants. Magnesia should be administered in about 20 times its weight of water in order to prevent the formation of a gelatinous mass. The internal dose to an adult is from 15 to 30 grains (1–2 Gm.) as an antacid, and from 30 grains to 1 drachm (2–4 Gm.) as a laxative. Magnesia may also be employed as a dusting-powder for the treatment of superficial abrasions of the skin.

MAGNESII OXIDUM PONDEROSUM, *U. S.*—Heavy Magnesium Oxide; Heavy Magnesia.

Magnesia ponderosa, Br. (U. S. 1890).—*Magnésie calcinée pesante*, Fr.; *Schwere gebrannte Magnesia*, G.

Formula, MgO. Molecular weight, 40.06.

Preparation.—The process for preparing heavy magnesium oxide is identical with that mentioned under Magnesii Oxidum, except that heavy magnesium carbonate is used in place of the light article.

Properties and Tests.—Heavy magnesium oxide is a white, dense, and very fine powder, which should conform to the reactions and tests given under Magnesii Oxidum. It differs, however, from the latter in not readily uniting with water to form a gelatinous hydroxide.—U. S. When heated to dull redness it should lose little or no weight.—Br.

Pharmaceutical Uses.—Heavy magnesia, on account of its compact nature, is admirably adapted to admixture with other substances in powder form, but should not be used for liquid mixtures, for which latter purpose the light magnesia is better suited, especially for aqueous suspension.

Action and Uses.—The medicinal application of this preparation differs in no respect from that of the light oxide.

MAGNESII SULPHAS, *U. S., Br.*—Magnesium Sulphate.

Magnesium sulfuricum, P. G.; *Sal amarum, Sal Epsomense, Sal anglicum, Sal Sedlicense.—Sulphate of magnesia, Epsom Salt*, E.; *Sulfate de magnésie, Sel d'Epsom, Sel de Sedlitz, Sel amer*, Fr.; *Magnesiumsulfat, Bittersalz, Schwefelsaure Magnesia*, G.; *Solfato di magnesia*, It.; *Sulfato de magnesia*, Sp.

Formula, $MgSO_4 + 7H_2O$. Molecular weight, 244.69.

It should contain not less than 99.7 per cent. of the pure salt, and be kept in well-closed vessels.—U. S.

Origin and Preparation.—Magnesium sulphate is contained in sea water and in the waters of many mineral springs, which thereby acquire a bitter taste. The *Crab Orchard Salt* of Kentucky is the same salt in an impure state, and, as analyzed by J. T. Viley (1871), contains about 65 per cent. of magnesium sulphate after having been dried at 120° C. (248° F.). It probably results from the mutual decomposition of gypsum and magnesium limestone, and is obtained by evaporating the water which collects in wells dug in the ground. The pure salt is made on the large scale from *magnesite*, which is principally $MgCO_3$, by dissolving it in dilute sulphuric acid and crystallizing; large quantities of the salt are made by various processes from magnesian limestone, and more recently it is extensively obtained at the Stassfurt salt-works, principally from the mineral *kieserite*, which is $MgSO_4$ combined with varying quantities of water, and in its natural state as insoluble as gypsum. In 1897 the production of kieserite was nearly 26,000 tons. Magnesium sulphate was prepared as early as 1675, by evaporating the water of Epsom Spring, England. It was from this circumstance that the salt received its commercial name.

Properties.—As found in the market, magnesium sulphate has generally been purified by re-solution in water and rapid crystallization, and forms small rhombic prisms or needles, which resemble those of oxalic acid and zinc sulphate, are perfectly transparent, without odor, and have a cooling and bitter, saline taste, and a neutral reaction. It dissolves at 25° C. (77° F.) in 0.85 part of water, and in 0.13 part of boiling water (U. S.); it is also soluble in diluted alcohol, but insoluble in strong alcohol. The German Pharmacopœia gives the solubility of crystallized magnesium sulphate as 1 part in 1 part of water at 15° C., and in 0.3 part of boiling water. Exposed to air, the crystals slowly effloresce, becoming superficially opaque; when heated to 52° C. (125.6° F.) the salt loses 1 molecule (7.3 per cent.) of water, and is converted into a white powder. At about 130° C. (266° F.) it still retains 1 molecule of water, and at a temperature of 200° to 238° C. (392°–460.4° F.) it is rendered anhydrous (U. S.); the total weight of water amounts to 51.34 per cent. The aqueous solution on the addition of barium chloride yields a white precipitate of barium sulphate, insoluble in hydrochloric acid. It is not precipitated in the cold by potassium bicarbonate or ammonium carbonate, but gives white precipitates with the carbonates and the hydroxides of sodium and potassium, which are redissolved by ammonium chloride. Ammonia added to its solution likewise causes a white precipitate soluble in ammonium chloride, and this solution, on the addition of ammonium phosphate, deposits all magnesium in the form of a crystalline powder, which is magnesium and ammonium phosphate, $MgNH_4PO_4.6H_2O$, and is insoluble in diluted ammonia, sparingly soluble in water, and freely soluble in diluted acetic and other acids; the precipitate, after having been well washed with diluted ammonia, then dried, and ignited in a porcelain crucible, is converted into magnesium pyrophosphate, $Mg_2P_2O_7$ (molecular weight, 221.06), which represents 21.88 per cent. of Mg or 36.24 per cent. of MgO.

Tests.—Impurities are detected in precisely the same manner as in the solution of magnesium carbonate (see above). The following tests have been adopted by the U. S. P.: 10 Cc. of the aqueous solution of the salt (1 in 20), acidified with 1 Cc. of diluted hydrochloric acid, should not be colored or made turbid by an equal volume of hydrogen sulphide solution, when kept corked at 35° C. (95° F.) for at least half an hour, either before or after rendering alkaline with ammonia water (absence of heavy metals). 5 Cc. of the aqueous solution of the salt (1 in 10) should not respond to the modified Gutzeit's test for arsenic described under Arseni Trioxidum. 0.5 Gm. should yield 0.22 Gm. of magnesium pyrophosphate, corresponding to 15.93 per cent. of MgO (Br.). Theoretical percentage of oxide in magnesium sulphate is 16.37.

Magnesii Sulphas Exsiccatus. *Magnesium sulfuricum siccum*, P. G. *Dried magnesium sulphate. Getrocknetes Magnesiumsulfat.*—The crystallized sulphate is exposed in a warm place until it has lost from 35 to 37 per cent. of its weight, and is then passed through a sieve. It is a white powder having the properties of the crystallized salt, except that it contains less water; on exposure to air it gradually attracts moisture, and should therefore be kept in well-stoppered bottles. The German Pharmacopœia directs it to be dispensed when powdered magnesium sulphate is prescribed.

Action and Uses.—Magnesium sulphate when taken internally produces a watery stool if the dose is sufficient to move the bowels thoroughly. This action is due to the fact that it causes a more or less profuse flow of fluid to take place from the walls of the intestine by reason of the fact that the concentration of its solution is greater than that of the blood, and also because it is a substance very slowly absorbed, so that the greater part remains in the intestine, thereby maintaining the concentration of the solution except for the dilution caused by the outpouring of the fluid from the tissues just described. The greater its concentration in the presence of free fluid in the tissues, the greater the purgative effect; but if the tissues have been deprived of fluids, then the best effect is produced by giving it with a moderate amount of fluid, to give it bulk. Magnesium sulphate is used in medicine as a rapidly acting depletant purge, which will unload the bowel as a rule in a couple of hours at the latest. In cases of dropsy it is given in concentrated solution to relieve the general anasarca, and should be administered to the patient when fasting. In the various inflammations of the bowel and peritoneum it is useful both because it unloads the bowel and because it allays the inflammatory process by depleting the inflamed intestine. Magnesium sulphate is the most active ingredient of many natural purgative waters. It is used also as a purge whenever offensive matter is to be expelled from the alimentary canal.

The dose of sulphate of magnesium is about ½ ounce (16 Gm.), dissolved in half to one tumblerful of water, and taken before breakfast for its full effect. Sometimes 1 ounce (30 Gm.) is taken. The most active effects are produced by giving it in divided doses.

Sulphate of magnesium, if injected into the bloodvessels, produces death very rapidly. Introduced in this way it is to be considered a deadly poison.

MAGNESII SULPHAS EFFERVESCENS, *U. S., Br.*—Effervescent Magnesium Sulphate.

Magnesium sulphuricum effervescens.—Effervescent Epsom Salt, E.; *Brausendes Magnesiumsulfat*, G.

Preparation.—Take of magnesium sulphate in unefflorescd crystals, 500 Gm.; sodium bicarbonate, 403 Gm.; tartaric acid, 211 Gm.; citric acid, in unefflorescd crystals, 136 Gm. Dry the magnesium sulphate, on a water-bath, until it ceases to lose weight; after powdering the dry salt, mix it intimately with the citric and tartaric acids, then thoroughly incorporate the sodium bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. (199.4° and 219.2° F.). When the mixture has acquired a moist consistence, by the aid of careful manipulation with a wooden spatula, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.).—U. S. The yield is about 1000 Gm.

By taking the ingredients in the above order and in the proportion of 5 ounces; 4 ounces, 13 grains; 2 ounces, 48 grains; 1 ounce, 157½ grains, respectively, the resulting product will weigh about 10 ounces.

The Br. P. preparation differs somewhat from the U. S. product, as may be seen from the following formula: Take of crystallized magnesium sulphate, 500 Gm.; sodium bicarbonate, 360 Gm,; tartaric acid, in powder, 190 Gm.; citric acid, in powder, 125 Gm.; refined sugar, in powder, 105 Gm. The magnesium sulphate is dried at 54.4° C. (130° F.) until it has lost 23 per cent. in weight, and is then powdered. It is mixed first with the sugar and then with the other ingredients. The mixture is heated between 93.3° and 104.4° C. (200° and 220° F.) until, by careful manipulation, it has assumed a granular form, after which it is separated by sieves into granules of uniform size and dried at a temperature not above 54.4° C. (130° F.). Weight of product, about 1000 Gm.

This preparation was made official in the U. S. P. of 1900, and represents 50 per cent. of crystallized magnesium sulphate. It should be kept in well-closed bottles.

Action and Uses.—This new salt possesses the properties of MAGNESII SULPHAS (which see). It is a more agreeable form for the administration of the remedy. The dose is from ½ to 1 ounce (16–30 Gm.), dissolved in water and swallowed during effervescence.

MAGNESIUM.—Magnesium.

Magnesium, Fr., G.

Symbol, Mg. Bivalent. Atomic weight, 24.18.

The compounds of magnesium show some resemblance to those of the alkaline earth metals, and also to those of zinc and cadmium. In the insolubility of the hydroxide and its easy decomposition by heat and slight alkaline reaction, and the ready solubility of the sulphate, magnesium stands very close to zinc. Its compounds are widely distributed, but are less abundant than those of calcium; it is found as silicate in *meerschaum, olivine, mica, serpentine*, and other minerals; as chloride in sea water and the waters of saline springs; and as carbonate in most spring and mineral waters, in *magnesite*, and in *dolomite* or magnesian limestone. Black (1755) first proved magnesia to be distinct from lime, and Davy (1808) isolated the metal, which is now generally prepared by modifications of the process elaborated by St. Claire-Deville and Caron (1856), by heating sodium with anhydrous magnesium chloride; the resulting sodium chloride is dissolved by water, and the magnesium left behind in the form of a gray powder, which is fused and moulded as desired. Instead of using the chloride, which it is difficult to prepare anhydrous in large quantity, *carnallite*, $KMgCl_3.6H_2O$, a mineral occurring in abundance in the German salt-beds, is employed, after thoroughly drying it, when it has the composition $KMgCl_3$. Magnesium is also largely prepared from molten carnallite by passing a strong electric current through it, whereby the metal separates at the negative pole.

Magnesium is silver-white with strong luster, malleable, fusible at a red, and volatile at a white heat. Its density is 1.78. It is not altered in dry air, but is slightly tarnished in damp air, and decomposes water actively at 100° C. (212° F.), hydrogen and magnesium hydroxide being formed. When heated in the air, it burns to the oxide, and gives an intensely brilliant white light, which, being rich in chemically active rays, is employed in photography. Sunlight is more than 500 times as strong in intensity, but only 5 times as strong in chemically active rays, as magnesium light. Magnesium is readily dissolved by acids. It occurs in the market in four forms, namely, powder, ribbon, wire, and bars. It is used on account of its intense light in signalling; also in fireworks and as a reducing agent in chemical processes.

Magnalium.—This is a name applied generically to alloys of aluminum containing 10 to 25 per cent. of magnesium, which have very valuable properties. Magnalium of 2–2.5 specific gravity is still lighter than aluminum, but at the same time much harder, and takes on a high polish. The properties of magnalium vary according to the content of magnesium.

COMPOUNDS OF MAGNESIUM.

Magnesii Acetas. *Magnesium acetate*, E.; *Acétate de magnésie*, Fr.; *Magnesiumacetat*, G. $Mg(C_2H_3O_2)_2.4H_2O$.—This salt may be obtained by neutralizing acetic acid with magnesium carbonate, filtering, and evaporating to crystallization. It is a white salt, easily soluble in water and alcohol, melts at 80° C. (176° F.) and deliquesces in moist air. It is employed commercially in the preparation of white lead because of its power to dissolve lead oxide, which is reprecipitated by passing carbon dioxide through the solution.

Magnesii Benzoas. *Magnesium benzoate*, E.; *Benzoate de magnesie*, Fr.; *Magnesiumbenzoat*, G. $Mg(C_7H_5O_2)_2.3H_2O$.—Obtained by neutralizing a hot solution of benzoic acid with oxide or carbonate of magnesium, and crystallizing. It is a white, crystalline, non-hygroscopic powder, soluble in 20 parts of water and the same amount of alcohol. It melts at 200° C. (392° F.), and when calcined, it gives off inflammable vapors of benzene and leaves 12.5 per cent. of oxide. It has been recommended for gout, urinary calculi, and tuberculosis. Dose, from 2.5 to 15 grains (0.125–1 Gm.).

Magnesii Bromidum. *Magnesium bromide*, E.; *Bromure de magnésie*, Fr.; *Magnesiumbromid*, G. $MgBr_2.6H_2O$.—Obtained by neutralizing hydrobromic acid with magnesium oxide, evaporating, and crystallizing in a desiccator. Colorless, very deliquescent crystals. It is used as a nervine, in the same manner and dose as potassium bromide. It is also employed in the manufacture of mineral waters.

Magnesii Lactas. *Magnesium lactate*, E.; *Lactate de magnésie*, Fr.; *Magnesiumlactat, Milchsaure Magnesia*, G. $Mg(C_3H_5O_3)_2.3H_2O$.—6 parts of calcium lactate (see page 71) and 5 parts of magnesium sulphate are separately dissolved in hot water, the solutions mixed and filtered from the precipitated calcium sulphate, the last traces of which are removed by

digesting with a little magnesium carbonate; the filtrate is then evaporated and crystallized. Magnesium lactate may also be conveniently prepared by adding an excess of magnesium carbonate to lactic acid diluted with water, filtering, and evaporating the solution to dryness on a water-bath. The salt forms white granular crystals or needles, is insoluble in alcohol, soluble in about 30 parts of cold and 6 parts of boiling water, and when heated is decomposed without melting. It is a mild laxative in doses of from 15 to 45 grains (1–3 Gm.), 3 or 4 times a day.

Magnesii Salicylas. *Magnesium salicylate*, E.; *Salicylate de magnésie*, Fr.; *Magnesiumsalicylat*, G. $Mg(C_6H_4(OH)CO_2)_2.4H_2O$.—Obtained in the usual way by neutralizing a hot solution of salicylic acid with iron-free magnesium carbonate, evaporating the solution, which should be slightly acid, to crystallization. It forms colorless or reddish crystals, stable in air, soluble in 10 parts of water and in alcohol, and gives the usual reactions for salicylic acid. According to Huchard, it is an excellent remedy in abdominal typhus in doses of from 15 to 20 grains (1–2 Gm.), 3 times daily.

Magnesii Sulphis. *Magnesium sulphite*, E.; *Sulfite de magnésie*, Fr.; *Magnesiumsulfit*, G. $MgSO_3.6H_2O$.—Obtained by leading sulphur dioxide into a suspension of magnesium carbonate in water until no more carbon dioxide is evolved, letting the mixture stand for some time, then filtering and washing the crystals with cold water, and drying on porous plates. It is a white powder, soluble in 80 parts of cold and 120 parts of boiling water, loses its water at 200° C. (392° F.), and at a higher temperature is decomposed into sulphate and oxide. On keeping, magnesium sulphate is gradually formed by oxidation. It should be kept in well-closed, full, small bottles. It has been recommended in typhus, puerperal fever, pyæmia, scarlet fever, etc., in doses of from 15 to 30 grains (1–2 Gm.), in powder 5 to 8 times daily.

Asbestos is a name given to a variety of soft fibrous minerals, which are metamorphic products of augite and hornblende minerals, consisting chiefly of magnesium silicate. It is insoluble in reagents, incombustible, and poorly conducting, which properties make it useful in a variety of ways. It is admirably adapted as a filtering medium.

A number of magnesium salts, not mentioned above, have been proposed for various purposes. Some of these are borate, borocitrate, glycerophosphate, ichthyolate loretinate, phenolsulphonate, sozoiodolate.

MAGNOLIA.—Magnolia Bark.

Magnolienrinde, G.; *Écorce de magnolier*, Fr.; *Corteza de Laurel-tulipan*, Sp.

The dried bark of various species of *Magnolia* L. (Fam. *Magnoliaceæ*).

The genus comprises some 21 species, and all are apparently closely similar in composition and properties. Several species grow in the southeastern United States. The bark was formerly official in the U. S. Pharmacopœia, and was accredited to *M. Virginiana* L. (*M. glauca* L.), the *Small, Sweet, Swamp,* or *Laurel magnolia, Sweet* or *White bay, Swamp laurel* or *Sassafras* or *Beaver tree*, which extends along the coast from Texas to Massachusetts, is a deciduous shrub in the north, and an evergreen tree in the south, bears large oblong leaves which are very glaucous underneath, and small, white, very fragrant flowers; *M. tripetela* L. (*M. Umbrella* Lam.), the *Umbrella tree* or *Cucumber tree*, a large deciduous-leaved tree, bearing large leaves in an umbrella-like whorl at the ends of the branchlets, and large white flowers; and *M. acuminata* L. (*M. Virginiana acuminata* L.), the *Mountain magnolia* or *Cucumber tree*, which bears shortly acuminate leaves and yellowish-green flowers with a peculiar bluish tinge.

Description.—The commercial bark varies most widely, according to the species, the age, and the presence or absence of the corky layer, so that a general description is extremely difficult. The outer surface of old bark of all species is more or less ashy-gray, due to the growth of lichens. When young, it is smooth or even glossy and of a brown color, varying more or less to orange or purplish-red. With age, it gradually becomes warty, the warts at length confluent into ridges and the ridges at length fissured. The inner surface is at first whitish, becoming gradually yellowish or pale-brown, smooth, and very finely and closely striate, the striæ long and straight. When the bark has been deprived of the corky layer, the outer surface is almost exactly like the inner. In young bark, however, a green layer appears upon the removal of the cork. The fracture of the outer layer is smooth, short, and granular, of the inner more or less tough-fibrous. The transverse section is brownish and exhibits rather broad bast-wedges and medullary rays. The odor is slight, the taste warm, spicy, and somewhat astringent and, especially of the young bark, bitter.

Constituents.—Both the bark and the fruit (the latter from *M. tripetala*) contain *magnolin*, an odorless crystalline principle, with taste at first slight and later irritant,

nearly insoluble in cold but slightly soluble in hot water, and very soluble in alcohol. ether, chloroform, benzin, and carbon bisulphide. It is analogous to *liriodendrin*, and is probably present in all the commercial magnolia barks. Besides this, there have been found volatile oil, tannin, starch, sugar, and in the bark of *M. glauca*, 3 uncrystallizable resins, a crystalline glucoside soluble in alcohol and ether, and a crystalline tasteless body soluble in alcohol, chloroform, ether, and alkalies, the solution showing a blue fluorescence. The remaining material gives alkaloidal reactions, but no alkaloid could be isolated (Lloyd). The leaves yield a bitter glucoside and a bright-green volatile oil of sweetish fennel-like odor. The pungent taste of the fruit is due to a soft resin, and the odor to a little volatile oil.

Action and Uses.—Magnolia has been employed for its tonic, stimulant, and diaphoretic properties. Like other bitters, it may be employed in the treatment of malarial fever, and it is thought by some to be a valuable remedy for rheumatism. The dose of the powdered drug in substance is from ½ to 1 drachm (2–4 Gm.). A saturated tincture made by maceration in brandy may be given in doses of 1 fluidrachm (4 Cc.).

Other Species.—In China and Japan, the buds and seeds of *M. conspicua* Salisb. (*M. Yulan* Desf.) are used under the names *Shin-i* and *Ying-chun-hwa*, as aromatic bitters; the bark of *M. rubra* is the *Ch'ih-p'oh;* that of *M. hypoleuca* S. et Z. is *Hau-p'oh;* that of *M. Kobus* DC. (*M. gracilis* Salisb.) is *Opke-nit* or *Onan kusk-ni*.

Magnoliaceæ.—This family, of some 9 genera and about 70 species, shares generally in the aromatic-bitter properties of Magnolia, and a number of its members are similarly employed. Next to Magnolia, its most important drug is the following:

Liriodendron, or *Tulip-tree bark*, is the dried bark of *Liriodendron Tulipifera* L., the *Tulip tree, White-wood, Yellow, White, Blue, Hickory*, or *Tulip poplar, Saddle-leaf* or *-tree, Lyre-tree* (*Tulipenbaum*, G.; *Tulipier*, Fr.), one of the very largest trees of eastern and central North America and occurring also in China. Its peculiar leaves well distinguish it. They are very smooth, about as broad as long, rounded at the base and with a broadly notched or occasionally truncate summit. It bears large, tulip-like, greenish-yellow flowers, striped with orange-red. The bark is similar in structure, odor, and taste to that of Magnolia. The outer surface is darker, usually of a very dark-purplish or blackish-brown, and in the older bark more deeply fissured. The inner bark is usually more nearly white than that of Magnolia. Like Magnolia, it contains volatile oil and a bitter principle. The latter is *liriodendrin*, which occurs in white needles, melting at 82° C. (180° F.), is neutral, scarcely soluble in cold water, but soluble in alcohol and in ether. It is precipitated by caustic alkalies and gives an orange-yellow color with sulphuric acid, none with nitric acid, and volatilizes, partly undecomposed, near 132° C. (270° F.). Lloyd describes the colorless, odorless, and tasteless alkaloid *tulipiferine*, which apparently does not affect its medicinal properties, and Coblentz reports a glucoside. Resin is present in variable amount. The properties and uses of Tulip-tree bark are practically identical with those of Magnolia.

Talauma.—A number of species of this genus, closely related to Liriodendron, are similarly employed. *T. macrocarpa* Zucc. is the Mexican *Yoloxochitle*.

Michœlia champaca L. (*M. rufinervis* DC.; *M. Doltsopa* Ham.), of the East Indies, and cultivated in various tropical countries, yields an important aromatic bitter bark, largely used under many local names: *Champa, Champo*, or *Shampang*, in India; *Chenpoh, Chen-p'o-kia*, in China; *Tsampaka*, in the Philippines. Its volatile oil yields a camphor which has been called *campacol*. Several other species of the genus yield barks which have also been called *champaca*, or by names having a similar sound.

MALLEIN.

Mallein is a glycerin extract of the soluble substances produced by the glanders bacillus when grown in 5 per cent. glycerin-beef bouillon.

Löffler and Schultz proved that glanders or farcy (*Morve*, Fr.; *Rotz*, G.), a disease attacking horses, donkeys, mules, etc., was due to a microörganism which they called *Bacillus Mallei*. Subsequent investigations showed that the subcutaneous injection of the soluble product of potato, bouillon, or other cultures of the germs, produced tumefaction at the point of injection and a marked rise of temperature in animals affected with the disease, and but very slight symptoms in unaffected animals.

While many methods have been employed in the past for producing mallein, the following is the one generally employed at present: Flasks of beef-bouillon (see ANTITOXINS), containing 5 per cent. of glycerin, are planted with virulent cultures of *B.*

Mallei, placed in an incubator kept at 37.5° C. (99° F.), and allowed to remain for several weeks, when they are examined microscopically, and, if found pure, are sterilized by heat at 100° (212° F.). The culture is then filtered through porcelain, which removes all bacteria, and usually concentrated to one-tenth of its volume. The resulting dark syrupy glycerin extract is the concentrated mallein found on the market. This concentrated product may be purified by precipitating with 95 per cent. alcohol, collecting the precipitate, and drying. Occasionally 0.5 per cent. carbolic acid is added to the unconcentrated culture, and marketed in that form, when it is called *Dilute Mallein.*

Mallein is a fairly stable product, but should not be exposed to light.

Uses.—Mallein is injected into horses, donkeys, mules, etc., to determine whether they are infected with glanders. 1 to 2 Cc. of the concentrated mallein are diluted with a 0.5 per cent. carbolic acid solution, and injected subcutaneously behind the shoulder of the animal. The temperature of the animal should be carefully determined before the injection. If the animal be infected with glanders, a rise of temperature, beginning usually about 8 hours after the injection is made, of 1.5 to 3 degrees above normal occurs, lasting from 12 to 48 hours, accompanied by marked sensitive tumefaction at the point of injection.

MALTUM, *U. S., P. A.*—Malt.

Maltum hordei.—Barley Malt, E.; *Malz, Gerstenmalz*, G.; *Malt d'orge, Drêche*, Fr. The seed of barley, *Hordeum distichum* L. (Fam. *Gramineæ*), partially germinated artificially, and then dried.

Preparation and Properties.—The grain is soaked in water and then placed in heaps; heat is spontaneously generated and, by occasional turning, is prevented from rising too high. Under these conditions, germination takes place, and when the germ has acquired the desired length, the grain is rapidly dried, the sprouts being then removed, and constitutes *malt.* According to the degree of heat employed in drying, the color of the malt varies somewhat, and is known as either "pale," "pale-amber," or "amber-brown." For some purposes, malt is made to undergo a roasting process in revolving cylinders, to obtain roasted or black malt if the integuments only are of a dark-brown color, or crystallized malt if the interior of the grain has become dark-brown. Only pale or pale-amber malt is used medicinally. The grain is increased about 9 per cent. in size, but loses about 20 per cent. in weight, and becomes soft and easily crumbled. Malt has an agreeable odor and a sweet taste, and yields with water a more or less deep yellowish-brown or brown infusion. About two-thirds of it is soluble in water.

Properties.—Malt occurs in yellowish or amber-colored grains, shading to brown; crisp when fractured, the interior surface whitish or tinged with brown if the grains have been heated sufficiently to cause caramelization. It should have an agreeable, characteristic odor, and a sweet taste due to the conversion of the starch in the seed into maltose, through the action of diastase. Malt should float on cold water. The solid soluble constituents of malt, obtained by evaporating an aqueous infusion to dryness, should weigh not less than 70 per cent. of the dried malt from which they are derived. The acidity of malt (calculated as lactic acid) should not exceed 0.3 per cent.—U. S.

Constituents.—Almost the first chemical change in the germinating barley is the development in it, from an imperfectly known substance, of the ferment or enzyme *diastase*, which is known only by its effects. It is supposed to exist to the extent of about 0.2 per cent. During the continuation of the process, the diastase converts a large part of the starch into sugar. A second ferment, *peptose*, is also produced, and this converts the albumen into peptones. In other respects, the composition of malt does not differ essentially from that of barley (see HORDEUM). By grinding and infusing (*mashing*) and maintaining this *wort* at 70° C. (158° F.), nearly all of the remaining starch is likewise converted.

By an improvement over the oriental method of fermenting rice to make *Arrack* (rice beer), it is now proposed to convert rice into malt for beer-making, and the experiment is under trial in Germany.

Pharmaceutical Preparations.—EXTRACT OF MALT, U. S. P.; FLUIDEXTRACT OF MALT, N. F.

Action and Uses.—Malt depends for its activity upon the diastase and peptose which it contains. In the form of EXTRACTUM MALTI (which see) it may be employed as an adjunct to the diet of that class of patients whose digestion is impaired by certain chronic constitutional diseases such as tuberculosis and marasmus. It is also said to be valuable in the treatment of cholera infantum and the summer diarrhœa of infants.

MALVACEÆ.—The Mallow Family.

The Mallow family, comprising 33 recognized genera and about 1000 species, occurring mostly in tropical and warm-temperate regions, is of economic interest chiefly in the following four directions: It contributes a large number of ornamental flowering plants (Abutilon, Hibiscus, Hollyhock, etc.). Its bast-fibers are usually tough, some of them with special properties, and a number have been utilized for cordage, as have the hairs of the seeds of others (see GOSSYPIUM). Several yield important starchy and mucilaginous foods (Althæa, Okra, etc.). Many species have been employed medicinally, chiefly for their mucilage, giving them value for poultices, and as demulcents. A great many are diuretic, and these diuretic properties are of peculiar interest, since combined with a demulcent action. Special properties occur, as in cotton-root bark, but are rare. With the facts stated above in view, little else is called for than an enumeration of the drugs, with brief descriptions of the more important of them. The decline in the once general and ignorantly confident use of these drugs has been coincident with and indicative of the development of the scientific basis of modern medicine.

FIG. 266.

Althæa leaf (¼ Nat.).

ALTHÆA LEAVES, or *Marshmallow leaves* (*Folia Althææ*, P. G., P. A.; *Feuilles de guimauve*, Fr. Cod.; *Eibischblätter*, *Althee*, G.), are the dried leaves of *Althæa officinalis* L. (see ALTHÆA). They are petiolate, 5 to 8 Cm. (2–3 In.) long, roundish-ovate or subcordate, 3- or 5-lobed, irregularly crenately toothed, of a grayish-green color, and both sides velvety-downy with stellate hairs, the taste mucilaginous. The *flowers* of this species (*Fleurs de guimauve*, Fr. Cod.) are somewhat employed like the next. They have a 9-leaved downy epicalyx, 5 sepals and petals, the latter rose-colored and retuse above; stamens numerous, united in a column and with the short claws of the petals; taste mucilaginous.

Flores Malvæ Arboreæ or *Flores Althææ* (*Hollyhock flowers*, *Althea rose*, E.; *Stockrose*, *Stockmalve*, G.; *Passerose*, *Rose trêmière*, Fr.) are the dried flowers of *Althæa rosea* (L.) Cav. (*Alcea r.* L.), native of the Levant and everywhere cultivated for ornament. The tomentose, yellowish-green or whitish-green, 6-cleft epicalyx and calyx should be removed before using. The corolla, of 5 broad, usually retuse petals, coherent at the base, is 7 to 10 Cm. (3 to 4 In.) broad and of a very deep-purple color. The numerous stamens are coherent with a cylindrical tube for most of their length and adherent to the base of the petals. They are valued for their purple coloring-matter as well as for their mucilage.

Flores Malvæ (P. G.) or *F. M. vulgaris* (*Blue malva flowers*, *High mallow flowers*, E.; *Waldmalve*, *Kaesepappel*, *Malvenbluethen*, G.; *Mauve sauvage*, *Grande mauve*, Fr.) are the flowers of *Malva sylvestris* L., the *High* or *Common mallow*, *Cheese* or *Cheese-cake flower* or *Pan-cake plant*, of the same region as that of the last, cultivated in gardens and somewhat naturalized in the United States. The entire herb is sometimes used. It has an erect or decumbent stem 0.75 M. (about 2½ Ft.) high, roundish-reniform, 5- or 7-lobed and crenately toothed leaves, and purplish, dark-veined flowers, which resemble the preceding, but are only 25 Mm. (1 In.) wide and have a pubescent 3-leaved epicalyx. The dried flowers are bluish, and turn green with ammonia and red with acids. This flower is rather more valued for its coloring than for its demulcent properties.

The herbage, and more so the leaves, of the above and also of *M. vulgaris* Fries (*M. neglecta* Wallr.) are the *Folia Malvæ*, P. G. (*Mallow leaves*, E.; *Malvenblätter*, G.; *Feuilles de mauve*, Fr.; *Malva*, Sp.). The species last named has a procumbent stem, smaller, obtusely lobed leaves, and rose-colored or whitish flowers.

Malva rotundifolia L. is the *Low*, *Dwarf*, or *Running mallow*, *Cheesies*, *Doll-* or *Fairy-cheeses*, E.; *Kaesekraut*, G.; *Petite mauve*, Fr., and is very commonly naturalized in the United States. It has a procumbent stem, round, heart-shaped, somewhat lobed and crenate leaves, whitish flowers with slightly retuse, rather short petals, and numerous wrinkled 1-seeded carpels, circularly arranged.

Semen Abelmosehi, *Grana Moschata*, or *Semen Alceæ Ægytiaceæ* (*Abelmoschus* or *Musk-seed*, *Amber-seed*, *Ambrette*, E.; *Moschuskoerner*, *Bisamkoerner*, G.; *Graine de muse*, *Ambretta*, Fr.), are the seeds of *Hibiscus Abelmoschus* L. (*H. moschutus* Moench), of Egypt and India, and

widely cultivated. These seeds are flattish reniform, about 3 Mm. (⅛ In.) long, grayish brown, concentrically striate, blackish at the hilum, internally whitish and oily, and have a thin endosperm and curved embryo. The strong musk-like odor resides in the testa, and becomes more apparent on rubbing or warming. The seeds are used in perfumery as a substitute for musk. The distilled oil contains acetic and palmitic acids, and when freed from the fat acid remains liquid at 0° C.

The calyx of the flower of *Hibisena Sabdariffa* L.; the *Red sorrell* or *Roselle* (E.), *Oseille de Grimée, Ketmie acide* (Fr.), of Africa, and cultivated in warm countries, is sour from the presence of tartaric and malic (or oxalic?) acids, and is thus used as a refrigerant, as well as for its mucilage, in Mexico, under the name of *Jamaica*. The root of *H. Rosa-Sinensis* L., or *China rose*, a beautiful decorative plant, is used like *Althea* root in China. The herbage and flowers of *Abutilon Abutilon* (L.) Rusby (*Sida A.* L.; *A. Avicennæ* Gærtn., the *American jute, Indian mallow, Velvet-leaf*, etc.) are employed for their mucilaginous properties, and the fiber as a substitute for hemp or jute.

The seeds of *Abutilon Indium* (L.) Sweet (*Tung-kwei-tsze*) are used in China like Abelmoschus, and the bark in India, under many names, as a diuretic.

Thespesia populnea Carr. is the *Babing gabut* of the Philippines. The yellow juice of the fruit is applied for itch and other skin diseases. The bark is astringent.

The root of *Abroma angusta* Lam. is used in India as an emmenagogue, and has, apparently, properties similar to those of cotton-root bark.

Sida lanceolata Retz., of southern Asia, has a bitter root which is used as a diuretic. The herbage of several other species of this genus is similarly employed, and that of *S. carpinifolia* L. widely diffused through the tropics, is said to be insecticidal. Several species of *Pavonia* are used as diuretics in South America.

The pulp surrounding the seeds of *Adansonia digitata* L. (Fam. *Bombacaceæ*), the *Baobab, Cream of tartar tree* or *Sour gourd tree*, of tropical Africa and the East Indies, has acid properties similar to those of the calyx of *Hibiscus Sabdariffa*, mentioned above. The fruit, under the name of *Monkey-bread*, or *Sour gourd*, is used in the East Indies as a refrigerant and appetizer, and was at one time reported, evidently without reason, as an antiperiodic.

MANGANI DIOXIDUM PRÆCIPITATUM, *U. S.*—Precipitated Manganese Dioxide.

Bioxyde (Peroxyde) de manganèse précipité, Fr.; *Präcipitistes Mangandioxyd*, G.

This is chiefly manganese dioxide ($MnO_2 = 86.36$), with small amounts of other oxides of manganese, corresponding to not less than 80 per cent. of manganese dioxide. —U. S. It was introduced into the Pharmacopœia of 1900 as suitable for internal use, being formed by precipitation and thus free from foreign matter, which renders the native dioxide unfit for this purpose.

Preparation.—Manganese sulphate, 50 Gm.; ammonia water, 250 Cc.; solution of hydrogen dioxide, 250 Cc. Dissolve the manganese sulphate in 1000 Cc. of distilled water. Dilute the 250 Cc. of ammonia water with an equal volume of distilled water, and mix with the 250 Cc. of hydrogen dioxide solution, which has likewise been diluted with an equal volume of distilled water. Pour this mixture slowly with constant stirring into the solution of the manganese sulphate. Allow the mixture to stand for 1 hour, stirring frequently. Then decant the supernatant clear liquid from the precipitate, and wash the latter repeatedly by the affusion and decantation of distilled water, using 1000 Cc. of hot water each time. Collect the precipitate on a plain filter and continue the washing with hot distilled water until the washings no longer have an alkaline reaction upon litmus-paper, nor react with barium chloride test-solution. Allow the precipitate to drain and dry at 150° C. (302° F.).—U. S.

Properties and Tests.—A heavy, very fine, odorless, tasteless, black powder, which is permanent in the air, insoluble in water or alcohol. It is not affected by cold concentrated sulphuric acid, but when heated with the latter it is converted into manganous sulphate with evolution of oxygen. When heated with hydrochloric acid, it is converted into manganous chloride, with the evolution of chlorine. At a red-heat precipitated manganese dioxide gives off oxygen, and is converted into reddish-brown manganoso-manganic oxide (Mn_3O_4). On intimately mixing 1 part of the dioxide with 1 part of potassium hydroxide and 1 part of potassium chlorate, introducing the mass into a crucible, moistening with water, drying and igniting, a dark fused mass is obtained, which yields, with water, a green solution, changing to purplish red on being boiled, or on the

addition of diluted sulphuric acid. If to 1 Gm. of the dioxide and 2 Gm. of oxalic acid, 20 Cc. of water be added, followed by 3 Cc. of sulphuric acid, and the mixture digested for several hours on a water-bath, complete solution should be effected (absence of antimony sulphide and insoluble substances). If 0.2 Gm. of precipitated manganese dioxide be dissolved in a mixture of 50 Cc. of tenth-normal oxalic acid solution, and 3 Cc. of sulphuric acid contained in a flask and heated on a water-bath, the resulting solution, after dilution with 100 Cc. of warm water, should require the addition of not more than 13 (12.95) Cc. of tenth-normal potassium permanganate solution to produce a slight pink tint (corresponding to not less than 80 per cent. of pure manganese dioxide). —U. S. Since 86.36 parts of pure manganese dioxide are capable of oxidizing 125.10 parts of crystallized oxalic acid, as shown by the equation $MnO_2 + H_2C_2O_4.2H_2O + H_2SO_4 = 2CO_2 + MnSO_4 + 4H_2O$, it follows that 1 Cc. of tenth-normal oxalic acid solution (containing 0.006255 Gm. of the acid) will require 0.004318 Gm. of manganese dioxide. As the Pharmacopœia demands that 0.2 Gm. of manganese dioxide shall oxidize not less than 37 Cc. of tenth-normal oxalic acid solution, this would indicate at least 80 per cent. of pure MnO_2, for $0.004318 \times 37 = 0.159766$ and 80 per cent. of 0.2 is 0.160.

The above method of precipitation was proposed by Jannasch, and when carried out as described yields a product of fairly constant composition which is approximately represented by the formula, $4MnO.(20 \text{ to } 25\ MnO_2)$. The proportion of manganese oxide present varies largely with the temperature of drying; at 210° C. (410° F.) the precipitate begins to lose oxygen, but some water of hydration is still retained at this temperature. The manganous oxide is also increased if the manganese sulphate solution is poured into the alkaline solution. The effect of the hydrogen dioxide is to oxidize the precipitated manganous hydroxide, $Mn(OH)_2$, forming in large part $Mn(OH)_4$; thus $Mn(OH)_2 + H_2O_2 = Mn(OH)_4$ or $MnO_2.2H_2O$. The water of hydration is nearly all driven off in drying at 150° C.

Commercial manganese dioxide, also known as black oxide of manganese, or pyrolusite, is no longer recognized in any of the pharmacopœias. It is found in different parts of Russia, Germany, France, Spain, and Great Britain, and also in Nova Scotia, Vermont, Pennsylvania, and other parts of North America. Sometimes it is found nearly pure, but it is generally associated with other manganic ores, particularly with the inferior brown manganite, and often with iron, lime, baryta, silica, etc. Pyrolusite is the most important and most abundant manganese mineral. When pure it consists of 63.19 per cent. of manganese and 36.81 per cent. of oxygen. The only use to which black oxide of manganese is put in pharmacy is in the preparation of pure chlorine water, and for this purpose it should contain at least 65 to 70 per cent. of manganese dioxide, which may be determined by the following method of assay given in the 1890 Pharmacopœia: To 1 Gm. of the finely powdered black oxide of manganese contained in a small long-necked flask add 5 Cc. of water and 4.22 Gm. of ferrous sulphate in clear crystals; subsequently 5 Cc. of hydrochloric acid are added and the mixture digested for about 15 minutes at a gentle heat and finally heated to boiling. After the mixture has been filtered and cooled, it should be immediately tested with freshly prepared potassium ferricyanide test-solution, when a blue color should not be produced (showing the presence of at least 66 per cent. of manganese dioxide). The reaction consists in oxidation of the ferrous salt to the ferric state, as shown by the following equation: $3MnO_2 + 12HCl + 6(FeSO_4 + 7H_2O) = 2Fe_2(SO_4)_3 + Fe_2Cl_6 + 3MnCl_2 + 48H_2O$. 1 Gm. of absolute manganese dioxide is capable of completely oxidizing 6.398 Gm. of crystallized ferrous sulphate.

Besides its use for the manufacture of chlorine water, black oxide of manganese is also used to generate oxygen in mixture with potassium chlorate. For the latter purpose the dioxide must be free from impurities of organic (combustible) matter, carbon, antimony sulphide, etc., since the presence of these may cause violent explosions when the oxygen mixture is heated.

Action and Uses.—Binoxide of manganese is said to possess tonic and alterative properties, but at the present time it is seldom employed. It has been recommended in the treatment of syphilis, scurvy, and secondary anæmias. An ointment containing from 10 to 15 per cent. of the drug in benzoinated lard may be tried as a remedy for parasitic skin diseases. Its principal employment at the present time is in the treatment of amenorrhœa, and it is said to be especially valuable when this condition is the result of functional nervous disturbance or anæmia. The dose is from 3 to 10 grains (0.20–0.60 Gm.), 3 times daily.

MANGANI HYPOPHOSPHIS, *U. S.*—Manganese Hypophosphite.

Manganum hypophosphorosum.—Manganous hypophosphite, E.; *Hypophosphite de manganèse, Hypophosphite manganeux*, Fr.; *Unterphosphorigsaures Manganoxydul*, G.

Formula, $Mn(PH_2O_2)_2.H_2O$. Molecular weight, 201.54.

It should contain not less than 97 per cent. of the pure salt, $Mn(PH_2O)_2$, and be kept in well-stoppered bottles.—U. S.

Preparation.—The salt is of interest chiefly on account of its use in the preparation of the official *compound syrup of hypophosphites*. It may be made by mixing a solution of 1 part of calcium hypophosphite with a solution of 1.31 parts of manganese sulphate, stirring well, and setting aside in a warm place to allow the resulting calcium sulphate to separate, after which the solution is filtered and evaporated, or allowed to crystallize.

Properties.—The salt occurs as a pink, crystalline, odorless, and nearly tasteless powder, permanent in the air. It is almost insoluble in alcohol, but soluble in 6.6 parts of water at 25° C. (77° F.), and in 6 parts of boiling water. The solution in water is neutral to litmus-paper, and gives with ammonium sulphide solution a salmon-colored precipitate of manganese sulphide, soluble in acetic acid. When strongly heated, spontaneously inflammable hydrogen phosphide is given off and a residue of manganous pyrophosphate remains. It is readily oxidized by nitric acid and other oxidizing agents. Like all hypophosphites, it reduces mercuric chloride, acidulated with hydrochloric acid, to mercurous chloride, and finally to dark metallic mercury.

Tests.—No effervescence should occur if 0.5 Gm. of the salt be added to 5 Cc. of acetic acid (absence of carbonate). If 0.5 Gm. of the salt be boiled with 10 Cc. of potassium hydroxide test-solution, and the flesh-colored precipitate, which gradually turns brown in the air, be filtered, the liquid, after slight acidulation with hydrochloric acid and then rendering alkaline with ammonia water, should yield no precipitate in one portion with magnesia mixture (absence of phosphate), nor with ammonium oxalate solution in the other portion (absence of calcium). If 5 Cc. of the aqueous solution of the salt (1 in 10) be mixed with 3 Cc. of nitric acid diluted with about 10 Cc. of water and evaporated in a beaker to dryness on a water-bath, the residue should not respond to the modified Gutzeit's test for arsenic described under ARSENI TRIOXIDUM.

Action and Uses.—The uses and dose of manganese hypophosphite are the same as of CALCIUM HYPOPHOSPHITE (which see).

MANGANI SULPHAS, *U. S.*—Manganese Sulphate.

Manganum sulfuricum, Manganous sulphate, E.; *Sulfate de manganèse, Sulfate manganeux*, Fr.; *Manganosulfat, Schwefelsaures Mangan (oxydul)*, G.

Formula, $MnSO_4 + 4H_2O$. Molecular weight, 221.47.

It should contain not less than 99.5 per cent. of pure salt, and be kept in well-stoppered bottles.—U. S.

Preparation.—Manganese dioxide is mixed with sufficient strong sulphuric acid to obtain a thin magma, which is heated to boiling and evaporated to dryness; the mass is now heated in a crucible to dull redness for some time, for the purpose of decomposing the iron sulphate. When cool, it is treated with water, and the solution, if iron be still present, digested with manganous carbonate, then filtered and evaporated to crystallize. By the warm digestion the iron is converted into a ferric compound, which is precipitated as ferric hydroxide by the manganese carbonate, some of which goes into solution as sulphate.

The salt may also be prepared from the solution of manganese chloride obtained in the preparation of chlorine, either by adding sulphuric acid, evaporating to dryness, and calcining as above, or by precipitating the solution with sodium carbonate, and dissolving three-fourths of the manganese carbonate in sulphuric acid and digesting the solution with the remaining carbonate to remove iron.

Properties.—When crystallized below 6° C. (43° F.) the salt contains 7 molecules of water, and is isomorphous with ferrous sulphate; above that temperature and below 20° C. (68° F.) it contains only 5 molecules of water, and has the

crystalline form of copper sulphate. But the salt usually met with is crystallized between 20° and 30° C. (68°–86° F.), and forms right rhombic—or, according to Marignac, monoclinic—prisms, containing $4H_2O$, 3 molecules of which are given off at a temperature of 115° C. (239° F.). A salt of the same composition as this residue is also obtained by adding sulphuric acid to a solution of manganous sulphate and evaporating; it forms a granular powder. The crystals of the official salt are transparent and colorless, or more frequently of a pale rose-red color, slightly efflorescent in a dry atmosphere, insoluble in strong alcohol, but dissolve at 15° C. (59° F.) in 150 parts of 60 per cent., in 50 parts of 50 per cent., and in 2 parts of 10 per cent. alcohol. The salt requires at 25° C. (77° F.) 0.7 part of water, and 0.53 part of boiling water (U. S.). The solution has a styptic and slightly bitter taste, a neutral or faintly acid reaction, and yields with ammonium sulphide a flesh-colored precipitate (manganese sulphide), with ferrocyanide a white one, and with ferricyanide a grayish-brown one, but is not disturbed by tannic acid. The fixed alkalies and alkali carbonates produce white precipitates (hydroxide and carbonate), which on exposure to air are rapidly oxidized, turning brown. Barium chloride yields an insoluble white precipitate (sulphate). If a fragment of the salt be mixed with a little sodium hydroxide test-solution, and the mixture then dried and fused, it will yield a dark-green mass of sodium manganate, Na_2MnO_4, dissolving in water with a green color.

Tests.—The most common impurity likely to be met with is sulphate of iron. The aqueous solution (1 in 20), after adding a few drops of hydrochloric acid and a little chlorine water, should, after boiling, not be colored red by potassium sulphocyanide test-solution (absence of iron). Sulphate of copper would in the slightly acidulated solution produce a black precipitate with hydrogen sulphide (a yellow precipitate indicates arsenic). The precipitate with ammonium sulphide should be completely soluble in acetic acid, proving the absence of zinc salt. The sulphates of magnesium and the fixed alkalies are indicated by the residue left after precipitating the solution completely with ammonium sulphide or carbonate, evaporating the filtrate to dryness, and igniting. When heated to dull redness, the salt should lose not more than 32.3 per cent. of its weight (proper—official—amount of water of crystallization).

Action and Uses.—Manganese sulphate is rarely employed in medicine at the present time. It was formerly prescribed internally as a remedy for anæmia, and in the form of an ointment applied externally to enlarged joints and glands. It may be tried in the treatment of malarial jaundice. The ordinary internal dose is from 1 to 3 grains (0.05–0.20 Gm.).

MANGANUM.—Manganese.

Manganèse, Fr.; *Mangan*, G.

Symbol, Mn. Atomic weight, 54.6.

Manganese in combination occurs in small quantity in many mineral waters and in ashes of plants and animal substances. It frequently accompanies iron in its ores, but it occurs chiefly as the dioxide or black oxide. It is found to some extent also in the form of other oxides in the minerals *braunite*, *manganite*, and *hausmannite*, and as carbonate. The black oxide and similar minerals of manganese were looked upon by the older chemists as belonging to the iron ores, but Scheele proved (1774) that these contained a new metal, which was isolated by Gahn in 1807. The metal is difficult to obtain by the older process of reduction of the oxide by charcoal at intense heat, but it is now obtained comparatively easily by Goldschmidt's method, namely, reduction of an oxide (Mn_3O_4) by powdered aluminum. The metal is grayish-white with a reddish sheen, and sufficiently hard to scratch glass and steel; it is more brittle and melts at a higher temperature than iron (1900° C.), and has the specific gravity 8. It is easily attacked by acids. Of practical value in the steel industry are the alloys of iron and manganese, namely, spiegeleisen, containing 10–20 per cent. of manganese, and ferromanganese, containing 20–80 per cent. of manganese.

Manganese has a variable valence and forms a number of oxides: *Manganous oxide*, MnO, gives rise to the manganous salts, which are the stable combinations of manganese. *Manganic oxide*, Mn_2O_3, found in nature as the mineral braunite, gives rise to the man-

ganic salts, which are unstable and easily converted into the manganous salts. *Manganoso-manganic oxide*, Mn_3O_4, is found as the mineral hausmannite, and is formed when any of the other oxides are highly heated. *Pyrolusite*, or the dioxide, MnO_2, is official. *Manganese trioxide*, MnO_3, is a dark-red liquid volatile at 50° C. (122° F.). *Manganese heptoxide*, Mn_2O_7, is a greenish-black thick liquid, volatile between 60° and 70° C. (140° and 158° F.), and very explosive. These last two oxides have acid properties, and give rise to manganic and permanganic acid, respectively, H_2MnO_4 and $HMnO_4$. The latter exists in the free state, but the former exists only in its salts.

Conclusive tests for the presence of manganese, even in very small quantities are: 1, the dark-green mass obtained by fusion with sodium carbonate and potassium nitrate or chlorate (salt of manganic acid); 2, the red color of permanganic acid when a trace of manganese is treated with red lead oxide and moderately strong nitric acid; 3, the violet color imparted to a borax bead.

SALTS OF MANGANESE.

Mangani Carbonas. *Manganese carbonate*, E.; *Mangankarbonat*, G. $MnCO_3$.—It is prepared by precipitating in the presence of a little syrup a solution of manganous sulphate with sodium carbonate, washing the precipitate well, and drying it rapidly at a moderate heat. It is a white powder, having a brownish tinge and dissolving in carbonic acid water, leaving a slight residue of brown manganic oxide. It has been recommended in the treatment of anæmia, and is said to increase the quantity and improve the character of the blood. Dose, from 10 to 30 grains (0.60–1 Gm.), daily, in pill-form.

Mangani Chloridum. *Manganese chloride*, E.; *Manganchlorür*, G. $MnCl_2.4H_2O$.—Manganese chloride is most economically obtained by evaporating the liquor obtained in the preparation of chlorine to get rid of free acid, dissolving the residue in water and digesting with manganous carbonate until the iron has been completely precipitated; the filtrate is evaporated, crystallized, and by recrystallization purified from calcium chloride if present. The salt is in granular, or when slowly evaporated in tabular, crystals of a pale rose-red color. It is soluble in alcohol, and requires at ordinary temperature about 2½ parts of water for solution. It has been employed locally as a stimulant to syphilitic and other indolent ulcers.

Mangani Iodidum. *Manganese iodide*, E.; *Manganjodür*, G. MnI_2.—Manganese iodide is a very deliquescent salt, and is best administered in the form of *syrup*, which may be prepared by dissolving manganese carbonate in hydriodic acid, or by the following formula proposed by Procter (1850): Take of manganese sulphate, 16 drachms; potassium iodide, 19 drachms; sugar, water, of each a sufficient quantity. Dissolve each of the salts in 3 fluidounces of water containing 2 drachms of syrup; mix, and after precipitation filter the solution into a bottle containing 12 ounces of sugar; add water to make a pint, and shake the bottle till the sugar is dissolved. Each fluidounce contains 1 drachm of manganese iodide; it may be given in doses of 10 drops to ½ fluidrachm (0.7–4 Gm.). Procter also proposed a *syrup of the iodides of iron and manganese*, to be prepared as follows: Take of potassium iodide, 1000 grains; ferrous sulphate, 630 grains; manganese sulphate, 210 grains; clean iron filings, 100 grains; powdered sugar, 4800 grains; distilled water, sufficient. Rub the sulphates and iodide separately to powder, mix with the iron filings, add ½ fluidounce of water, and rub to a uniform paste; add the same quantity of water a second and a third time at intervals of 15 minutes, and rub. Place the sugar in a bottle, and drain the dense solution into it through a filter, adding water slowly to the magma until the solution of the iodides is displaced and the liquid measures 12 fluidounces. Lastly, agitate the bottle till the sugar is dissolved. Each fluidounce contains 50 grains of the iodides in the proportion of 3 parts of ferrous iodide to 1 of manganous iodide. The dose is the same as the preceding. Both syrups contain potassium sulphate. It is employed for its alterative effect, and is thought to be especially useful in the treatment of anæmia dependent upon syphilis, tuberculosis, and cancer. Dose, 2 grains (0.10 Gm.), daily, in pill-form.

Mangani Lactas. *Manganese lactate*, E.; *Milchsaures Manganoxydul*, G. $Mn(C_3H_5O_3)_2.3H_2O$.—Manganese lactate is formed by adding manganese carbonate to hot lactic acid; on evaporating the filtrate the salt is obtained in pale rose-red shining crystals, which contain 19 per cent. of water of crystallization, are soluble in 12 parts of cold water, and dissolve likewise in hot alcohol, crystallizing again on cooling. Dose, from 1 to 5 grains (0.05–0.30 Gm.) daily.

Mangani Phosphas. *Manganese phosphate*, E.; *Manganphosphat*, G.—Manganese phosphate is obtained by precipitating 10 parts of manganese sulphate with 11 parts or sufficient of sodium phosphate, each separately dissolved in about 80 parts of water, washing the precipitate well to remove the sodium sulphate, and drying. It is a white crystalline powder, sometimes with a reddish tint, having the composition $Mn_3(PO_6)_2.4H_2O$, and dissolving

readily in dilute acids. It may be employed in the treatment of chlorosis in doses of from 1 to 5 grains (0.05–0.30 Gm.) daily.

Mangani Tannas. *Manganese tannate*, E.; *Mangantannat*, G.—Manganese tannate was recommended by Marletta (1865). It is obtained by adding recently precipitated manganese carbonate to a hot solution of tannic acid in distilled water until it ceases to dissolve, filtering, and evaporating to dryness. The carbonate must be absolutely free from iron, and the solution must be protected from contact with iron, otherwise it will acquire an inky color. The salt is soluble in water, and when prescribed in solution syrup or glycerin should be added for preservation.

Mangani Tartras. *Manganese tartrate*, E.; *Mangantartrat*, G.—On dissolving 10 parts of Rochelle Salt and 8 parts of manganese sulphate, each in its own weight of hot water, and mixing the solutions, small white or pale-reddish crystals of manganese tartrate are obtained on cooling, which must be washed with cold water, since hot water decomposes them into a soluble acid and an insoluble basic salt. Dose, 1 to 5 grains (0.065–0.32 Gm.) daily.

MANNA, *U. S., Br., P. G., P. A.*—Manna.

Manne, Fr. Cod.; *Manna*, G., Sp.

The concrete saccharine exudation of *Fraxinus Ornus* L. (*F. Ornus rotundifolia* L.; *F. Ornus Europæus* Pers.; *F. rotundifolia* Lam.—Fam. *Oleaceæ*).

Origin and Collection.—The *Manna* or *Flowering Ash* is a slender tree, of ornamental habit, native of the Mediterranean region and often cultivated, both for the production of manna and for ornament. Manna is produced by it chiefly, or perhaps wholly, in the northern part of Sicily. When the tree is about 8 years old and its trunk at least 75 Mm. (3 In.) in diameter, it will yield manna, and it remains productive for from 12 to 20 years, when the stem is cut down and replaced by a shoot from the stump. The incisions are made in dry weather with a hooked knife, one each day, commencing near the root and one directly above another; they are transverse, 5 Cm. (2 In.) or less in length, and penetrate through the bark to the wood. In the following year the same operation is repeated on the untouched side. The juice flowing from the lower incisions is collected on tiles or in receptacles made from the stem of an Opuntia; that from the upper incisions hardens on the stem, or, for producing a superior variety called *manna a cannolo*, which is rarely seen in commerce, is allowed to harden on sticks or straws inserted into the cuts. When sufficiently hard, the large pieces are gathered, and completely dried before being packed, while the smaller ones are afterward scraped from the stem and sold separately.

Description and Tests.—The varieties of manna generally distinguished in our commerce are *large flake*, *small flake*, and *sorts*. Flake manna (*Manna cannellata* or *electa*) consists of 3-edged pieces varying in length from 1 to 15 or 20 Cm. (½ In. to 6 or 8 In.), 1 to 5 Cm. (½ to 1 or 2 In.) wide, and somewhat less in thickness, flat or curved on one side where it adhered to the tree, and uneven from roundish projections on the others, showing the marks of different layers. It is externally of a yellowish-white, in some places pale-brownish color, friable, internally porous, and the cavities filled with white glistening crystals of mannit. Its odor is honey-like, somewhat nauseous, and its taste sweet, but combined with a very slight bitterness and acridity. Large and small flake manna differ only in size, the latter, however, being often of a dark shade. Small flake manna is often called *Manna in tears* (*in lachrymis*). Manna in sorts (*Manna communis*, *geracina*, *calabrina*, or *in sortis*) consists of the scrapings, and is met with in fragments from the size of a pin's head to about 12 Mm. (½ In.) in diameter, with a rather adhesive surface and of a brownish color outside, but internally nearly white and crystalline; not infrequently the fragments are united by a viscid brownish matter, which, without the flakes, constitutes *fat manna* (*Manna pinguis*, *crassa*, or *de Puglia*), a variety rarely seen in this country, and rejected by the pharmacopœias. It flows from the incisions late in autumn, and is more particularly yielded by old trees; it is soft and glutinous, entirely devoid of crystals, and less agreeable in odor and taste than flake manna, from which it differs in containing much less mannit and more gum, sugar, and coloring-matter.

The U. S. P. states that on boiling 5 parts of manna with 100 parts of alcohol, a solution should be obtained which does not affect the color of litmus, and while cooling deposits many crystals of mannite.

Different pharmacopœias limit the ash at from 1.3 to 4 per cent. Several specify that it should contain not more than 10 per cent. of water. The amount of mannite required by different pharmacopœias to be contained ranges from 70 to 80 per cent.

Composition.—The best dry-flake manna contains about 90 per cent. of *mannite* [$C_6H_8(OH)_6$], the remainder being fermentable sugar, mucilage, and resin. Manna of inferior quality contains cane-sugar, levulose, and bitter substances soluble in ether, and may have a greenish color due to *fraxin* ($C_{16}H_{18}O_{10}$), a fluorescent glucoside resembling æsculin, crystallizing in colorless prisms with faint, astringent, bitter taste, and easily soluble in hot water and alcohol. With dilute acids fraxin yields *fraxetin* ($C_{10}H_8O_5$) and glucose.

Mannite crystallizes from the boiling alcoholic solution of manna in colorless needles or glossy rhombic prisms. It dissolves in 6 parts of cold water, in much less hot water, and in 90 parts of 67 per cent. alcohol, and is insoluble in ether and nearly so in absolute alcohol. It sublimes at 200° C. (392° F.), when most of it is converted into *mannitan* ($C_6H_{12}O_5$), a sweetish, syrupy liquid. The solutions of mannit are not altered by boiling with dilute acids, do not reduce Fehling's Solution, and except under special conditions do not ferment. Nitric acid converts it into racemic acid and sugar, and ultimately into oxalic and saccharic acids. Moist platinum-black converts it into *mannitic acid* ($C_6H_{12}O_7$) and *mannitose* ($C_6H_{12}O_6$), a fermentable sugar.

Pharmaceutical Preparation.—Syrup of Manna, N. F.

Action and Uses.—Manna usually operates as a gentle laxative, but in some persons produces flatulent colic. When given to adults it is usually combined with more energetic remedies, such as rhubarb, senna, and magnesia, as it disguises their taste and aids in their laxative effect. It may also be added to the milk of bottle-fed infants suffering with obstinate constipation. The dose for an infant is from 1 to 2 drachms (4–8 Gm.), for an adult from 1 to 2 ounces (30–60 Gm.).

Other Mannas.—The number of saccharine exudations to which the name Manna has been applied, is very large. That sometimes obtained in southern Europe from incisions into the trunk of *Fraxinus excelsior* L. is identical with the kind above described. *Briançon manna* is a whitish exudation from the European birch, and contains the sugar *melezitose* ($C_{12}H_{22}O_{11}.3H_2O$). The leaves of *Eucalyptus viminalis* Lab., *E. Gunnii*, and of other Australian species of *Eucalyptus*, yield *Australian manna* containing *melitrose*, a condensation-product of equal molecules of galactose, glucose, and fructose. Baker and Smith report upon another kind of Australian manna, called *Blue-grass manna*, which exudes from the stems of *Andropogon annulatus* (Forsk.?), concreting in masses as large as marbles, and containing 75 per cent. of mannit, together with a ferment which decomposes cane-sugar without the evolution of CO_2 or other gas. A *Californian manna* is collected by the Indians of that State from the stems of *Phragmites communis* Trin. In Oregon, a kind of manna is collected from *Pinus Lambertiana* Dougl. *Bamboo manna* is the name applied in India to an exudation very similar to cane-sugar, from the stems of *Dendrocalamus strictus* Nees. It exudes rarely, but then in great abundance. About 95 per cent. of it is a sugar which becomes inverted in 20 minutes when boiled with a 1 per cent. solution of hydrochloric acid. *Persian manna* comes from *Alhagi Camelorum* Fisch. (Fam. *Leguminosæ*), and contains spines and leaflets of the plant; other varieties are produced by *Salix fragilis* L., and different species of *Astragalus*. *Tamarisk manna* exudes from *Tamarix mannifera* Ehrh. in consequence of a puncture made by an insect, *Coccus manniparus* Ehrh., and is collected near Mount Sinai, and sold by the monks of the convent of St. Catharine; it contains cane-sugar, glucose, and dextrin. *Armenian* (*oak*) *manna* results from the puncture of a coccus upon the leaves of *Quercus Vallonea* Kotschy, and *Q. persica* Jaubert et Spach; it is either dissolved from the leaves by water, which is then evaporated, or else scraped off, and then is mixed with numerous small fragments of the leaves; it consists chiefly of grape-sugar. *Lebanon manna* is in small sweet grains obtained from *Cedrus libanotica* Link. Saccharine exudations have been observed upon the larch and a number of other plants, and the saccharine products of some insects, like the *trehala* (*tigala*) of Syria, containing the peculiar sugar *trehalose*, and the *lerp* of Australia, have sometimes been classed with the mannas; they are not entirely soluble in water.

MARRUBIUM.—Hoarhound; Horehound.

Herba marrubii.—Herbe de marrube blanc, Fr. Cod.; *Andornkraut, Weisser Andorn*, G.; *Marrubia*, Sp.; *Marroio branco*, Port.

The dried leaves and tops of *Marrubium vulgare* L. (Fam. *Labiatæ*).

Marrubium was official in the U. S. P. of 1890 and previously, and is official in a number of European pharmacopœias. The Spanish requires the flowering herb. The Portuguese specifies the leaves only and that they be from *M. hamatum* Kunth.

Origin.—Hoarhound is a perennial herb with numerous weak stems, the basal portions mostly prostrate. It is native of Europe and Asia, largely cultivated as an aromatic, in gardens, and naturalized in most temperate and subtropical regions.

Fig. 267.

A, *Marrubium vulgare* (Nat.); a, calyx (×3). B, spurious marrubium (Nat.); b, calyx (×3).

Description.—Leaves opposite, exstipulate, shortly and broadly petioled, the blades 2 to 4 Cm. (1 to 1½ In.) long, roundish-ovate, truncate or subcordate at the base, obtuse, strongly rugose-veiny, more or less white-hairy, especially underneath; stems quadrangular, densely white-hairy; flowers in dense, axillary, white-woolly whorls; calyx tubular, 5- to 10-nerved, with 10 almost equal, erect-spreading, pungent teeth; corolla whitish, bilabiate; stamens didynamous; fruit of 4 ovoid, obtuse, smooth nutlets, 1 to 2 Mm. long and about half as broad; aromatic and bitter.

A spurious Marrubium is sometimes sold, having leaves of about half the size, thinner, less rugose, and 5 of the calyx-teeth much smaller or wanting.

Constituents.—Hoarhound contains about 0.02 per cent. (Harms) or about 4 per cent. (Matuson) of the amaroid marrubiin, two other bitter bodies, tannin, a trace of volatile oil, fat, wax, resin, gum, and pectin. *Marrubiin* ($C_{30}H_{43}O_6$) forms bitter, somewhat acrid, prismatic or tabular crystals, slightly soluble in water, and not precipitated by tannin. It melts at 154° to 155° C. (309.2° to 311° F.). It is neither a glucoside nor an aldehyde.

Action and Uses.—Horehound may be employed as an expectorant, diaphoretic, and in large doses as a laxative. In the form of candy or syrup it is largely used by the laity in the treatment of chronic bronchial affections, and an infusion (1 ounce [30 Gm.] to 1 pint [480 Cc.]) is likewise thought to be beneficial as a remedy for chronic rheumatism and menstrual disorders. It has also been recommended in the treatment of chronic hepatitis and jaundice. The dose of the infusion is about 4 fluidounces (120 Cc.).

MASSA COPAIBÆ.—Mass of Copaiba.

Pilulæ copaibæ.—Solidified copaiba, E.; *Masse pilulaire de copahu*, Fr.; *Copaiva-Pillenmasse*, G.

Mass of Copaiba is no longer officially recognized.

Preparation.—The U. S. P., 1890, gave the following directions: Copaiba, 94 Gm.; magnesia, 6 Gm.; water, a sufficient quantity. Upon the magnesia, contained in an enamelled iron capsule, sprinkle a sufficient quantity of water to make it distinctly damp, and render it homogeneous by trituration. Then gradually incorporate with it the copaiba, so that a uniform mixture may result, place the capsule on a water-bath and heat during half an hour, frequently stirring. Lastly, transfer the mixture to a suitable vessel and set this aside until the mass has acquired a pilular consistence.

The directions to sprinkle the magnesia with water are for the purpose of properly hydrating the same, as it is well known that anhydrous magnesia does not readily combine with the acid resin. The combination may be looked upon as magnesium copaivate with volatile oil of copaiba.

The variety of copaiba best adapted for this mass is Maracaibo copaiba, since it contains a larger proportion of resin; this enters into combination with the magnesia, forming a resin soap, which gradually becomes dry and hard. If thin Para copaiba is to be used, it is advisable to evaporate sufficient of the volatile oil until the residue, after cooling, forms a viscid liquid, when it may be mixed with the magnesia.

In Europe pills of copaiba and powdered cubebs are sometimes used, and made into a mass by means of wax. The quantities necessary are 1 part of each of the ingredients named, or 3 parts of copaiba, 5 of cubebs, and 1 of wax. This mass retains its plasticity for a long time.

Action and Uses.—This preparation forms a convenient method for the administration of copaiba in pill-form. When administered in this manner, the efficacy of the copaiba is probably decreased. It should be administered in 5-grain (0.30 Gm.) pills, of which from 2 to 6 may be taken 2 or 3 times daily.

MASSA FERRI CARBONATIS, *U. S.*—Mass of Ferrous Carbonate.

Pilula ferri carbonatis, Br.—*Vallet's Mass, Vallet's pill mass*, E.; *Masse pilulaire de Vallet, de carbonate ferreux*, Fr.; *Valletsche, Pillenmasse*, G.

Preparation.—Ferrous sulphate, in clear crystals, 100 Gm.; monohydrated sodium carbonate, 46 Gm.; clarified honey, 38 Gm.; sugar, in coarse powder, 25 Gm.; syrup, distilled water, each a sufficient quantity to make 100 Gm. Dissolve the ferrous sulphate and the monohydrated sodium carbonate, each separately, in 200 Cc. of boiling distilled water, and, having added 20 Cc. of syrup to the solution of iron salt, filter both solutions, and allow them to become cold. Introduce the solution of monohydrated sodium carbonate into a bottle having a capacity of about 500 Cc., and gradually add the solution of the iron salt, rotating the bottle constantly or frequently until carbon dioxide no longer escapes. Add a sufficient quantity of distilled water to fill the bottle; then cork the bottle and set it aside, so that the ferrous carbonate may subside. Pour off the supernatant liquid, and, having mixed syrup and distilled water in the proportion of 1 volume of syrup to 19 volumes of distilled water, wash the precipitate with the mixture by decantation until the washings no longer have a saline taste. Drain the precipitate on a muslin strainer, and express as much of the water as possible. Lastly, mix the precipitate at once with the honey and sugar, and, by means of a water-bath, evaporate the mixture in a tared capsule, with constant stirring, until it is reduced to 100 Gm.—U. S.

To make 4 avoirdupois ounces of Vallet's Mass will require the following quantities: ferrous sulphate, crystals, 4 avoirdupois ounces; monohydrated sodium carbonate, 805 grains; clarified honey, 665 grains; sugar, in coarse powder, 438 grains.

On mixing solutions of ferrous sulphate and sodium carbonate, ferrous carbonate and sodium sulphate are formed by mutual decomposition. In contact with air the white iron precipitate rapidly oxidizes. The change is prevented by washing the precipitate in bottles by decantation with water recently boiled, and excluding the air; an additional protection is afforded by dissolving some sugar in the water. The pill mass, when recently made, is of a greenish-gray color, but on exposure becomes superficially greenish-black.

The quantity of ferrous sulphate ordered in the official formula is capable of yielding very nearly 42 Gm. of ferrous carbonate, but as some of the precipitate is lost by washing, and as the weight of the finished product is directed to be brought to 100 Gm., scarcely more than 35 or 36 Gm. of ferrous carbonate will be present, equal to 35 or 36 per cent.

The formula of the French Codex is almost identical with that of the United States Pharmacopœia, except that milk-sugar is used in place of sugar; 3 parts of the mass are mixed with 1 part of powdered licorice-root, and divided into pills, each weighing 0.25 Gm., which are to be silvered.

Action and Uses.—Because of its freedom from astringency, this preparation is less liable to produce dyspeptic disorders than the other preparations of iron. Vallet's mass is largely employed in the treatment of simple anæmia and chlorosis, and is probably the most effective preparation of iron we have for the treatment of the latter condition. The ordinary dose is from 3 to 5 grains (0.20–0.30 Gm.), 3 times daily.

MASSA HYDRARGYRI, *U. S.*—Mass of Mercury.

Pilula hydrargyri, Br.; *Massa cærulea.—Blue mass, Blue pill*, E.; *Masse pilulaire bleue*, Fr.; *Mercurialpillenmasse*, G.

Preparation.—Mercury, 33 Gm.; glycyrrhiza, in No. 60 powder, 10 Gm.; althæa, in No. 60 powder, 15 Gm.; glycerin, 9 Gm.; honey of rose, 33 Gm.; to make 100 Gm. Triturate the mercury with the honey of rose until it is extinguished, and globules of mercury are no longer visible under a lens magnifying at least 10 diameters. Then add the glycerin, then the glycyrrhiza and althæa, and continue the trituration until the mass is homogeneous. Keep the product in well-closed containers.—U. S.

To prepare 4 avoirdupois ounces of blue mass will require 578 grains of mercury, 174 grains of glycyrrhiza, 261 grains of althæa, 159 grains of glycerin, and 578 grains of honey of rose.

Mercury, 2 parts; confection of roses, 3 parts; licorice-root, in fine powder, 1 part. —Br., Fr. Cod.

The British Pharmacopœia still directs the mercury to be extinguished by trituration with confection of roses, and the U. S. Pharmacopœia recommends trituration with a saccharine liquid (honey), which facilitates division of the metal.

The U. S. P. prescribes the following tests: If a portion of the mass be triturated in a mortar, with warm acetic acid, the filtrate should not become more than slightly opalescent on the addition of a few drops of hydrochloric acid (limit of mercurous oxide). If another portion of the mass be digested with warm diluted hydrochloric acid and a little purified animal charcoal, the filtrate should not be affected by hydrogen sulphide test-solution nor by stannous chloride test-solution (absence of mercuric oxide).

When properly prepared, blue mass contains metallic mercury in the state of very fine division. It is not impossible that when kept on hand for a long time a change, due to the partial oxidation of mercury, may gradually take place, as has been repeatedly observed. Such a change, however, could only be very superficial, since the metal is well protected by the other ingredients of the pill mass.

Pulvis Massæ Hydrargyri, Æthiops Saccharatus.—*Powdered blue mass*, E.; *Poudre de mercure saccharin, Mercure (Ethiops) saccharin*, Fr.; *Wurmzucker*, G.—Blue mass, or blue pill, is not infrequently ordered in powders, but is unsuited for the purpose unless mixed with other absorbent powders. It may, however, be readily obtained in the state of a permanent powder having the same relative composition as the pill mass by substituting in the above directions for the glycerin and honey of rose an equal weight of milk-sugar, using a drop of oil of roses to impart the requisite flavor, and keeping the mixture moist by the addition of alcohol; after a uniform mass has been obtained it is spread out to allow the alcohol to evaporate spontaneously, after which it may be reduced to a permanent powder. W. E. Bibby (1876) recommended 1 part of mercury to be triturated with 2 parts of sugar of milk, without adding any liquid, the metal being rapidly extinguished.

Pilulæ cum Hydrargyro, Pilules Mercurielles Simples, Fr. Cod.—*Blue pills*, E.; *Pilules de mercure, Pilules bleues*, Fr.; *Mercurialpillen*, G.—Each pill contains $\frac{3}{4}$ grain. (0.5 Gm.) of mercury, Fr. Cod.

Action and Uses.—Massa hydrargyri is rarely employed at the present time for its systemic effect. Given in doses of from 3 to 5 grains (0.20–0.30 Gm.) it is said to increase biliary secretion and produce purgative effects analogous to those of Calomel (which see). If employed for its systemic effect, it should be given in divided doses, $\frac{1}{4}$–$\frac{1}{2}$ grain (0.015–0.03 Gm.), repeated every 2 hours. If given in this manner, absorption occurs, and intestinal irritation is to some extent avoided.

MASTICHE, *U. S., P. A.*—Mastic; Mastich.

Resina pistaciæ, Ph. Nor.; *R. mastiche, mastix*, G.; *Mastic*, Fr.; *Almaciga*, Sp.; *Mastica, Almecega da India*, Port.

A concrete resinous exudation from *Pistacia Lentiscus* L. (*P. L. Chia* Duham.) (Fam. *Anacardiaceæ*).

Origin and Collection.—The mastic plant is a large shrub or small tree of the Mediterranean region, particularly abundant on the Island of Scio or Chio, in the Grecian Archipelago, where most of the resin is collected. The resin is contained in the bast-layer of the bark, in elongated ducts having a large elliptic cavity and surrounded by one or more layers of small cells, in which the resin is secreted. To obtain it, vertical incisions are made in June and July in the bark of the trunk and larger branches, and in July and August, after the exuding resin has hardened, it is carefully removed from the tree and collected in baskets; this is the finest quality. An inferior quality consists of the tears which have dropped from the incisions upon tiles or flat stones kept under a tree. A vigorous tree may yield 10 pounds of mastic. The chewing of mastic, especially by women, is very general in the country of its production, and a large part of the crop is consumed in this way.

Description.—In more or less globular, flattened or elongated tears about as large as peas, the surface free from dust, or nearly so, smooth, and lustrous, varying from a pale to a rather deep-yellow, transparent, and of an opalescent refraction, brittle when cold, the fracture conchoidal; becoming readily plastic when chewed; softening below the boiling-point of water and fusing at a few degrees above it; specific gravity, about 1.07; odor balsamic, especially when heated; taste terebinthinous; soluble in ether, benzene, acetone, volatile oils, cold creosote and warm petroleum, and partly soluble in alcohol, the last-named solution reddening litmus. The acid number should not be less than 65.

Mastiche loses greatly in plasticity upon being kept, and its color at the same time deepens. In inferior grades, sand and fragments of bark adhere to the tears, many of which are gray or brown.

Constituents.—The volatile oil of mastiche varies in amount from 1 to 2.5 per cent. It has a powerfully balsamic odor, similar to that of the drug, is clear, of a pale-yellow color, and has a specific gravity of about 0.858. Its important constituent is d-pinene. The remainder of mastiche consists of two resins, about 90 per cent. *alpha-resin* or *mastichic acid*, which is soluble in alcohol, combines with bases, and has the composition $C_{20}H_{32}O_2$. The rest is *beta-resin* or *masticin*, which is white and tenacious, insoluble in alcohol, soluble in ether and oil of turpentine, and has a composition of $C_{20}H_{31}O_2$. There is a very small amount of a bitter principle which is dissolved by hot water, to which it imparts an acid reaction, and which is precipitated by tannin.

Pharmaceutical Preparation.—Pills of Aloes and Mastiche, U. S. P.

Action and Uses.—Mastiche is rarely employed in medicine in this country, except in the form of Pilulæ Aloes et Mastiche. It was formerly employed in the treatment of catarrh of the bronchial and urinary tracts, in leucorrhœa, gastric debility, and chronic diarrhœa. A solution in alcohol may be applied with a camel's-hair brush as a styptic in epistaxis, leech-bites, and other small wounds. Dissolved in one-fourth its weight of ether mastiche has been recommended as a temporary filling for carious teeth.

Substitutes and Related Products.—*Bombay mastiche* closely resembles the official, but is generally of a darker color and a less agreeable odor. Usually, it is less clear and transparent. Its botanical origin is somewhat in doubt, but is believed to be *P. mutica* F. et M. (*P. cabulica* Stokes) and *P. khinjuk* Stokes. *Barbary mastiche, Roman mastiche,* or *Mustagi Rumi,* is similar and is from *P. Atlantica* Desf.

Astronium Urundeuva (All.) Eng. (*Myracrodendron U.* All.), of the same family, yields, in Brazil, a mastiche-like resin, which is used in varnishes.

Acantho-mastiche or *Pseudomastiche* is a Grecian product of *Atractylos gummifers* L. (Fam. *Compositæ*).

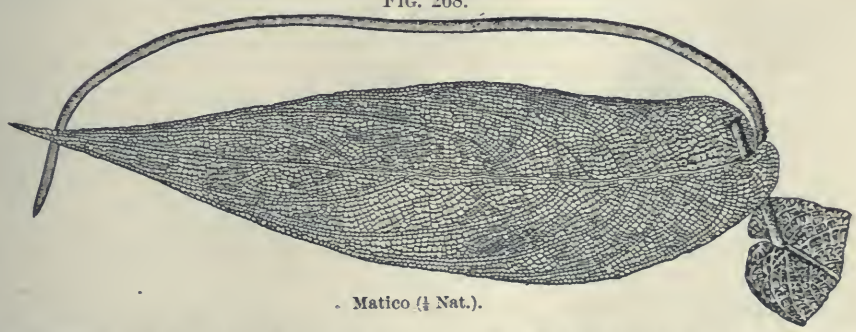
MATICO, *U. S., Fr. Cod.*—Matico.

Feuilles de matico, Fr.; *Maticoblätter,* G.; *Yerba del soldado,* Sp.

The dried leaves of *Piper angustifolium* R. et P. (*P. elongatum* Vahl.; *Artanthe e.* Miq.; *Steffensia e.* Kunth.—Fam. *Piperaceæ*).

Matico is still official in several pharmacopœias, and was so until recently in the British. The plant is a large soft-wooded shrub or very small tree of the Andes of Peru and Bolivia. The plants so-called from Brazil, Mexico, and other sections are of different species.

Fig. 268.



Matico (½ Nat.).

Description.—From 12 to 20 Cm. (5 to 8 In.) long; and 2.5 to 5 Cm. (1 to 2 In.) broad, subsessile, lanceolate, very unequal and lightly cordate at the base, long-tapering and acute, very finely crenulate, thickish and brittle, dark-green, scabrous, and very finely and regularly bullate above, grayish- or yellowish-gray-green, short-hairy and lacunate underneath; aromatic, pungent, bitter, and somewhat astringent.

The axillary flower-spikes, sometimes present, are very slender and longer than their leaves.

Constituents.—The important constituents of Matico are its tannin, volatile oil, and bitter principle, with which occur a ruby-red, pungent, and acrid resin, and crystalline *artanthic acid.* The volatile oil exists to the extent of 2 or 3 per cent., varies in color from yellow to brown, and has a specific gravity of about 0.930. Upon being cooled, crystals of *matico camphor* ($C_{12}H_{20}O$) separate from it. Its active properties are apparently due to the presence of this stearopten.

Pharmaceutical Preparations.—Fluidextract of Matico, U. S. P.

Action and Uses.—Matico possesses the properties of an aromatic, stimulant, tonic, and diuretic. It may be employed in the treatment of subacute and chronic bronchial affections, catarrhal and specific inflammations of the urinary tract, chronic diarrhœa, and in hemorrhage from the lungs, kidneys, and gastro-intestinal tract. When locally employed, it acts as a styptic, but this action is probably mechanical. Matico is said to be used locally by the natives as a vulnerary, and to be taken internally by them for its aphrodisiac properties. The dose of the powdered leaves is from ½ to 2 drachms (2–8 Gm.).

Other Maticos.—A number of astringent and hæmostatic leaves are known in tropical America as "maticos." Several of these are from species of Piper, and have appeared in commerce for Matico, especially those from *P. aduncum* L. (*Artanthe a.* Miq.). Their form is somewhat similar, but the summit is not nearly so tapering. The upper surface is marked by some sunken, ascending, and parallel nerves, and the lower surface by corresponding reticulations, but they have not the tessellated appearance nor the roughness and hairiness on the lower surface observed on the official matico leaves; their properties appear to be the same. The flower-stalks are much shorter than the leaves from the axils of which they arise.

Other leaves to which the name has been applied are those of *Eupatorium glutinosum* Kunth (Fam. *Compositæ*) and *Waltheria glomerata* Presl. (Fam. *Sterculiaceæ*).

MATRICARIA, *U. S.*—Matricaria; German Chamomile.

Flores chamomillæ, P. G.; *Flores chamomillæ vulgaris; Wild chamomile, Horse gowan, Dog's chamovyne*, E.; *Kamille, Kamillenblumen*, G.; *Camomille commune (d'Allemagne)*, Fr. Cod.; *Manzanilla comun, de Aragon*, or *de Alemania*, Sp.; *Flori di Camomilla Comune*, It.; *Camomilla dos Allemaes*, Port.

The dried flower-heads of *Matricaria Chamomilla* L. (*Chrysanthemum C.* Bernh.; *Chamomilla vulgaris* S. Gray; *C. officinalis* Koch.—Fam. *Compositæ*).

Matricaria is official in nearly all pharmacopœias. Many of them require the rejection of certain named species which resemble the official. The same result is attained by the German for all such species, by requiring the rejection of all similar flower-heads having a solid and chaffy receptacle.

Fig. 269.

Matricaria: *a*, flower-head; *b*, involucre; *c*, receptacle and involucre; *d*, longitudinal section of receptacle, with disk-florets; *e*, ray-floret; *f*, disk-floret; *g*, stamens and style of disk-floret.

Origin.—The matricaria plant is a smooth, slender, branching annual with elongated and slender stems and branches, mostly decumbent at the base, the leaves twice to thrice

pinnatifid with sebaceous, spreading segments. It is native and abundant in temperate Europe and Asia, and is naturalized in most similar regions. It is a common roadside weed in many parts of the United States, its white flowers appearing in late spring and through the summer. The drug loses 75 to 80 per cent. in drying.

Description.—About 6 to 8 Mm. (¼ to ⅓ In.) broad, exclusive of the rays; involucre flattish, closely imbricated; rays about 15, 1-serialled, reflexed, ligulate, white, about 8 Mm. (⅓ In.) long; disk yellow, hemispherical, of very numerous tubular, perfect flowers, without pappus; receptacle conical, naked, hollow; odor mild, pleasant; taste strongly aromatic and bitter.

The similar flower-heads of *Anthemis arvensis* L., and *Maruta Cotula* De Candolle (Fam. *Compositæ*), which are sometimes substituted, and which have similar properties, have conical, solid, and chaffy receptacles.

Constituents.—German chamomile flowers contain about ¼ per cent. of volatile oil, some bitter extractive, malates, tannates, and a little tannin, besides the principles common to vegetables. Pattone's *anthemic acid*, isolated (1859) from *Anthemis arvensis* L., was obtained by Werner (1867) from the official flowers by exhausting them with hot water acidulated with acetic acid, concentrating, precipitating with alcohol, evaporating the filtrate, and treating with chloroform. It is described as in colorless silky needles having an agreeable odor of chamomile, a strongly bitter taste, and dissolving in water, alcohol, ether, and chloroform. The precipitate obtained with alcohol is stated to contain a tasteless crystalline principle, *anthemidin*, which is insoluble in alcohol, ether, and chloroform, but soluble in acetic acid. Doubts were expressed by Flückiger as to the existence of anthemic acid and anthemidin in Matricaria.

Oil of German chamomile is a somewhat viscid fluid of intense blue color, having at 15° C. (59° F.) a specific gravity of 0.930–0.940. It is soluble in 8 parts of 90 per cent. alcohol. Upon exposure to light and air, it gradually changes in color to green and finally to brown. At 0° C. (32° F.) it increases in viscidity, and upon still further reduction of temperature assumes the consistence of butter. Subjected to fractional distillation, it yields at 150° to 165° C. (302°–327° F.) a colorless oil possessing a strong odor of the flowers, and another colorless fraction at 250° C. (482° F.). The azure-blue constituent, known as azulene, passes over between 270° to 300° C. (518°–572° F.), and is identical with the blue constituent of the oils of absinthe, sumbul, valerian, yarrow, etc.

Action and Uses.—Matricaria is rarely prescribed in this country except by German practitioners. It possesses mild tonic properties, and in large doses acts as an emetic and anthelmintic. It may be substituted for ANTHEMIS (which see).

MEL, *U. S., Br.*—Honey.

Miel, Fr. Cod.; *Honig*, G.; *Miel*, Sp.

A saccharine secretion deposited in the honeycomb by *Apis mellifica* L., the hive bee (Class, *Insecta;* Order, *Hymenoptera*).

Honey is official in nearly all pharmacopœias and is by them variously named as *Mel crudum*, *M. communis*, *M. naturale*, *M. album*, and *M. flavum*.

Properties.—When recently prepared, honey is a translucent or nearly transparent, pale-yellowish or brownish, thick, syrupy liquid, which, on keeping, separates a granular deposit, and is ultimately changed into a crystalline mass intermixed with some liquid. It is stated that California honey gathered in May becomes granular in a few days, but if taken later in the season remains liquid for a long time. It has a slight acid reaction, an agreeable odor, varying more or less from causes mentioned above, and a sweet taste, followed by a slight acridity. E. Dieterich (1877) ascertained that by dialyzing honey into water the dialyzed portion, on concentration, had a golden-yellow color and a remarkably fine floral odor, while the residue upon the dialyzer was destitute of honey odor and had a sweet but insipid taste.

Honey dissolves readily in water, also in diluted alcohol, yielding in both cases slightly turbid solutions which have a faint acid reaction. A mixture of honey with 2 parts of water should have a specific gravity not lower than 1.099 (U. S.), which corresponds to a specific gravity of 1.370 for the original honey.

By other pharmacopœias, the specific gravity is variously stated from 1.100 to 1.419. The Swiss and Russian mention that it should not change color upon the addition of an equal weight of ammonia.

Constituents.—The odor of honey is doubtless due to a minute quantity of volatile oil, which, according to Calloud, is intimately associated with a yellow coloring-matter, *melichroin*, separated by the nectaries and bleached on exposure to sunlight. Small quantities of wax and gummy matter are usually present, and A. Vogel (1882) found in crude honey about 0.1 per cent. of formic acid, which appears to preserve it from decomposition; but the main constituents are *grape-sugar* or *dextrose* and *fruit-sugar* or *levulose*, of each of which from 32 to 42 per cent., or a total of about 72 to 78 or 80 per cent., is present. The honey of an American wasp, *Polybia apicipennis* Sauss., according to Karsten (1857), contains cane-sugar, and the same may be the case with honey from other sources; this constituent, however, is gradually changed to *invert-sugar*, which is a mixture of grape- and fruit-sugars. It is the grape-sugar which renders honey granular, while the fruit-sugar remains liquid; the former turns polarized light to the right, the latter to the left. The albuminates, mucilaginous matter, pollen, and wax present in honey vary between about 0.5 and 1 or 2 per cent.; the ash left on incineration is generally between 0.12 and 0.16 per cent., and, according to Hager, should not exceed 0.5 per cent.

Adulterations.—The coarse adulteration with starchy substances is easily recognized in the soluble matter left on treating with alcohol, and by the blue color produced on the addition of solution of iodine. Adulterations with artificial grape-sugar prepared from starch by boiling with sulphuric acid are difficult to establish; aside from the physical properties, the presence of soluble sulphate (of calcium) affords the best criterion. Beet-root molasses contains chlorides, and if used for adulterating honey causes a white precipitate with silver nitrate. Starch paste, added with the view of rendering honey thick, is deposited as a jelly-like, stringy mass on dilution with water. Neither crude honey nor honey clarified by the process of the U. S. P. yields with water an absolutely clear solution. The tests given by the pharmacopœias are as follows: If 1 part of honey be dissolved in 4 parts of water, a clear solution should result, which should not be rendered more than faintly opalescent by a few drops of test-solution of silver nitrate (limit of chlorides) or of barium chloride (limit of sulphates). If 2 Cc. of a filtered solution of the honey (1 in 4) be placed in a test-tube 1 Cm. in diameter, and 1 Cc. of absolute alcohol be allowed to flow down the walls of the tube held in an inclined position, so as to form an overlaying layer, this should remain clear, and the line of contact should not show more than barely noticeable opalescence, which soon disappears; a permanent milky zone should not be produced (proof of purity and absence of starch sugar). If 2 Cc. of pure concentrated sulphuric acid be placed in a test-tube of 1 Cm. diameter, and 0.5 Cc. of a solution of honey (1 in 4) be allowed to flow upon it so as to form a distinct upper layer, no colored line of contact should show at once, and at the end of one hour the zone of contact should be at most yellowish or clear brown; a brownish color, becoming nearly black at the end of half an hour, should not develop (absence of cane sugar). When incinerated in small portions at a time in a platinum crucible, it should not leave more than 0.3 per cent. of ash. Water boiled with honey and allowed to cool should not be rendered blue or green on the addition of test-solution of iodine (absence of starch).—U. S.

Action and Uses.—Honey may be employed in medicine for the same purposes as syrup. It is employed principally as a vehicle, but its addition to mouth-washes and gargles increases the secretion of the mucous membranes and relieves congestion. It is useful in aphthæ, ulcerative stomatitis, and pharyngitis.

Special Varieties.—The honey produced in different parts of the world, by the species of bee yielding the official, as well as that produced by others, differs considerably in sensible properties, though but little in its general composition. The same is also true of honey produced in the same locality, at different seasons, and the difference is believed to be chiefly due to variation in the food of the bees; hence the terms "clover-honey," "buckwheat-honey," etc., the animals feeding almost wholly upon one plant while it is obtainable. Both isolated and epidemic cases of poisoning by honey have occurred, and these have also been attributed to poisonous substances having been fed upon by the bees. In some parts of Africa a brown, and even greenish, honey has been observed, which may be produced by different species of *Apis*.

Some years since, excitement was created by the announcement of the discovery of an Australian product (*Eucalyptus honey*) gathered in the Eucalyptus forests, made by the bees while feeding upon this tree, and possessing the supposed medicinal properties of the latter. Such a honey does exist, and its flavor is doubtless determined to some extent by the above-mentioned cause, but it possesses no special properties.

MEL BORACIS, *Br.*—Borax Honey.

Mel sodii boratis.—Honey of sodium borate, E.; *Mellite de borax, Miel boraté,* Fr.; *Boraxhonig,* G.

Preparation.—Take of borax, in fine powder, 1 ounce; glycerin, ½ ounce; clarified honey, 8 ounces. Mix.—Br.

Uses.—It is made extemporaneously, and is applied to most of the local affections enumerated in the article on HONEY.

MEL DEPURATUM, *U. S., Br., P. G.*—Clarified Honey.

Mel despumatum.—Miel despumé, Mellite simple, Sirop de miel, Fr.; *Gereinigter Honig,* G.

Preparation.—Honey, a convenient quantity; glycerin, a sufficient quantity. Mix the honey intimately with 2 per cent. of its weight of paper-pulp, which has been previously reduced to shreds, thoroughly washed and soaked in water and then strongly expressed and again shredded. Then apply the heat of a water-bath, and, as long as scum rises to the surface, carefully remove this. Finally, strain and mix the strained liquid with 5 per cent. of its weight of glycerin—U. S.

The object of clarification is to remove the wax and other impurities of honey, which rise to the surface when the honey is kept for a while in the condition of a thin fluid by exposing it to the heat of a water-bath; in the above process the impurities are more effectually removed by aid of the paper-pulp, and the final addition of glycerin is for the purpose of better preservation.

The Br. P. simply directs that honey shall be melted in a water-bath and strained while hot through flannel previously moistened with warm water. The process of the Fr. Cod. is similar to that of the U. S. P., except that the honey is first diluted with one-fourth its weight of water; no glycerin is used. The P. G. orders that honey (of which 10 Gm. require not more than 0.5 Cc. of normal potassium hydroxide solution for neutralization), mixed with one and a half times its weight of water, shall be digested at 100° C. (212° F.) for one hour, cooled to 50° C. (122° F.), then strained through flannel, and rapidly concentrated on a water-bath until a density of 1.33 is obtained. Various other methods have been suggested involving the use of different clarifying agents, such as white of egg, gelatin and tannin, animal charcoal, aluminum hydroxide, Irish moss, etc., but all require dilution of the honey with water and subsequent concentration by heat, which is apt to darken the color and impair the aroma. In our experience the first-mentioned process yields quite a satisfactory result.

Properties and Tests.—These should correspond to those mentioned under Crude Honey.

Pharmaceutical Uses.—Clarified honey is used as an excipient for some pill masses and confections, and also as a basis of *mellita.*

MELLITA.—*Medicated honeys,* E.; *Mellites,* Fr.; *Honige,* G.—These are simply mixtures of honey with certain medicinal substances. Owing to their proneness to change, the number of these official mixtures has been considerably diminished, and with but few exceptions none are kept on hand, but are prepared extemporaneously when required by the physician.

OXYMELLITA—*Oxymels,* E., Fr.; *Sauerhonige,* G.—are medicated honeys containing acetic acid. (See OXYMEL.)

Action and Uses.—See MEL.

MEL ROSÆ, *U. S.*—Honey of Rose.

Mel rosatum, P. G.; *Mellitum rosatum.—Mellite de roses rouges, Miel rosat,* Fr.; *Rosenhonig,* G.

Preparation.—Fluidextract of rose, 120 Cc.; clarified honey, a sufficient quantity to make 1000 Gm. Into a tared vessel introduce the fluidextract of rose, then add sufficient clarified honey to make the contents weigh 1000 Gm., and mix them thoroughly.—U. S.

If it is desired to make this preparation entirely by measure, 120 Cc. of fluidextract of rose should be mixed with 630 Cc. of clarified honey, or if 12 fluidrachms of the

fluidextract be mixed with 8 fluidounces of clarified honey, the official strength will be practically maintained.

The P. G. requires that 1 part of rose-petals shall be macerated with 5 parts of diluted alcohol for 24 hours; the expressed liquid to be mixed with 9 parts of clarified honey and 1 part of glycerin, and evaporated to 10 parts.

Action and Uses.—(See MEL.) The addition of fluidextract of rose to this preparation renders it more agreeable and somewhat astringent.

MELIACEÆ.—The Mahogany Family.

A family of about 50 genera and some 700 species of shrubs and trees of tropical and warm-temperate regions, of great interest botanically and of much economic importance, if only for its mahogany, the most important of cabinet-woods. It yields several drugs (AZEDARACH, *Oleum Cedrelæ*, *Cocillana*) of commercial interest, and a large number having active properties and important domestic and native uses. Many of these are emetico-cathartic, their action being strikingly like that of ipecac, and many are anthelmintic.

Oleum Cedrelæ, so called "Cedar-wood," or "Red-cedar wood" oil, is a volatile oil distilled from the wood of various species of *Cedrela*, of tropical America. This is the *Cigar-box cedar*, *Spanish cedar*, or *Red cedar of the tropics*, well known as the material of which cigar-boxes are made, and chiefly the product of *C. odorata* L. The bark and wood are used by the natives as a febrifuge and antiperiodic and the fruits as an anthelmintic. A gum, somewhat resembling ACACIA, has been collected from the species named, as well as from the East Indian *C. Toona* Roxb. (*Wandurika* or *Tunp-maram*). The oil is chiefly obtained as a bye-product in distilling the chips and shavings resulting from cigar-box manufacturing. The yield varies in the different species from 0.5 to 2 per cent. or more. The properties differ considerably, from the different species. It is usually of a light-blue color, sometimes greenish. The specific gravity varies from about 0.90 to 0.93. The principal constituent is cadinene. The oil is used for perfuming purposes.

The barks of the mahogany tree (*Swietenia mahogoni* L.) of tropical America, and of *Khaya senegalensis* Guill. et Per., of Western Africa, are used for their astringent and antiperiodic properties. *Soymida febrifuga* (Willd.) Juss. (*Swietenia f.* Willd.) yields the East Indian *Rotun bark*, a useful astringent tonic.

Carapa oil ("crab oil") is the fixed oil of the seeds of several species of *Carapa*. That from *C. Guianensis* Aubl. (*Xylocarpus Carapa* Spr.) is described by Gane as liquid above 20° C. (68° F.), yielding a liquid, oily portion if strongly cooled; specific gravity, 0.923. A bitter principle is extracted with warm water acidulated with acetic acid, which is alkaloidal. Carapa oil has a very nauseous taste and is somewhat purgative. It is not only obnoxious, but toxic to insects. Its great use by the natives is for repelling tormenting tropical insects, by smearing it upon the body or clothing. The importance of its use by travellers for this purpose cannot be overestimated. A very similar oil is yielded to the extent of more than 60 per cent. by the seeds (*Mote nuts*) of the Soudan species *C. procera* DC. (*C. Toulouconna* Guill. et Per.); this oil is known as *Tallicouna*, *Coundi*, or *Kundah* oil. It is a much-used anthelmintic in its home. The barks of both the above species are used as antiperiodics.

Cocillana is the bark of *Guarea Rusbyi* (Britton) Rusby (*Sycocarpus R.* Britton), a good-sized tree of the eastern Andean slope in Bolivia. The bark is from 3 to 10 Mm. ($\frac{1}{8}$ to $\frac{2}{5}$ In.) thick, strongly and roughly fissured, of an ashy-gray color externally and yellowish-brown internally. It has a weak but fibrous fracture, a peculiar and rather nauseating odor, and a rather weak but nauseous taste. It contains large oblong resin-cells containing a caoutchouc-like substance. It contains an alkaloid, *Rusbyine*, about 2.5 per cent. of 2 resins, an equal amount of fat, and a little tannin. Its action is closely similar to that of ipecac, for which it can be successfully substituted in nearly all cases. In overdoses it is a drastic cathartic.

Other species of the genus Guarea exert a similar action. *G. trichilioides* L. (Yto?), *G. Aubletii* Juss. (*Trichilia Guarea* Aubl.), the *Bois Balle* of Brazil and Guiana, *G. purgans* St. Hil., the Brazilian *Marinheiro*, and *G. spiciflora* Juss., the Brazilian *Marinheiro da folha larga*, have been named. The genus *Trichilia* is closely related and very similar, and a number of its species have similar properties. *T. emetica* Vahl. is the Egyptian *Djong el Kai*. *T. cathartica* Mart. (*Moschoxylon c.* Mart. is the Brazilian *Marinheiro da folha minha*. *T. Catigua* A. Juss. is the Brazilian *Aohite*. *T. moschata* Sw. is the *Juribali* of Jamaica. In India, the bark of *Walsura Piscidia* Roxb. is used under the name *Walurasi*, as a fish poison, and it is recognized as an emetic and emmenagogue. *Dysoxylon Blancoi* Vidal is the source of the Philippine medicinal bark *Igiw* or *Agiw*, much used as an anthelmintic, antiperiodic, and emmenagogue, and in large doses emetic.

Naregamia alata W. et A. yields the Indian drug *Goancse ipecac*. The plant is an under-

shrub a few inches in height, the stems terminating in a cluster of alternate, trifoliolate entire, or dentate leaves with winged petioles. The roots somewhat resemble ipecac. They are of a rich brown color, or greenish above, tortuous and possess a thick friable bark. The odor and taste are much like those of cocillana, above described. It contains the alkaloid *Naregamine*, an abundance of fat, wax, etc. Its properties appear almost identical with those of Cocillana.

MELISSA.—Melissa.

Folia melissæ, P. G.; *Melissa officinale*, Fr. Cod.; *Folia melissæ citratæ or citrinæ.—Balm, Lemon, Garden, Blue*, or *Sweet balm, Lemon Lobelia, Sweet Mary, Honey plant, Pimentary*, etc., E.; *Melissenblætter, Citronenkraut*, G.; *Herbe au citron, Celine, Citronelle*, Fr.; *Erba Limoncina, Cedronella*, It.; *Melisa, Toronjil*, Sp.; *Herva cidreira*, Port.

The leaves and tops of *Melissa officinalis* L. (*M. o. citrata* Bisch.—Fam. *Labiatæ*).

Melissa is official in most pharmacopœias.

Origin.—The plant is a perennial herb, with pubescent, branching stems 2 to 4 feet long from a woody rhizome. It is native of southern Europe and adjacent Asia, and is considerably cultivated. The leaves lose about 75 per cent. in drying.

Description.—Leaves slenderly petioled, the blades rarely exceeding 5 Cm. (2 In.) in length and about two-thirds as broad, ovate, rounded to subcordate at the base, obtuse, rather coarsely crenate-dentate, thin, pale-green, prominently veiny on the lower surface, sparsely hairy, the hairs soft and very fine; flowers in about 4-flowered axillary cymules, with a bell-shaped, 13-nerved, 2-lipped, 5-toothed calyx, a whitish or purplish, tubular, curved, 2-lipped corolla and didynamous stamens; odor lemon-like when crushed and warmed in the hand; taste bitterish, slightly astringent, scarcely aromatic.

When fresh, the leaves are delightfully lemon-scented, but quickly lose their fragrance after drying. Hence, the Austrian Pharmacopœia requires that they be renewed annually.

Constituents.—The leaves contain, besides the common constituents of plants, a small quantity of tannin and bitter principle and about $\frac{1}{8}$ to $\frac{1}{4}$ per cent. of volatile oil, which is colorless or yellowish, has a specific gravity of about 0.89, dissolves in about 5 parts of alcohol, has a specific gravity of 0.85 ,and contains a stearopten.

Action and Uses.—An infusion of balm [$\frac{1}{2}$ ounce (16 Gm.) to 1 pint (480 Cc.)], if drunk while hot, greatly favors diaphoresis and forms an excellent adjuvant in the treatment of febrile diseases. It may be taken in doses of from 2 to 4 fluidounces (60–120 Cc.).

Allied Products.—*M. cordifolia* Pers., perhaps a variety of *M. officinalis*, has larger, somewhat woolly leaves, of rather disagreeable odor. The leaves of *Nepeta cataria citriodora* L. have a similar odor, but are cordate-ovate, gray-green, soft-downy above and tomentose underneath.

FIG. 270.

Melissa (½ Nat.).

MENISPERMACEÆ.—The Moonseed Family.

This is a family of 50 to 60 genera and some 300 or 400 species, mostly woody twiners of the tropics of both hemispheres. Medicinally, the plants are noted for containing alkaloids and other bitter principles, on which account many of them are extensively used as bitter tonics, antiperiodics, and alteratives. A few are actively poisonous. CALUMBA, PAREIRA, PICROTOXINUM, and some allied drugs are elsewhere considered in this work. In Brazil, various species of *Abuta* are used much like Pareira. The root of *Tinospora cordifolia* (DC.) Miers (*Cocculus c.* DC.; *Chasmanthera c.* DC.) is a favorite substitute for Calumba, in India. Numerous species of *Cocculus* are similarly employed in various countries. The roots of various species of *Stephania* are employed like Serpentaria. *Cyclea peltata* Hook. f. et Th. (*Cocculus p.* DC.), of the East Indies, apparently contains the alkaloid *buxine*, and is used as a bitter tonic.

MENISPERMUM.—Menispermum.

Canadian moonseed, Yellow parilla, Yellow or *Texas sarsaparilla, Vine maple,* E.; *Canadisches Mondkorn,* G.; *Ménisperme du Canada,* Fr.

The dried rhizome and roots of *Menispermum Canadense* L. (Fam. *Menispermaceæ*).

Origin.—The plant is a herbaceous twiner of eastern and central North America, having peltate, roundish-cordate, and angular leaves, small clusters of greenish-yellow flowers, and black, glaucous, roundish kidney-shaped drupes. The drug collected in the southwest presents quite a different appearance from that of the north, and may yet be found specifically distinct.

Description.—Rhizome in simple or little-branched, rather straight pieces, often several feet in length and 2 to 5 Mm. ($\frac{1}{12}$ to $\frac{1}{5}$ In.) thick, consisting of joints mostly 2.5 to 5 Cm. (1 to 2 In.) long, and bearing fine, hair-like, wavy, branched, spreading roots of similar, or a little darker, color; yellowish-brown or gray-brown, bearing straight and regular rib-like wrinkles; fracture soft and tough; transverse section exhibiting a white (becoming yellow with long keeping) pith of very irregular relative thickness, a yellowish-white wood with broad, porous wood-wedges which are longer on the lower side, and a somewhat darker, rather thin bark; almost inodorous and bitter.

Maisch found the rhizome to contain a small quantity of berberine and a larger proportion of the white alkaloid *menispine,* which has a bitter taste, neutralizes acids completely, and yields precipitates with the group reagents for alkaloids, differing from oxyacanthine and menispermine, and insoluble in benzene and alkaline liquids; it dissolves in 75 parts of water, in 6 parts of alcohol, in 40 parts of ether, and in 20 parts of chloroform, and gives with sulphuric acid a brown color, gradually fading; with nitric acid, a yellow color; and with fused zinc chloride, a brownish-yellow color. Starch, gum, resin, tannin, and other common constituents of plants also occur.

Action and Uses.—Menispermum is probably devoid of medicinal activity. It is thought by some to be tonic and alterative, and has been employed as a substitute for sarsaparilla in the treatment of scrofulous affections. It is rarely used by practitioners.

MENTHA PIPERITA, *U. S.*—Peppermint.

Folia menthæ piperitæ, P. G.; *Menthe poivrée,* Fr. Cod.; *Brandy mint, Lamb mint,* E.; *Pfefferminzblätter,* G.; *Yerba buena piperita,* Sp.; *Hortela Pimenta,* Port.

Fig. 271.

Peppermint: *a*, branch (¾ Nat.); *b*, flower (× 3); *c*, leaf; *d*, hair, containing menthol crystals, greatly enlarged.

The dried leaves and flowering tops of *Mentha Piperita* L. (*M. Balsamea* W.—Fam. *Labiatæ*).

Peppermint is official in most pharmacopœias, a number of which caution against other species with which there is danger of confounding it, especially with Spearmint. The Austrian specifies that it should be renewed annually.

Origin.—Peppermint is a perennial herb, propagating by runners or rhizomes, and covering large areas of low or swampy land, often to the total exclusion of other vegetation. The erect or partly prostrate stems are mostly from 60 to 100 Cm. (2 to 3 Ft.) long, are quadrangular, nearly smooth, and often purplish. It is a native of central and northern Europe and has become abundantly naturalized in many, if not in most temperate regions. The fragrance and general quality are distinctly improved by careful cultivation, and the commercial article, as well as the oil distilled from it, is now almost wholly the product of cultivated plants. The largest amount of peppermint is produced in the United States, especially in Michigan and New York, Germany standing next. English peppermint has a higher repute than

any other. The very large quantity produced in Japan is mostly consumed in the manufacture of menthol. The drug loses about 80 per cent. in drying. An interesting account of its history and cultivation may be found in *Proc. Amer. Pharm. Assoc.*, 1903, p. 271 *et seq.*

Description.—Very sparingly and obscurely hairy, the hairs short and stout, usually containing menthol crystals in one or more cells; stems quadrangular, usually purplish; leaves opposite, exstipulate, petioled, the petioles winged toward the summit, the blades usually less than 5 Cm. (2 In.) long and about half as broad, ovate, with the rounded base very abruptly produced into the petiole, acute, sharply serrate, thin, wrinkled, of a bright- and usually light-green; flower-spikes oblong or oval, 1 to 2 Cm. ($\frac{2}{5}$ to $\frac{4}{5}$ In.) broad, with rounded summit, dense, or somewhat interrupted at the base; flowers about 6 Mm. ($\frac{1}{4}$ In.) long, the calyx tubular, 10-nerved, scarcely 2-lipped, 5-toothed; corolla light-purple, nearly equally 4-lobed, or one lobe (consisting of 2 united) a little larger; stamens 4, short, equal; fruit of 4 ovoid, smooth nutlets, about 0.5 to 0.75 Mm. long and half as broad; odor strong, but not heavy, characteristic; taste characteristic, pungent, and cooling.

The powder, while exhibiting many interesting elements, is especially characterized by subglobular, shortly and stoutly stalked oil-glands, and hairs, in one or more of the cells of which menthol crystals frequently occur.

Constituents.—The only important constituent of peppermint is about 1 per cent. of volatile oil (see OLEUM MENTHÆ PIPERITÆ and MENTHOL), with which there are a very small amount of tannin, much chlorophyll, and ordinary plant-constituents.

Action and Uses.—The activity of this herb depends upon the volatile oil which it contains (see OLEUM MENTHÆ PIPERITÆ). Peppermint may be employed as a carminative, stimulant, and anodyne. It may be given in the form of an infusion for the relief of nausea and flatulent colic. The fresh leaves when bruised may be applied for the relief of local pains, and when applied to the epigastrium are of value in the treatment of infantile diarrhœa.

Other Species.—The genus *Mentha*, L., is credited with some 15 species, although their great variability has resulted in the proposal of many more names. They are, as a class, among the most highly valued aromatics. Besides peppermint and spearmint (see next title), the species yielding MENTHOL, considered under that title, and *M. Pulegium*, considered under HEDEOMA, the following are worthy of notice:

M. crispa L. is the *Crisped* or *Curled-leaved*, *Cross* or *Balm mint*, or (G.) *Krauseminze*. It is a European species, sparingly naturalized in the eastern United States. It is sparsely pilose, the erect or ascending stems 1 to 3 feet long, the leaves petioled, excepting the uppermost, ovate, acutish, rounded to subcordate at the base, the margin crisped, the inflorescence much as in peppermint. This species was formerly official in the P. G. as *Folia menthæ crispæ*, together with the very similar leaves of *M. crispata* Schrad.

M. citrata Ehrh. is the *Bergamot* or *Fish mint* of Europe, and is a smaller and more slender species, its leaves larger, thinner, mostly obtuse, sharply serrate, the flower-spikes more interrupted than in the last.

M. rotundifolia (L.) Huds. (*M. spicata r.* L.; *M. sylvestris glabra* Koch), the *Round-leaved*, *Apple*, or *Patagonia mint*, is apparently a native of temperate or subtropical South America, and considerably naturalized in the United States. It is somewhat glandular-pubescent, its stems stout, but weak and prostrate at the base, the subsessile to sessile and clasping leaves oval- or ovate-rotund, obtuse, mostly cordate at the base, crenate-serrate, thick, very rugose, the flower-spikes long, but thick, and interrupted.

MENTHA VIRIDIS, *U. S.*—Spearmint.

Herba menthæ acutæ (or *romanæ*).—*Brown*, *Garden*, *Lamb*, or *Mackerel mint*, E.; *Grüne Minze*, *Roemische Minze*, G.; *Menthe verte*, Fr. Cod.; *Menthe romaine*, *Baume vert*, Fr.; *Yerbe Buena*, Sp.; *Hortela vulgar*, Port.

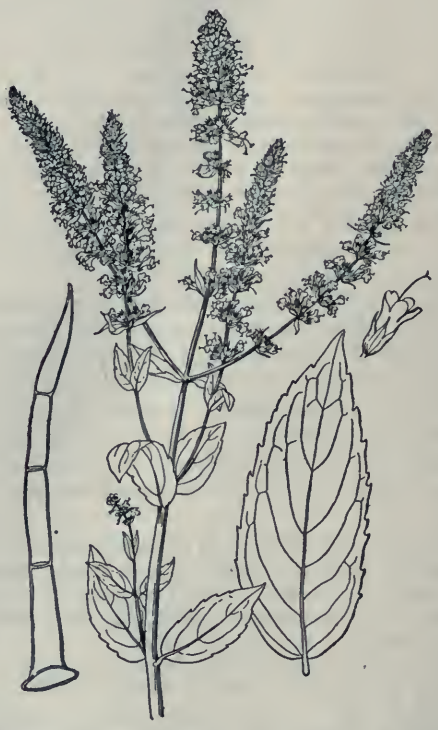
The dried leaves and flowering tops of *Mentha spicata* L. (*M. spicata viridis* L.; *M. viridis* L.; *M. sylvestris glabra* Koch.—Fam. *Labiatæ*).

Spearmint is official only in the United States and French pharmacopœias.

Origin.—The nativity and range of Spearmint are the same as those of Peppermint. It also is cultivated, but less extensively than the latter plant. Its habit is the same as that of Peppermint, but the stems are scarcely so long. It is well distinguished by its longer and more slender, acute flower-spikes and by its heavier and less pleasing odor.

Description.—Sparingly and obscurely hairy, the hairs short and stout, without menthol crystals in their cells; branches quadrangular, slender, usually pale-green, rarely purplish; leaves opposite, exstipulate, very shortly petioled, the blades usually less than 5 Cm. (2 In.) long and about one-third as broad, lanceolate or lanceovate, rounded at the base, acuminate

FIG. 272.



Spearmint: *a*, branch (Nat.); *b*, flower (× 3); *c*, leaf; *d*, hair (much enlarged).

and acute, sharply serrate, thickish and rigid, deep- and usually dark-green; flower-spikes usually appearing clustered at the summit, interrupted, elongated and acute, about 5 to 8 Mm. (^{1} to $\frac{1}{3}$ In.) thick; flowers about 3 Mm. ($\frac{1}{8}$ In.) long, the calyx-tube nearly equally 5-toothed, 10-nerved, the corolla light-purple, nearly equally 4-lobed, the stamens 4, nearly equal, rather long; odor characteristic, aromatic, rather heavy; taste characteristic, pungent.

Constituents.—The only appreciable difference in composition between Spearmint and Peppermint is in the character of the volatile oil (see OLEUM MENTHÆ VIRIDIS).

Action and Uses.—The properties of this plant are identical with those of MENTHA PIPERITA (which see).

MENTHOL, *U. S.*, *Br.*—Menthol.

Mentholum, P. G., Fr. Cod. *Pipmenthol, Peppermint camphor*, E.; *Menthol, Camphre de menthe*, Fr.; *Menthol, Pfefferminzkamfer, Mentha-Kamfer, Pip-Menthol*, G.

Formula, $C_{10}H_{19}OH$ or $C_6H_9.OH.CH_3.C_3H_7$. Molecular weight, 154.98.

Menthol is a stearopten (having the nature of a secondary alcohol), obtained from the official oil of peppermint (from *Mentha piperita* L.), or from the Japanese or Chinese oil of peppermint (from *Mentha arvensis piperascens* Holmes, and *Mentha arnavensis* Holmes).—Fam. *Labiatæ*.

Origin and Preparation.—The Chinese and Japanese solid oil of peppermint, which consists mainly of menthol, was shown by E. M. Holmes to be prepared from the

varieties *glabrata* and *piperascens* of *Mentha arvensis* De Candolle. This volatile oil, carefully rectified by steam, is cooled by means of ice and salt to —22.2° C. (—8° F.), and after it has solidified the temperature is allowed to rise very slowly, the liquid portion being drained off from time to time. This article has become known in the United States as *pipmenthol.* The yield is about 20 per cent. of the weight of the oil. The A. M. Todd Company, of Kalamazoo, Mich., has prepared a very handsomely crystallized and perfectly dry menthol from oil of peppermint distilled from *Mentha piperita* grown in the United States.

Properties.—Menthol forms colorless, acicular, or prismatic glossy crystals, which, seen in quantity, have a white appearance; if rapidly congealed, the crystals are thin, stellately arranged, and of a satiny lustre. They melt at 43° C. (109.4° F.) U. S., P. G., 42° C. (107.6° F.) Br., to a colorless liquid, boiling at 212° C. (413.6° F.), and have an agreeable odor and taste of peppermint, producing, if air is inhaled, a sensation of coolness. The Chinese menthol appears either in fused crystalline masses or in colorless acicular crystals, which are more or less moist from adhering oil, and differ somewhat in odor from that of pipmenthol. Menthol dissolves sparingly in water, but is freely soluble in alcohol, ether, chloroform, and other solvents of volatile oils; the solutions have a neutral reaction to test-paper. Boiled with sulphuric acid diluted with half its volume of water, menthol acquires an indigo-blue or ultramarine color, the acid becoming brown. Menthol should be entirely volatilized by the heat of a water-bath (absence of magnesium sulphate and other saline or waxy impurities). In contact with thymol, which has a higher melting-point, it becomes liquid (Flückiger). Triturated with an equal weight of hydrated chloral, thymol, or camphor, an oily, colorless liquid is produced, soluble in alcohol, benzin, chloroform, ether, and carbon disulphide, and on being mixed with sulphuric acid acquiring a blue color, the mixture yielding with alcohol a nearly colorless solution (H. V. Becker, 1886).

If a few crystals of menthol be dissolved in 1 Cc. of glacial acetic acid, and then 3 drops of sulphuric acid and 1 drop of nitric acid added, no green color should be produced (absence of thymol).—U. S. Thymol may also be detected by the development of a deep rose-red color upon heating with sulphuric acid.

Menthol readily combines with acids to form the corresponding esters. Menthyl acetate and valerianate are known to be present in oil of peppermint. Heated with potassium dichromate and sulphuric acid, menthol is changed to the lævorotatory ketone menthone, $C_{10}H_{18}O$. If dehydrated by means of zinc chloride, potassium acid sulphate, etc., it is reduced to the hydrocarbon menthene, $C_{10}H_{18}$. By the action of hydriodic acid and phosphorus menthol is converted into hexahydrocymene, $C_{10}H_{14}H_6$, and upon being heated together with anhydrous copper sulphate to 250°–280° C. (482°–506° F.), it is made to yield cymene, $C_{10}H_{14}$.

Solutions of menthol are lævorotatory. Its alcoholic solution of 10 per cent. strength shows $[a]_D = -50.1°$, and a 20 per cent. solution, —49.3°.

Pharmaceutical Uses.—Menthol is used both in form of ointment and plaster and in the form of cones, either pure or adulterated with spermaceti and paraffin.

Under the name *validol*, a mixture of 2 parts of menthyl valerianate and 1 part of menthol has been placed on the market in form of a colorless liquid of thin syrupy consistence, sparingly soluble in water but readily soluble in alcohol, ether, and chloroform.

Action and Uses.—Menthol has been employed internally as a remedy for gastric pain. When given in large doses, it impairs the motor and sensory activity of the cord and nerve-trunks. In the form of a cone it has been largely employed as a local application for the relief of headache, toothache, and superficial neuralgias. Its application produces at first a cooling sensation, which is followed by one of burning. A 2 per cent. solution in water may be employed locally as a palliative in the treatment of pruritus ani et vulvæ and in urticaria, and a 5 per cent. solution in bland oil as a spray may be used with excellent results in acute coryza and hay fever. An ethereal solution containing from 10 to 50 per cent. of the drug may be tried for the purpose of aborting superficial inflammations, such as boils and carbuncles. The dose is from 1 to 2 grains (0.06–0.12 Gm.), either in pill or in oil.

MENYANTHES.—Bogbean; Buckbean.

Folia (or *Herba*) *trifolia fibrina*, P. G.; *Trèfles d'eau* (or *de marais*), Fr. Cod.—*Marsh trefoil, Water shamrock, Bog-hop, -nut,* or *-myrtle, Brook-bean*, E.; *Wasserklee, Bitterklee, Fieberklee, Dreiblatt*, G.; *Trébal acuatica*, Sp.

The dried leaves of *Menyanthes trifoliata* L. (Fam. *Gentianaceæ*).

Fig. 273.

Menyanthes (½ Nat.).

Origin and Description.—From a smooth perennial herb, growing in boggy places, usually in water, through most of the north-temperate zone. The horizontal rhizome is yellowish-white, 1 to 2.5 Cm. (⅖ to 1 In.) thick, fleshy, and invested by the sheathing bases of the petioles. The leaves grow from near the base of the stem, which is mostly a foot or two high, and terminates in a raceme of about 15 to 20 white or rose-colored, fringed flowers. The leaves are mostly gathered in the spring and lose about 85 per cent. in drying. The leaves are on petioles 10–15 Cm. (4 or 6 In.) long, ternate, the leaflets sessile, 5–8 Cm. (2 to 3 In.) long, obtuse, oblong or obovate, entire or slightly crenate, smooth, and pale-green. They are inodorous, and have a very bitter taste, free from astringency.

Constituents.—The important constituent of Menyanthes is the very bitter, whitish, amorphous, neutral glucoside *menyanthin* ($C_{30}H_{46}O_{14}$), which melts at 100° to 115° C. (212° to 239° F.), is soluble in alcohol and chloroform, with difficulty in water, and insoluble in ether, and yields a white precipitate with tannic acid. When boiled with dilute acids it is resolved into sugar, a brown resin, and *menyanthol*, the latter being oily, volatile, heavier than water, and having an odor resembling that of bitter almonds. The leaves contain a pectin compound, which causes the infusion, sweetened with sugar, to gelatinize in a few days; this compound is insoluble in diluted alcohol.

Pharmaceutical Preparation.—Fluidextract of Menyanthes, N. F.

Action and Uses.—Buck-bean is a tonic, purgative, and emmenagogue. In large doses it acts as an emetic and vermifuge. The remedy has been recommended in the treatment of atonic dyspepsia, malarial fevers, rheumatism, amenorrhœa, scrofula, scurvy, and chronic cutaneous eruptions. The dose of the powdered drug is from 10 to 30 grains (0.60–2 Gm.). An infusion [½ ounce (16 Gm.) to 1 pint (480 Cc.)] may be given in doses of from 1 to 2 fluidounces (30–60 Cc.). As a purge double this dose may be given.

METHYLENI BICHLORIDUM.—Methylene Bichloride.

Methylenum bichloratum.—Dichlormethane, Chloro-methyl, E.; *Chlorure de méthyle monochloré, Ether chlorhydrique monochloruré de l'esprit de bois*, Fr.; *Methylenchlorid, Chlormethylchlorür*, G.

Formula, CH_2Cl_2. Molecular weight, 84.27.

Preparation.—Chlorine gas is conducted into a glass globe containing methyl chloride, CH_3Cl, which glass is drawn out below so as to form a thin tube, passing into one aperture of a Woulfe's bottle, the second tubulure being connected, by means of a bent glass tube, with a second Woulfe's bottle placed in ice, and this with a flask cooled by means of a freezing-mixture; the liquid condensed in the Woulfe's bottles is chiefly chloroform, while that condensing in the flask will be pure methylene bichloride. This is Regnault's process, by whom the compound was discovered (1840). It can also be obtained by the reduction of chloroform (in alcoholic solution) by zinc and hydrochloric

acid; the heavier liquid is separated and purified by successive treatment with soda solution, sulphuric acid, water, calcium chloride, and fractional distillation.

Properties.—Methylene bichloride is a colorless liquid, having at 15° C. (59° F.) the specific gravity 1.351, and boiling between 40° and 41° C. (104°–105.8° F.). Its odor resembles that of chloroform. It has no action upon test-paper, is soluble in alcohol and ether, and scarcely affected by alcoholic solution of potassium hydroxide. It is decomposed when exposed to light and air, the change being prevented by the addition of a little alcohol. Its vapor has the density 3.012 and burns with a bright flame.

In composition it may be regarded as the chloride of methylene (CH_2) or as a derivative of methane, CH_4.

English Methylene Chloride, or methylene, is a mixture of methylene chloride and ether; it was recommended as a safe anæsthetic in doses of from 1 to 4 drachms (Richardson), but is not so free from danger as its originator believed. Care should be taken to distinguish between this mixture and the definite chemical compound above mentioned.

A mixture of chloroform and methyl chloride has also figured in commerce as "methylene chloride" (Helbing).

Action and Uses.—Methylene bichloride has been proposed as a general anæsthetic safer than chloroform. It is, however, rarely employed on account of its high price, and any preparation offered at a low figure is in all probability an impure article. It is said to act more rapidly than chloroform, to cause less muscular relaxation, and to interfere less with the circulatory and respiratory functions than the older anæsthetic. The average quantity required for the production of anæsthesia is 1 fluidrachm (4 Cc.), every 5 minutes. It may be administered internally in doses of from 5 to 15 minims (0.3–1 Cc.).

Allied Compounds.—Methyl Chloride. *Chlormethyl, Monochlormethane.* CH_3Cl. Molecular weight, 50.09.—A gaseous compound first proposed by Berthelot, and obtained by the reaction between methyl alcohol and hydrochloric acid in the presence of zinc chloride. After purification by means of water, acid, and alkali, it occurs as a colorless gas with an ethereal odor; it is soluble in one-fourth its volume of water, much more so in alcohol, and freely in ether and chloroform. Under a pressure of 5 atmospheres at normal temperature methyl chloride is a liquid which should be neutral to test-paper and unaffected by silver nitrate or potassium iodide and starch paste. The compressed liquid form of methyl chloride has been recommended for use as a spray to produce local anæsthesia.

Carbon Tetrachloride. *Tetrachlormethane.* CCl_4. Molecular weight, 152.63.—A transparent, colorless liquid, of the specific gravity 1.599, boiling at 77° C. (170.6° F.), and of an agreeable aromatic flavor. It is obtained in an impure form when dry chlorine is first passed through a bottle containing carbon disulphide, and then through a porcelain tube filled with pieces of porcelain and kept at a bright-red heat; the vapors are condensed in a cooled receiver, forming a yellowish-red liquid, which is a mixture of carbon tetrachloride and sulphur chloride. The sulphur chloride is removed by slowly adding the liquid to an excess of potash lye or milk of lime, the mixture being set aside and agitated from time to time till the sulphur compound is decomposed, and then distilled. Carbon tetrachloride passes over, and, if necessary, may be freed from remaining carbon disulphide by further treatment with caustic potash. It has been recommended in place of benzin, gasoline, etc., over which it has the advantage of non-inflammability and non-explosiveness. For detailed account of its uses, see *Proc. Am. Pharm. Assoc.*, 1903.

METHYLIS IODIDUM.—Methyl Iodide.

Iodure de méthyle, Fr.; *Jodmethyl*, G.

Formula, CH_3I. Molecular weight, 140.81.

Preparation.—This compound was first obtained by Dumas and Peligot (1835) by adding very gradually 1 part of phosphorus to a solution of 8 parts of iodine in 12 or 15 parts of methyl alcohol, agitating the distillate with water and rectifying. According to Wanklyn (1867), potassium iodide and anhydrous methyl alcohol are mixed in a retort in equivalent proportions; dry hydrochloric acid gas is passed into the mixture, which is then distilled, and the distillate purified as before.

Properties.—Methyl iodide is a colorless liquid of an ethereal odor and the specific gravity 2.199 at 0° C. (32° F.). It boils at 43.8° C. (111° F.), and by the aid of a wick burns with difficulty, giving off violet vapors. It turns brown on exposure to light, and in the cold unites with water to form a crystalline hydrate.

Action and Uses.—This substance was formerly proposed as a general anæsthetic, but because of its irritant properties its employment as such has been abandoned. It may be applied under a watch-crystal for the purpose of producing vesication. When employed in this manner, the maximum pain is felt in from 5 to 15 minutes, after which it should be removed.

Methyl iodide is largely used in the synthetic manufacture of numerous chemicals.

Allied Compound.—Methyleni Iodidum, *s.* Biniodidum. CH_2I_2. Molecular weight, 267.03.—Prepared by Butlerow (1859) by acting upon iodoform with sodium ethylate. It is readily formed by heating chloroform with very concentrated hydriodic acid for several hours to near 130° C. (266° F.). It is a yellow liquid having the specific gravity 3.34, congealing to glossy scales near the freezing-point, and boiling at 180° C. (356° F.), at the same time suffering partial decomposition.

METHYLIS SALICYLAS, *U. S.*—Methyl Salicylate.

Artificial or synthetic oil of wintergreen, E.; *Salicylate de méthyle*, Fr.; *Methylsalicylat, Künstliches Wintergrünöl*, G.

An ester produced synthetically; it is the principal constituent of oil of gaultheria and oil of betula. For flavoring purposes, oil of gaultheria, oil of betula, and methyl salicylate may be regarded as identical products. It should be kept in well-stoppered bottles, protected from light.—U. S.

Formula, $CH_3C_7H_5O_3$ or $C_6H_4(OH)COOCH_3$. Molecular weight, 150.92.

Preparation.—The process probably most used is the one which is employed extensively for the preparation of compound ethers, and consists in heating salicylic acid and methyl alcohol together in the presence of sulphuric acid. The reaction occurring may be expressed by the following equation: $C_6H_4OHCOOH + CH_3OH = C_6H_4OHCOOH_3 + H_2O$; the sulphuric acid serving only to abstract the water as fast as eliminated. The newly formed methyl salicylate floats on the surface of the liquid and is subsequently purified by distillation.

Properties.—Methyl salicylate is a colorless, or slightly yellowish liquid, having the characteristic, strongly aromatic odor, and the sweetish, warm, and aromatic taste of oil of wintergreen, with the essential constituent of which it is identical, and in place of which it may be used. Specific gravity, 1.180–1.185 at 25° C. (77° F.). Boiling-point, 219° to 221° C. (462.2°–429.8° F.). It is optically inactive. Sparingly soluble in water, but soluble in all proportions in alcohol, glacial acetic acid, and carbon disulphide. The alcohol solution is neutral or slightly acid to litmus-paper. If a drop of methyl salicylate be shaken with a little water, and a drop of ferric chloride test-solution subsequently added, a deep-violet color will be produced. When heated on a water-bath, in a flask provided with a suitable condenser, it should yield no distillate having the characteristics of alcohol or chloroform. If to 1 Cc. of methyl salicylate, contained in a capacious test-tube, 10 Cc. of sodium hydroxide test-solution be added, and the mixture agitated, a bulky, white, crystalline precipitate will be produced; and, if the test-tube, loosely corked, be subsequently allowed to stand in boiling water for about 5 minutes, with occasional agitation, a clear, colorless or faintly yellowish and complete solution should be obtained without the separation of any oily drops, either on the surface or at the bottom of the liquid (absence of other volatile oils or of petroleum). If the alkaline liquid thus obtained be subsequently diluted with about 3 times its volume of water, and a slight excess of hydrochloric acid added, a white crystalline precipitate will be produced, which, when collected on a filter, washed with a little water, and recrystallized from hot water, should respond to the tests of identity and purity described under Acidum Salicylicum (absence of methyl benzoate, etc.).—U. S.

Action and Uses.—This preparation apparently differs in no particular from oil of *wiutergreen*. (See Oleum Gaultheræ.)

METHYLTHIONINÆ HYDROCHLORIDUM, *U. S.*—Methylthionine Hydrochloride.

Tetramethylthionine hydrochloride, Methylene blue, E.; *Chlorhydrate de tetraméthylethionine*, Fr.; *Tetramethylthioninchlorid, Methylen Blau*, G.

Formula, $C_{16}H_{18}N_3SCl$. Molecular weight, 317.36.

Preparation.—When para-amido-dimethylaniline, also known as dimethyl-para-

diamidobenzene and dimethyl-para-phenylendiamine, $C_6H_4(NH_2)N(CH_3)_2$, is treated in hydrochloric acid solution with hydrogen sulphide and subsequently with ferric chloride, tetramethylthionine hydrochloride is produced. It may also be prepared by treating para-amido-dimethylaniline hydrochloride with sodium nitrite and then successively with hydrogen sulphide and ferric chloride.

Properties and Tests.—Methylene blue occurs as a dark-green, crystalline powder, or in form of prismatic crystals having a bronze-like lustre. It is readily soluble in water and somewhat less readily in alcohol, the solutions having a deep-blue color. The addition of hydrochloric acid to its aqueous solution changes the color to a lighter shade of blue. The addition of sodium hydroxide test-solution to the aqueous solution changes the color to a purplish shade, and if added in excess, produces a precipitate having a dull-violet color. The dry powder dissolved in sulphuric acid containing powdered zinc produces a solution which, upon standing, is gradually decolorized. 2 Gm. of methylene blue, when heated until it is decomposed, should leave not more than 0.004 Gm. of residue, which, when examined, should be free from zinc oxide (absence of commercial dye and other mineral impurities). 2 Gm. of methylene blue ignited with dry sodium carbonate and potassium nitrate should leave a residue which should not respond to the modified Gutzeit's test for arsenic, given under ARSENI TRIOXIDUM.—U. S. Methylene blue stains during life the axis cylinders of both sensory and motor nerves, and has proved the best stain for the plasmodia found in the blood corpuscles of malarial patients.

Methylene blue is usually dispensed in capsules, either dry or in form of a mass. Some little care is necessary to avoid soiling the hands and clothing of the operator. When it is ordered in powder form, the best plan would seem to be to rub the methylene blue into powder, not too fine, in a glass mortar, and divide the powder into the prescribed number of doses on glazed paper, and then carefully transfer to the capsules. If a mass is to be made, methylene blue may be rubbed into powder with half its weight of powdered licorice-root and then massed with glucose or some similar excipient. By keeping the hands and pill-tile well dusted with licorice powder, it is possible to prevent coloring while the mass is divided into the required number of cylinders, which may then be transferred to the capsules in the usual manner with the aid of a long needle.

Commercially, methylene blue is sometimes found as the double chloride of zinc and tetramethylthionine, in which form it is used as a dye, but is unfit for medicinal purposes, hence the test for absence of zinc, given above. It must not be confounded with methyl blue, the sodium salt of triphenyl-para-rosaniline-trisulphonic acid, which is made by treating pararosaniline with aniline and the resulting product with sulphuric acid. A solution of methyl blue, upon the addition of sodium hydroxide, changes to reddish brown, whereas the color of methylene-blue solution changes to violet.

Action and Uses.—Methylene blue has been used with some success in intermittent malarial fever. It is not nearly so effective as quinine, but may be tried in those cases in which quinine fails. If employed, it should be administered in doses of from 2 to 4 grains (0.12–0.25 Gm.) every 4 hours, and be continued for some time after the paroxysms have ceased. It has been highly recommended by Horwitz in the treatment of the earlier stages of the gonorrhœal urethritis, and may be given alone in tablet or pill, or combined with balsamic drugs dispensed in capsule. The dose for this purpose is 1 grain (0.06 Gm.) three times a day. It has been used to test the eliminative function of the kidney, by injecting into a muscle 1 grain dissolved in 10 minims of water. If the kidneys are not diseased the urine should show a greenish discoloration in from 15 to 30 minutes, and continue discolored for 36 hours.

METHYSTICUM.—Kava; Kava-kava.

Awa, Ava, Kawa.

The dried root of *Macropiper latifolium* (L. f.) Miq. (*Piper l.* L. f; *Piper Methysticum* Forst.; *Macropiper M.* Miq.; *Methysticum-M.* Lyons; *M. esculentum* Raf.—Fam. *Piperaceæ*).

Origin.—From a tall, soft-wooded shrub, native and largely cultivated in the Polynesian Islands, where the drug is used in the production of a beverage which induces a peculiar kind of intoxication, the motor functions, especially of the lower limbs, being incoördinated, but the intellectual functions little or not at all affected. More or less of

a general anæsthetic effect is also produced, as well as profuse diuresis. The natives prepare it by chewing and then fermenting the mass; the Europeans, by powdering and macerating. It may be employed either without or after alcoholic fermentation.

Description.—Blackish- or dark-brown externally, white internally; root consisting of a large knotty crown 5 to 15 Cm. (2 to 6 In.) thick, which is light, soft, spongy, and very starchy, the fibrovascular bundles thin and very crooked, and of numerous branches which are mostly 30 to 60 Cm. (1 to 2 Ft.) long and 1 to 2.5 Cm. ($\frac{2}{5}$ to 1 In.) thick, little-branched, tough-fibrous and readily separating into their fibrovascular bundles, lighter without and more yellowish within than the crown; odor slight; taste agreeably pungent, starchy, slightly bitter.

Constituents.—What is regarded as the important active constituent of Kava is about 2 per cent. of two resins, the alpha- and the beta-, the former more strongly anæsthetic. Bossingham differentiates a third resin. There is a very small amount of the alkaloid *kavaine*, of which little is known. *Methysticin* is a crystallizable neutral and apparently inactive body, soluble in alcohol and ether, and regarded as the methyl-ester of methysticinic acid. Authorities differ as to whether this is identical with "kavahin." About one-half of the weight of Kava consists of starch. The ash amounts to about 2.5 per cent.

Pharmaceutical Preparation.—Fluidextract of Kava, N. F.

Action and Uses.—If a solution of kava resin be injected hypodermically, it occasions a local anæsthesia lasting for a number of days. If the quantity injected be sufficiently large, the local effect is followed by complete paralysis due to the depressing action of the drug upon the motor side of the cord. This remedy increases the force, but decreases the rapidity of the heart's action, and at first stimulates and later depresses the respiratory center. Locally applied to mucous membranes, it at first produces a tingling sensation, which is followed by anæsthesia of the parts to which it is applied. A beverage prepared from this drug by the natives produces a peculiar form of intoxication, characterized by great muscular weakness, drowsiness, and incoherent muttering. This drug has been employed in the treatment of diseases of the urinary tract, and is said to be of especial value in acute and chronic diarrhœa, acute cystitis, vaginitis, and leucorrhœa. It has also been tried in the treatment of nocturnal incontinence. Because of its irritating properties it cannot be employed as a local anæsthetic. The dose of the fluidextract is from 10 minims to 1 fluidrachm (0.6–4 Cc.), 3 or 4 times daily.

MEZEREUM, *U. S.*—Mezereum.

Mezerei cortex, Br.; *Cortex mezerei, Cortex thymeleæ* (or *coccognidii*).—*Mezereon bark, Dwarf-bay, Wild pepper, Spurge-flax* or *-olive, Magell*, E.; *Seidelbast, Kellerhals*, G.; *Mézéréon, Bois gentil, Garou sainbois*, Fr. Cod.; *Lauréole, Thymelée*, Fr.; *Timelea*, It.; *Macereon, Torviso*, Sp.; *Trovisco*, Port.

The dried bark of *Daphne Mezereum* L. and of other European species of *Daphne* (Fam. *Thymelæaceæ*).

Mezereum is official in most pharmacopœias, which differ greatly in the species named. *D. Gnidium* L. (*Thymelæa* G. All.), also called *Spurge-flax, Garou*, and *Sainbois*, is the principal species, next to that above named. *D. Laureola* L. (*Thymelæa L. Scop.*), the *Lady-* or *Wood-laurel*, is another species named by some pharmacopœias.

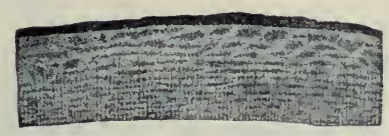
Fig. 274.

Mezereum (Nat.).

Origin.—All the above are slender, deciduous shrubs of mountainous or hilly regions, the flowers appearing before the leaves in earliest spring. The first named grows throughout most of Europe and extends into northern Asia, the others in southern Europe.

Description.—In long, thin, exceedingly tough bands, the edges fringed with partly detached bast-fibres, usually folded or rolled into disks; outer surface yellowish or reddish brown, smoothish and slightly lustrous, but with transverse scars and small blackish dots, or pale-greenish where this thin, easily detachable layer has been removed; inner surface whitish

Fig. 275.



Mezereon bark: transverse section, magnified.

or pale-green, silky, lustrous, very finely striate; bast in transverse layers, very tough; inodorous; taste very acrid.

Constituents.—The bark of Mezereum contains wax, acrid resin, yellow coloring-matter, an uncrystallizable and fermentable sugar, malic acid, and a bitter principle. A small amount of *daphnin* ($C_{15}H_{16}O_9.2H_2O$), an isomer of æsculin, occurs in the root-bark of *D. alpina* and *D. Gnidium*, and much more in the stem-bark. It is most abundant during flowering and fruiting.

Pharmaceutical Preparations.—Fluidextract of Mezereum, U. S. P.; Ointment of Mezereum, N. F.

Action and Uses.—When taken internally in overdose, mezereon acts as an acrid, narcotic poison, producing violent gastro-enteritis, with nausea, vomiting, and purging. If locally applied in the recent state, and allowed to remain sufficiently long, the drug produces vesication. When dry, the remedy is less active; but if it be moistened with vinegar and applied twice daily, vesication will eventually occur. Mezereon has been locally employed in the form of an ointment for the purpose of maintaining the discharge from cantharidal blisters, issues, and setons, and is said to be of value also as a stimulant to foul or ill-conditioned ulcers. It was formerly employed internally in the treatment of syphilitic, rheumatic, and scrofulous conditions, and was thought to be advantageous in chronic skin diseases. Its efficacy in these conditions is questionable, however, and at present it is rarely employed except in combination, for example, the compound decoction of sarsaparilla. Poisoning by mezereon should be treated by the prompt evacuation of the stomach and the administration of demulcent drinks, opium, and stimulants. The dose in powder is 10 grains (0.60 Gm.).

Allied Drugs.—Fructus (Grana) Mezerei, F. Gnidii, F. Coccognidii. *Mezereon fruit*, E.; *Kellerhalskörner*, G.; *Grains de garou*, Fr.—The berry-like fruit of the above species is in the fresh state red, or of the spurge-laurel blackish, globular-ovate or oval, about 5 Mm. ($\frac{1}{5}$ In.) thick; after drying, brown or black, wrinkled; contains a black glossy seed, is inodorous, and has a strongly acrid and burning taste. Besides gum, vegetable acids, protein compounds, and other medicinally unimportant principles, Casselmann obtained from the fruit 31 per cent. of drying oil, 0.22 per cent. of acrid resin, and 0.38 per cent. of *coccognin*, which differs from daphnin in having a neutral reaction, in being very sparingly soluble in hot water, and in not being a glucoside; when heated, it melts, and sublimes apparently unchanged, giving off a coumarin-like odor.

Daphne salicifolia Kunth grows in Mexico; the leaves, *Hojas del San Pedro*, are used for their epispastic properties.

Aloe-wood.—One of the sources of East Indian Aloe-wood is *Aquilaria Agallocha* Roxb., and perhaps other species of Aquilaria, of the family *Thymelæaceæ*.

MISTURA CREOSOTI, *Br.*—Creosote Mixture.

Mixture de créosote, Fr.; *Kreosotmixtur*, G.

Preparation.—Take of creosote, spirit of juniper, of each, 16 minims; syrup, 1 fluidounce; distilled water, a sufficient quantity. Shake the creosote with 14 fluidounces of the distilled water; add the syrup and the spirit of juniper, and sufficient distilled water to produce 16 fluidounces of the mixture.—Br.

This preparation is of practically the same strength as that of the 1885 Br. P., except that the glacial acetic acid has been omitted.

Uses.—This mixture is intended to allay vomiting. Dose, 1 fluidounce (30 Cc.).

MISTURA CRETÆ, *U. S., Br.*—Chalk Mixture.

Mixture avec la craie, Fr.; *Kreidemixtur*, G.

Preparation.—Take of compound chalk powder, 20 Gm.; cinnamon water, 40 Cc.; water, a sufficient quantity to make 100 Cc. Rub the compound chalk powder in a mortar with the cinnamon water and about 20 Cc. of water, gradually added, to a uniform mixture; transfer this to a graduated vessel, and rinse the mortar with sufficient water to make the product measure 100 Cc. Mix the whole thoroughly. This preparation should be freshly made when wanted.—U. S.

To prepare 4 fluidounces of chalk mixture will require 365 grains of compound chalk powder, 13 fluidrachms of cinnamon water, and sufficient water to make 32 fluidrachms.

Take of prepared chalk, $\frac{1}{4}$ ounce; tragacanth, in powder, 15 grains; refined sugar, $\frac{1}{2}$ ounce; cinnamon water, a sufficient quantity. Triturate the prepared chalk with the tragacanth and refined sugar, and gradually add sufficient cinnamon water to produce 8 fluidounces of the mixture.—Br.

This mixture spoils readily during warm weather; the addition of a little glycerin or the substitution of glycerin for the sugar, as recommended by G. W. Kennedy (1872), would tend to preserve it for several days while in the hands of the patient, but it should be dispensed only freshly made.

Uses.—Chalk mixture forms an agreeable method for the administration of chalk. It may be employed in the treatment of diarrhœa due to fermentation. Dose, from 1 to 4 fluidrachms (4–16 Cc.).

MISTURA FERRI COMPOSITA, *U. S., Br.*—Compound Iron Mixture.

Griffith's Mixture, E.; *Mixture de Griffith*, Fr.; *Griffithsche Eisenmixtur*, G.

Preparation.—Take of ferrous sulphate, in crystals, 6 Gm.; myrrh, in small pieces, 18 Gm.; sugar, 18 Gm.; potassium carbonate, 8 Gm.; spirit of lavender, 60 Cc.; rose water, a sufficient quantity to make 1000 Cc. Rub the myrrh, sugar, and potassium carbonate, in a mortar, with 700 Cc. of rose water, at first very gradually added, so that a uniform mixture may result. Transfer this to a graduated vessel, add the spirit of lavender, then the ferrous sulphate, previously dissolved in about 50 Cc. of rose water, and lastly sufficient rose water to make the product measure 1000 Cc. Mix the whole thoroughly. This preparation should be freshly made when wanted.—U. S.

Each fluidounce of this preparation contains about 3 grains of ferrous sulphate, 9 grains each of myrrh and sugar, 4 grains of potassium carbonate, $\frac{1}{2}$ fluidrachm of spirit of lavender, and $7\frac{1}{2}$ fluidrachms of rose water.

In the formula directed by the Br. P. the ingredients are ferrous sulphate, 25 grains; potassium carbonate, 30 grains; myrrh and refined sugar, each 60 grains; spirit of nutmeg, 50 minims; and rose water, 10 fluidounces (Imperial).

The preparation of this mixture presents no difficulty if good tears of myrrh are selected and the directions are strictly followed. The reaction between the iron and potassium salts, resulting in the formation of ferrous carbonate and potassium sulphate, takes place in the myrrh emulsion, by which the insoluble ferrous carbonate is kept in suspension. Unless in full and well-corked bottles, the mixture, at first of a dirty greenish color, is hardly protected against oxidation by the small quantity of sugar present, and should be freshly made when needed.

Uses.—Griffith's mixture is employed for the relief of the anæmia of tuberculosis, and is said to be useful in the treatment of chlorosis, and the menstrual disorders and nervous manifestations depending upon anæmia. It should not be administered if gastro-intestinal irritation or inflammation exists. Dose, from 1 to 2 fluidounces (30–60 Cc.).

MISTURA GLYCYRRHIZÆ COMPOSITA, *U. S.*—Compound Mixture of Glycyrrhiza.

Brown Mixture, E.; *Mixture de réglisse*, Fr.; *Lakritzenmixtur*, G.

Preparation.—Take of pure extract of glycyrrhiza, 30 Gm.; syrup, 50 Cc.; acacia, granulated, 30 Gm.; camphorated tincture of opium, 120 Cc.; wine of antimony, 60 Cc.; spirit of nitrous ether, 30 Cc.; water, a sufficient quantity to make 1000 Cc. Rub the pure extract of glycyrrhiza and acacia in a mortar with 500 Cc. of water until it is dissolved. Transfer the solution to a graduated vessel containing the other ingredients, and rinse the mortar with sufficient water to make the product measure 1000 Cc. Mix the whole thoroughly.—U. S.

Each fluidounce of "Brown Mixture" contains about 15 grains each of pure extract of glycyrrhiza and acacia, 25 minims of syrup, 1 fluidrachm of camphorated tincture of opium, 30 minims of wine of antimony, and 15 minims of spirit of nitrous ether.

The appearance of the finished product is unsightly and by no means in keeping with modern elegant pharmacy. The formula suggested by C. Tilyard in 1860 yields an equally efficient and far handsomer preparation: it prescribes a larger proportion of sugar (by no means a disadvantage), and can be still further improved upon by the use of purified extract of licorice, as now ordered by the Pharmacopœia. The formula as modified and adapted to the proportions of the Pharmacopœia is as follows: Dissolve 1 avoirdupois ounce of purified extract of glycyrrhiza in 10 ounces of water; add 4 fluidounces of camphorated tincture of opium, 2 fluidounces of antimonial wine, and 1 fluidounce of spirit of nitrous ether, and set the mixture aside for 12 or 24 hours with occasional agitation; filter the liquid into a bottle containing 3 fluidounces of mucilage of acacia and 20 avoirdupois ounces of granulated sugar, and wash the filter with sufficient water to bring the volume of the finished product up to 2 pints. The sugar is readily dissolved by agitation, and the result is a thin, rich-looking, clear syrup which keeps admirably.

Uses.—Brown Mixture is popularly employed as a cough mixture in the acute and subacute stages of bronchitis and laryngitis. It allays irritation, increases the activity of the bronchial and laryngeal mucosa, and thereby increases secretion, overcomes congestion, and promotes expectoration. The dose is from 1 to 4 fluidrachms (4–16 Cc.).

MISTURA GUAIACI, *Br.*—Guaiacum Mixture.

Mixture of Guaiac, E.; *Mixture de résine de gayac*, Fr.; *Guajakharzmixtur*, G.

Preparation.—Take of guaiacum resin, refined sugar, each ½ ounce; tragacanth, in powder, 35 grains; cinnamon water, 1 pint (Imperial measure). Triturate the guaiacum resin with the refined sugar and the tragacanth; add gradually the cinnamon water.—Br.

The preparation of the National Formulary differs from the above mainly in containing acacia in place of tragacanth. The formula is as follows: guaiac, in powder, and sugar, of each, 25 Gm.; acacia, in fine powder, 15 Gm.; cinnamon water, 1000 Cc. Triturate the powdered guaiac with the sugar and acacia, then gradually add the cinnamon water and mix thoroughly.—N. F.

Owing to the greater density of the British preparation, this mixture is less liable to separate than that of the National Formulary. Guaiac mixture should always be well agitated before using.

Uses.—For uses of guaiac mixture, see GUAIACI RESINA. Dose, from ½ to 1 ounce (16–30 Cc.).

MISTURA OLEI RICINI, *Br.*—Castor Oil Mixture.

Mixture d'huile de ricin, Fr.; *Ricinusoelmixtur*, G.

Preparation.—Take of castor oil, 3 fluidounces; mucilage of acacia, 1½ fluidounces; orange-flower water, undiluted, 1 fluidounce; cinnamon water, 2½ fluidounces. Mix the undiluted orange-flower water and the cinnamon water; place the mucilage of acacia in a mortar and to it add, alternately, in portions, the castor oil and the mixed waters, with constant trituration.—Br.

This preparation represents a 37.5 per cent. castor oil emulsion, but in accordance with the nomenclature of the Br. P. is designated as a mixture. Each fluidrachm contains 22.5 minims of castor oil.

Uses.—(See OLEUM RICINI.) Dose, from ½ to 2 fluidounces (16–60 Cc.).

MISTURA RHEI ET SODÆ, *U. S.*—Mixture of Rhubarb and Soda.

Potion à la rhubarbe alcaline, Fr.; *Alkalische Rhabarbermixtur*, G.

Preparation.—Take of sodium bicarbonate, 35 Gm.; fluidextract of rhubarb, 15 Cc.; fluidextract of ipecac, 3 Cc.; glycerin, 350 Cc.; spirit of peppermint, 35 Cc.; water, a sufficient quantity to make 1000 Cc. Dissolve the sodium bicarbonate in about 400 Cc. of water. Then add the fluidextracts, the glycerin, and the spirit of peppermint, and lastly, sufficient water to make 1000 Cc.—U. S.

To prepare 4 fluidounces of this mixture dissolve 64 grains of sodium bicarbonate in 14 fluidrachms of water, add 30 minims of fluidextract of rhubarb, 6 minims of fluidextract of ipecac, 12 fluidrachms of glycerin, 72 minims of spirit of peppermint, and, finally, sufficient water to make the volume as desired.

The mixture has a deep brown-red color.

Uses.—This preparation is employed as a carminative, antacid, and mild laxative. It may be given to children suffering with flatulent colic or fermentative diarrhœa. Dose to a child, from ½ to 1 fluidrachm (2–4 Cc.).

MISTURA SENNÆ COMPOSITA, *Br.*—Compound Mixture of Senna.

Black Draught, E.; *Mixture de séné composée*, Fr.; *Zusammengesetze Sennamixtur*, G.

Preparation.—Take of magnesium sulphate, 5 ounces; liquid extract of liquorice, 1 fluidounce; compound tincture of cardamoms, 2 fluidounces; aromatic spirit of ammonia, 1 fluidounce; infusion of senna, a sufficient quantity. Dissolve the magnesium sulphate in 10 fluidounces of infusion of senna; add the mixed liquid extract of liquorice, compound tincture of cardamoms, and aromatic spirit of ammonia; and sufficient infusion of senna to produce 1 pint (Imperial measure) of the compound mixture.—Br.

This preparation, officially designated as Black Draught, should not be confounded with the *compound infusion of senna* of the U. S. P., which is also known as *black draught* in this country. Not only do the two preparations differ in composition, but the British compound mixture of senna is also stronger than the U. S. compound infusion, containing about twice as much magnesium sulphate and one-fourth more senna.

The addition of compound tincture of cardamoms and aromatic spirit of ammonia materially improves the keeping qualities of the preparation and serves to correct the tendency to cause griping pains.

Uses.—This preparation has no advantages over INFUSUM SENNÆ COMPOSITUM (which see). Dose, from 1 to 1½ fluidounces (30–45 Cc.).

MISTURA SPIRITUS VINI GALLICI, *Br.*—Mixture of Brandy.

Brandy Mixture, E.; *Mixture de cognac*, Fr.; *Branntweinmixtur*, G.

Preparation.—Take of brandy, cinnamon water, each, 4 fluidounces; the yolks of 2 eggs; refined sugar, ½ ounce. Rub the yolks and sugar together, then add the cinnamon water and spirit.—Br.

In our opinion this preparation scarcely deserves a place in a pharmacopœia.

Uses.—This mixture forms an agreeable method for the administration of both stimulation and food in the various typhoid states. Dose, from 1 to 2 fluidounces (30–60 Cc.).

MORACEÆ.—The Mulberry Family.

This family, formerly regarded, together with the *Ulmaceæ* (Elm Family), as a division of the *Urticaceæ* (Nettle Family), comprises upward of 50 genera and about 900 species, of very diverse habit and appearance. Among them are the highly important food-plants Ficus (see FICUS and ELASTICA) and *Artocarpus*, or *Bread fruit*. From *Chlorophora tinctoria* (L.) Gaud. (*Morus t.* L.; *Maclura t.* D. Don) and *Maclura Brasiliensis* Endl. (*Broussonetia B.* Mart.) important dye-woods are obtained. Various rubber-yielding plants are considered under ELASTICA. *Brosimum galactodendron* Don (*Galactodendron utile* Kunth) is the *Cow-* or *Milk-tree*, *Palo de vaca* or *Arbol de leche*, of tropical America, the milk-juice said to be usable as is cows' milk. It contains, according to Boussingault, 58 per cent. of water and 42 per cent. of fixed matter, the latter consisting of wax and fat 32.2, sugar 2.8, proteids 1.7, salts 0.5, and undetermined substances 1.8 parts. The milk of *B. Alicastrum* Swz., of Jamaica, is acrid, though its seeds (*Bread-nuts*) are edible. The bast-fibers of many Moraceæ are tough and

are used in the manufacture of cordage and paper. The leaves of Morus are an important food for silk-worms. The poisonous and somewhat medicinal plant ANTIARIS has already been considered. The following, of minor importance medicinally, require brief mention:

MORUS is the fresh fruit of *Morus nigra* L., the *Black mulberry* (*Maulbeere*, G.; *Mures*, Fr.; *Mora*, Sp.), native of northeastern Europe and adjacent Asia, and largely cultivated. *Mori succus*, *Succus morarum*, *Mulberry-juice*, *Maulbeersaft* (G.), *Suc de mûres* (Fr.), or *Jugo del moras* (Sp.), is the juice of the ripe fruit, and is considerably used in medicine and pharmacy, though far less than formerly. The fruit is multiple, about 2.5 Cm. (1 In.) long and a third as thick, cylindraceous to oblong, purplish-black, fleshy, juicy, sweet, and edible. It consists of a great number of individual fruitlets, each a lenticular akene, enclosed in the fleshy calyx and crowned with a short filiform style. The juice is of a dark reddish-purple, nearly odorless, but sweet and acidulous. The analytical results, as obtained by Van Hees, were as follows, calculated for 100 parts of the fruit: sugar, 9.192, free acid (estimated as malic acid) 1.860, albuminous compounds 0.394, pectin, gum, and other organic compounds 2.031, ash 0.566, and water 84.707 parts, the remaining 1.250 parts consisting of the akenes and other tissues, with the insoluble inorganic compounds and ash. This composition varies much, as in all fleshy fruits, with the ripeness and other conditions. Except for its slightly laxative and expectorant qualities, mulberry-juice is to be regarded merely as an adjuvant, useful, in the form of a syrup, as a vehicle. The juice of the American *Black* or *Red mulberry* (*M. nigra* L.) may be substituted. It is less acid than the European, while that of *M. alba* L., the *White mulberry*, native of China, is sweet but rather insipid. The bark of the root of *M. nigra* is reputed anthelmintic. The root-bark of *M. Indica* Rumph. and other species, is much used in the Orient under the name *San-pai-p'i*, as a diuretic and expectorant, in hæmoptysis, etc.

CONTRAYERVA (*Bezoarwurzel*, *Giftwurzel*, G.; *Contrayerve*, Fr.) is the root of several species of *Dorstenia*, notably *D. Contrayerva* L. and *D. Brasiliensis* Lam., which have become famous in tropical America as antidotes to snake-bite. There is no reason to suppose that this repute rests upon any better basis than in the case of the immense number of others to which it applies. The root has 1 or 2 short annulate heads, is fusiform, about 12 Mm. (½ In.) thick, 50 or 75 Mm. (2 or 3 In.) long, and below divided into fine fibres; that of the second species is globular-ovate, about ¾ inch long, annulate, and beset with fine fibers. The color is reddish-brown, internally whitish. The bark is thick, with the inner portion of a punctate appearance, and encloses a brownish-yellow wood which is radiately marked by the medullary rays. The root has a rather unpleasant odor and a bitter and acrid taste. It contains the alkaloids *cajapine* and *contrayerbine*, volatile oil, resin, gum, free acid, starch, etc. The drug is an aromatic, with slight bitter qualities, and is hence mildly beneficial as a stomachic and stimulant. The dose is about 30 grains (2 Gm.).

ARTOCARPUS INCISA L. is indigenous to the Moluccas and the islands of the southern Pacific. The nearly ripe pistillate inflorescence, known as *Bread-fruit*, forms a globular sorosis about 15 Cm. (6 In.) in diameter, and consists of a mealy and spongy receptacle in which the oblong angular akenes are imbedded. A similar product, known as *Jack-fruit*, is yielded by *Artocarpus integrifolia* L.; it is nearly pear-shaped, and is largely used in India and the East Indian islands.

BICHETEA OFFICINALIS Heerm., of Brazil, is one of the domestic antisyphilitic drugs to which the names *Murure* and *Mercurio vegetal* have been applied. The milk-juice is employed. The milk-juices of various species of *Cecropia* are similarly employed. That of *C. peltata* L. is used in Paraguay as a digitalis-substitute, and contains the alkaloid *cowleyine*. *Streblus asper* Lour. (*Trophis a.* Roxb.), of Java, contains a poison which acts like that of *Antiaris*.

MORPHINA, *U. S.*—Morphine.

Morphia, *Morphinum*.—*Morphia*, E.; *Morphine*, Fr.; *Morphium*, *Morphin*, G.

Formula, $C_{17}H_{19}NO_3 + H_2O$ or $C_{17}H_{17}(OH)NO.OH + H_2O$. Molecular weight, 300.92.

Morphine is the principal alkaloidal constituent of opium, in which it occurs both as sulphate and meconate. It is said to be present in several members of the *Poppy* family, but is particularly found in the capsules of *Papaver somniferum* L. just before maturity. The statement of Charbonnier, that morphine is present in *Argemone mexicana* L., has been shown by Schlotterbeck (*Proc. Am. Pharm. Assoc.*, 1901, p. 247) to be erroneous.

Morphine was the first alkaloid known. It was separated by Derosne (1803) from concentrated infusions of opium by precipitation with ammonia, but mistaken for narcotine. Sertürner (1816) finally established the identity of morphine and proved its basic nature as well as its poisonous effects. Chemically morphine is a phenanthrene derivative containing two hydroxyl groups, one of phenolic, the other of alcoholic character.

Preparation.—Morphine for commercial purposes may be obtained in several ways, and it is probable that manufacturers, in each case, follow some favorite economical

process. The method of Staples, which was adopted in the U. S. P. of 1870, consists in exhausting opium by repeated maceration with cold water, concentrating the mixed infusions, filtering, adding alcohol and ammonia water, and finally setting the liquid aside to allow crystals to form, which latter after removal by filtration are dissolved in hot alcohol, treated with animal charcoal and the solution again allowed to crystallize.

The Gregory-Anderson method, originated by Robertson and recognized in the Br. P. of 1885, directs the exhaustion of opium with cold water, after which the united liquids are concentrated, strained through calico and mixed with calcium chloride, whereby the alkaloids are kept in solution as hydrochlorides, while meconic acid, coloring-matter and other constituents are precipitated as calcium compounds. After filtration, the liquid is concentrated and yields a crystalline mass of morphine and codeine salts, narcotine and other bases remaining in the dark-colored mother-liquors. The crystals are purified by re-solution in water, boiling with animal charcoal, and final recrystallization. The purified salts are dissolved in hot water and the solution mixed with ammonia water, which precipitates the morphine and retains the codeine in solution. The morphine may be subsequently recrystallized from alcohol.

Merck's process consists in precipitating a concentrated infusion of opium by means of sodium carbonate. The precipitate is washed with water and treated with alcohol, whereby the less important alkaloids are removed together with resinous and coloring-matters. The crude morphine remaining is expressed and dissolved in a slight excess of diluted acetic acid, whereby it is freed from narcotine, which latter does not combine with the acid and remains undissolved. After filtration through animal charcoal the acetous solution is precipitated with ammonia water, the finely crystalline morphine being collected on a strainer and washed with cold water and dried.

Properties.—Morphine occurs in short, transparent, colorless or white, inodorous rhombic prisms or fine needles, or as a crystalline powder, permanent in the air, and having a bitter taste. It contains 1 molecule (5.94+ per cent.) of water of crystallization, which it gradually loses at 75° C. (167° F.), becoming completely anhydrous if heated for 4 hours at 100° C. (212° F.). When heated to about 200° C. (392° F.) it turns brown, and melts at 254° C. (489.2° F.) to a black liquid, some of the alkaloid volatilizing undecomposed.

The solubility of morphine depends much upon whether it is in a crystalline, amorphous, or nascent condition. Crystalline morphine is soluble at 15° C. (59° F.) in 4350 (5000, Hager, Schmidt) parts of water, 300 parts of alcohol, 100 parts of absolute alcohol, 6148 parts of ether (Prescott, 1250 parts Schmidt, 1300 parts Hager), 4379 parts of chloroform (Prescott), 1700 parts of acetic ether (Hager, 1665 parts Schmidt). Prescott has found that the amorphous alkaloid requires only about one-third, and the alkaloid in the nascent condition about one-fifth as much ether or chloroform for solution as the crystalline variety. Morphine is also soluble at 15° C. (59° F.) in 8930 parts of benzene (Prescott, insoluble U. S. P.), 91 parts of amyl alcohol (Prescott) (113.5 parts at 25° C. (77° F.), U. S. P.), 4.75 parts of 80 per cent. chloral hydrate solution, 220 parts of glycerin, 3125 parts of carbon tetrachloride, or 117 parts of 10 per cent. ammonia water. At 25° C. (77° F.) morphine requires for solution 3330 parts of water, 168 parts of alcohol, 4464 parts of ether, 1800 parts of chloroform or 525 parts of acetic ether (U. S. P.); at 80° C. (176° F.), 1040 parts of water (U. S. P.); at 60° C. (140° F.), 76 parts of alcohol (U. S. P.); at 100° C (212°), 500 parts of water (Schmidt). Boiling alcohol dissolves $\frac{1}{36}$ of its weight, and boiling absolute alcohol $\frac{1}{18}$ of its weight of morphine (Schmidt). Morphine is insoluble in oil of anise (means of separation from codeine), but dissolves in aqueous solutions of the fixed alkali hydroxides and in 100 parts of lime water, forming morphinates of the respective bases. The alkaloid is precipitable from these solutions by carbon dioxide, as well as ammoniacal salts. The alkaline solutions on exposure to air are gradually oxidized, turning brown, and developing pseudo- or oxydimorphine; the same changes occur when aqueous solutions are boiled with exposure to air. Morphine is a strong base and reducing agent. Its aqueous solution is strongly alkaline to litmus and curcumin. It forms crystallizable salts with acids. Solutions of morphine and its salts are strongly lævorotatory, the rotation depending much upon the nature of the solvent. In alcoholic solution the specific rotation has been found to be $[\alpha]_D = -70°$. Morphine gives numerous color reactions, which are usually obtained by adding the reagent to a minute crystal of morphine, or to the residue left upon a porcelain surface by evaporation of a solution of morphine in alcohol or amyl alcohol,

In using the latter solvent, the amyl alcohol should be previously distilled and tested to avoid misleading results.

Concentrated sulphuric acid, free from nitric acid, dissolves morphine without color, but upon heating a dark-brown color is produced. If a crystal of potassium nitrate be added to the solution, a light or dark-brown color is produced, depending on the amount of alkaloid employed. (Codeine under like conditions gives a green color, changing to brown, while narcotine produces a cherry-red color.) Nitric acid alone dissolves morphine with an orange to reddish-yellow color, gradually fading to yellow. If morphine be dissolved in concentrated sulphuric acid and the solution heated to near 150° C. (302° F.), the addition of a little nitric acid produces a violet-blue color, changing quickly to blood-red, and afterward to deep orange (Husemann, 1863). Other oxidizing agents, such as chlorine or chlorates, may be used in place of nitric acid, in the Husemann test, with equally good results. Mixed with 6 to 8 times its weight of sugar, morphine acquires with sulphuric acid a bright-purple-red color, gradually changing to violet-blue, blue-green, and dingy-yellow (Schneider, 1872), the delicacy of the reaction being increased by the addition of a little bromine water, so that 0.00001 Gm. still shows a rose-red color (Weppen, 1874). Morphine mixed with about 8 times its weight of hydrastine acquires with concentrated sulphuric acid a violet-blue color (Lloyd, 1900). With Fröhde's reagent (0.001 to 0.005 Gm. of sodium molybdate in 1 Cc. of concentrated sulphuric acid) morphine acquires a violet color, changing to blue, olive-green, yellow, and in 24 hours to purplish-blue. If the morphine be dissolved in concentrated sulphuric acid, the solution heated, and Fröhde's reagent then applied, a green color appears, which on the addition of a minute fragment of potassium nitrate changes to a red color (G. Bruylants). Morphine dissolved in concentrated sulphuric acid containing formaldehyde (2 drops of 40 per cent. solution to 3 Cc. of sulphuric acid) produces a fine violet to almost blue coloration (Marquis, 1900). Mecke's reagent (0.5 Gm. of selenous acid in 100 Cc. of concentrated sulphuric acid) or Lafon's reagent (1 Gm. of ammonium selenite in 20 Cc. of concentrated sulphuric acid) dissolves morphine with a bluish color, changing through blue to an intense green or olive-green, and on heating, to brown. (If codeine be added to sulphuric acid containing a little selenous acid, a green color is produced, which changes to blue and back again to green, the green color caused by narcotine under the same conditions changing to brown and then to cherry-red.) A brownish-red to violet color is produced when titanic acid is added to a solution of morphine in concentrated sulphuric acid (Flückiger). When morphine is dissolved in a few drops of a 5 per cent. aqueous solution of sulphuric acid, a little lead dioxide added to the solution and the mixture stirred for a few minutes, the clear liquid drawn from the same, upon the addition of ammonia produces an immediate brown color (G. Fleury, 1901). Ehrlich's reagent (1 Gm. of sulphanilic acid dissolved in water containing 50 Cc. of hydrochloric acid and diluted to a liter; when required, 10 Cc. of the solution are mixed with 2 Cc. of a 0.5 per cent. solution of sodium nitrite and the mixture added drop by drop to the solution to be tested) produces in an ammoniacal solution of morphine a wine-red coloration (*Jour. Chem. Soc.*, 1900, ii. p. 776). A few drops of a 20 per cent. solution of benzaldehyde in absolute alcohol added to a trace of the alkaloid on a porcelain surface, followed by a drop of concentrated sulphuric acid, dissolves morphine with the production of red to yellowish-red streaks (H. Melzer, *Fres. Zeitschr. anal. Chem.*, 1898, pp. 747, 748). The addition of 5 per cent. sodium phosphomolybdate solution causes a yellow precipitate in morphine solutions, which is soluble in ammonia water. Morphine decomposes iodic (Sérullas) and periodic (Boedeker) acids, liberating iodine; in dilute solution the addition of a little sulphuric acid is advisable; the red (or yellow in dilute solutions) color developed is intensified by the addition of ammonia (M. Lefort). If a solution of morphine be mixed with a solution of starch and evaporated on a porcelain surface at a gentle heat, and the residue after cooling be moistened with iodic acid, the presence of $\frac{1}{20000}$ of a grain of morphine will produce a blue color (A. Dupre). An equally satisfactory application of the iodic acid test is to shake a dilute solution of iodic acid, or iodate, slightly acidulated with sulphuric acid, with chloroform. If the chloroform remains uncolored, the solution of morphine to be tested is then added and the mixture again shaken, when in the presence of morphine the chloroform layer will turn pink through the liberated iodine. Solutions of silver nitrate, gold chloride, potassium ferricyanide, ammonio-cupric sulphate, and chromic acid, are reduced by morphine and its salts. Dilute solutions of ferric chloride give a blue color with morphine,

A blue precipitate is produced when a few drops of a 10 per cent. solution of ferric chloride are added to a solution of morphine, followed by a few drops of a fresh 1 per cent. solution of potassium ferricyanide. Subjected to the action of the electric current, morphine is converted into pseudomorphine (also known as oxydimorphine or dehydromorphine), which see under constituents of Opium. Morphine is rapidly oxidized by potassium permanganate, and this oxidizing action has been studied by C. W. Johnson (*Proc. Am. Pharm. Assoc.*, 1903), who found that when a solution of 0.5 Gm. of the permangauate is added to a solution of 1 Gm. of morphine hydrochloride, instantaneous reaction ensues, the color of the liquid changing to mahogany-brown, while manganese dioxide is precipitated, nearly all the morphine being converted into pseudomorphine. With the use of increasing quantities of the permanganate, oxidation continues, the color of the liquid gradually changing to straw-yellow, while the newly formed pseudomorphine disappears and alkali oxalate is found in solution.

Tests.—Sulphuric acid containing a crystal of potassium dichromate imparts to morphine no color at first, but after a time a green color appears (absence of strychnine, which gives a purple color, or of acetanilide, which gives a crimson color, changing to green). If 0.1 Gm. of morphine be dissolved in 10 Cc. of diluted hydrochloric acid, no red coloration should be produced by the addition of a few drops of ferric chloride test-solution (absence of meconic acid or meconates). If to a neutral 1 per cent. solution of morphine made by the careful addition of dilute sulphuric acid, a few drops of ferric chloride test-solution be added, a blue color will be produced, which is destroyed by acids, alcohol, or heating. On adding 4 Cc. of potassium hydroxide test-solution to 0.2 Gm. of morphine, a clear colorless solution, free from any undissolved residue, should result (absence of and difference from various other alkaloids), and no odor of ammonia should be noticeable.—U. S. The salts of morphine are precipitated from their solutions by the alkalies and alkaline earths, the precipitates being soluble in an excess of the precipitant. Similar precipitates are produced by the alkali carbonates and cyanides, but the alkali bicarbonates fail to precipitate acid solutions in the cold. Tannin causes a white precipitate soluble in acetic acid, in mineral acids, and in alcohol. Auric or platinic, but not mercuric, chloride occasions a yellow precipitate. Codeine causes a precipitate of morphine in the solution of the salts. The acidulated solutions of morphine are precipitated by potassio-mercuric iodide, potassio-cadmium iodide, and other general reagents for alkaloids; the precipitate with phosphomolybdic acid turns blue with cold sulphuric acid and brown on warming. 1 Cc. of Mayer's test-solution precipitates 0.020 Gm. morphine. When a salt of morphine is heated with an excess of sulphuric or hydrochloric acid to near 150° C. (302° F.), the alkaloid parts with H_2O and is converted into apomorphine, $C_{17}H_{17}NO_2$ (see p. 206).

Pharmaceutical Preparation.—Solution of Morphine Citrate, N. F.

Action and Uses.—Morphine is rarely employed as morphine, but when combined with acids it forms soluble salts which are largely used. It is the principal narcotic alkaloid of Opium (which see), and its action is closely allied to that of the latter drug. This alkaloid possesses the sudorific, soporific, and anodyne properties of opium, but it is less liable to produce the constipation and other untoward effects which frequently follow the administration of the crude drug. The salts of morphine are usually employed either internally by the stomach or hypodermically. The symptoms and treatment of poisoning by this drug are identical with those of opium. The dose is from $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.03 Gm.).

Unofficial Salts of Morphine.—Among the unofficial salts of morphine used at different times may be mentioned Morphine Benzoate, M. Borate, M. Citrate, M. Lactate, M. Oleate, M. Stearate, and M. Valerianate. They may be prepared by neutralizing the respective acids in alcoholic or aqueous solution (as may be necessary) with pure morphine and crystallizing the resulting solution or evaporating same to dryness. Morphine oleate is generally employed in the form of solution in excess of oleic acid, prepared by dissolving the desired quantity of pure morphine, 2, 4, or 5 parts, in 98, 96, or 95 parts of oleic acid by aid of a water-bath.

Derivatives of Morphine.—Dionin. *Ethylmorphine hydrochloride.* $C_{17}H_{18}NO_3C_2H_5HCl+H_2O$.—When ethyl iodide is made to act on morphine in an alkaline solution, ethylmorphine, also known as codethyline, $C_{17}H_{17}NO(OH)OC_2H_5$, is formed, a base, which when pure melts at 93° C. (199.4° F.). By neutralizing the newly formed base with hydrochloric acid, the salt commercially known as *dionin* is obtained. Dionin occurs as a crystalline powder, soluble in about 7 parts of water at 15° C. (59° F.) and in an equal weight of alcohol, but nearly

insoluble in ether and chloroform. Its aqueous solutions are precipitated by the usual alkaloidal reagents. If 0.10 Gm. of dionin be dissolved in 10 Cc. of pure sulphuric acid, a colorless liquid results, which upon addition of a drop of ferric chloride solution assumes a violet or blue color; the further addition of 2 or 3 drops of nitric acid changes the color to deep red. Dionin may be distinguished from morphine salts by not causing a blue coloration immediately when added to ferric chloride solution containing some potassium ferricyanide; a bluish-green color is gradually developed. Dionin possesses the narcotic properties of opium to a very limited degree, and has been used in phthisis and other pulmonary affections to allay excessive cough. As it possesses local anæsthetic powers it has also been employed in cases of corneal ulcer, glaucoma, and iridocyclitis. For these purposes it is employed in 5 per cent. solutions, and the anæsthesia lasts about 24 hours. DeSchweinitz has not found it satisfactory. Dose, ¼ to ½ grain (0.015–0.025 Gm.).

HEROINE. *Diacetyl-morphine.* $C_{17}H_{17}NO(C_2H_3O_2)_2$. (See HEROINÆ HYDROCHLORIDUM.)—Heroine has been employed as a substitute for morphine for the purpose of allaying excessive cough. Unlike the latter remedy it acts as a respiratory stimulant and does not produce constipation or stupor. It should be given in doses of from $\frac{1}{20}$ to $\frac{1}{5}$ grain (0.003–0.01 Gm.), several times daily.

PERONIN. *Benzyl-morphine hydrochloride.* $C_{17}H_{18}NO_3(C_6H_5CH_2)HCl$.—If benzyl chloride be allowed to act on morphine, hydrochloric acid is split off, which unites with the newly formed benzyl-morphine, producing a white salt to which the name *peronin* has been given. The compound is soluble in water and in diluted alcohol, more readily when warmed, but is insoluble in ether and chloroform.

MORPHINÆ ACETAS, *U. S., Br.*—Morphine Acetate.

Morphiæ acetas, Morphinum (s. Morphium) aceticum. Acetate of morphia, E.; *Acétate de morphine,* Fr.; *Morphinacetat, Essigsaures Morphium,* G.

Formula, $C_{17}H_{19}NO_3HC_2H_3O_2 + 3H_2O$. Molecular weight, 396.26.

Preparation.—Freshly precipitated morphine, while still moist, is diffused in water, dissolved by neutralizing with acetic acid, the solution evaporated on a water-bath until it concretes on cooling, and the mass dried with a gentle heat and reduced to powder. A very slight excess of acetic acid is rather of advantage, since the salt begins to decompose during the evaporation by liberation of acid. The salt may be crystallized with some difficulty in the form of white silky needles, but is very generally obtained in powder as directed above.

For giving the salt a very handsome appearance, Hager gives the following directions: Rub 10 parts of pure morphine into powder, keeping it moist by the addition of a little alcohol, and add 25 parts of glacial acetic acid, triturating constantly; then drop alcohol into the mixture until it has become of syrupy consistence, and afterward ether until the color of the mixture has changed to milk-white; after 2 or 3 days the solidified mass is loosened in the mortar and turned, and when completely dry is rubbed into powder and preserved.

The U. S. P. directs the salt to be kept in well-stoppered dark-amber-colored vials, together with a minute quantity of acetic acid.

Properties.—Morphine acetate forms a white or faintly yellowish, crystalline or amorphous powder which has a slight acetous odor and a very bitter taste. It is soluble at 15° C. (59° F.) in 2.5 parts of water (Br.; in 12 parts Hager), in about 100 parts of 90 per cent. alcohol (Br.; in 30 parts Hager); at 25° C. (77° F.) in 2.25 parts of water, 21.6 parts of alcohol, 5.2 parts of glycerin, or 480 parts of chloroform (U. S.); at 60° C. (140° F.) in 2.5 parts of alcohol (U. S.); at 80° C. (176° F.) in 2 parts of water (U. S.). The salt is also soluble in 3 parts of boiling water (Hager), but is insoluble in ether (U. S.), and when exposed to air gradually loses acetic acid. When heated, the salt loses water and acetic acid, and melts at 200° C. (392° F.). An alcoholic solution of morphine acetate, mixed with an excess of ether, deposits crystals of morphine, free acetic acid remaining in solution. Cold strong sulphuric acid dissolves the salt without color only when recently made. When kept on hand, it slowly loses acetic acid; its reaction to test-paper changes from neutral to alkaline, and the salt becomes incompletely soluble in water unless a little acid be added; it gradually acquires a yellowish-gray, and finally brownish, color, and should then be redissolved in acetic acid and evaporated or converted into another salt of morphine. Its aqueous solution undergoes similar changes, the acetic acid being slowly decomposed, with the

separation of brown flocculent compounds, while the morphine crystallizes out, forming long prisms if the solution is not disturbed.

Tests.—The salt responds to the reactions and tests described above under MORPHINA and leaves no residue when ignited. If its solution is precipitated by tannin, the addition of dilute hydrochloric acid redissolves the precipitate; solution of potassium or sodium hydroxide gives a white precipitate soluble in excess of the alkali; a remaining turbidity would indicate the presence of narcotine. Sulphuric acid added to the salt liberates acetous vapors. "2 Gm. of the salt form with 6 Cc. of warm morphinated water a slightly turbid solution, which is rendered clear by the addition of 0.1 Cc. of acetic acid; and this solution, when mixed with solution of ammonia in excess, yields a precipitate which, after washing and drying as described under MORPHINÆ HYDROCHLORIDUM, weighs 1.42 Gm. If the salt yield a larger proportion of morphine than this, it should be recrystallized from hot water acidulated with acetic acid."—Br.

Pharmaceutical Preparation.—SOLUTION OF MORPHINE ACETATE, Br. P.

Action and Uses.—See MORPHINA. Dose from $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.03 Gm.).

MORPHINÆ HYDROCHLORIDUM, *U. S., Br.*—Morphine Hydrochloride.

Morphinum Hydrochloricum, P. G.; *Morphiæ hydrochloras, Morphiæ murias.*—*Muriate of morphia*, E.; *Chlorhydrate de morphine*, Fr.; *Morphinhydrochlorid, Salzsaures Morphium*, G.

Formula, $C_{17}H_{19}NO_3HCl + 3H_2O$. Molecular weight, 372.86.

Preparation.—Diffuse pure morphine in boiling distilled water placed in a porcelain capsule kept hot, and add, constantly stirring, the diluted hydrochloric acid, proceeding with caution, so that the morphine may be entirely dissolved and a neutral solution obtained. Set aside to cool and crystallize. Drain the crystals, and dry them on filtering-paper. By further evaporating the mother-liquor and again cooling additional crystals are obtained. If pure morphine has been used and an excess of hydrochloric acid avoided, the salt may be wholly obtained in crystals by judicious evaporation of the mother-liquor. On account of the greater stability of this salt and of its solution, the German Pharmacopœia directs it to be dispensed whenever morphine acetate is prescribed.

Properties.—Morphine hydrochloride crystallizes in white, silky, flexible, and inodorous needles or minute, colorless, cubical crystals having a bitter taste and neutral reaction. It is soluble in 24 parts (Br.) (25 parts P. G.) of cold water, or 1 part of boiling water (Br.), or 50 parts of cold alcohol (Br., P. G.); at 25° C. (77° F.), in 17.2 parts of water or 42 parts of alcohol (U. S.); at 60° C. (140° F.) in 35.5 parts of alcohol (U. S.); at 80° C. (176° F.) in 0.5 part of water (U. S.). It is said to be soluble in 19 parts of glycerin or 800 parts of olive oil, but is insoluble in ether and chloroform. Heated to 100° C. (212° F.) the salt loses all of its water of crystallization (14.38+ per cent.), and when heated to 250° C. (482° F.) it begins to turn brown, and on higher heating chars without melting. On shaking an aqueous solution of the salt with ammonium chloride and diluted ammonia water, a crystalline precipitate is formed, which should respond to all tests and reactions given under MORPHINA. The color tests for the identification of morphine hydrochloride and those showing the absence of impurities are identical with those described under MORPHINA.

Tests.—The salt should not have an acid reaction, and should answer to all the morphine reactions and tests described before; its aqueous solution yields with silver nitrate a white precipitate, which is insoluble in nitric acid, but dissolves in ammonia. With solution of potassium or sodium hydroxide it should yield a precipitate soluble in excess of alkalies and corresponding to the tests for morphine. When ignited, the salt should leave no fixed residue. Heated on a water-bath for 10 or 15 minutes with a few drops of sulphuric acid, cooled, and treated with a few drops of diluted nitric acid, it gives a violet color rapidly passing to blood-red. It dissolves without coloration in strong sulphuric acid; the addition of a small quantity of sodium arsenate to a portion of this solution causes a bluish-green coloration, and a small quantity of bismuth oxynitrate added to another portion gives a purplish-brown coloration. "2 Gm. of morphine hydrochloride dissolved in 250 Cc. of warm morphinated water, with solution of ammonia added in the slightest possible excess, will give on cooling a crystalline precipitate which, when washed with a little cold morphinated water and dried, should weigh 1.51 Gm.

The drying should be accomplished, first by pressing the precipitate between sheets of bibulous paper, then by exposing it to a temperature from 55° to 60° C. (131°–140° F.), and finally to a temperature of 110° C. (230° F.) for 20 minutes."—Br. 5 Cc. of an aqueous solution of morphine hydrochloride (1 : 30) give upon the addition of a drop of solution of potassium carbonate, either immediately or after a few seconds, a pure white crystalline precipitate, which should not discolor on exposure to air, nor color chloroform reddish when chloroform is shaken with the same (absence of apomorphine, U. S., P. G.). Upon adding a drop of solution of ammonia to 5 Cc. of an aqueous solution of morphine hydrochloride (1 : 30) a pure white crystalline precipitate should form, which is readily soluble in aqueous sodium hydroxide solution. When the latter solution is shaken with an equal volume of ether, the ether after complete separation and evaporation of the ethereal layer should not leave a weighable residue.—P. G.

Pharmaceutical Preparation.—Solution of Morphine Hydrochloride, Br. P.

Action and Uses.—See Morphina. Dose from $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.03 Gm.).

MORPHINÆ SULPHAS, *U. S.*—Morphine Sulphate.

Morphinum sulphuricum, Morphiæ sulphas.—Sulphate of morphia, E.; *Sulfate de morphine*, Fr.; *Morphinsulfat, Schwefelsaures Morphium*, G.

Formula, $(C_{17}H_{19}NO_3)_2H_2SO_4 + 5H_2O$. Molecular weight, 752.83.

Preparation.—This salt may be prepared in the same manner as the hydrochloride. 1 ounce of pure morphine is diffused in 2 ounces of boiling distilled water, and diluted sulphuric acid is cautiously added until the alkaloid is dissolved and the liquid has a neutral reaction to test-paper; it is then allowed to cool and crystallize; the crystals are drained and dried, and the mother-liquor concentrated to obtain an additional crop of crystals.

Properties.—Morphine crystallizes in white fascicles of transparent, silky, inodorous, and bitter needles, which are neutral to test-paper, and are not altered on exposure to air. At 100° C. (212° F.) it parts with 3 molecules of water (7.12+ per cent.), but on being heated to 130° C. (266° F.) it loses the remaining 2 molecules (4.75+ per cent.) (U. S.). According to Hager, the crystals part with their water more readily, losing some on exposure at 30°–40° C. (86°–104° F.), and all of it at 100° C. (212° F.). The official salt dissolves at 15° C. (59° F.) in 20 parts of water or 702 parts of alcohol; at 25° C. (77° F.) in 15.3 parts of water or 465 parts of alcohol (U. S.); at 60° C. (140° F.) in 187 parts of alcohol (U. S.); at 80° C. (176° F.) in 0.6 part of water (U. S.). It is said to be soluble in 144 parts of boiling alcohol, but is insoluble in ether and chloroform. Its aqueous solution is neutral to test-paper and yields a white precipitate with barium chloride insoluble in nitric acid. On heating the salt to 250° C. (482° F.) it turns brown and chars, but does not melt; upon ignition it burns without residue.

Tests.—Upon adding dilute solutions of ammonium chloride and ammonia to an aqueous solution of morphine sulphate, a precipitate results which, when filtered off and washed, should respond to all the reactions and tests mentioned under Morphina (U. S.).

Pharmaceutical Preparations.—Compound Morphine Powder, U. S. P.; Hypodermic Solution of Morphine, Compound Syrup of Morphine, Syrup of Morphine Sulphate, N. F.

Action and Uses.—See Morphina. Dose from $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.03 Gm.).

MORPHINÆ TARTRAS, *Br.*—Morphine Tartrate.

Morphinum tartaricum.—Tartrate de morphine, Fr.; *Morphintartrat, Weinsaures Morphium*, G.

Formula, $(C_{17}H_{19}NO_3)_2C_4H_6O_6 + 3H_2O$. Molecular weight, 768.64.

Morphine tartrate may be prepared by the combination of morphine and tartaric acid in molecular proportions.—Br.

On dissolving 4 parts of morphine with 1 part of tartaric acid in 15 parts of hot water, the greater part of the salt crystallizes in small needles on cooling. The Br. P. describes morphine tartrate as "A white powder consisting of fine nodular tufts of minute acicular crystals. Efflorescent at 20° C. (68° F.). Soluble in 11 parts of cold water, almost insoluble in alcohol (90 per cent.). 2 Gm. dissolved in 20 Cc. of warm morph-

inated water, with solution of ammonia added in the slightest possible excess, will give, on cooling, a crystalline precipitate which, after washing and drying as described under MORPHINÆ HYDROCHLORIDUM, should weigh 1.47 Gm." The salt represents 78.3 per cent. of crystallized morphine. This salt was introduced on account of its greater solubility in water, and therefore is more suitable for hypodermic injections than the other salts of morphine.

Pharmaceutical Preparation.—SOLUTION OF MORPHINE TARTRATE, Br. P.

Action and Uses.—See MORPHINA. Dose $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.03 Gm.).

MOSCHUS, *U. S., Br.*—Musk.

Moschus orientalis, M. Chinensis, M. Tibetanus; Musc, Fr. Cod.; *Chinese, Thibet, or Tonquin musk*, E.; *Moschus*, G.; *Muschio*, It.; *Almizell, Almizole*, Sp.; *Almiscar*, Port. The dried secretion from the preputial follicles of *Moschus moschiferus* L. (Ord. *Ruminantia*).

Musk is official in nearly all pharmacopœias.

Origin.—The general appearance of the musk-deer is that of a very small deer, but it is hornless and has long, downwardly projecting canine teeth. It inhabits chiefly the mountainous regions and elevated table-lands of Central Asia, and is met with from Anam, in Farther India, northwestward to Thibet, and northward in China and Tartary to Manchuria and southern Siberia. It lives in pine forests in the Himalayas, frequently at an altitude of 3000–4260 M. (10,000 to 14,000 Ft.). The musk-sac is found in the male only, and is located on the abdomen, immediately before the preputial orifice and to the rear of the umbilicus. The animal has nocturnal habits and is taken by snares and pit-falls, or sometimes by shooting; the sac is cut off as soon as possible, and rapidly dried by pressing it against heated stones. It is usually imported in small boxes, lined with sheet lead and containing about 25 sacs, each wrapped in paper. The outer hairs are trimmed short, and are of a yellowish or grayish color. Musk enters commerce through Chinese ports. Musk should be kept in not too warm a place, and where the air can have some access to it.

FIG. 276.

Musk-deer.

Description.—The musk-bag (called sac, pod, or pouch) is oval in shape, about 5 Cm. (2 In.) long and 38 Mm. (1½ In.) wide, with a thickness of about 13 Mm. (½ In.); upper surface smooth and flat, the lower convex and hairy; hairs grayish and brown, rather stiff and appressed, arranged in a circle toward the aperture near the center of the bag, and in the form of a pencil toward the preputial orifice, which is about 6 Mm. (¼ In.) in the rear of the former; extending from this orifice, underneath the hairy skin between the strata of the muscular coat and toward the posterior end of the sac, is a canal containing the front portion of the thin penis; following the muscular coat, the musk-pouch proper, with an external fibrous coat, having on the inner surface numerous depressions resembling meshes and surrounded by folds, and covered by two coats—the one soft and pearly, and the other very delicate, silvery-white on the outside, and yellowish or brownish on the inside. The musk is supposed to be separated by a number of glands, of which two or more are situated in each depression. In the young animal the secretion is slight and of a milky appearance, but after it has passed its third year the musk is of better quality; in the fresh state it is of an unctuous consistence. The average weight of musk-bags is about 394 grains, and of the contained musk about 157 grains, according to Cramer and Small. The Swiss and Italian pharmacopœias require each sac to yield from 10 to 30 Gm. of musk, the Russian 15 to 40 Gm., and the latter rejects sacs which do not yield 50 per cent. of good musk.

FIG. 277.

Chinese musk-sac.
Lower surface. Upper surface.

Musk is of a crummy appearance, near the musk-orifice mixed with grayish hairs of a

reddish-brown color or darker brown, and irregularly granular, somewhat unctuous to the touch, of a strong, diffusible, and persistent odor, and of a bitterish taste. When entirely exsiccated it is almost inodorous, but the odor reappears on moistening, and is increased by the addition of a little alkali. The odor disappears or is more or less modified on triturating the musk with camphor, oil of bitter almond, fennel, ergot, mustard, sulphur, acids, various salts, etc.

Other Varieties, Substitutes, and Adulterants.—*Siberian musk* comes by way of St. Petersburg, hence the name *Russian musk;* it often resembles and has the same quality as the preceding; when in flatter ovate sacs with thinner and paler hairs, and of fainter, less aromatic, and more urinous odor, it is called *Cabardine musk.* The small and inferior *Bucharian* and *Assam musk-sacs* rarely, if ever, reach this country. The substitution of artificial musk-bags, made from a piece of the hide stitched to a membrane, is readily recognized by the absence of the circular arrangement of the hairs and of the central aperture. Genuine sacs are sometimes slit open, the musk partly removed, and other substances introduced in place thereof. This may usually be detected by being stitched together on the edge of the hide and inside membrane. There is no means of detecting the fraudulent introduction through the orifice of pieces of lead, etc., until after the bags have been opened.

Tests.—Musk should not have an ammoniacal odor, and not contain more than 15 per cent. of moisture. Water dissolves from 50 to 75 per cent. of the weight of the musk; the solution should be deep brown, faintly acid, and scarcely affected by solution of corrosive sublimate (ammonium carbonate). Weak alcohol yields a similar solution. Strong alcohol dissolves about 10 per cent., yielding a slightly colored tincture, which should scarcely become turbid on the addition of water (absence of resins, etc.). Carefully freed from fragments of skin and hairs and heated upon platinum-foil, musk should give off a slightly urinous odor, but very distinct from the odor of burning blood, and should leave about 6 to 8 per cent. of a gray (not red) ash. The German Pharmacopœia has adopted the examination of musk by the method suggested by Bernatzik: a small quantity of musk, kept in a thin layer under oil of turpentine (or warmed with a little glycerin), and examined under the microscope, is seen to consist of diaphanous brown amorphous splinters and lumps, without being mixed with other foreign substances.

Constituents.—Musk, treated with potassa, gives off ammonia; it contains cholesterin, various fatty and waxy substances, gelatinous and albuminous compounds, and salts. The odorous principle volatilizes partly with the vapors of water, but is not a volatile oil; it is most probably formed in the presence of moisture by the slow and continuous decomposition of one of the constituents.

Pharmaceutical Preparation.—Tincture of Musk, U. S. P.

Action and Uses.—Musk is employed in medicine as a nervous sedative and for the purpose of acting as a diffusible stimulant in conditions of profound feebleness or asthenia, as in the advanced stages of typhoid fever. The dose for these purposes is 20 grains (1.3 Gm.) given in starch water by the rectum. By the mouth it is given in the dose of from 2 to 5 grains (0.12–0.30 Gc.) in pill, or in the dose of from ½ to 1 drachm (2–4 Gm.) of the tincture, for obstinate hiccough and for gastro-intestinal flatulence. At one time it was a very popular remedy, but it is now rarely employed.

Artificial Musk.—Under the names of *tonquinol* and *Bauer musk,* trinitro-butyl-toluene has been introduced as artificial musk, chiefly for use in perfumery. It is made by action of tertiary butyl chloride on toluene in the presence of aluminum chloride, the resulting compound being slowly added to 5 times its weight of a mixture of 2 parts of fuming sulphuric acid and 1 part of nitric acid of 1.5 specific gravity, and the whole heated on a water-bath for 8 or 10 hours. Upon pouring the mixture finally into water, trinitro-butyl-toluene, $C_6H.CH_3.C_4H_9.(NO_2)_3$, is precipitated and may be recrystallized from alcohol. It occurs in the form of colorless or slightly yellowish needles, which melt at 96.5° C. (205.7° F.) and possess a strong, musk-like odor.

Allied Drugs.—Antilope Dorcas L.—This is a deer-like ruminant inhabiting northern Africa. Its small globular excrements have a strong musk-like odor, and have been recommended as a substitute for musk, more especially in perfumery. Jacqueme obtained from them 7 per cent. of alcoholic extract, consisting of biliary substances, of a crystallizable acid, and of an odorous resin, which is also soluble in carbon disulphide. Water dissolves ammonium and sodium salts, and the insoluble portion contains calcium phosphate.

Hyraceum is supposed to be the dry excrements of the *klipdas* or *badger* (*Hyrax Capensis* Cuvier), a mammal of the order *Hyracoidea,* inhabiting southern Africa and attaining a

length of about 45 Cm. (18 In.). Hyraceum is in irregular tough but plastic pieces of a black-brown color; when warmed of a castor-like odor and having a bitter, nauseous taste. It is partly soluble in water, less soluble in alcohol and ether, and when heated becomes soft, and afterward burns, giving off acrid vapors. It contains a volatile oily matter, resin, fat, various acids, biliary constituents, etc.

CIVETTA, ZIBETHUM.—*Civet*, E.; *Civette*, Fr. Cod.; *Zibeth*, G.; *Zibeto*, Sp.—This is an unctuous secretion contained in a pouch located between the anus and genitals of both the males and females of *Viverra Civetta* Schreber, and *V. Zibetha* Schreber (Class *Mammalia*, Ord. *Carnivora*). The former animal inhabits Africa, the latter southern Asia, and they are occasionally kept captive for collecting the secretion, which is removed by means of a small ladle. It is at first yellowish, but becomes dark-brown, is fusible, nearly insoluble in water, partly soluble in ether and in hot alcohol, and has a strong musk-like odor and a bitterish, acrid, nauseous taste. It contains volatile oil, different fats, resin, coloring-matters, and salts.

The above substances are sometimes, though rarely, employed as stimulants and antispasmodics, but are more or less used in perfumery.

MUCILAGINES.—Mucilages.

Mucilages, Fr.; *Schleime*, G.

These preparations consist of viscid, more or less tenacious, and adhesive liquids, or of opaque semiliquid jellies; in all cases the solvent vehicle is water. All mucilages as directed by the pharmacopœias are prone to change, and gradually acquire an acid reaction and offensive odor, at the same time becoming more liquid. If not intended for medicinal use, the change may be retarded or prevented by the addition of alum, creosote, or glycerin.

MUCILAGO ACACIÆ, *U. S.*, *Br.*—Mucilage of Acacia.

Mucilago Gummi Arabici, P. G.—*Mucilage of gum arabic*, E.; *Mucilage de gomme arabique*, *Mucilage arabique*, Fr.; *Gummischleim*, G.

Preparation.—Acacia, in small fragments, 340 Gm.; lime water, 330 Gm.; water, a sufficient quantity to make 1000 Gm. Wash the acacia with cold water, and let it drain; then add to it the lime water and sufficient water to make the mixture weigh 1000 Gm.; agitate or stir occasionally until it is dissolved and strain.—U. S.

To prepare 1 pint of mucilage of acacia use 6 avoirdupois ounces and 175 grains of selected acacia, 5 fluidounces of lime water, and 7 fluidounces of water; after solution has been effected add sufficient water to make the required volume.

Gum arabic, 4 ounces (avoirdupois); distilled water, 6 fluidounces (Imperial).—Br. Gum arabic, 1 part; distilled water, 2 parts.—P. G. Powdered gum arabic, 1 part; cold water, 1 part; dissolve in a mortar.—Fr. Cod.

Owing to the fact that the solution of acacia becomes denser as it progresses, stirring or agitation of the mixture will be found somewhat difficult, and solution can be more readily effected by what is known as circulatory displacement, namely, the suspension of the washed acacia in the water in a bag of loosely textured cloth; if the bag be occasionally moved about in the liquid, fresh portions of water will continually displace the solution formed, which latter will sink to the bottom by reason of its gravity. The addition of lime water is made for the purpose of neutralizing the natural acidity of the acacia solution caused by the presence of acid calcium arabate. Mucilage of acacia should be kept in well-stoppered, completely filled bottles in a cool place.

White and clear pieces of gum arabic should be selected for preparing this mucilage. The impurities which necessitate the subsequent straining are generally accidental admixtures of the gum, and may mostly be removed by rapid washing with cold water before dissolving it.

Mucilage of acacia is a nearly transparent, colorless, or scarcely yellowish, viscid liquid, having a faint rather agreeable odor and an insipid taste. It forms turbid mixtures with solutions of alkali carbonates and bicarbonates, due to precipitation of calcium carbonate.

Pharmaceutical Uses.—This mucilage serves for the suspension of insoluble substances in mixtures and to impart adhesiveness to pill masses. The British Pharmacopœia directs it to be used as an excipient in the preparation of troches.

MISTURA GUMMOSA.—*Potio Gummosa.*—*Gum mixture*, E.; *Potion gommeuse*, *Julep gommeux*, Fr.; *Gummimixtur*, G.—Powdered gum, 10 parts; syrup, 30 parts; water, 100 parts; and orange-flower water, 10 parts.—Fr. Cod.

Uses.—Mucilage of acacia is employed as a soothing agent in inflammatory conditions of the respiratory, digestive, and urinary tracts. It may be diluted and flavored to suit the taste. The ordinary dose is from 1 to 4 fluidrachms (4–16 Cc.).

MUCILAGO SALEP, *P. G.*—Mucilage of Salep.

Mucilage de salep, Fr.; *Salepschleim*, G.

Preparation.—Salep, in fine powder, 1 Gm.; cold water, 9 Cc.; boiling water, 90 Cc. Place the powdered salep in a flask containing the cold water, and shake until the powder is uniformly distributed. Then add the boiling water, and shake the mixture continuously until it has become cold. The cooling may be hastened by frequent and brief immersion of the flask in cold water. Mucilage of salep should be freshly made when wanted for use.—P. G.

If sugar or syrup is prescribed in the same mixture with mucilage of salep, it is preferable to triturate the required quantity of powdered salep with either of the former, as the case may be, and then to add rapidly the proportionate amount of boiling water.

Uses.—This preparation may be given as a demulcent.

MUCILAGO SASSAFRAS MEDULLÆ, *U. S.*—Mucilage of Sassafras Pith.

Mucilage de moëlle de sassafras, Fr.; *Sassafrasmarkschleim*, G.

Preparation.—Take of sassafras pith 2 Gm.; water, 100 Cc. Macerate for 3 hours, and strain. It should be freshly made when wanted.—U. S.

It is a colorless, thickish, transparent liquid of a bland taste.

Uses.—Mucilage of sassafras pith may be given in bronchial affections and intestinal disturbances. It has been recommended as a local application for acute conjunctivitis.

MUCILAGO TRAGACANTHÆ, *U. S., Br.*—Mucilage of Tragacanth.

Mucilage de gomme adragante, Mucilage adragant, Fr.; *Traganthschleim*, G.

Preparation.—Tragacanth, 6 Gm.; glycerin, 18 Gm.; water, a sufficient quantity to make 100 Gm. Mix the glycerin with 75 Cc. of water; heat the mixture to boiling, add the tragacanth, and let it macerate for 24 hours, stirring occasionally. Then add sufficient water to make the mixture weigh 100 Gm., beat it so as to render it of uniform consistence, and strain forcibly through muslin.—U. S.

The Br. P. directs that 60 grains of powdered tragacanth be mixed with 2 fluidrachms of 90 per cent. alcohol, after which sufficient distilled water is added to form 10 fluidounces, and the whole well shaken.

Uses.—This mucilage may be employed locally as a protective to burns and scalds.

MUCILAGO ULMI, *U. S.*—Mucilage of Elm.

Mucilage d'écorce d'orme fauve, Fr.; *Ulmenrindenschleim*, G.

Preparation.—Elm, bruised, 6 Gm.; water, 100 Cc. Digest for 1 hour in a covered vessel on a water-bath, and strain.—U. S.

The mucilage contains at least a portion of the starch of the bark; if intended to be free from starch, cold water should be used.

Uses.—Elm mucilage is employed for its demulcent properties in the treatment of inflammatory affections of the respiratory, intestinal, and urinary tracts. It may be applied locally for the relief of erysipelas and other cutaneous inflammations.

MUSCI.—The Mosses.

This very large group of plants is probably of less economic importance, except for some mechanical uses, than any other of similar size. Its medicinal products are almost limited to a few species used for their mildly expectorant, and in some cases diuretic properties. *Hypnum cupressiforme* L. is credited with slight antiperiodic properties. *Funaria hygrometrica* Hedw. and *Meesia uliginosa* Hedw. are used as diuretics.

Polytrichum (*Hair-cap, Ground, Bear, Besom*, or *Golden moss, Robin's rye, Bear's bed,*

Goldilocks, Silver ling or *heather, Golden maiden-hair,* E. ; *Goldner Widerthon,* G.) is the entire plant of various species of *Polytrichum,* especially *P. commune* L. and *P. juniperinum* Hedw., of Europe and the United States, used commonly under the name *Herba adianthi aureæ.* The last-named plant grows in dense beds, on somewhat shaded banks. The stems are mostly simple, a few inches high, polished, and of a reddish color ; leaves spreading or appressed, lance-linear, awned, entire, but the edges somewhat incurved ; capsule quadrilaterally ovoid-oblong, the edges acute. The constituents are unknown. It appears to have quite active diuretic properties.

MYRICACEÆ.—The Bayberry Family.

This family, of 1 or 2 genera and less than 50 species, is of medicinal interest because of the generally aromatic properties of its foliage, the astringency of many of its barks, and the wax yielded by the fruits of many species. The last-mentioned product has been considered under CERA.

MYRICA (*Wax-myrtle, Bayberry, Tallow bayberry, Candle-berry, Wax-berry, Tallow shrub,* E. ; *Wachsmyrtel, Wachsbaum, Wachsgagel,* G.; *Arbre à suif,* Fr.; *Arbol de la Cera,* Sp.) is *Myrica cerifera* L., a densely growing evergreen shrub of about the height of a man, or less, abundant, mostly in the coast-region of the eastern and southern United States. The flowers appear in early spring, the staminate in yellow cylindraceous catkins about 18 Mm. ($\frac{3}{4}$ In.) long, the pistillate in smaller greenish aments. The fruits are globular, 1-seeded nuts, blackish, but densely covered with a bluish-white wax. *The leaves* are here illustrated. They are thick and smooth, except for the resinous dots on both sides, and are highly aromatic, like *Myrcia leaves,* when bruised, and of a somewhat bitter and astringent taste. Their important constituent is about 0.021 per cent. (*Gildemeister and Hoffmann*) of a greenish volatile oil, of a specific gravity of 0.926 and congealing in a freezing mixture. The leaves have some celebrity in domestic practice as an antispasmodic, antiscorbutic, and astringent, and have been used in hæmoptysis. *The bark* occurs in quills or curved pieces about 1.5 Mm. ($\frac{1}{16}$ In.) thick, externally covered with a whitish, slightly wrinkled, thin, corky layer, which separates in small fragments, underneath which the bark is dark reddish-brown and nearly smooth, resembling the inner surface, except that the latter is slightly striate. The fracture is granular, of a pale-reddish color, and scarcely fibrous in the inner layer. The bark yields a light reddish-brown irritating powder, which has a peculiar aromatic odor and an astringent somewhat bitter and pungently acrid taste. The constituents of bayberry bark, as determined by G. M. Hambright (1863), are, besides those more generally met with, a trace of volatile oil, tannin, an acrid resin soluble in alcohol and ether, an astringent resin insoluble in ether, and *myricinic acid,* the latter obtained from the alcoholic extract, after having been treated with ether, by exhausting it with hot absolute alcohol. It forms small granules, which produce a thick froth on being agitated with water, and on the addition of ammonia a deep-green color, rapidly changing to red and yellow. It has a lastingly acrid taste. Dana obtained from the fruit 32 per cent. of solid fat, 5 of resin, and 45 of starch. The myrtle-wax consists, according to G. E. Moore, of about one-fifth palmitin, the remainder being palmitic acid, with a small quantity of lauric acid. The bark of the root is acrid and stimulant, and in doses of a drachm causes a sensation of heat in the stomach, followed by vomiting and sometimes by diuresis. When chewed, it acts as a sialagogue, and has proved useful in *toothache.* The powder is an active errhine. Myrica has been employed internally for its tonic and astringent properties. In large doses it is said to be diuretic and emetic. Externally, the leaves are said to possess antiscorbutic and astringent properties. A decoction of 1 ounce (30 Gm.) to 1 pint (480 Cc.) may be given internally in doses of 2 fluid-ounces (60 Cc.) in the treatment of dysentery and scrofulous affections. The dose of the powdered drug is from 10 to 30 grains (0.60–2 Cc.). An alcoholic extract may be given in 5-grain (0.30 Gm.) doses.

FIG. 278.

Myrica cerifera (Nat.).

M. Gale L. (*Gale Belgica* Hum.), the *Sweet gale, Dutch myrtle,* E. ; *Piment royal, Galé odorant,* Fr.; *Gagel, Brabanter Myrte,* G., is a smaller shrub than the preceding, growing in swampy places from the mountains of North Carolina northward to Canada, and in the

northern parts of Europe and Asia. The leaves are on short petioles, obovate-lanceolate, wedge-shaped at the base, serrate near the apex, subcoriaceous, softly pubescent beneath, and bears on both sides yellow resinous dots. The fruit is likewise resinous-dotted. The leaves and brown branches have a strong balsamic odor and an aromatic, astringent, and bitterish taste. Rabenhorst (1836) obtained from 3000 parts of leaves 1 part of a thickish volatile oil containing 70 per cent. of stearopten.

The genus comprises about 35 species and most of them share the above composition and properties. *M. Nagi* Thunb., of India, is especially employed, the bark largely used as a tanning agent, and also for dyeing. It contains the coloring-matter *myricetin* ($C_{15}H_{10}O_8.H_2O$) and the quercitrin-like glucoside *myricetrin* ($C_{21}H_{22}O_{13}.H_2O$), which yields the former and rhamnose. When deprived of its water, it occurs in pale-yellow laminæ.

COMPTONIA (*Sweet fern, Ferngale, Meadow fern, Fern bush, Bush* or *Shrubby fern, Sweet bush, Spleenwort bush*, E.; *Liquidambar à feuilles de caterach*, Fr.) is the leaves of *Comptonia*

FIG. 279.

Comptonia leaf (⅔ Nat.).

peregrina (L.) Coulter (*Liquidambar p.*—L.; *Myrica asplenifolia* Gærtn.; *M. Comptonia* DC.), a low shrub, abundant in dry meadows, especially on rocky hillsides and among blueberry bushes, in northeastern North America. The leaf is here illustrated. It is deciduous, thin, pubescent and resinous-dotted, and has an aromatic odor and taste, much like *Myrica*, and is slightly astringent. The dried leaves yield a saponin-like substance, resin, 0.08 per cent. of aromatic volatile oil, gallic acid (?), fat, and 7–10.5 per cent. of tannin, the greater amount in summer. The dried rhizome yielded 6 per cent. of tannin and 8.24 per cent. of starch. The oil has a cinnamon-like odor and a specific gravity of 0.926. Sweet fern is stimulant and astringent; sometimes used to relieve colic and check diarrhœa and as a fomentation in rheumatism.

MYRISTICA, *U. S., Br.*—Myristica; Nutmeg.

Semen myristicæ, P. G.; *Nux moschata, Muscade, Noix muscade*, Fr. Cod.; *Muskatnuss*, G.; *Noca moscata*, It.; *Nuez mosedda*, Sp.; *Noz moschada*, Port.

The kernel of the ripe seed of *Myristica fragrans* Houttuyn (*M. officialis* L. f.; *M. moschata* Thunb.; *M. aromatica* Swz.; *Palala fragrans* Kuntze.—Fam. *Myristicaceæ*).

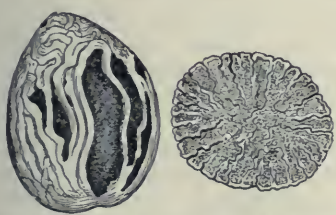
Nutmeg is official in all pharmacopœias.

Origin.—From a handsome, small, evergreen, dicœcious tree, native of the Molucca Islands, but the product now obtained wholly from trees cultivated in various tropical countries. It bears a dense crown of dark-green, somewhat lustrous foliage, inconspicuous yellowish flowers and a fleshy fruit much resembling a peach. The pericarp splits into halves at maturity, disclosing the solitary seed, partly covered by the scarlet aril (see illustration). This aril, removed and dried, constitutes MACIS. The seeds are then dried at a carefully maintained temperature of about 140° F., being in some cases (as at Bencoolen) first exposed for some hours to sunshine. The drying process requires many weeks. The testa then exhibits a rich brown color, somewhat shining and slightly furrowed where the mace has laid upon

FIG. 282.

Wild nutmeg, with mace.

FIG. 280.



Nutmeg with mace, and transverse section.

FIG. 281.

Nutmeg with testa (Nat.).

it. The kernel has shrunken so that it rattles loosely within the testa. In this condition, the seed constitutes the "Chinese Nutmeg," so called because it is the form imported by the Chinese. For use by other peoples the testa is broken and the kernel shelled out and exported, either in its natural condition (*Brown* or *Penang Nutmeg*, as the U. S. P. definition would require), or after having received a coating of lime (*Limed* or *Dutch Nutmegs*). It has been said that the liming process was originally resorted to by the Dutch to kill the vitality of the kernel, thus preventing the possibility of the loss of their monopoly, but since it affords an important protection against the attacks of insects, to which nutmegs are very liable, this may have been the real object of the procedure.

Although nutmegs are grown for local consumption in many tropical countries, the only considerable export is from the Malay Archipelago. The term "Banda," applied to Nutmegs and Mace, is a relic of the period of original export from the Banda Islands. Good crops of excellent, though rather small nutmegs are produced in the West Indies, but the industry is local and small.

Description.—Nearly 2.5 Cm. (1 In.) in length and of varying breadth, but never narrow and pointed, oval-ovoid, marked at the broad end with a circular scar, from which proceeds a shallow furrow to a deeper depression near the smaller end, and by a coarse reticulation of shallow furrows over the entire surface. In the official article the color is a light-brown, with a slight waxy luster, but the ordinary nutmeg of commerce is more or less grayish-white from a partial coating of lime. The embryo is small and occupies a conical cavity near the broad end, the remainder of the nutmeg consisting of endosperm. The transverse section exhibits a pale brownish-yellow, fatty-lustrous surface, penetrated by numerous narrow curved channels filled with brown tissue and containing involutions of the tegmen. Nutmeg is strongly and pleasantly aromatic in odor and taste, the latter also somewhat bitter and slightly pungent. Pure nutmeg yields not more than 2.5 per cent. of ash, though 5 per cent. is commonly allowed.

Substitutes and Adulterants.—No other natural product sufficiently resembles nutmeg to substitute it successfully in the natural condition, though a number of the kernels described under *Other Species* are occasionally reported. The most important of these is called *Long*, *Wild*, or *Male Nutmeg*, an important article of commerce for its fat, which is used to substitute or adulterate Nutmeg Butter. This nutmeg is commonly referred to *M. fatua* Houtt. (*M. tomentosa* Thunb.), but Warburg states that there are two varieties of it, the species yielding the better one being called by him *M. argentea*. Both varieties are much longer, narrower, and more pointed than the official. That from *M. argentea* he describes as differing from the other in being more brittle and with a stronger aroma, more resembling that of the official nutmeg, and in being furrowed with four broad stripes united above and below. That from *M. fatua* possesses almost no aroma after being dried. *Artificial Nutmegs* have been reported from time to time. Those examined by Vanderplankin closely resembled the natural externally, but were so softened by heating for 3 minutes in boiling water that they fell to pieces when rubbed between the thumb and finger. They were formed by compression of some mixture of earthy and powdery matter. Although aromatic, the aroma is weaker and somewhat different from that of the genuine. They yield from 11 to 18 per cent. of ash, only about 15 per cent. of fat, and less than 2 per cent. of volatile oil. The so-called *California Nutmeg*, the seeds of *Torreya Californica* Torrey (*T. Myristica* Hooker.—Fam. *Pinaceæ*), was formerly offered. These are readily distinguished by their smooth surface and their terebinthinate odor and taste. Ground nutmeg is heavily adulterated, especially with refuse nutmegs which have been distilled. Doubtless more or less of the kernels of *M. Malabarica* Lam., from which the Bombay Mace (see adulterants of Macis) has been removed, are also thus utilized. Since the practice of purchasing for consumption nutmegs in the entire state is almost universal, the adulterants of the ground article are of slight interest.

Constituents.—Nutmeg is commonly stated to contain from 2 to 8 per cent. of volatile oil (see Oleum Myristicæ), but it is a poor article which does not yield to the distiller at least double the larger amount named. Pressure removes 25 to 30 per cent. of fixed oil (*Oleum Myristicæ Expressum* or *Nutmeg Butter; Oleum Nucistæ*, P. G.), which commonly carries considerable of the volatile oil in solution, and about a third as much more remains in the pummice, Proteids, gum, and a peculiar starch are also present.

Action and Uses.—Nutmeg possesses aromatic, narcotic, and intoxicating properties. Given in overdose it produces stupor, decreased reflex excitability, slowness of

respiration, and slight cardiac sedation. It is not largely employed in internal medicine, but it may be combined with purgative drugs for its corrigent effect. It is largely employed as a condiment, and is especially useful as such in cases of gastric debility. The expressed oil is occasionally employed externally as a mild counter-irritant. The internal dose of the powdered drug is from 5 to 10 grains (0.30–0.60 Gm.).

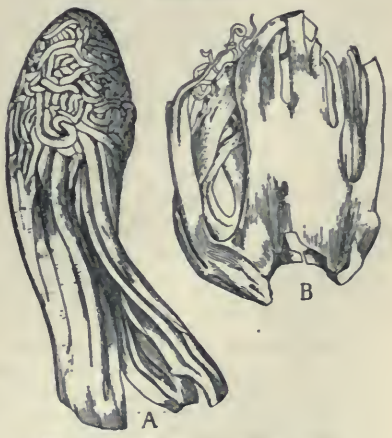
The properties and dose of mace are practically the same as those of nutmeg.

Other Species.—The genus *Myristica* L. contains about 80 species. The kernels of many are but faintly, some not at all, aromatic, while several (*M. succedanea* Scheinw., *M. argentea* Warb., *M. speciosa* Warb., *M. Schefferi* and *M. Madagascariensis* Lam.) are said to compare favorably with the official. Quite a number of the inferior ones, though not employed like nutmeg, have native medicinal uses. *M. fatua* is an important antidysenteric in the Moluccas. *M. Surinamensis* Bl., the "Cuago" or "Ucuhuba," yielding *Ucuhuba* or *Ocuhuba fat*, *M. Bicahyba* Schott., the "Bicahyba," and *M. officinalis* Mart., the "Bikuiba," all of tropical America, have important uses as antispasmodics and intestinal stimulants. *M. sebifera* (Aubl.) Sw. (*Virola s.* Aubl.) yields a red juice somewhat similar to Kino, which is used as an astringent; also a wax (*Ocuba wax* or *Virola tallow*). In the Philippines, the seed of *M. Philippinensis* Lam. (*M. Lusonensis* Man.) is used as a nutmeg-substitute, under the names *Dragon*, *Dunghan*, and *Gono-gono*. *M. gibbosa* Hook. f. et T., and *M. kingis* Hook. f., Indian species, yield a kind of Kino. So-called *Jamaica*, *Mexican*, or *Calabash nutmegs* are from *Monodora Myristica* (Gærtn.) Dunal (*Anona M.* Gærtn.—Fam. *Anonaceæ*). *Clove nutmegs* are from *Agathophyllum aromaticum* Willd. (*Ravensara a.* J. F. Gmel.—Fam. *Lauraceæ*).

Macis (*Arillus Myristicæ.—Mace*, *Banda Mace*, E.; *Muskatbluethe*, G.; *Fleur de Muscade*, Fr.; *Machias*, Sp.; *Arillo do Noz Moschada*, Port.) is the arillode removed from the Nutmeg seed, as described under that title. It is commonly dried in the sun and is often sprinkled with sea water, this being supposed to aid in its preservation.

Description.—Flat; nearly 2.5 Cm. (1 In.) long or sometimes longer, and of variable width, about 2 Mm. ($\frac{1}{12}$ In.) thick at the base, becoming gradually thinner upward, irregularly palmately divided into narrow, somewhat branching bands; smooth, very slightly lustrous, brownish-orange, slightly translucent, exuding oil when pressed or scratched; fracture short and weak; of a pleasant nutmeg-like aroma and taste.

FIG. 283.



Mace: A, Bombay; B, official (Nat.).

Adulterants.—Powdered Mace is heavily adulterated with Wild, Bombay, or Malabar Mace, derived from the seed of *Myristica Malabarica* Lam., and perhaps also from *M. fatua* Houttuyn. Whether in the entire or powdered condition, this adulterant is readily detected. In the entire condition, it is longer and relatively narrower, less divided at the base, the divisions more slender, the color darker and more reddish or brown, the surface more lustrous, the odor and taste weaker, more fatty, and having more of a resinous character. The addition of so little as 1 per cent. to genuine powdered mace can be easily detected by the treatment of a microscopic specimen with potassium hydroxide solution, which turns the particles of a dark-brown color, which becomes yellow upon the addition of sulphuric acid. The spurious article yields 10 times as much ether-extract as the genuine, after removal of the fat by petroleum ether, that from genuine mace not exceeding 5.5 per cent. If there be an addition of only 10 per cent. of the spurious article, the ether-extract is thus brought up to 6 per cent. (*Solstein*).

Constituents.—The important constituents are the fixed and volatile oils. The latter exists to the extent of from 4 to 9 per cent. or more, occasionally up to 17 per cent. There are two odorous fixed oils, one yellow and soluble in ether, insoluble in boiling alcohol, the other red and miscible in all proportions with alcohol and ether. There are also 25 per cent. of soft resin, 1.8 per cent. of amylodextrin, 1 per cent. of uncrystallizable sugar, a little myristicin, gum, etc. Starch is wanting. The ash should not exceed 3 per cent.

Action and Uses.—The action of mace is practically the same as that of MYRISTICA (which see). It is occasionally employed to impart an agreeable taste to medicines, and is added as a condiment to certain articles of diet.

MYRRHA, *U. S., Br., P. G.*—Myrrh.

Somali Myrrh, Herabol Myrrh, Gummi resina Myrrha.—Resina Balsamodendri, Nor.; *Myrrhe,* Fr. Cod., G.; *Mirra,* Sp., Port., It.

A gum-resin obtained from *Commiphora Myrrha* (Nees) Engler (*Balsamodendron M.* Nees; *Balsamea M.* Baill.—Fam. *Burseraceæ*).

Myrrh is official in all pharmacopœias. The Br. P. definition employs the synonym *Balsamodendron M.*, and adds "probably from other species." The P. G. uses the proper generic name, *Commiphora,* but gives the species as *C. Abyssinica* (Berg.) Engl. and *C. Schimperi* Engl. Other pharmacopœias have incorrectly defined the plant as *B. Opobalsamum* Kunth. (*B. Ehrenbergianum* Berg.).

Origin.—The determination by Nees of *C. Myrrha* as the source of Myrrh has been at various times called into question, but has recently been definitely settled by Holmes, who identified a leaf-bearing specimen collected by Phillips, natural Myrrh being attached to the twigs. There appears to have been some confusion in Engler's transferral of the name from the genus *Balsamodendron* to *Commiphora,* he calling the Myrrh plant a variety of the species *C. Myrrha,* but it is quite clear that the specific name *Myrrha* can never belong to any other than the species to which it was originally applied by Nees. Holmes's shrewd observations, based upon an examination of the same specimens which gave origin to the idea that the substance is derived from *C. Abyssinica* and *C. Schimperi,* as well as of other specimens, have sufficed, furthermore, to render it exceedingly unlikely that any other species than that named in our definition yields Myrrh corresponding to the official description. Even if the inferior Arabian Myrrh were to be officially accepted, its reference to *C. Schimperi* would not appear justified. The occurrence of Myrrh in the bark, in both lysigenous and schizogenous ducts, renders it an easy matter for an expert pharmacogonist to determine its origin, by an examination of good herbarium specimens.

Official Myrrh is collected by the Somalis in northeastern Africa, partly from natural fissures and partly from incisions made for the purpose. It is at first yellowish-white, but as it hardens becomes darker, until finally of a reddish-brown color and without the rough and powdery surface characteristic of the commercial article. It is accumulated at Aden and Berbera, chiefly the former. Long ago, it went from there to India and Turkey, whence it was re-exported. That passing through Turkey was of the best grades only, hence the titles, now obsolete, of "Turkish" and "Indian" Myrrh. Up to recent times, most of our Myrrh was imported from India, but it now chiefly comes direct from Aden. It is assorted before being exported, but more or less spurious and inferior pieces are commonly found intermixed.

Description.—In irregular, more or less rounded nodules or tears, from 2.5 to 10 Cm. (1 to 4 In.) in diameter, the surface more or less roughened by nodules and small cavities, as though eroded, red-brown, dull, and more or less gray from adhering powder; heavy, hard, and rather tough-splintery in fracture, the freshly-fractured surface of a waxy luster and oily feel, red-brown, usually variegated by gray crescent-shaped spots and intersecting lines; thin fragments translucent, usually strongly so; strongly and agreeably aromatic, the odor characteristic; bitter, and somewhat acrid, and producing a hardening and slight wrinkling of the mucous membrane of the mouth, though different from the astringency of tannin; readily powdered when cold and dry, but with difficulty when warm and damp; the freshly fractured surface, moistened with alcohol, colored purplish, as is the brownish-yellow alcoholic tincture, by nitric acid (distinction from Bdellium); yielding a brownish-yellow emulsion with water; the 10 per cent. ethereal extract acquiring a violet color in the presence of bromine vapor, or the film left from the evaporation of such an extract in a watch-glass slowly acquires such a color if inverted over another watch-glass containing nitric acid; if 6 drops of a 7 per cent. petroleum-ether extract be mixed with 3 Cc. of acetic acid, and 3 Cc. of sulphuric acid be then added, forming a heavy lower layer, the latter takes only a light-rose color, which does not deepen (*distinction from Bissabul Myrrh*); not more than 70 per cent. should be insoluble in alcohol, and the ash should not exceed 6 per cent.

In connection with the above description, the following facts should be considered: the tears of genuine Myrrh are of all sizes under 1 inch, but these smaller forms are

inferior and more likely to be spurious; on the other hand, very large masses sometimes occur, but one of the varieties of Bdellium usually occurs in such masses. The ash-limit is sometimes placed at 10 per cent., but in a first-class article it is not more than 2 or 3 per cent., and the limit given above is a liberal one. Different pharmacopœias variously state the alcohol-insoluble portion at from 60 to 66 per cent., the Italian saying "from 40 to 60 per cent." The smaller the amount, the better the Myrrh, and a strictly good article should yield not more than 65 per cent.

Merson (*Pharm. Jour. and Trans.*, Jan., 1900, p. 42) has made an extensive comparison of commercial samples, showing that the poorest ("small, common sorts") contain 33 per cent. soluble in 90 per cent. alcohol, and nearly 14 per cent. of ash. From this, the quality gradually improved through 11 successive grades up to a "select medium"-sized article which yielded about 48 per cent. to 90 per cent. alcohol and less than 3 per cent. of ash.

Other Varieties, Substitutes, and Adulterants.—While the official tests given under *Description* suffice for the distinction of Myrrh from all common admixtures and substitutes, yet the very best method of distinction, for one familiar with the article is by the odor and taste.

Arabian Myrrh rather closely resembles the official, but its largest fragments rarely much exceed half the size of large fragments of the latter. It contains more gum, commonly above 70 per cent., and less volatile oil. Its surface is less dusty, it is tougher, the fragments less transparent, the fractured surface rarely (never in the variety which commonly occurs) spotted or veined, and the odor is less fragrant. It is represented by two principal varieties, the Fadhli and the Yemen. The latter, scarce in commerce, is the poorer, being dark-colored, very gummy, and of a peculiar heavy, not agreeable odor. It does not react to the bromine test.

Bissabul, or *Bisabol Myrrh* or *Hebbakhade*, referred by Holmes to *C. Kataf* (Kunth) Engl., is much like the genuine in color, though lighter and more yellowish, but not so dusty. It is characteristically soft and gummy, and the fractured surface exhibits small brown, angular resin-spots. Its odor is not disagreeable, but is sufficiently distinct from that of Myrrh. The filtrate from its 50 per cent. extract with cold petroleum ether is yellow, while that from genuine myrrh is colorless. On applying the acetic-sulphuric acid test described above, the lower layer becomes rose-red, changing shortly to deep-red. Bissabul Myrrh contains only about 21 per cent. of resin, which is strongly acid, 1.5 per cent. of bitter constituent, and up to 8 per cent. of volatile oil. To the latter, which has been called *Bisabolene*, is attributed the color-reaction last mentioned. It is light-yellow and of a specific gravity of 0.8836 (Gildemeister and Hoffmann). Bissabul Myrrh is said to be now in commerce under the name of *Opopanax*.

Bdellium.—This substance probably constitutes the commonest and most important adulterant of Myrrh. It presents several quite distinct varieties. *African Bdellium*, from *C. Africanum* (Arn.) Endl. (*Balsamodendron A.*—Arn.; *Hendeletia A.*—Rich.; *Balsamea A.*—Baill.), is powdery on the surface, hard, rather brittle, the fractured surface dark red-brown, not or little lustrous, the thin fragments slightly translucent and deep-red. It is aromatic, but the odor is quite distinct from that of Myrrh, and it is quite bitter. *Indian Bdellium*, probably from *C. Mukul* (Hook) Engl., is similar in appearance, but is slightly or not at all aromatic and not bitter. The fractured surface is peculiarly sparkling from the presence of small resin-dots and the fragments are somewhat translucent. Another variety is sometimes seen which is intermediate between these two in odor and taste, but not at all translucent, and very distinct from the others in having its tincture blackened by ferric salts.

Constituents.—Myrrh ordinarily contains from 2 to 5 per cent. of volatile oil. The amount is occasionally considerably higher, but a high percentage occurs regularly in Bissabul Myrrh, the oil, however, being of a very different character. There is 25 to 40 per cent., occasionally in select pieces nearly 50 per cent. of resin, the remainder mostly gum. The bitter principle is sparingly soluble in water, partly in carbon disulphide, soluble in ether and alcohol, and precipitated from alcohol by lead acetate. Its alkaline solution reduces Fehling's Solution and precipitates floccules on the addition of acid. *Oil of Myrrh* (Myrrhol), which is an article of commerce, is a yellow or yellowish-brown thickish liquid having the intensified odor of myrrh, its specific gravity varying from 0.988 to 1.007 (*Gildemeister and Hoffmann*). Its boiling-point is most variously stated by different authors. Dissolved in carbon disulphide, it gradually

assumes a permanent violet or blue color after the addition of nitric acid or bromine. Its constituents are entirely unknown.

Resin of Myrrh has been much studied, but is not yet well known. It is entirely soluble in ether, alcohol, and chloroform. It consists of 2 parts, one soft, the other hard and acid, the latter being again divisible into 2 parts. This acid portion yields protocatechuic acid and pyrocatechin.

Myrrh Gum consists of 2 parts, one soluble, the other swelling in water. The relative proportions of the two parts appear quite variable. This gum is considered of good quality for mucilage, its keeping qualities being unusually good.

Pharmaceutical Preparations.—Compound Iron Mixture, Pills of Aloes and Myrrh, Tincture of Aloes and Myrrh, Tincture of Myrrh, U. S. P.

Action and Uses.—This substance is employed for its tonic and stimulating properties. In moderate doses it acts as a mild circulatory stimulant, and increases the activity of the respiratory, gastric, and uterine mucous membranes. It may be employed as an expectorant in subacute and chronic bronchitis, and is believed to be of value in the treatment of chronic cystitis, and leucorrhœa depending upon chronic metritis. When combined with iron, it is frequently used in the treatment of amenorrhœa depending upon chlorosis or functional inactivity. Locally applied, it is a useful application to spongy gums, aphthous stomatitis, and indolent ulcers. In the treatment of anæmia it may be given in the form of Mistura Ferri Composita (which see). The drug is rarely administered in substance, but an emulsion may be prepared and given in doses representing from 10 to 15 grains (0.60–1 Gm.). The tincture is usually employed as a local application for ulcerative sore throat, but may be given internally in doses of from 10 to 30 minims (0.6–2 Cc.).

Allied Substances.—The genus *Commiphora* is credited by Engler with 63 species, all of Africa and adjacent Asia, and as a class characterized by their gum-resinous exudations. Probably most of the substances occurring as substitutes for and adulterants of Myrrh are derived from this genus. Several are independent articles of commerce.

Mecca Balsam, Balm of Gilead, or *Opobalsamum,* is the product of *C. Opobalsamum* (Kunth) Engl. While this species is said to have a very wide distribution, the Balsam is collected only in the vicinity of Mecca. The substance is of interest because it appears to be that referred to in the Bible under the name of Myrrh. The method of its collection appears to be unknown. It is an opaque, yellowish or whitish, fragrant, viscid liquid, containing from 10 to 30 per cent. of volatile oil, according to different authors, and up to 70 per cent. of soft and 12 per cent. of hard resin. This substance, formerly an important article of commerce, is now rarely seen.

Mulu Kilavary is an exudation from *C. Berryi* (Arn.) Engl. It is described by Hooper as occurring in tough, translucent fragments, ranging from pale-yellow to brown and breaking with a shining conchoidal fracture, the surface oily and, when scratched, showing a milky-white marking. The odor was oily, not fragrant, and the taste simply mucilaginous. It yielded 5 per cent. of moisture, 6.6 per cent. of mineral matter, and 84 per cent. of gum similar to that of Myrrh. The resin was soft, transparent, tasteless, odorless, and neutral, and soluble in alcohol, ether, chloroform, and carbon disulphide. Moistened with alcohol, it gave no color with nitric or hydrochloric acid, and no violet color on treatment with bromine. It appears likely that this is one of the "tasteless gums" which have been reported as used to adulterate Myrrh.

Hotai is a gum-resin obtained from *C. Playfairii* Hook. (now referred to *C. Myrrha*).

Kafal wood is an article of commerce in Egypt, and is said to be yielded by *C. erythræa* Engl.

MYRSINACEÆ.—The Myrsine Family.

A family of about 25 genera and about 500 species of shrubs and trees of tropical and subtropical regions. The properties of its plants have been but little studied, but many of the fruits are purgative and anthelmintic, and the family appears worthy of careful investigation.

Embelia is the fruits of *Embelia Ribes* Burm. (*Samara R.*—B. et H.), a small tree of India. This article has attracted some attention as an adulterant of pepper and cubeb. The drupe is dark-red, drying blackish, and resembles black pepper. It is very aromatic. Warden (1887, 1888) isolated from it *embelic acid,* $C_9H_{14}O_2$, which crystallizes in brilliant golden spangles and is insoluble in water; its alcoholic solution combined with ammonia turns red, and on spontaneous evaporation yields the salt crystalline and tasteless. The fruits are used as an anthelmintic. From 2 to 3 drachms (8 to 12 Gm.) are given with milk before breakfast and followed, after some hours, by a dose of castor oil or other purgative.

Saoria, from Abyssinia, is the fruit of *Mæsa lanceolata* Forsk., *M. pieta* Hochst. It is

drupaceous, globular-ovate, about 4 Mm. (⅛ In.) thick, partly united with the calyx, brownish-green, and contains a resinous pulp with many turbinate angular seeds attached to the central placenta; the taste is bitterish, pungent, and acrid. Apoiger (1857) met with an acrid principle, some iron-greening tannin, volatile oil, fat, pectin, etc. This fruit is also used as a tænicide.

Satzé or Tatzé, the fruit of *Myrsine Africana* Schimp., differs from the preceding in being more globular, not united with the calyx, of a reddish-brown color, and in containing only one nearly globular seed, which is grooved at the base. The taste of the fruit is more disagreeable than that of saoria. It gives a violet tint to the urine and occasions slight nausea and liquid stools. According to some authorities, it is a more certain remedy for *tænia* than the indigenous tænifuges of France, but others regard its action as uncertain. It may be given in powder, mixed with porridge, in the dose of from 1 to 1½ ounces (32–48 Gm.). Strohl found it partly successful in 6 cases of tænia, administering 4 to 6 drachms (16–24 Gm.) of the powder in a liquid vehicle.

The fruit and leaves of *Jacquinia armillaris* Jacq. (*Tuigi da praya* or *Barbaseo*) are poisonous and used in capturing fish.

MYRTACEÆ.—The Myrtle Family.

The Myrtle family comprises 72 recognized genera, according to Niedenzu, and about 3000 species of shrubs and trees, almost wholly of tropical distribution. In its botanical characters, chemical constituents, and physiological and medicinal properties it is very uniform. The plants are highly ornamental, with dense crowns of mostly thick, dark-green leaves, and producing an abundant, usually white inflorescence. The fruits too are often very showy, persisting for some time, and many of them are somewhat edible. The important constituents are volatile oils and tannin, on account of which latter many of the barks are used in tanning. The general character of the volatile oils, which are particularly expectorant and antiseptic, is fully indicated elsewhere, in our accounts of Caryophyllus, Eucalyptus, Oleum Cajuputi, Oleum Myrciæ, and Pimenta. A very large number of the species have been medicinally employed for their similar constituents and properties.

Myrtus or *Myrtle, Common, Dutch, Bridal,* or *Jew's myrtle* (*Myrte,* G., Fr.), is the leaves of *Myrtus communis* L., native of the Mediterranean region, and largely cultivated for decorative purposes. They vary from 1.2 to 5 Cm. (½ to 2 In.) in length, and from lance-linear to ovate in form, and are very short-petioled, mucronate, entire, thick, smooth and glossy, densely pellucid-punctate, finely aromatic, and slightly astringent and bitter. The fruits, which are also used, resemble allspice. The only important constituent is the volatile oil, of which the yield is said to be less than 0.5 per cent. It is yellowish or greenish, has a specific gravity of 0.890 to 0.915. It apparently contains a camphor, with *d*-pinene and dipentene. Myrtle depends for its activity upon the volatile oil which it contains. It possesses some germicidal activity and acts as a nervous sedative. The drug has been recommended in the treatment of chronic bronchitis, pulmonary gangrene, bronchitis, menorrhagia, chronic cystitis, and pyelitis; but it is rarely employed in this country. The powdered drug may be given in from 15 to 30 grain (1–2 Gm.) doses. The dose of the oil is from 2 to 4 minims (0.10–0.25 Cc.), 4 times daily.

Chequen, *Chekan,* or *Arrayan,* used in Chile as a substitute for Myrtle, is the leaves of *Eugenia Chequen* Mol. (*Myrtus Cheken* Spr.; *Eugenia Cheken* DC.). They are nearly sessile, about 1.5 to 2 Cm. (⅗ to ⅘ In.) long, rhomboidally oval, with oblique base, entire and revolute margin, smooth and somewhat shining, pellucid-punctate, highly aromatic, astringent and bitterish. They contain upward of 1 per cent. of a volatile oil very similar to that of myrtle, about 4 per cent. of tannin, and, possibly, a volatile alkaloid and a glucoside. Chekan is said to be a valuable remedy in the treatment of catarrhal inflammations of the respiratory and genito-urinary tracts. The dose of the fluid extract is from 1 to 3 fluidrachms (4–12 Cc.).

Jambul or Jambol Seeds are the seeds of the *Rose apple, Eugenia jambolana* Lam. (*Syzygium J.*—DC.; *Calyptranthes J.*—Willd.), native of the East Indies, where it is largely cultivated for its edible fruit. The bark is similarly used, but is regarded as inferior to the seeds. The seeds are about 1.2 Cm. (½ In.) long and a third as thick, oval, with one end truncated, blackish-gray externally, green internally, hard, heavy, and with little odor or taste. No important constituent has been isolated, and a small quantity of resin, with about 2 per cent. of gallic acid, are the only constituents worthy of note. In the form of a decoction the bark of the root has been recommended for its astringent properties in the treatment of gonorrhœa, leucorrhœa, and chronic diarrhœa.

Guava Leaves, the leaves of various species or varieties of *Psidium,* have quite an extensive domestic use for their astringent and mildly aromatic properties.

Nearly 300 species of *Myrtaceæ,* chiefly in the genus *Eucalyptus, Melaleuca, Eugenia, Myrcia, Calyptranthes, Psidium, Campomanesia,* and *Myrtus,* are recorded as being in use for similar properties to those considered above.

N.

NAPHTHALENUM, *U. S.*—Naphthalene.

Naphthalinum, P. G.; *Naphthalin*, E.; *Naphtaline, Naphthalène*, Fr.; *Naphthalin*, G. Formula, $C_{10}H_8$. Molecular weight, 127.10.

A hydrocarbon obtained from coal-tar, and purified by crystallization.—U. S.

Origin.—Naphthalene was discovered by Garden (1820) in coal-tar oil, and recognized by Reichenbach as resulting from the decomposition of the products of distillation of coal. It has since been obtained from a large number of organic bodies, particularly if the distillation-products are conducted through a red-hot tube, and is a constituent of the petroleum of Burmah. Naphthalene has also been obtained synthetically from the condensation-product resulting from cinnamaldehyde and hippuric acid, by heating it with concentrated hydrochloric acid (*Ber. d. D. Ch. Ges.*, 1902, pp. 217–219).

Preparation.—The fraction of coal-tar oil collected during the distillation of coal tar between 180° and 250° C. (356°–482° F.) gradually deposits a dark crystalline substance, which consists chiefly of impure naphthalene. By treatment successively with sodium hydroxide solution and sulphuric acid certain acid and basic by-products (phenols, aniline, etc.) are removed, and the residue after distillation in the presence of steam, is further purified by repeatedly heating with concentrated sulphuric acid to 188° C. (356° F.) and redistilling. Finally, a white product is obtained which is practically pure naphthalene, but has a tendency to darken when exposed to air and light, owing to slight contamination with some remaining phenols; to remove these the oxidizing effect of a mixture of sulphuric acid and manganese dioxide is resorted to for 15 or 20 minutes at a water-bath heat, and the mixture is then washed with water and sodium hydroxide, and finally resublimed.

Naphthalene recrystallized from alcohol should alone be used for pharmaceutical purposes, and should be kept in well-stoppered bottles.

Commercial naphthalene in the form of balls and flakes is sold under the names of coal-tar camphor and moth-balls.

Properties.—Naphthalene occurs in the form of colorless to white, shining, transparent laminæ or crystalline rhombic plates, having a strong characteristic tarry odor and burning, aromatic taste. At 15° C. (59° F.) its specific gravity is 1.1517, and at 98.8° C. (209.8° F.) 0.9628. It melts at 80° C. (176° F.) to a clear colorless liquid, and boils at 217.2° C. (423° F.), 218° C. (424.4° F.) U. S., and is completely volatilized on continued application of heat, the vapors being inflammable and burning with a luminous sooty flame. Though practically insoluble in water and dilute aqueous solutions of alkalies and acids, naphthalene imparts its odor to the same. Naphthalene volatilizes slowly on exposure to air at ordinary temperatures, and rapidly on application of heat, the vapors possessing antiseptic properties. It is also volatilized with the vapors of volatile liquids. It is soluble in 13 parts of alcohol at 25° C. (77° F.), very soluble in boiling alcohol, and readily soluble in ether, chloroform, carbon disulphide, benzene, and fixed and volatile oils. It is neutral to litmus-paper moistened with alcohol.

On dissolving naphthalene and picric acid together in hot alcohol the two unite, forming on cooling golden-yellow needles having the composition $C_{10}H_8.C_6H_2(NO_2)_3OH$, and yielding all the picric acid to ammonia. Naphthalene yields with chlorine and bromine numerous products of addition and substitution and with sulphuric acid well-defined naphthalene-sulphonic acids. When treated with strong nitric acid, *nitronaphthalenes*—$C_{10}H_7(NO_2)$ and $C_{10}H_6(NO_2)_2$—are generated, which by the action of reducing agents are converted into *naphthylamine*, $C_{10}H_7.NH_2$, which is crystallizable, turns red in the air, and the salts of which yield blue, and finally purple-colored, precipitates with ferric chloride, chromic acid, and other oxidizing agents. By means of diluted nitric acid it is converted into phthalic acid, $C_8H_6O_4$.

Tests.—The ordinary impurities of naphthalene are detected by means of the sulphuric acid test. On shaking a small portion of naphthalene with concentrated sulphuric acid, the acid should remain colorless; nor should it acquire more than a pale-reddish tint, if the mixture be heated for 5 minutes on a water-bath (absence of impurities derived from coal-tar.—U. S. Naphthalene may be identified by treating the substance

with fuming nitric acid, pouring the product into water, and after washing the precipitate with water, boiling it with a solution of equal parts of potassium hydroxide and potassium monosulphide, when in presence of naphthalene a purple color will appear.

Action and Uses.—Naphthalene is employed as an antiseptic in the treatment of gastro-intestinal diseases associated with fermentative changes. It has been recommended in the treatment of enteric fever, but its usefulness in this condition is questionable. It may be employed in intestinal catarrh and in the summer diarrhœa of infants, and in the latter condition its administration is frequently productive of a cure. It has also been recommended as an expectorant in the treatment of chronic bronchial affections. A 10 per cent. ointment may be tried in the treatment of indolent ulcers, eczema, prurigo, and tinea tonsurans. In the hands of the laity it has almost entirely supplanted camphor for the destruction of moths. In the treatment of summer diarrhœa the dose is from $\frac{1}{6}$ to $\frac{1}{4}$ grain (0.01–0.015 Gm.). The ordinary adult dose is from 5 to 10 grains (0.30–0.60 Gm.), in powdered form, best administered in capsules.

NICOLUM.—Nickel.

Nickel, Fr., G.

Symbol, Ni. Bivalent. Atomic weight, 58.3.

Nickel exists in various ores found in Sweden, Germany, and other parts of Europe, and in North America, in Pennsylvania and near Lakes Huron and Superior, and in Canada. It frequently accompanies cobalt, iron, and copper in their ores. It constantly accompanies iron in meteoric stones. The most common nickel ore is the arsenide, NiAs, known as *niccolite;* next in order is *gersdorffite*, $NiS_2.NiAs_2$. The metal was first obtained in 1751, by Cronstedt, from niccolite (*Kupfernickel*). The preparation on the large scale is somewhat complicated, but small quantities can be obtained in the laboratory by reduction of the oxide in a current of hydrogen at high temperature; by strongly heating nickel oxalate; or by reduction of the oxide by carbon at white heat. Canada and New Caledonia (in the Pacific Ocean) produce the largest quantity of nickel ore; that from Canada is smelted mostly in the United States. The New Caledonian ore is a hydrated silicate containing magnesium, and is free from arsenic, cobalt, and sulphur. The purest nickel is obtained by the Mond process, which consists in forming at a moderate heat a gaseous compound with carbon monoxide, $Ni(CO)_4$ (boiling point, 43° C. (109.4° F.)), known as nickel-carbonyl, and decomposing this at a higher temperature with deposition of nickel. The metal occurs in commerce generally in cubes.

Properties.—It is a lustrous white metal, with a slight tinge of yellow, very hard, and capable of a high polish. Impure nickel, containing carbon, is brittle like cast-iron, but when pure or when containing about 1 per cent. of magnesium or manganese it is malleable. The specific gravity of the metal is 8.9, melting-point about that of wrought iron, and in magnetic properties it is a little weaker than iron. It is not changed in the air, dissolves slowly in sulphuric and hydrochloric acids, but readily in nitric acid. It is not advisable to use cooking utensils, as pots, spoons, etc., made of nickel, as the salt and vinegar used in foods dissolve an appreciable amount of nickel, forming nickel salts which are poisonous (Erdmann, *Anorg. Chemie*).

Alloys.—These are extensively used. Argentan or German silver consists of copper, zinc, and nickel. Various copper-nickel alloys are used in coins. Nickel-steel is used for armor-plates.

At present, nickel is extensively used in nickel-plating, a solution of nickel-ammonium sulphate being employed for that purpose.

Reactions.—Nickel, cobalt, and iron are a group of metals which resemble one another somewhat in their chemical behavior. Iron and cobalt form two series of salts, but nickel forms only one set of salts, corresponding to the ferrous salts.

Caustic alkalies precipitate pale-green nickel hydroxide, $Ni(OH)_2$, from solutions of nickel salts, which is soluble, like that of cobalt and copper, in ammonia water. Heated to redness, it gives a greenish oxide, NiO. There is also a black oxide, Ni_2O_3, but it does not give nickelic salts with acids. Ammonium sulphide gives black nickel sulphide, NiS, similar to cobalt sulphide, scarcely acted on by 5 per cent. hydrochloric acid. Nickel salts give a reddish-brown bead with microcosmic salt in the oxidizing flame when hot, pale-yellow when cold, while cobalt gives a blue bead. Cobalt and nickel resemble each other so closely that it is not a simple matter to separate them in solution, but this can be done by a few reactions. One method, readily carried out, is to add barium or

calcium carbonate to a neutral solution, and then bromine water in excess. Cobalt is precipitated as black cobaltic oxide, which is filtered off after 10 minutes' standing. From the filtrate barium is removed by sulphuric acid, and nickel is determined electrolytically (modified Rose's method by R. L. Taylor, *Chem. News*, 1902, p. 269). In general, crystallized nickel salts are green while the anhydrous salts are yellow.

SALTS OF NICKEL.

Nicoli Bromidum.—*Nickel bromide*, E.; *Bromure de nickel*, Fr.; *Nickelbromür*, G. $NiBr_2 3H_2O$.—It is prepared by digesting nickel with bromine and water, or by dissolving nickel carbonate in hydrobromic acid and crystallizing. It crystallizes in green deliquescent needles or prisms, which are soluble in alcohol, ether, and water; the latter solution on exposure is decomposed, depositing nickel hydroxide. The physiological action of nickel bromide is analogous to that of sodium bromide. It is more irritant to the stomach, however, and because of this fact should be given largely diluted. The dose is 10 grains (0.60 Gm.), corresponding to 30 grains (2 Gm.) of the sodium salt. It is best administered as an effervescing draught. A powder prepared by mixing the salt, tartaric acid, and sodium bicarbonate, may be triturated with alcohol, granulated, and dried. This may then be added to water and swallowed during effervescence.

Nicoli Carbonas.—*Nickel carbonate*, E.; *Carbonate niccolique*, Fr.; *Nickelkarbonat*, G.—It is pale-green or blackish-green, of variable composition, and is prepared by precipitating the solution of a nickel salt with sodium or potassium carbonate. This salt was formerly employed in the treatment of anæmia in doses of 2 grains (0.12 Gm.), several times daily. It is probably of little therapeutic value.

Nicoli Chloridum.—*Nickel chloride*, E.; *Chlorure de nickel*, Fr.; *Nickelchlorür*, G.—The hydrated salt is green, very deliquescent, and contains $6H_2O = 45.4$ per cent. The anhydrous chloride is yellow, or, in the presence of cobalt, has a green tint; it sublimes in yellow lustrous scales.

Nicoli Sulphas.—*Nickel sulphate*, E.; *Sulfate de nickel*, Fr.; *Nickelsulfat*, G. $NiSO_4 \cdot 7H_2O$.—Nickel sulphate may be prepared by dissolving pure nickel carbonate in diluted sulphuric acid, concentrating the solution, and crystallizing at or below 20° C. (68° F.), or precipitating it with alcohol. The salt is extensively manufactured on the large scale from impure carbonate, the process involving the separation of other metals, like arsenic, iron, copper, and cobalt. The salt forms either a green crystalline powder, or it is generally seen in emerald-green transparent rhombic prisms, which effloresce on exposure, losing 1 molecule of H_2O, and being at the same time converted into an aggregation of octahedral crystals. A salt containing $6H_2O$ is also obtained by crystallization from an acid solution at above 20°C. (68° F.). The salt has a sweetish and styptic taste and a slight acid reaction, is soluble in about 3 parts of water at 15° C. (59° F.), insoluble in alcohol and ether, and loses at 103.3° C. (218° F.) 38.5 per cent. (the salt with $6H_2O$, 34.2 per cent.) of water, the remaining molecule of water being expelled above 250° C. (482° F.). The solution of nickel sulphate, on being mixed with a saturated solution of ammonium sulphate in excess, gives a precipitate of *nickel-ammonium sulphate*, $(NH_4)_2Ni(SO_4)_2 \cdot 6H_2O$. This salt is blue-green, almost insoluble in solutions of alkali sulphates, but soluble in about 8 parts of water; it, like the sulphate, is largely used for the electroplating of iron, copper, and other metals with nickel.

NITROGENII MONOXIDUM.—Nitrous Oxide.

Laughing-gas, E.; *Oxyde nitreux, Protoxyde d'azote*, Fr.; *Stickstoffoxydul, Lachgas*, G.
Formula, N_2O. Molecular weight, 43.74.

Origin.—Nitrous oxide was first obtained by Priestley (1772), by acting upon nitric oxide with moist iron filings; he also noticed that ignited bodies burn in this gas with a brighter flame than in atmospheric air. The composition of the gas was determined by Deimann and Troostwijk (1793), who prepared it from ammonium nitrate. H. Davy (1800) observed its exhilarating effects.

Preparation.—Ammonium nitrate which is absolutely free from chloride is gradually heated to about 200° C. (392° F.), when decomposition commences, and the heat may be slowly increased, but should not go above 240° C. (464° F.). The salt yields then water and nitrous oxide: $NH_4NO_3 = 2H_2O + N_2O$. If the temperature is too high, other products are formed, as nitric oxide, nitrogen, and ammonia. To remove possible impurities, the gas is passed through solutions of potassium hydroxide and ferrous sulphate. Nitrous oxide occurs in the market compressed in steel cylinders.

Properties.—Nitrous oxide is a colorless gas, of a very slight agreeable odor and a sweetish taste. It has the specific gravity 1.6 (Dalton), and a liter of it at 0° C. (32°

F.) weighs 1.97 Gm. It is not inflammable, but supports the combustion of ignited bodies, which burn more vigorously than in the open air. By the aid of pressure and cold it may be condensed into a thin, very mobile, colorless liquid, which at a temperature of about —100° C. (—148° F.) congeals to colorless crystals. The gas is soluble in water, alcohol, ether, volatile and fixed oils.

Nitrous Oxide Water.—The solubility of nitrous oxide in water has been determined by Carius (1855) as follows: Water absorbs at a barometric pressure of 760 Mm. and a temperature of 0° C., 1.3052; 5°, 1.0954; 10°, 0.9196; 15°, 0.7778; 20°, 0.6700; 25°, 0.5963 measures of the gas. Such an aqueous solution, prepared under a pressure of about 5 atmospheres, has been employed under the name of *oxygenous aërated water.*

Action and Uses.—When nitrous oxide gas is inhaled in small amounts, it produces mental disturbances with hilarity, which give it the name "laughing-gas." Used in concentrated form, as in medicine and surgery, it does not cause these symptoms if properly inhaled, but after a few deep inspirations a flush followed by a deadly pallor overspreads the countenance, unconsciousness comes on almost instantaneously, and the surgical operation can then be performed without pain. The gas is not suitable for any but brief and minor operations, as its effects are too fleeting. For this reason, and also because of its lack of producing after-effects, it is popular with dentists for the extraction of teeth, and with some surgeons to produce primary anæsthesia, which can be readily continued by immediately employing ether or chloroform. Nitrous oxide is the safest anæsthetic known, its death-rate being less than 1 in 500,000.

As nitrous oxide raises arterial pressure, and so places stress upon the heart and blood-vessels, it ought not to be used in persons who have fatty heart or atheroma of the blood-vessels, as it may cause heart-failure or apoplexy. As the jaws may be firmly closed when the patient is under the effects of the drug, dentists usually place a cork between the teeth to keep the jaws apart, and tie a string to the cork to prevent its being drawn into the glottic opening should the patient's jaws relax so that the cork is freed from pressure.

Nitrous oxide gas causes anæsthesia by a direct influence on the central nervous system, and by virtue of the asphyxiation it produces.

NITROGENIUM.—Nitrogen.

Stickstoff, Stickgas, G.; *Azote,* Fr.

Symbol, N (French, Az). Valence in nearly all compounds either 3 or 5. Atomic weight, 13.93.

The occurrence of nitrogen in the free state and in combination has been noted under Aër, Acidum Nitricum, Aqua Ammoniæ, and Potassii Nitras. In the putrefactive changes of nitrogenous organic substances the nitrogen is not all converted into ammonium compounds and nitrates, but a portion escapes in the uncombined state. Under the influence of certain nitric acid destroying bacteria, large quantities of the nitrogen which is in combination in manures often escape into the air in the free state.

Nitrogen may be obtained from the atmosphere by absorbing the oxygen, for which various substances may be used, such as copper turnings heated to redness, yellow phosphorus, alkaline solution of pyrogallic acid. Such atmospheric nitrogen, however, is not pure, since it contains about 1 per cent. of argon, which cannot be absorbed. Pure nitrogen can be obtained by decomposing ammonium nitrite by heat: $NH_4NO_2 = 2H_2O + N_2$; or by passing chlorine into an excess of ammonia water: $8NH_3 + 6Cl_2 = 6NH_4Cl + N_2$.

Properties.—Nitrogen is a colorless, odorless, tasteless gas, slightly lighter than air, density (air = 1) 0.967, and weight of 1 liter at 0° C. and 760 Mm. barometric pressure 1.2507 Gm. The weight of atmospheric nitrogen under like conditions is 1.2572 Gm. 100 volumes of water at 10° C. (40° F.) dissolve 1.61 volumes of nitrogen; in alcohol it is slightly more soluble. Under great pressure and a low temperature it liquefies, the liquid having the boiling-point —194° C. (—317.2° F.) at atmospheric pressure. It has also been solidified. Nitrogen does not support combustion or respiration, hence the French name *azote* (from *a*, and *ζωτικός*, life) and the German *Stickstoff* (from *sticken*, to choke). In the atmosphere it serves as a diluent of the oxygen. It is very inert, having very little affinity for other elements, except in the case of a few substances, as magnesium, lithium, boron, silicon, and a few others, with which it combines readily at red heat, forming *nitrides;* for example, Mg_3N_2, Li_3N. Indirectly, however, it gives

rise to a number of nitrogen compounds, such as the oxides, nitric and nitrous acids, ammonia, which are described elsewhere. Nitrogen is essential to plant-life, but plants can, as a rule, assimilate it only when in the form of ammonium salts or nitrates. Hellriegel discovered the highly interesting and important fact that the roots of leguminous plants, by the aid of certain bacteria, located in nodules on the same, can assimilate free atmospheric nitrogen. Thus we have a connecting link between nitrogenous compounds which are the source of the nitrates and ammonia of commerce, and atmospheric nitrogen. At the present time nitrogen of the air is also converted directly into nitric acid by bringing air into intimate contact with a number of extremely high-tension electric arcs. This process, devised by Bradly and Lovejoy, is carried out at Niagara Falls, and bids fair to have commercial value.

Determination of Nitrogen.—Various methods are available which will be described in a general way. For details as to quantities and manipulations, reference must be had to extensive works on chemistry, such as Fresenius' *Quantitative Analysis*, or to *Bulletin No. 46*, Division of Chemistry, U. S. Department of Agriculture.

Dumas Method.—Applicable to all nitrogen compounds without exception. A weighed quantity of the substance is heated to redness in a hard-glass tube, with copper oxide or lead chromate, or a mixture of both. The nitrogen passes off free and also as oxides. To reduce the latter to free nitrogen, the vapors are passed over a spiral of copper gauze, heated to redness, lying in the forward part of the combustion-tube. The nitrogen gas is finally collected in a tube over caustic alkali and measured.

Will-Warrentrapp Method.—Applicable only to derivatives of ammonia, and not to derivatives of nitric acid. It was formerly used to determine the protoid nitrogen in foodstuffs, but for this purpose is now replaced by the Kjeldahl method. The substance mixed with soda-lime is heated in a tube, whereby nitrogen is liberated as ammonia, which is passed into a measured volume of decinormal sulphuric acid and the excess determined by titration. From the quantity of ammonia found the amount of nitrogen in the substance is calculated.

Kjeldahl Method.—This method is in very general use, especially at agricultural stations, where nitrogen in fertilizers and food-products is frequently determined. It depends on the fact that when bodies, like albumin, which are derivatives of ammonia, are boiled with concentrated sulphuric acid to complete decomposition, the nitrogen is converted into ammonia, which, with the acid, forms ammonium sulphate. The decomposition is performed in a pear-shaped flask with a long neck. In some instances, in order to facilitate the reaction, potassium permanganate, or mercury or potassium bisulphate, is added. After the action is over, the contents of the flask are diluted, caustic alkali is added in excess, and the ammonia distilled into decinormal sulphuric acid and determined as above. In this manner nitrogen can be determined in: (1) amido compounds, ammonium bases, most alkaloids, bitter principles, all protein and related bodies; (2) nitrates, which must, however, be converted into nitro compounds by addition of phenol or salicylic acid to the sulphuric acid; the nitro compounds are reduced to amido derivatives, which are then decomposed as described above. The method is not applicable to inorganic nitrites, hydrazo, diazo, and azo compounds, and many cyanides. In the case of albumins, the quantity present is found by multiplying the amount of nitrogen by the factor 6.25.

Ulsch Method.—This has almost entirely displaced the Kjeldahl method in the case of nitrates. 1 Gm. of the nitrate is dissolved in 50 Cc. of water in a 800 Cc. flask, 10 Gm. of reduced iron, and 20 Cc. of sulphuric acid (1 of acid to 2 of water) are added, the flask covered with a watch-crystal, and after 5 minutes heated to boiling for about 8 minutes. The cover is then rinsed into the flask, 150 Cc. of water and 60 Cc. of caustic soda solution (specific gravity 1.25) are added, and the whole distilled until about one-half the volume or more has passed over into a receiver containing an excess of normal or half-normal acid, the excess being determined by back titration, using Congo-red as indicator.

Nitragin.—This is a name applied to cultures of the bacteria (*Rhizolicum Leguminosarum* or *Bacterium radicicola*) which are found in the nodules on the roots of leguminous plants. The cultures are used as a fertilizing medium.

NUX VOMICA, *U. S.*, *Br.*—Nux Vomica.

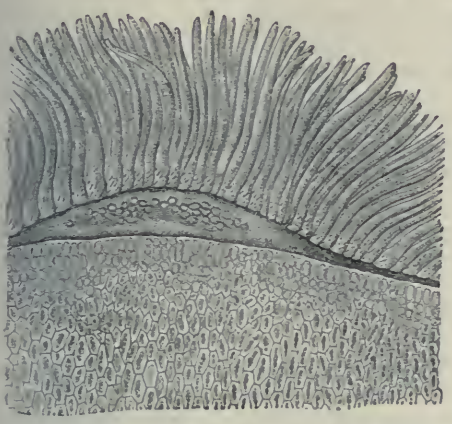
Semen strychni, P. G.; *Semen nucis vomicæ.—Poison-nut, Dog-buttons, Quaker buttons*, E.; *Krähenaugen, Brechnuss*, G.; *Noix vomique*. Fr. Cod.; *Noce Vomica*, It.; *Nuez vomica*, Sp.; *Noz Vomica*, Port.

The seed of *Strychnos Nux-vomica* L. (Fam. *Loganiaceæ*), yielding, when assayed by the process given below, not less than 1.25 per cent. of strychnine.—U. S.

Nux vomica is official in all pharmacopœias.

Origin.—From a small straggling tree of India, Ceylon, Cochin-China, and northern Australia. The fact that the commercial seeds exhibit well-marked, though slight differences in appearance, corresponding to quantitative differences in composition, has led to a question as to their origin from different species or varieties of the plant, a question which has not been definitely settled. The seeds, numbering from 1 to 4, usually with a few undeveloped ones, occur imbedded in a white gelatinous pulp, in a fruit resembling a small orange in form, size, and color. Notwithstanding the oft-published statement that this pulp is harmless, and even edible, Dunston and Short have shown that, when dry, it contains about 1.5 per cent. of strychnine and 1 per cent. of brucine, together with 5 per cent. of the crystalline glucoside loganin ($C_{25}H_{34}O_{14}$), and that it is promptly fatal to animals, with the characteristic symptoms of strychnine-poisoning. The seeds are simply washed free from the pulp and dried in the sun.

FIG. 284.



Nux vomica: section through hilum and albumen (× 65).

Description.—About 1.5 to 2.5 Cm. ($\frac{3}{5}$ to 1 In.) broad, lenticular, but irregularly curved, with an elevated central spot upon one or both sides and upon one side a low ridge (the raphe) running thence to the edge; externally gray, greenish-gray or light-yellowish-gray, silky in luster and to the touch, densely clothed with a coat of closely appressed, shining hairs; internally hard, very tough, somewhat translucent, consisting of 2 disks of perisperm which enclose a thin circular cavity and the embryo which has small heart-shaped, palmately nerved cotyledons; inodorous and intensely and persistently bitter.

Since the content of active constituent in Nux vomica corresponds closely with certain physical differences, their careful selection is a matter of high importance. The best

FIG. 285.

Nux vomica: surface with raphe; longitudinal section, showing albumen and embryo; and transverse section, showing central cavity.

quality, here described, usually corresponds with the Ceylon variety, which produces larger seeds and fewer in a fruit, the above-named authors having shown that the quality of the seed varies proportionally with such difference in their occurrences. The best seeds are known by their greater breadth (nearly or quite an inch), the thinness of their edge, their lightness of color and greater silkiness of surface and the prominence of the hilum.

So far as adulteration is concerned, there is nothing which in the least resembles Nux Vomica in the entire condition. The powdered article is not only subject to adulteration and to the presence of an undue amount of hairs in some lots, but, unless carefully and evenly powdered, is not apt to yield readily its active constituent to the extracting menstruum. It should therefore be purchased wholly upon its guaranteed assay, yielding, according to the official requirement, not less than 1.25 per cent. of strychnine.

Constituents.—From the standpoint of their activity, the important constituents of Nux Vomica are the two alkaloids strychnine and brucine, the characters of which will be fully discussed under the title STRYCHNINA. Their percentages, both absolutely and relatively to one another, vary most widely. Of total alkaloid, the amount is ordinarily

stated to be 1½ to 3 per cent., but Dunston and Short's analyses indicate much more, namely 4 to 5 per cent., and in one case nearly 5½ per cent. The probability is that, owing to the difficulty of its extraction, analysts ordinarily fail to obtain full results, and that at least 3 to 4 per cent. must be considered as existing in seeds of fair quality. Of this amount, the strychnine is ordinarily from a third to nearly a half, the remainder being brucine. From a pharmaceutical point of view, the fixed oil is important, being quite troublesome. The alkaloids are found combined with *igasuric* ("strychnic") acid, which is similar to tannic acid, occurring as an amorphous, yellowish-white, strongly acid and somewhat astringent mass, its solution colored dark-green by ferric salts, precipitated yellow by lead acetate, and rapidly reducing an ammoniacal solution of silver. The tough, horny qualities of the perisperm are considered to be due to proteids, of which about 11 per cent. is present. The presence of a small amount of loganin has been proved. Other alkaloids which have been reported, especially "igasurine," have proved to be mixtures, though the presence of small amounts of undetermined alkaloids is regarded as probable. The presence of traces of copper in Nux Vomica preparations has been frequently recorded, but its occurrence as a natural constituent of the seeds has been shown to be improbable.

Assay of Nux Vomica.—The U. S. P. requires that nux vomica shall contain not less than 1.25 per cent. of strychnine, which may be determined as follows: Place 20 Gm. of nux vomica, in No. 60 powder, in a 250 Cc. flask, and pour over it 200 Cc. of a mixture of ether 137.5 Cc., chloroform 44 Cc., alcohol 13.5 Cc., and 10 per cent. ammonia water 5 Cc. Cork well, shake frequently during an hour, and let stand in a cool place overnight. Decant into a measuring cylinder 100 Cc. of the ethereal liquid (representing 10 Gm. of nux vomica) and pour this into a separator, preferably of globular shape. Now wash out the cylinder with a little chloroform, and add this to the separator. Next add to the contents of the latter 15 Cc. of normal sulphuric acid, and shake moderately during 1 minute, being careful to avoid emulsification, and after allowing the liquids to separate completely, draw off the entire acid liquid into another separator or a beaker. Repeat this treatment with 5 and 3 Cc. more of normal sulphuric acid, and after mixing all the acid solutions, pour them into a separator. If a drop of the last acid solution yields a precipitate with mercuric-potassium iodide test-solution, repeat the washing of the ethereal liquid with 5 Cc. more of normal sulphuric acid. To the combined acid solutions in the separator, add a small piece of red litmus-paper, 25 Cc. of chloroform, and then an excess of ammonia water, shaking until all the alkaloids have been dissolved in the chloroform. Draw off the latter into a 100 Cc. flask, and repeat the shaking-out process with two additional portions of 15 Cc. each of chloroform, adding the latter to that already in the flask. Evaporate the combined chloroformic solutions in the flask until the alkaloidal residue is dry. Dissolve the residue in 15 Cc. of 3 per cent. sulphuric acid by the aid of water-bath heat, and cool the solution to ordinary temperature. To this solution add 3 Cc. of a previously cooled mixture of equal volumes of nitric acid (specific gravity 1.41) and distilled water, and after rotating a few times set the liquid aside for exactly 10 minutes, shaking it gently 3 times during this interval. The resulting red liquid is transferred to a separator containing 25 Cc. of a 10 per cent. solution of sodium hydroxide, the flask being washed 3 times with very small quantities of distilled water, which is then added to the contents of the separator. If the liquid is not quite turbid, add 2 Cc. more of the 10 per cent. sodium hydroxide solution. Now add 20 Cc. of chloroform to the liquid in the separator, and shake well by a rotating motion for a few minutes, let separate and draw off the chloroform through a small filter, wetted with chloroform, into a beaker. Repeat this treatment twice, using 10 Cc. of chloroform each time, and draw both portions off into the beaker through the same filter. Finally, wash both filter and funnel with 5 Cc. of chloroform, and then evaporate all the chloroform on a water-bath very carefully to avoid decrepitation. To the residual alkaloid, add 6 Cc. of tenth-normal sulphuric acid, 5 drops of iodeosin test-solution, about 80 Cc. of distilled water, and 20 Cc. of ether. When all the alkaloid is dissolved, titrate the excess of acid with fiftieth-normal potassium hydroxide solution until the aqueous liquid just turns pink. Divide the number of Cc. of fiftieth-normal potassium hydroxide solution used by 5, subtract this number from 6 (the 6 Cc. of tenth-normal sulphuric acid taken), multiply the remainder by 0.033, and this product by 10, which will give the percentage of strychnine in the sample of nux vomica.

Pharmaceutical Preparations.—Extract of Nux Vomica, Fluidextract of Nux Vomica, Tincture of Nux Vomica, U. S. P.

Action and Uses.—When nux vomica is taken in poisonous dose, it produces nervous excitability, followed by violent tetanic or tonic convulsions, in which the muscles of the body are almost universally thrown into rigid contractions. These contractions bend the body in the direction of greater strength, and as the muscles on the posterior surface are usually stronger than those on the anterior surface, the patient takes the attitude

which is known as opisthotonos, often resting during the convulsive seizure upon his occiput and heels, the middle portion of the body not touching the bed. After the convulsive seizure has lasted a varying length of time, from a few seconds to a minute or more, the muscles undergo complete relaxation, and the individual lies before us in a condition of profound exhaustion because of the violence of the convulsive seizures through which he has just passed. During the convulsion respiration is completely, or almost completely, arrested by the fixation of the respiratory muscles, and if the convulsive seizure lasts for a long time death may result from what is known as cramp asphyxia. In other words, the respiratory muscles are fixed for so long a period that air is not drawn into the lungs and death ensues. In the majority of instances, however, death comes quite as much from exhaustion and the violence of the nervous storm as it does from cramp asphyxia, although the interference with respiration produces marked cyanosis in each attack. The circulation, under the influence of these doses, is not directly affected to any extent, but the action of the heart and the condition of the blood-vessels, and the blood which is circulating in them, is necessarily modified very greatly by the violence of the muscular contractions. If death does not ensue in the first or second convulsion, after a time the convulsions may become slightly less severe in character. This decrease in the severity is not due necessarily to diminution in the activity of the drug, but to the fact that the motor nerves which carry the impulses from the spinal cord to the muscles become exhausted because of the severity of the strain which is thrown upon them. The mind is unaffected by the drug, and intellection only becomes disturbed as the result of exhaustion or cyanosis. If strychnine is given in massive doses and life maintained by means of artificial respiration, the peripheral ends of the motor nerves become paralyzed. Such an effect, however, never occurs in man, for death takes place before the poison has time to produce this effect. As the convulsive seizures of strychnine-poisoning are not brought into existence except by means of some peripheral irritation, it is exceedingly important that all noises should be avoided, and that the patient should not be touched except when absolutely necessary, since the whole nervous system is in a condition of hyperexcitation.

The treatment of the poisoning, if the patient is seen early enough, consists in the administration of an emetic. If there is reason to believe that the poison has already been absorbed in sufficiently large quantities to cause immediate danger of a convulsive seizure, the patient should be chloroformed, and while under the influence of chloroform should receive by the rectum 60 grains (4 Gm.) of potassium bromide and 40 grains (2.6 Gm.) of chloral in starch water, and should be kept under the chloroform until sufficient time has elapsed for these drugs to be absorbed from the rectum, and act as physiological antagonists to the influence of the strychnine upon the motor tracts of the spinal cord. If the patient is already in a convulsion, little can be done unless he is breathing, in which case amyl nitrite should be held under his nose in order to produce speedy muscular relaxation. Before its transient effects pass off, the influence of chloroform should be produced. If the patient cannot breathe because of the convulsive seizure, 5 to 10 minims of amyl nitrite may be injected hypodermically. It is a noteworthy fact that the convulsions of strychnine-poisoning are characterized by periods of complete relaxation, whereas those of tetanus are usually characterized by only partial relaxation.

The muscles of the face, both in tetanus and strychnine-poisoning, may be so contracted as to produce a curious expression, which is known as the "risus sardonicus."

In medicinal dose nux vomica and its alkaloid, strychnine, act as powerful excitants and stimulants to nervous protoplasm throughout the body, increasing the acuity of the nerves of sense; not only those of touch, but also those of hearing and sight. For this reason strychnine is largely employed for the purpose of stimulating nervous protoplasm which is incapable of performing its normal function as a result of various forms of depression and paralysis. It ought never to be employed during the stage of inflammation in any nervous affection, but after the acute inflammatory process has passed by it often proves itself a valuable remedy. Ophthalmologists employ it largely for the purpose of combating blindness which is due to disease of the optic nerve. While in many instances it cannot necessarily be of any permanent value, it is nevertheless often of benefit. It is also employed in cases of insufficiency of the ocular muscles. In all these affections it is commonly given in rather large doses, and is not infrequently administered hypodermically. It is needless to add that conditions of overexcitability in the nervous system contraindicate its employment. When administered by the stomach, it is often used as a bitter tonic for the purpose of aiding digestion, and, to some extent, for over-

coming constipation by giving tone to the alimentary canal. Because of its action in this manner it is largely employed as a tonic in convalescence and in exhausting fevers like typhoid fever and pneumonia. Strychnine has probably no direct stimulating influence upon the circulatory system, the increased force and activity of the heart under its influence being largely dependent upon the increased nerve-supply of the circulatory system under the powerful stimulant influence of the strychnine upon nervous protoplasm. The drug, nevertheless, is highly regarded by physicians as a most important remedy in the treatment of collapse and shock, and to tide the patient over critical periods in acute and chronic diseases. It ought not to be given for a long period of time as a circulatory stimulant. When it is employed over a long period of time, it is apt to produce great nervous and mental irritability, and a rapid, feeble pulse. This is particularly apt to be the case in old persons and in individuals suffering from asthenia.

Strychnine is one of the best stimulants for the respiratory centers that we have, and is largely employed as a respiratory stimulant in all conditions where such an action is desired.

As is the case with most vegetable alkaloids, the drug is oxidized in the body unless it is given in excess, when it is eliminated as strychnic acid.

Powdered nux vomica beans are sometimes given in the dose of 1 to 2 grains (0.06–0.12 Gm.). The dose of the solid extract of nux vomica is from $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.008–0.015 Gm.); of the fluidextract, from 1 to 5 minims (0.05–0.30 Cc.); of the tincture, from 5 to 20 minims (0.30–1.30 Cc.). The dose of strychnine, the chief alkaloid, is from $\frac{1}{40}$ to $\frac{1}{20}$ grain (0.0015–0.003 Gm.). The sulphate of strychnine is usually employed. (See STRYCHNINÆ SULPHAS.)

Allied Products.—Nux Vomica leaves are used to a slight extent by the natives of India and have been examined by Hooper. These leaves are rather stoutly and shortly petioled, range from 6 to 12 Cm. (2½ to 5 In.) long, are oval to rotund-oval, rounded or narrowed at the base, acute at the apex, entire, smooth, strongly 3-, or occasionally 5-nerved and thickish. They yield about 0.3 per cent. of brucine and have proved very poisonous to cattle. Brucine is also present in large quantity in the bark and wood. Thus far, strychnine has not been detected in leaves, bark, or wood.

The genus *Strychnos*, L., contains nearly 100 species, distributed through most tropical countries. They are characterized generally by the possession of violently poisonous constituents. Of the Old World species, the seeds have received most attention, while the barks of the New World species have been more studied. This is due doubtless to the extensive use of these barks in the manufacture of arrow poisons. For an account of these see CURARE.

Ignatia, U. S. 1880 (*Semen Ignatiæ*, *Faba Ignatii*, *Bean of St. Ignatius*, E.; *Ignazbohne*, G.; *Fève de Saint-Ignace*, Fr. Cod.; *Fève Ignasurique*, Fr.; *Haba de San Ignacio*, Sp.), is the dried ripe seed of *Strychnos Ignatia* Lindl. (*S. Philippinensis* Blanco; *Ignatiana Philippica* Lour.). It is derived from a plant and fruit very similar to those yielding Nux Vomica, but native of the Philippines, and naturalized in Cochin-China. It is usually a little more than 2.5 Cm. (1 In.) in length and a half to two-thirds as broad, irregularly and angularly oval-ovate, the angles rounded or blunt, the hilum in a small depression on one of the edges, the dull reddish-gray or brownish, rarely blackish, surface somewhat granular or papillose, occasionally bearing remains of the covering of light-brown silky hairs; heavy and of bony hardness, the fracture irregular and granular; translucent in thin fragments, an irregular cavity near one end, into which the embryo projects, its radicle rather long, its cotyledons oblong-ovate and acute; almost inodorous and of a very bitter taste.

FIG. 286.

Ignatia: vertical section of seed.

It is said that the powder of Ignatia can be readily distinguished from that of Nux Vomica by the occurrence of its, relatively few, hairs in clusters instead of singly as in Nux Vomica. The constituents of Ignatia are very similar to those of Nux Vomica. The percentage of total alkaloid is usually smaller than in Nux Vomica. Testimony concerning the relative proportion of the two alkaloids is very contradictory, due probably to their imperfect separation in the assays made. Ignatia has been somewhat used in the same way as Nux Vomica, but it is much more expensive. Its introduction to the Pharmacopœia in 1880 did not result in bringing it into extended use.

Tieute seeds are produced by *S. Tieute* Lesch, of Java, and are quite similar in appearance to Nux Vomica, though smaller and whiter. The seeds are little used, but the root-extract is employed in the preparation of the poison known as *Upas Tieute* or *U. Radja*.

Akazgine is an alkaloid obtained by Fraser from a shrubby species of *Strychnos* used in equatorial Africa under the names *Akazga*, *Ikaju*, *Quai*, or *Boundou*. Other authors found an alkaloid having the color-reactions of strychnine.

Hoang-nan is the bark of the Chinese species *S. Malaccensis* Benth. (*S. Galthieriana* Pierre), and contains both strychnine and brucine. The same constituents occur in the wood of *S. colubrina* L., the *Snake-wood tree*, the wood an article of commerce in India under the name *Lignum colubrinum*. In India, the seeds of *S. potatorum* L. are used under the name of *Clearing-nuts* for clearing muddy water, as well as for diabetes and as an emetic. In 1871, they were imported into the United States under the name *Indian gum-nuts*. They are sub-globose, brownish-gray, and insipid. In South America, the bark of *S. Pseudochina* St. Hil. has been used as a cinchona-substitute.

NYMPHÆA.—Water Lily; Pond Lily.

Sweet-scented or *Fragrant water lily*, *Water nymph*, E.; *Seerose*, *Wasserlilie*, G.; *Nénuphar*, *Lune d'eau*, Fr.; *Ninfea*, *Ninfa*, Sp.

The rhizome of *Castalia odorata* (Dryander) Woodv. et Wood (*Nymphæa o.* Dryander; *Castalia pudica* Salisb.—Fam. *Nymphæaceæ*).

Origin.—The white water-lilies are too well known to require a description. The species here named is more common in eastern North America, becoming gradually replaced westward by the larger and little fragrant *C. tuberosa* (Paine) Greene. The European species is *C. alba* (L.) Lyons (*Nymphæa a.* L.; *C. speciosa* Salisb.). The long-continued misapplication to these plants of the name *Nymphæa*, which had previously been given, and therefore properly belongs, to the yellow pond-lilies, has caused much confusion.

Description.—A very long rhizome, occurring in pieces of irregular length, or more usually in transverse slices, 2.5 to 7 Cm. (2 to 3 In.) thick, cylindraceous, roughly annulate and heavily wrinkled, bearing on the upper side broad, sub-circular or oblong leaf-scars and underneath remnants or scars of thick fleshy roots; dark-brown or blackish externally, yellowish-white internally, very spongy and light, the wood-bundles irregular; nearly odorless, of a mucilaginous, bitter, and astringent taste.

Constituents.—The constituents are very imperfectly known. Resin, tannin, starch, and gum have been reported, but do not account for the bitter taste, which in related species is due to alkaloids.

Action and Uses.—The American water lily, because of its astringency, may be tried as a remedy for diarrhœa, dysentery, and leucorrhœa. The European species was formerly employed in the East as an anaphrodisiac.

Other Nymphæaceæ.—This, the *Water-lily family*, contains 8 genera and about 50 species, of great beauty and of universal interest, the *Victoria regia* Lindl. producing one of the largest of known flowers. The rhizomes of a number of species are employed like that above described. That of *C. alba* was formerly a highly prized aphrodisiac, apparently without good reason. It contains an amorphous alkaloid. The flowers of this, as of *C. odorata*, have also been employed. The *Yellow pond-lilies*, the true *Nymphæas*, have also been employed. *N. lutea* L. (*Nuphar luteum* Sibth. et Sen.; *Nymphozanthus vulgaris* Rich.), the European *Yellow pond-lily*, *Flatter-*, *Spatter-*, or *Can-dock*, *Water-blab*, or *Water coltsfoot*, has been chiefly employed. The rhizome is very similar to that above described, but is even thicker and coarser. It contains the white, amorphous alkaloid *nupharine*, soluble in alcohol. Its uses are similar to those of the Water-lily. There are several American species, some of them formerly regarded as identical with the European, which have been similarly employed, especially *N. advena* Solander, the common names similar to those of the European, also called *Cow-*, *Horse-*, *Dog-*, *Frog-*, *Bull-head-*, or *Beaver-lily*, *Beaver-root*, *Muskrat-root*, etc. *Castalia Lotus* (L.) Rusby (*N. Lotus* L.; *C. mystica* Salisb.—*Lawas* or *Taylalo* in the Philippines) has had very many uses, mostly based upon superstition, but also those of the species above considered. In China, the root-stock of *Euryale ferox* Salisb. (*Anneslea speciosa* Roxb.) is used as an astringent and tonic under the names *Kien-shih* and *Ki-t'u*. The leaves of *Brasenia purpurea* (Mx.) Casp. (*Hydropeltis p.* Mx.; *Brasenia Schreberi* Gmel.; *B. peltata* Pursh.), the common *Water-shield*, *-target*, or *-jelly*, *Deer-foot*, *Frog-leaf* or *Water-leaf*, of almost world-wide distribution, in stagnant waters, are used in many countries in the treatment of phthisis, also for dysentery. The rhizomes of the several species of *Nelumbo*, Adans., bear fleshy-thickened portions, rich in starch, for which reason they have been much used as foods. Their seeds, under the name *Water-bean*, have also been used as food, those of the North American *N. lutea* (W.) Pers. (*American lotus*, *Water chinquapin*, *Duck acorn*, *Water-nut*, *Waukapin*, or *Yoncopin*) having been an important food among the North American Indians. In India, the similar seeds of *Euryale ferox* Salisb. are used for food in the same way as those of Nelumbo. Church reports the following constituents: starch, 73.3 per cent.; fat, 0.97 per cent.; albuminoids, 12.8 per cent.; fiber, 0.3 per cent.; ash, 0.4 per cent. What portion of these nutrients is digestible is not stated.

O.

OLEA.—Oils.

The term oil, or rather its equivalent, appears to have been applied originally to the liquid fats from the olive and other vegetable fat-producing substances. Its immiscibility with water, its unctuous touch and fatty consistence were early noticed. By extension the term oil was made to include even water-soluble substances which in consistence resembled the oils, as, for instance, oil of vitriol or sulphuric acid. With the classification of all natural objects and seminatural products according to the three natural kingdoms, oils were grouped according to their source as mineral oils, vegetable oils, and animal oils. The term mineral oil is restricted almost entirely to petroleum and related products, which have nothing in common with the inorganic world but their name, *oleum petræ*, rock oil. The classification into vegetable and animal oils, although these terms are in good use to-day in technology and commerce, has been largely dropped with the development of organic chemistry during the past century. The designation of liquid fats or fatty oils as fixed oils serves the purpose of distinguishing these substances at once from other bodies, also known as oils but which are characterized by their volatility and on this account called volatile oils.

OLEA INFUSA.—Infused Oils.

Olea cocta.—Oleoinfusions, Oleols, E.; *Oléolés, Elæolés, Huiles médicinales,* Fr.; *Gekochte Oele,* G.

This class of preparations was formerly much used, especially in Europe, and several of them have retained a place in the pharmacopœias of the Continent. They are made from flowers or herbs, either aromatic or narcotic, by digesting 1 part of the dry drug in 10 parts of olive oil, or by moistening the ground drug with alcohol 1 part, allowing the mixture to stand in a covered vessel for several hours, then adding the oil and warming on a water-bath until all alcohol has been dissipated, after which the mixture is expressed and the oil filtered. In the manner last stated the P. G. directs *Oleum hyoscyami* (*Infused oil of hyoscyamus,* E.; *Bilsenkrautöl,* G.) to be prepared, and the same directions may be followed for making *Oleum absinthii infusum, Oleum chamomillæ* (*matricariæ*) *infusum,* etc.

The National Formulary gives the following general formula for the preparation of infused oils, which is a modification of the P. G. directions and yields better results:

Take of the dry herb, in moderately coarse (No. 40) powder, 200 Gm.; alcohol, 130 Gm.; ammonia water (10 per cent.), 4 Gm.; lard oil, 500 Gm.; cotton-seed oil, 500 Gm. Moisten the powdered herb with a sufficient quantity of the alcohol and ammonia water, previously mixed, then pack it tightly in a stone or enamelled iron vessel of suitable capacity, pour on the remainder of the ammoniated alcohol, cover it well, and allow the mixture to macerate for 24 hours. Then add 120 Gm. of the mixed oils, digest with frequent agitation, during 12 hours, at a temperature between 50° and 60° C. (122° to 140° F.), transfer the mixture to a strainer, and express strongly. To the residue, returned to the vessel, add the remainder of the oils, digest and express in the same manner, and unite the expressed portions.—N. F.

This process is well adapted for all narcotic herbs, the object being to liberate the alkaloidal constituents, which are then taken up by the warm oil. Infused oils of this character are of a deep-green color, which, however, gradually fades upon exposure to light, hence they should be kept in dark bottles or in a dark place.

OLEA PINGUIA.—Fixed Oils.

Fats, Fatty oils, E.; *Huiles grasses, Huiles fixes,* Fr.; *Fette, Fette Oele,* G.

Fixed oils and fats, called fixed because they cannot be volatilized by heat at ordinary pressures without decomposition, are glycerides (excepting the waxes proper) of fatty acids, and obtained from the animal and vegetable kingdoms. As a class they are broadly characterized by being unctuous to the touch, imparting a non-volatile greasy stain to paper except in the case of crystalline fats, in being lighter than water, the specific gravity varying from 0.860 to 0.913–0.956, in being insoluble in water, and soluble in ether, chloroform, benzene, and carbon disulphide. According to their consistence at ordinary temperatures, 20° to 25° C. (68°–77° F.), they are known as *oils* (fixed oils proper)—liquid at ordinary temperatures; *fats* or *butters*—soft to quite firm;

tallows—firmer than fats; *waxes*—hard and more or less brittle. Their consistence is dependent upon the temperature, the liquid oils congealing to solid masses at suitably low temperatures, and the solid fats liquefying at high temperatures, both resuming their original consistence on restoration to the normal temperature.

Origin.—All plants, and perhaps all parts of plants, contain fat, though often in minute quantity. The liquid and solid fats are most likely generated from starch and other carbohydrates and allied compounds; De Luca (1862) proved that the fixed oil of olives increases in quantity as the mannite of the green olives disappears, and that access of air and light facilitates the conversion It is not unlikely that certain protein compounds may likewise be the source of fats. In the animal economy fats are, at least partly, produced in a similar manner, and to a considerable extent directly from the fats taken into the system with food.

Preparation.—From animal tissues rich in fat the latter is obtained by fusion either by itself or in the presence of water, and removal of the tissue by skimming or straining. Vegetable tissues containing notable quantities of fat yield it on being subjected to powerful pressure, either at the ordinary temperature or between plates which are heated slightly above the fusing-point of the fat; but since a certain quantity of the fat is mechanically retained by the tissues, a larger yield is had by the use of a solvent, such as carbon disulphide or petroleum benzin, which on being distilled off leaves the fat behind. When the bruised or cut vegetables are boiled with water, the fused fat rises to the surface, and may either be skimmed off or obtained by straining, expression, and subsequent separation from the water; such fats are usually inferior to those obtained from the dried article by pressure alone.

Purification.—The impurities contained in fats are protein and mucilaginous compounds derived from the vegetable tissue, and may be removed by means of felt or flannel filter-bags; the filtration is facilitated by a somewhat elevated temperature. On the large scale the purification is effected by the gradual addition to the oil of 0.5 to 2 per cent. of sulphuric acid, whereby the impurities are carbonized; the oil is then agitated with water to remove adhering acid, decanted, and often filtered through charcoal, or through tow, moss, or similar material, upward filtration being preferred. The use of sulphuric acid for the purification of oils was introduced into England by Gowen (1790). Chloride of zinc has a similar effect, according to R. Wagner, if used in concentrated solution, 1 to 1.5 per cent. being required; and Barreswill (1858) recommended for the same purpose the saponification of a small proportion of the fat by means of a weak solution of potassium or sodium hydroxide. From 1 to 2 per cent. of ammonia will often be effectual, and as mechanical agents for separating the impurities powdered clay, fullers' earth, and plaster-of-Paris have been found to serve a good purpose. The loss sustained in purification varies with the nature and amount of the impurities, and in some cases reaches 15 or 20 per cent. of the crude oil.

Bleaching.—The treatment of fats with sulphuric acid usually destroys also the coloring-matter wholly or in part; treatment with animal charcoal renders the fats lighter, and many are bleached (and often become rancid) by exposure to direct sunlight, a strip of lead being sometimes introduced into the fat if liquid, or this is occasionally agitated with an aqueous solution of ferrous sulphate. Palm oil is bleached by being rapidly heated to 240° C. (464° F.) and keeping it at this temperature for 10 minutes. The same effect is produced upon oil of poppyseed by heating it for 5 hours to between 90° and 95° C. (195° and 203° F.). Oxidation of the coloring principle by means of permanganic or chromic acid or hypochlorites has likewise been recommended.

Classification.—Fixed oils may be divided into drying and non-drying oils, the former upon exposure to air gradually thickening, and if in thin layers forming varnish-like masses, whereas non-drying oils remain fluid and become rancid. Drying oils may also be distinguished from non-drying oils by their behavior with sulphuric and nitrous acids. If 50 Gm. of a fixed oil be mixed with 10 Cc. of concentrated sulphuric acid, heat will be developed varying in intensity for different oils, the drying oils always showing the greatest rise in temperature. This is known as Maumené's test. Olive oil thus treated increases 42 degrees C. in temperature, castor oil 47 degrees C., almond oil 52 degrees C., cottonseed oil (crude) 69 degrees C.—(refined) 75 degrees C., hempseed oil 98 degrees C., and linseed oil 103 degrees C. When mixed with nitrous acid, non-drying oils are gradually converted into a solid mass, varying from soft to firm consistence, and known as elaïdin, while drying oils remain fluid even after prolonged contact, although a few become somewhat thicker. The test may be made by agitating

for a short time 1 part of copper foil with 5 parts each of nitric acid and the oil, and setting the mixture aside for about 6 hours, when solidification is generally completed.

The following classification of fixed oils and fats by Allen (*Commercial Organic Analysis*, 3d ed., 1899, vol. ii., Part I., p. 88) gives a general view of their more common properties and group relationships:

I. Olive Oil Group.—*Vegetable Oleins; Vegetable Non-drying Oils.*—Density 0.912 to 0.920. Their viscosity is notably greater than that of the drying oils. Exposure to air does not affect their power to produce a greasy stain on paper. These oils form very solid elaïdins, and embrace olive oil, almond oil, peach oil, apricot oil, earth-nut oil, and oil of ben.

II. Rape Oil Group.—The oils of this group, which includes rapeseed oil and the oils from black and white mustard seed, are all obtained from plants belonging to the family *Cruciferæ*. They are less perfectly non-drying oils than the members of the preceding group, slowly forming soft elaïdin, and have high iodine absorption-numbers and high saponification equivalents.

III. Cottonseed Oil Group.—Density, 0.920 to 0.930. These oils undergo more or less drying on exposure to air, and give little or no elaïdin on treatment with nitrous acid. In their general properties and in their behavior with sulphuric acid, bromine, and iodine, the oils of the cottonseed oil group occupy a position between the drying and non-drying oils. The group embraces cottonseed oil, cress-seed oil, sesamé or teel oil, sunflower oil, hazelnut oil, camelina oil, beech-nut oil, grapeseed oil, and maize oil.

IV. Linseed Oil Group.—*Vegetable Drying Oils.*—Density 0.923 to 0.937. The viscosity of these drying oils is lower than that of the preceding groups. The oils are not solidified on treatment with nitrous acid, evolve great heat with strong sulphuric acid, and combine with large proportions of bromine and iodine. The group includes linseed oil, hempseed oil, poppyseed oil, tobacco-seed oil, weld-seed oil, nigerseed oil, walnut oil, and Scotch firseed oil.

V. Castor Oil Group.—Density 0.937 to 0.970, and all very viscous. The group includes castor oil and croton oil, which are remarkable for their ready solubility in alcohol and glacial acetic acid, and their marked purgative properties.

VI. Palm Oil Group.—Solid vegetable fats not containing notable quantities of glycerides of lower fatty acids. Their melting-points and densities are somewhat variable and capable of permanent alteration The densities of the melted fats at 98°–99° C. (208.4°–210.2° F.) compared with water at 15.5° C. (60° F.) vary from 0.859 to 0.898. This group includes palm oil, cacao butter, nutmeg butter or mace butter, shea or galam butter, mahwah butter, and Chinese tallow.

VII. Cocoanut Oil Group.—Solid vegetable fats having high densities and low saponification equivalents. The members of subgroup A contain notable quantities of glycerides of the *volatile* fatty acids which distinguishes the oils from all other fats except fish oils and butter.

Subgroup A.—Includes cocoanut oil, palm-nut or palm-kernel oil, and laurel oil.

Subgroup B.—Glycerides of wax-like consistence. It includes Japan wax and myrtle wax.

VIII. Lard Oil Group.—*Animal Oleïns.*—This group includes those natural and manufactured oils, fluid at ordinary temperatures, which are obtained from terrestrial animals. They resemble the marine animal oils in their reaction with chlorine, but are not turned brown by boiling with caustic alkalies. They do not dry notably on exposure to air and give more or less solid elaïdin with nitrous acid. Density 0.914 to 0.916. The group includes neat's foot oil, bone oil, lard oil, and tallow oil.

IX. Tallow Group.—*Solid Animal Fats.*—Fats from terrestrial animals, solid or semisolid at ordinary temperatures. The group comprises tallow, suet, lard, horse fat, bone fat, wool fat (*suint*), oleomargarine, and butter fat. Butter fat (as well as the fat from the milk of all the mammalia) is distinguished from the other fats of this group by its high density, low saponification equivalent, and its content of a large percentage of butyric and other volatile fatty acids.

X. Whale Oil Group.—*Marine Animal Oils.*—Fluid oils obtained from fish and marine animals, and readily distinguished as a class by their offensive fishy odor, which becomes more perceptible on warming; by the reddish-brown color they assume when subjected to the action of chlorine; the reddish or reddish-brown color produced on boiling them with dilute solutions of caustic alkali. Concentrated sulphuric acid produces light-red to purple and brown coloration with considerable evolution of heat. Most of

these oils dry more or less on exposure to air, and yield but little elaïdin on treatment with nitrous acid. Density at 15° C. (59° F.) 0.911 to 0.933. The group comprises whale oil, porpoise oil, seal oil, menhaden oil, cod-liver oil, and shark-liver oil.

XI. SPERM OIL GROUP.—*Liquid Waxes.*—This group contains no glycerides (distinction from preceding groups), but consists of ethers of monatomic alcohols of the ethylic series, differing from the true waxes in being fluid at ordinary temperatures. They do not dry or thicken notably on exposure to air, but yield solid elaïdins on treatment with nitrous acid. Density at 15° C. (59° F.) 0.875 to 0.922. This group comprises sperm oil, Doegling oil, or bottlenose oil, and dolphin oil.

XII. SPERMACETI GROUP.—*Waxes Proper.*—The members of this group are solid at ordinary temperatures. They yield no glycerin on saponification, as they are compound ethers of the higher alcohol radicals of the ethylic series with in some cases an admixture of higher monatomic alcohols and higher fatty acids in the free state. The group includes spermaceti, beeswax, Pela or Chinese wax, opium wax, palm wax, and Carnauba or Brazil wax.

Properties and Composition.—Fats in a *pure* state *per se* are colorless, odorless, and tasteless. The color, odor, and taste common to many oils and fats are attributable to admixtures of more or less minute quantities of substances derived naturally from the seeds, etc., during the expression of the oil, the oil acting as a solvent of the coloring and other matter, and it is commercially impracticable to remove these entirely without destroying the oil. When oils and fats are heated to near 300° C. (572° F.) they undergo rapid decomposition, emitting among other gases extremely acrid and irritating vapors of *acrolein.* When heated to a red heat in a closed vessel without access of air, or passed through a tube under like conditions, oils undergo destructive distillation, breaking up into tarry matter and illuminating gases containing ethylene and acetylene. Fats are soluble in the usual volatile water-immiscible solvents. Castor and croton oil are soluble in alcohol, whereas other fats are but slightly soluble. Oils and fats are miscible with one another, and are good solvents of resins, camphor, and oleates. Both liquid and solid fats while in a pasty condition are separable by expression into a more liquid and a more solid fraction with a corresponding change in the melting-point of the same. With few exceptions natural fats and oils are mixtures of compound ethers or esters—glycerides—olein, myristin, palmitin, stearin, butyrin, etc., the liquid oils containing a preponderance of olein and the more solid fats a preponderance of palmitin and stearin, with admixtures of other glycerides in both instances. The glycerides are compound ethers of the triatomic alcohol—*glycerin*, $C_3H_5(OH)_3$, and the fatty acids combined with the same belong to two series of acids: the fatty acid group of the general formula $C_nH_{2n}O_2$—comprising butyric ($C_4H_8O_2$), valeric ($C_5H_{10}O_2$), caproic ($C_6H_{12}O_2$), caprylic ($C_8H_{16}O_2$), capric ($C_{10}H_{20}O_2$), lauric ($C_{12}H_{24}O_2$), myristic ($C_{14}H_{28}O_2$), palmitic ($C_{16}H_{32}O_2$), stearic ($C_{18}H_{36}O_2$), and arachidic ($C_{20}H_{40}O_2$) acids—the latter a component part of earth-nut and human fat; and the oleic acid group of the formula $C_nH_{2n-2}O_2$—and typified by oleic ($C_{18}H_{34}O_2$), erucic ($C_{22}H_{42}O_2$), and hypogæic ($C_{16}H_{30}O_2$) acids. Erucic acid is found in oil of mustard and hypogæic acid in ground-nut oil. All of these acids are monobasic. The neutral fats therefore contain 3 molecules of the acid to 1 of the triatomic radical—*glyceryl*—(C_3H_5), elucidated by the combination of *glycerin* with *stearic* acid to form *stearin:* $C_3H_5(OH)_3$ (glycerin) + $3HC_{18}H_{35}O_2$ (stearic acid) = $C_3H_5\begin{matrix}C_{18}H_{35}O_2\\C_{18}H_{35}O_2\\C_{18}H_{35}O_2\end{matrix}$ (stearin) + $3H_2O$. The compound with the fatty acids is conveniently named by changing the termination of the acid to *in;* thus stear*ic* acid to stear*in*, or tristearin, $C_3H_5(C_{18}H_{35}O_2)_3$, and ole*ic* acid to ole*in*, or triolein, $C_3H_5(C_{18}H_{33}O_2)_3$. The glycerides most prominently distributed as components of fats and oils are stearin, palmitin, myristin, laurin, caproin, and butyrin. The latter more particularly is found as a prominent constituent of milk fats and butter. There is evidence to support the theory that the glycerides in butter fat are of a compound nature—*i. e.*, that 2 or 3 fatty acids are combined with glyceryl in the same molecule. When heated with sulphuric acid, or superheated with water under pressure, or boiled with alkali hydroxides, the fats undergo saponification, splitting up into glycerin and fatty acids or a soap of the latter when alkali is used. Thus in the saponification of pure stearin the following reaction occurs: $C_3H_5(C_{18}H_{35}O_2)_3$ (stearin) + 3NaOH (sodium hydroxide) = $3NaC_{18}H_{35}O_2$ (sodium stearate) + $C_3H_5(OH)_3$ (glycerin).

OLEIN.—*Triolein. Elain.* $C_3H_5(C_{18}H_{33}O_2)_3$.—Olein cannot be obtained pure and

free from admixtures of palmitin and stearin by expression from fats or oils. It has been prepared by heating oleic acid with glycerin at 240° C. (464° F.). Olein is a clear colorless liquid having a specific gravity at 15° C. (59° F.) of 0.900. It is more readily soluble in ether, chloroform, and other solvents than palmitin or stearin. It may be distilled *in vacuo* without decomposition. Nitrous acid converts it into a pasty isomeric form—*elaïdin*, $C_3H_5(C_{18}H_{33}O_2)_3$, melting at 34° C. (93.2° F.), and which on saponification yields *elaïdic* acid ($C_{18}H_{34}O_2$), which in a purified state melts at 45° C. (113° F.), as against 14° C. (57.2° F.), the melting-point of its isomer oleic acid.

PALMITIN.—*Tripalmitin.* $C_3H_5(C_{16}H_{31}O_2)_3$.—Palmitin may be prepared synthetically by heating glycerin and palmitic acid and purifying the product by recrystallization from alcohol. It is obtainable in the form of white to pearl-white crystalline masses. It is less soluble in ether, chloroform, etc., than olein, and somewhat more soluble in the same solvents than stearin. In crystalline form it melts at 62°–64° C. (143.6°–147.2° F.) and congeals at 45.5° C. (114° F.). Its melting-point, like that of the other glycerides, is much affected by the manner in which it has been heated. Thus it may be made to melt at 47° C. (116.6° F.). With stearin it comprises the more solid portion of fats.

STEARIN.—*Tristearin.* $C_3H_5(C_{18}H_{35}O_2)_3$.—Stearin is obtained by heating a mixture of glycerin and stearic acid to about 275° C. (527° F.), and purifying the product by repeated crystallization from alcohol. It may be obtained by the purification of lard stearin by solution in ether and repeated recrystallization from ether to remove the palmitin. Stearin melts at 55°–71.6° C. (131°–161° F.). According to observations by Heintz, stearin when crystallized from ether melts at 71.6° C. (161° F.) and congeals to a crystalline mass at 70° C. (158° F.); but if heated to only 4 degrees C. above the melting-point it does not again congeal until about 52° C. (125.6° F.), forming a wax-like mass which will melt again at 55° C. (131° F.). Stearin is obtainable as a white to pearl-white crystalline powder. It is more difficultly soluble in the volatile solvents than the preceding glycerides.

BUTYRIN.—*Tributyrin.* $C_3H_5(C_4H_7O_2)_3$.—Butyrin is obtained on long-continued boiling of butyric acid and glycerin, or more rapidly by heating the mixture under pressure. It forms a butter-like substance having the specific gravity of 1.054 at 15° C. (59° F.), and may be distilled *in vacuo* without decomposition. It is soluble in ether, chloroform, and carbon disulphide. This glyceride is a constituent of all milk fats, which lends force to the theory that it performs some special function as a constituent of foods.

Preservation.—Fats should be kept in a dry place at a low temperature, and protected from light and air. On being exposed to the atmosphere the fats gradually become rancid, and this change is accelerated by the presence of animal and vegetable tissue, protein, and mucilaginous compounds; hence the importance of careful purification. The rancidity is due to the generation of odorous compounds and liberation of free fatty acids, besides some coloring-matter. Rancid fats may be improved, and to a certain extent restored, by washing with warm water or by treating them with magnesia or other weak alkali, and afterward washing them well. Treatment with strong alcohol or agitation of the oil with a little powdered borax and exsiccated sodium carbonate has likewise been recommended.

Adulterations.—The higher priced oils are not infrequently adulterated with cheaper ones, and occasionally with resin and mineral oils. Mixtures of animal and vegetable oils are generally difficult to detect owing to similarity in composition. Moreover, the physical and chemical characteristics of oils are to a considerable extent modified by various processes of refining and keeping, especially where the oils are exposed to the influence of light and air. Admixtures are detected by determining the physical and chemical properties and comparing same with oils of known purity. Adulteration by mineral and resin oils is detected by the character of the unsaponifiable matter extractable from the dried soap of the saponified oil. The color, taste, odor, consistence, viscosity, specific gravity, melting- and congealing-point of the oils, as well as of the fatty acids from the same, give valuable data which supplemented with chemical tests serve to identify the adulterations. The color reactions with concentrated sulphuric acid, nitric acid, mixtures of sulphuric and nitric acids, as well as the elaïdin test, should be made under fixed uniform conditions. Very useful data are obtained by determining the

Saponification value (Koettstorfer number)—the number of milligrammes of potassium hydroxide required for the complete saponification of 1 Gm. of fat.

The U. S. P. gives the following directions for ascertaining the saponification value of

fats and oils: Weigh out accurately in a flask holding 150 to 200 Cc. (1.5–2 Gm.) of the purified and filtered fat. Next run into the flask with a pipette, 25 Cc. of alcoholic potassium hydroxide test-solution. While exactly 25 Cc. is not indispensable, in comparative tests precisely the same amount must be used, allowing the pipette to drain in exactly the same way in each test. Then place a small funnel in the flask and heat it on a water-bath containing boiling water for ½ hour, so that the alcohol is simmering, frequently imparting a rotatory motion to the contents of the flask. Then add 1 Cc. of phenolphthalein test-solution and titrate back the excess of potassium hydroxide with half-normal hydrochloric acid. If a blank test is made at the same time with the alcoholic potassium hydroxide test-solution alone, the difference in the number of Cc. of half-normal hydrochloric acid consumed by the blank test and the real test, multiplied by 27.87, and divided by the weight in grammes of the fat or oil, will give the saponification equivalent of the sample tested.

Reichert (or Reichert-Meissl) *value*—the number of Cc. of tenth-normal alkali hydroxide solution required to neutralize the fractional distillate from 2.5 (or 5 in Reichert-Meissl) Gm. of fat under the conditions of the Reichert process. (See Allen's *Com. Org. Analysis*, 3d edit., 1899, vol. ii.). Excellent in the examination of butters.

Hübl or *iodine value*—the number of grammes of iodine absorbed by 100 Gm. of fat.

Hübl's process is based upon the saturation of unsaturated fatty acids and their glycerides by iodine in the presence of an alcoholic solution of mercuric chloride. The solutions required are: 1. *Solution of iodine* and *mercuric chloride.* Dissolve separately 25 Gm. of iodine and 30 Gm. of mercuric chloride, each in 500 Cc. of 95 per cent. alcohol and mix the clear solutions, and let the mixture stand 12 hours before use. 2. *Solution of sodium thiosulphate:* 24.8 Gm. of the crystallized salt in distilled water diluted to 1000 Cc. Tenth-normal solution of iodine = 0.01259 Gm. of iodine per Cc. 3. A 10 per cent. *solution* of *potassium iodide* in water. 4. *Starch solution* (a fresh solution of starch in water). 5. *Pure chloroform.*

Of the fats to be examined, take 0.15–0.18 Gm. of a drying or fish oil, 0.30–0.40 Gm. of a non-drying oil, and 0.80–1 Gm. of a solid fat. Dissolve the oil in a 500 Cc. stoppered flask in 10 Cc. of chloroform, add 25 to 30 Cc. of the iodine (1) solution, and shake the mixture. If it is not clear, add more chloroform; and if it decolorizes inside of 2 hours, add more of the iodine solution. At the end of 4 hours the solution may be titrated. Add about 20 Cc. of the potassium iodide (3) solution, shake the mixture, dilute it with about 300 Cc. of water, and, using the starch solution as an indicator, titrate the excess of iodine with the thiosulphate (2) solution.

Elaïdin test (Poutet, 1819) is conveniently applied by means of the following reagent: Dissolve 18 Gm. of mercury in 15.6 Cc. of nitric acid, specific gravity 1.42, keeping the solution cool. Of this solution, add 1 Cc. to 25 Cc. of the oil to be tested, shake the mixture, and repeat the shaking several times at 10 minute intervals, and then set it aside for 12 or more hours for observation. The following table arranged by Allen shows the effect of the reagent upon the more common oils: (*a*) *A solid, hard mass* is yielded by olive, almond, arachis, lard, sperm, and sometimes neat's foot oil. (*b*) *A butter-like mass* is yielded by neat's foot, bottlenose, mustard, and sometimes by arachis, sperm, and rape oils. (*c*) *A pasty or buttery mass which separates from a fluid portion* is yielded by rape, sesame, cottonseed, sunflower, niger-seed, codliver, seal, whale, and porpoise oils. (*d*) *Liquid products* result from linseed, hempseed, walnut, and other drying oils.

In the subjoined table are given the *saponification* (Koettstorfer) *value* (*A*), the *Hübl* or *iodine value* of the oils (*B*), as well as that of the fatty acids (*C*) from the same, the *melting-points*[1] (*D*) and the *congealing-points* (*E*) of the fatty acids, and the effect of nitric acid upon some of the commonly occurring oils. Under (*F*), (*G*), and (*H*) are given the reactions observed by Bach (1883) upon agitating equal volumes (5 Cc.) of oil and nitric acid for 1 minute (*F*), after placing the mixture in boiling water for 5 minutes (*G*), and finally after having been set aside for about 18 hours at 15° C. (59° F.):

	(*A*)	(*B*)	(*C*)	(*D*)	(*E*)	(*F*)	(*G*)	(*H*)
Olive oil	185–196	79.5–91.5	86–90.2	24–26.5°	20–22°	pale-green	orange-yellow	solid
Cottonseed	191–210	102–111	111–115	32–38	27–34	yellow-brown	reddish-brown	butyraceous
Sesame	187–193	103–112	109–112	24–26.5	21–23	white	brown-yellow	liquid
Earth-nut	190–197	85.6–101	95.5–103	27–34	24–38	pale-rose	"	solid
Rapeseed	170–179	97–105.6	96–105	16–20	12–18	"	orange-yellow	"
Castor	176–186	83.4–85.9	866–859	13	2	"	golden-yellow	butyraceous
Sunflower	188–194	120–133	125–134	17–24	17–18	dingy-white	reddish-yellow	"

[1] Degrees C.

In the manufacture of oils from seeds valuable by-products result. The principal one of these—*oil-cake*—is used as a fodder and as an adjunct to fertilizers. About one-fourth of the amount produced is used in this country, and the remainder exported.

The imports and exports of the principal fixed oils, fats, oil-cake, oil-cake meal, oil seeds, etc., entering into the commerce of the United States for the fiscal year ending June 30, 1902 (Treasury Reports Commerce and Navigation of the United States, Vol. I.) are exhibited in the following table:

Imports.		*Value.*
Codliver oil (gallons)	218,080	$112,458
Castor oil (gallons)	3,993	3,227
"Alizarin assistant" (sulpho-ricinoleic acid) (gallons)	31,587	15,544
Almond oil (gallons)	120,634	21,418
Cocoanut oil (pounds)	28,068,927	1,679,034
Cacao butter "	3,548,041	782,815
Croton oil "	1,135	565
Linseed oil (gallons)	37,779	21,651
Hempseed and rapeseed (gallons)	775,963	346,312
Mace oil (pounds)	582	304
Other nut oils (gallons)	405,021	177,145
Olive oil, for manufacturing purposes (gallons)	2,509,192	976,429
Olive oil, in bottles, jars, etc. (gallons)	1,140,042	1,454,856
Olive oil, other grades (gallons)	194,680	152,227
Palm oil (pounds)	16,922,090	888,674
Sesame oil (gallons)	707,760	57,359
Castor beans (bushels)	312,323	356,901

Exports.		*Value.*
Corn oil (gallons)	4,266,394	$1,769,370
Cottonseed oil (gallons)	33,042,848	12,992,393
Linseed oil (gallons)	102,113	68,617
Lard oil (gallons)	460,035	327,794
Lard (pounds)	556,840,222	52,375,864
Oleo oil (pounds)	138,546,088	12,254,969
Oleomargarine[1] (pounds)	5,721,254	601,521
Lard compounds, cottolene, etc. (pounds)	36,201,744	2,687,653
Butter[1] (pounds)	16,002,169	2,885,609
Cottonseed (pounds)	56,403,344	509,627
Flaxseed (bushels)	3,874,033	6,031,887
Corn oil-cake and oil-cake meal (pounds)	14,740,498	164,056
Cottonseed oil-cake and oil-cake meal (pounds)	1,050,466,246	12,271,009
Flaxseed oil-cake and oil-cake meal (pounds)	582,886,875	7,508,133

OLEA VOLATILIA—Volatile Oils.

Olea ætherea; Olea destillata; Ætherolea.—Ethereal oils, Essential oils, Distilled oils, E.; *Huiles volatiles, Huiles éthérées, Huiles essentielles, Huiles distillées, Essences*, Fr.; *Flüchtige Oele, Aetherische Oele*, G.

Volatile oils are mixtures of those substances to which, in the majority of cases, the odors of plants are due. Although the attribute volatile is indicative merely of a physical property which most of these substances have in common, and in nowise refers to their source, the designation volatile oil has been restricted entirely to volatile oily products from the vegetable kingdom. In recent years it has been made to include artificial substances identical with or at least closely related to such natural plant products, as, for instance, oil of bitter almond when applied to synthetic benzaldehyde, or oil of wintergreen when applied to synthetic methyl salicylate.

The volatile oils are to-day obtained almost entirely by a process of distillation. For several centuries every imaginable drug was distilled with water in the preparation of aromatic waters. These preparations were supposed to contain the essential constituents of the drugs. Hence, when the distillers of these waters learned to obtain the volatile oils first as a by-product in the preparation of aromatic waters and later as the principal product in the process of distillation of plant drugs with water, these oils were designated essential oils. The word essence is defined as the quality or qualities

[1] Average about 85 per cent. of fat.

on which an object depends for being what it is. Consequently these essential oils were also designated essences, a term commonly employed by the French. The Germans appear to restrict the term essence to those essential oils which are not obtained by distillation, but by expression, viz., the essential oils of the citrus fruits: lemon, orange, and bergamot. In the English language the term essence is commonly used to designate alcoholic solutions of those constituents of a plant that compose the essential oil—*e. g.*, essence of lemon, essence of peppermint. With the development of the volatile oil industry these essences were made less and less from the plant parts by extraction with alcohol, but more and more by simple solution of the essential oil in strong alcohol. With the increasing knowledge of the chemistry of these oils it has been found that the principal bearers of the aroma of a volatile oil sometimes constitute but a small percentage of such an oil and are more readily soluble in dilute alcohol than the entire oil. Preparations containing these more soluble bearers of the aroma of a plant are designated soluble essences, the attribute soluble applying to solution in water. Thus while "The . . . . word *essence* . . . . scarcely underwent a more complete transformation when from being the abstract of the verb 'to be,' it came to denote something sufficiently concrete to be inclosed in a glass bottle," it had to submit to a second violent change of meaning in the newly coined phrase *water-soluble* essences, whereas the term essence when used synonymously with oil implies something that is not soluble in water.

Inasmuch as the aromatic waters were regarded as containing the more spirit-like products of the plant separated from the grosser particles, it was but logical to designate the oils obtained by water distillation ethereal oils, the German equivalent of which, "Aetherische Oele," is used by the Germans much more than the German equivalents of volatile oils ("Flüchtige Öele") commonly used in America or of essential oils ("Wesentliche Oele") the term preferred in England.

The Latin designation commonly used is *Olea ætherea* in Anglo-Saxon countries and *Essentia* in Romanic countries (*e. g.*, French Codex), the terms *olea volatilia* and *olea essentialia* being used as synonyms. In order to separate the volatile oils from the fatty oils in works of an encyclopædic character the three Scandinavian pharmacopœias have adopted the term *Ætherolea.*

Certain semi-artificial products somewhat resembling the volatile oils have commonly been classified with them—*e. g.*, oil of cade, oil of tar, etc. Inasmuch as they are obtained by a process of destructive distillation, the term *Pyrolea* has been suggested for them. The volatile oil *par excellence* of the U. S. P., 1890, the *Oleum Æthereum*, has never been classed with the volatile oils by any authority on this subject.

As will be seen, the term volatile oil defies definition, although interested persons commonly understand each other when using it. Nevertheless, numerous attempts have been made not only to define the term, but even to classify chemically these products, thus designated by common consent and for want of a better word. In the early decades of the nineteenth century, when elementary organic analysis was being applied to the study of volatile oils, it was found that some consisted almost altogether of carbon and hydrogen, others contained oxygen in addition to these two elements, and a third class contained sulphur and nitrogen as well. Ignoring altogether small percentages of oxygen in many oils, a classification into (1) hydrocarbon oils, (2) oxygenated oils, and (3) sulphur-containing oils was suggested. Strange to say, this classification is still in use in many text-books at the present time when manufacturers reject 90 per cent. of lemon oil, a typical hydrocarbon oil of the above classification, in order to get the valuable 10 per cent. rich in oxygenated constituents.

A rational classification based on chemical constituents or physical properties being out of the question, the best method of classifying the oils is according to the botanical classification of the plants from which they are obtained. Such a classification at least occasionally brings out genetic relationships. The following table of volatile oils is therefore arranged in accordance with Engler and Prantl's system. For further information special works should be consulted. The three latest and best reference works are herewith given in the order of their publication: 1899, Gildemeister und Hoffmann, *Die aetherischen Oele*, which has been translated into English and French; 1899, Parry, *The Chemistry of Essential Oils and Artificial Perfumes;* 1900, Charabot, Dupont et Pilet, *Les huiles essentielles.*

	Sp. gr.	(α)D	Constituents.	Remarks.
Order **Pinaceæ**.				
Pinus.				
P. palustris Mill.	0.8612	+23.93°	Pinene.	These 4 species constitute the largest pine forests of the Southern States and are the principal ones used in the production of American turpentine oil. See *Oleum Terebinthinæ.*
P. glabra Walt.	. . . . .	—31.5°	Pinene.	
P. Cubensis Gries.	0.8650	+9.6°	Pinene.	
P. echinata Mill.	. . . . .	. . . . .	Pinene.	
P. tæda L.	. . . . .	. . . . .	Pinene.	
P. pinaster Sol.	0.859–0.872	—20° to —40°	Pinene.	From this species French turpentine oil is obtained. It resembles American turpentine oil closely, but is lævogyrate.
P. Laricio Poiret.	0.866	+3°46′	Pinene (?).	The so-called Austrian turpentine oil is obtained from this species. It has but local commercial significance.
P. Khasya Royle.	0.8627	+36°28′	Pinene.	Two species from Burma which, according to Armstrong, might supply India with turpentine oil if the industry were developed.
P. Merkusii Jung.	0.8610	+31°45′	Pinene.	
P. Sabiniana Dougl.	0.694	. . . . .	*n*-Heptane.	This was sold in the San Francisco market under the names of aurantine, abietene, erasine, and theoline as a substitute for petroleum benzin for the removal of stains.
P. sylvestris L.				
Wood.	. . . . .	. . . . .	Pinene, sylvestrene, dipentene.	This "Kienöl" is not a volatile oil proper, but, like oil of cade, a product of destructive distillation. It belongs to the class of *Pyrolea* of the Scandinavian pharmacopœias, but is used as a substitute for turpentine oil, which it resembles.
German.	0.865–0.870	+18° to 22°	Pinene, sylvestrene, dipentene.	
Russian.	0.862–0.872	+15° to 24°	Pinene, sylvestrene, dipentene.	
Swedish.	0.871	+14°48′	Pinene, sylvestrene.	
Finland.	. . . . .	. . . . .	Pinene, sylvestrene, dipentene.	
Needles.				
German.	0.884–0.886	+7° to 10°	Bornyl acetate (3.5 per cent.), pinene, sylvestrene, dipentene, cadinene.	"Kiefernadelöl," not a commercial article.
Swedish.	0.872	+10°40′	Bornyl acetate(?) (3.5 per cent.), pinene, sylvestrene.	Swedish "Fichtennadelöl" finds application as inhalant in affections of the lungs, as admixture to baths, and in sprays for sick chambers.
English.	0.885–0.889	—7° to —19°	Bornyl acetate (?) (2.9 to 3.5 per cent.), pinene, sylvestrene(?), dipentene(?).	
P. Pumilio Haenke.				
Needles.	0.863–0.875	—4° to —9°	Bornyl acetate (5 to 7 per cent.), pinene, sylvestrene, cadinene, phellandrene	"Latschenkieferöl" or "Krummholzöl" distilled in Austrian Alps, etc.
P. cembra L.				
Needles.	. . . . .	+29.1°	Pinene.	
Galican turpentine.	0.863	+17°18′	Pinene.	Of unknown origin.
Larix.				
L. Larix (L.) Karst.				
Wood.	0.878	—11°	Pinene.	This constitutes about 15 per cent. of the Venice turpentine.
Leaves.	0.878	+0°22′	Bornyl acetate (about 8 per cent.) (?), pinene(?).	
L. Siberica Ledeb.	. . . . .	. . . . .	Bornyl acetate, pinene, terpineol.	
Abies.				
A. Sibirica Ledeb.	. . . . .	. . . . .	Camphene.	A Russian oil.
A. balsamea (L.) Mill.				
Balsam.	. . . . .	. . . . .	Pinene.	Canada balsam yields about 16 to 24 per cent. of this oil. Comp. *Terebinthina Canadensis.*

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Pinaceæ.**				
A. balsamea (L.) Mill.				
Needles.	0.888	—28.9°	Pinene, bornyl acetate (17.6 per cent.).	
A. Fraseri (Pursh.) Lindl.				
Balsam.	. . . . .	. . . . .	Pinene.	Comp. *Terebinthina Canadensis.*
A. Picea (L.) Lyons.				
Balsam.	0.861	. . . . .	Pinene.	Comp. Strassburg turpentine.
Needles.	0.869–0.875	—20° to —59°	Bornyl acetate (5 to 10 per cent.), pinene, terpineol, sesquiterpene.	This is one of the pine-needle oils, "Fichtennadelöl," used in sprays: "Edeltannennadelöl.
Cones.	0.853–0.870	—60° to —76°	Bornyl acetate (0.5 to 4 per cent.) (?), pinene, limonene.	The "Templinöl" or "Edeltannenzapfenöl" distilled in Switzerland.
A. cephalonica Link.				
Cones.	0.868	—20°	Pinene (?), dipentene(?), limonene(?).	
A. Abies (L.) Rusby.				
Wood.	0.866	+3°5′	Pinene.	
Needles.	0.880–0.888	—21° to —37°	Bornyl acetate (8 to 10 per cent.), pinene, dipentene, phellandrene, cadinene.	"Fichtennadelöl" proper distilled from the fresh needles and twigs of the Norway spruce.
Picea				
P. Canadensis (Mill.) B. S. P.				
Needles.	0.9288	—18.4°	Bornyl acetate (about 52 per cent.), pinene.	
Balsam.	. . . . .	. . . . .	. . . . .	Comp. *Terebinthina Canadensis.*
P. Mariana (Mill.) B. S. P.				
Needles.	0.922	—36.3°	Bornyl acetate (about 50 per cent.), pinene (?).	
Cedrus.				
C. Libani Barr.	0.985	—10°48′		
Sequoia.				
S. gigantea Torr.				
Needles.	0.8522	. . . . .	Pinene(?), sesquojene.	
Callitris.				
C. quadrivalvis Vent.	. . . . .	. . . . .	. . . . .	About 1 per cent. of oil has been obtained from sandarac resin.
Thuja.				
T. occidentalis L.				
Needles.	0.915–0.935	—5° to —14°	Pinene, fenchone, thujone, dihydrocarvone (?).	
T. orientalis L.				
Root.	0.979	. . . . .	Thymoquinone (?).	
Cupressus.				
C. sempervirens L.	0.88–0.89	+4° to 14°	Pinene, sylvestrene(?), cedrol (?), sesquiterpenes (?).	Cypress oil has been recommended for whooping-cough.
Chamæcyparis.				
C. obtusa Endl.				
Leaves.	. . . .	. . . . .	. . . . .	A Japanese oil resembling savin oil.
Juniperus.				
J. communis L.				
Berries.	0.865–0.882	up to —11°	Pinene, cadinene, juniper camphor.	See *Oleum Juniperi.*
J. Phœnicea L.				
Berries.	0.859	—4°55′	. . . . .	A Smyrna oil resembling juniper oil.
J. Oxycedrus L.				
Berries.	0.851–0.854	—4° to —8°	. . . . .	This oil has a terebinthinate odor, resembling faintly that of juniper.
J. Sabina L.				
Leaves.	0.910–0.930	+42° to 60°		See *Oleum Sabinæ.*

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Pinaceæ.**				
Juniperus Virginiana L.				
Wood.	0.945–0.960	—30° to —40°	Cedrene, cedrol.	Virginia or red cedar oil is used in perfumery. The oil obtained as a by-product in drying the wood for lead-pencils is inferior.
Leaves.	0.887	+59°25′	Borneol, cadinene, limonene, bornyl valerianate (?).	Cedar leaf oil of commerce is not always distilled from this plant. See *T. occidentalis.*
Order **Liliaceæ.**				
Aloe.				
A. vera (L.) Webb.	0.863			
Xanthorrhœa.				
X. hastile R. Br.	0.937	—3°14′	Styrene, cinnamic acid.	
Allium.				
A. sativum L.	1.046–1.057	. . . . .	Allyl propyl disulphide, allyl disulphide, $C_6H_{10}S_3$, $C_6H_{10}S_4$.	
A. cepa L.	1.036	—5°	$C_6H_{12}S_2$.	
A. ursinum L.	1.015	. . . . .	Vinyl sulphide, vinyl polysulphides, mercaptan, and an aldehyde.	
Asagraea.				
A. officinalis (Ch. et Sch.) Lindl.	0.902–0.928	. . . . .	Methyl and ethyl esters of oxymyristic and veratric acids, aliphatic aldehyde.	
Order **Iridaceæ.**				
Crocus.				
C. sativus L.	. . . . .	. . . . .	Terpene.	
Iris.				
I. florentina L. *I. germanica* L. *I. pallida* L.	. . . . .	. . . . .	Myristinic acid (85 per cent.) and methyl ester, irone, oleic acid and esters, olcic aldehyde.	Myristic acid is odorless. The violet odor is due to the traces of irone.
Order **Zingiberaceæ.**				
Curcuma.				
C. longa L.	0.942	. . . . .	Phellandrene, turmerol, valerianic and capronic acids.	
C. zedoariæ Rosc.	0.990–1.01	. . . . .	Cineol, sesquiterpene (?).	
Kampferia.				
K. rotunda L.	0.886–0.894	. . . . .	Cineol.	
Hedychium.				
H. coronarium L.	0.869			
Alpinia.				
A. officinarum Hance.	0.915–0.925	—1° to —3°	Cineol.	
A. Malaccensis Rosc.	1.039–1.047	. . . . .	Methyl cinnamate.	
A. nutans Rosc.	0.95	. . . . .	Methyl cinnamate(?).	
Zingiber.				
Z. Zingiber (L.) Rusby.	0.875–0.885	. . . . .	Camphene, phellandrene, sesquiterpene.	
Elettaria.				
E. repens (Sonn.) Baill.	0.895–0.905	+12° to +15°	Dipentene (?), terpinene, terpineol, body m.-p. 60°(?), acetic acid, formic acid.	
E. (*Malabar* oil)	0.933–0.943	+26° to +34°	Terpinyl acetate, limonene.	
Amomum.				
A. Cardamomum L.	0.905	+38°	Borneol, camphor.	Its composition explains the term "camphor seeds."
A. Melegueta Rosc.	0.894	—3°58′	. . . . .	Grains of paradise oil.
A. aromaticum Roxb.	0.920	—12°41′	Cineol.	The characteristic cardamom odor is wanting in the Bengal cardamom oil.
A. (*Kamerun* oil).	0.907	—20°	Cineol.	Botanical source unknown.
A. angustifolium.	. . . . .	. . . . .	. . . . .	This is the oil from *Cardamomum majus.*

	Sp. gr.	(α)D	Constituents.	Remarks.
Order **Piperaceæ.**				
Piper.				
P. nigrum L.	0.87–0.90	−5° to +2°	Dipentene (?), phellandrene, caryophyllene (?).	
P. officinarum DC. / *P. longum* L.	0.861			
P. Cubeba L.	. . . . .	. . . . .	. . . . .	See *Oil of Cubeb.*
P. Betle L.				
Siam, artificially dried.	1.024	. . . . .	Cadinene, betel phenol.	
Siam, sun-dried.	1.020	. . . . .	Cadinene, betel phenol.	
Manila, fresh.	1.044	. . . . .	Betel phenol.	
Java, fresh.	0.959	. . . . .	Sesquiterpene, betel pheuol, chavicol.	
P. angustifolium.	1.06–1.13	−0°25′ to +5°	Asarone, methyl eugenol (?).	Old oil may also contain matico camphor.
P. geniculatum Swz. / *Piper Jaborandi* Vahl. / *P. ovatum* Vahl.				
P. Clusii C. DC.	. . . . .	. . . . .	Terpene (?).	
P. Lowong Bl.	0.865	. . . . .	Terpene (?), sesquiterpene (?).	
Heckeria.				
H. umbellata (L.) Kunth.				
Order **Salicaceæ.**				
Populus.				
P. nigra L.	0.900–0.905	+1° to +5°	Humulene.	
Order **Myricaceæ.**				
Myrica.				
M. cerifera L.	0.886	−5°5′		
M. Gale L.	0.876	. . . . .	Camphor?	
Comptonia.				
C. peregrina (L.) Coulter.	0.926			
Order **Juglandaceæ.**				
Juglans.				
J. regia L.	. . . . .	. . . . .	. . . . .	Oil of walnut leaves has a pleasant, tea-like odor.
Order **Betulaceæ.**				
Betula.				
B. lenta L.	. . . . .	. . . . .	. . . . .	See *Oil of Sweet Birch.*
Order **Moraceæ.**				
Humulus.				
H. Lupulus L.	0.855–0.880	+0°28′ to 0°40′	Humulene, olefinic terpene (?).	Oil of copaiba balsam can be detected in oil of hops by its high specific gravity and its larger angle of rotation.
Cannabis.				
C. sativa L.	. . . . .	. . . . .	Cannabene, cannabin hydride (?).	
Order **Santalaceæ.**				
Santalum.				
S. album L.	. . . . .	. . . . .	. . . . .	See *Oil of Santal.*
S. Yasi Seem.	0.9768	−25.5°	. . . . .	Fiji sandalwood oil.
S. species.	0.969	. . . . .	. . . . .	African sandalwood
Fusanus.				
F. acuminatus R. Br.	1.022	. . . . .	$C_{15}H_{23}O.OH$.	Australian sandalwood oil.
F. spicatus R. Br.	0.953–0.965	+5°20′	Santalol (?) (about 75 per cent.).	West Australian sandalwood oil. In India and China it is used as a substitute for East Indian oil. However, it differs from the E. I. oil in its properties.
Order **Aristolochiaceæ.**				
Asarum.				
A. Europæum L.	1.018–1.068	. . . . .	Asarone, pinene, methyl eugenol(?).	
A. Canadense L.	0.93–0.96	. . . . .	Pinene(?), methyl eugenol, geraniol(?), linalool(?).	
Aristolochia.				
A. Serpentaria L.	0.98–0.99	. . . . .	Borneol.	
A. reticulata Nutt.	0.974–0.978	. . . . .	Pinene (?), borneol.	
A. clematitis L.				

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Chenopodiaceæ.**				
Chenopodium.				
C. ambrosioides L. / *C. anthelminticum* L.	. . . . .	. . . . .	. . . . .	See *Oil of American Wormseed.*
Order **Ranunculaceæ.**				
Pæonia.				
P. Moutan Simson.	. . . . .	. . . . .	Pæonol.	
Nigella.				
N. sativa L.	0.875	+1°26′		
N. Damascena L.	0.895–0.906	+1°4′	Damascenine.	
Order **Magnoliaceæ.**				
Michelia.				
M. Champaca L.	0.901–0.903	—12° to 52°	Benzoic acid (S. N. 77).	The odor of the oil resembles that from the flowers of *Acacia Farnesiana* and of violets. Like ylang-ylang oil, it has a high ester content.
M. longifolia Bl.	0.883	—12°50′		
Illicium.				
I. verum Hook. f.				
Fruit.	. . . . .	. . . . .	. . . . .	See *Oil of Anise.*
Leaf.	0.9878	+1°	Anethol.	"Liquid" star anise oil appears to be used as an adulterant of the oil of the fruit.
I. anisatum L.				
Leaves.	1.006	—8°6′	Chavicol (?), safrol, eugenol, shikimene.	
Fruit.	0.984	—4°5′	. . . . .	Japanese star anise oil possesses a disagreeable odor and has nothing in common with the oil of the true star anise.
Drimys.				
D. Winteri Forst.	. . . . .	. . . . .	Winterene.	Winter's bark oil.
Order **Anonaceæ.**				
Cananga.				
C. odorata Hook.	0.91–0.94	—17° to —55°	. . . . .	Comp. *Ylang-ylang Oil.*
Order **Myristicaceæ.**				
Myristica.				
M. fragrans Houtt.	. . . . .	. . . . .	. . . . .	See *Oil of Nutmeg.*
Order **Monimiaceæ.**				
Peumus.				
P. Boldus Mol.	0.915–0.945	. . . . .	Terpene (?).	
Atherosperma.				
A. moschatum Labill.	1.0386			
Siparuna.				
S. oligandra Jul.	0.899			
S. cujabana A. DC.	0.894			
S. Apiosyce A. DC.				
Order **Lauraceæ.**				
Paracota bark.	0.9275	. . . . .	Terpenes, cadinene, methyl eugenol, sesquiterpene hydrate?	
Cinnamomum.				
C. camphora N. et E.	. . . . .	. . . . .	Acetaldehyde, pinene, phellandrene, cineol, dipentene, camphor, terpineol, safrol, eugenol, cadinene.	Normal camphor oil is a semisolid mass, or a liquid mixed with camphor. The camphor oil of commerce is a product from which much camphor has been removed. "White camphor oil" consists of the lowest boiling fractions and contains terpenes almost exclusively, also some cineol. Specific gravity up to 0.890. "Black camphor oil" is that portion which boils higher than camphor and contains safrol, eugenol, and sesquiterpenes. Sp. gr. from 0.900 to over 1.000.

	Sp. gr.	(α)D	Constituents.	Remarks.
Order **Lauraceæ.**				
Cinnamomum.				
C. Zeylanicum Breyne.				
Bark.	1.024–1.040	up to —1°	Phellandrene, eugenol, cinnamic aldehyde (65 to 75 per cent.), etc.	In the bark oil cinnamic aldehyde predominates, though its characteristic odor is due to esters, etc.; in the leaf oil, eugenol; in the root oil, camphor.
Leaves.	1.044–1.065	—0°5′ to +1°18′	Safrol, eugenol, cinnamic aldehyde, terpenes, benzaldehyde (?).	Commercial oil of Ceylon cinnamon mostly consists of leaf oil with some of the bark oil. It is used in preference to cassia oil where a finer cinnamon odor is desired.
Root.	. . . . .	. . . . .	Camphor, cinnamic aldehyde.	
C. Cassia Bl.	. . . . .	. . . . .	Cinnamic aldehyde.	See *Oil of Cinnamon.*
C. Loureirii Nees.	0.982	. . . . .	Cinnamic aldehyde, terpene (?).	Japanese cinnamon oil.
C. Kiamis Nees.	. . . . .	. . . . .	Massoy camphor.	Massoy bark oil.
C. Culilawan Bl.	. . . . .	. . . . .	Terpineol, eugenol.	
C. Wightii Meissn.	. . . . .	. . . . .	Methyl eugenol.	
C. Oliveri.	. . . . .	. . . . .	Cineol, safrol (?), eugenol (?), cinnamic aldehyde (?).	The tree is known in Australia as black, brown, or white sassafras.
Persea.				
P. Persea (L.) Cockerell.	0.9607	. . . . .	Methyl chavicol (?).	
P. caryophyllata Mart.	. . . . .	. . . . .	Eugenol (?).	
Nectandra.				
N. puchury-major Nees.	. . . . .	. . . . .	Lauric acid (?), safrol, terpenes (?).	
N. puchury-minor Nees.				
N. Caparrapi.	. . . . .	. . . . .	Acid $C_{15}H_{26}O_3$, caparrapiol.	
Ocotea.				
O. pretiosa Mart.	1.118			
O. species (?).	0.870–0.880	—15° to 20°	. . . . .	Guayana or Cayenne linaloe oil.
O. species.	0.864	. . . . .	Pinene (?).	Guayana laurel oil.
O. species.	1.155	+2°40′	Apiol.	Venezuelan camphorwood oil.
Umbellularia.				
U. californica (Arn.) Nutt.	0.936–0.940	. . . . .	Terpineol (?), terpene (?).	Mountain laurel oil.
Sassafras.				
S. sassafras (L.) Karst.				
Bark.	. . . . .	. . . . .	. . . . .	See *Sassafras Oil.*
Leaves.	. . . . .	. . . . .	Pinene, myrcene, phellandrene, sesquiterpene, linalool, and geraniol, both free and as acetic and valerianic esters, paraffin.	
Cryptocaria.				
C. moschata Nees et Mart.	0.917	. . . . .	. . . . .	Brazilian nutmeg oil.
Laurus.				
L. nobilis L.				
Leaves.	0.925–0.930	—15° to 18°	Pinene, cineol, eugenol, methyl chavicol (?).	
Berry.	0.915–0.935	—14°10′	Pinene, cineol, lauric acid, sesquiterpene.	
Benzoin.				
B. Benzoin (L.) Coulter.	0.923	. . . . .	Methyl salicylate (10 per cent.).	Spicewood oil.
L. sericea Bl.	0.890–0.905	—0°4′	Limonene, dipentene, terpineol, carvone.	Kuro-moji oil.
Tetranthera Nees.				
T. citrata.	0.890–0.896	. . . . .	Citral, terpene.	Japanese verbena oil.
Massoy bark oil.	1.04–1.06	. . . . .	Engenol, safrol, pinene, limonene, dipentene.	
Order **Cruciferæ.**				
Lepidium.				
L. sativum L.	. . . . .	. . . . .	Benzyl isocyanate, benzyl cyanide.	
L. latifolium L.	. . . . .	. . . . .	Contains sulphur.	

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Cruciferæ.**				
Thlaspi.				
T. arvense L.			Allyl sulphide (?), allyl isosulphocyanate.	
Cochlearia.				
C. officinalis L.		+55°27′	*s*-butyl isosulphocyanate, raphanol.	"Artificial spoonwort oil" of commerce is not the secondary butyl compound, and therefore should not be substituted for the natural for medicinal purposes.
Roripa.				
R. Armoracia (L.) Hitchcock.	1.01		Same as mustard oil.	Oil of horseradish causes burning and blistering when brought in contact with the skin.
R. Nasturtium (L.) Rusby.			Phenylpropionic acid nitrile, raphanol.	
Alliaria.				
A. Alliaria (L.) Britton.			Allyl sulphide, allyl isosulphocyanate.	
Sinapis.				
S. alba L.			*p*-hydroxy-benzyl isosulphocyanate.	Oil of white mustard blisters when in contact with the skin, but much more slowly than black mustard oil.
Brassica.				
B. nigra Koch.				See *Volatile Oil of Mustard.*
Raphanus.				
R. sativus L.			Raphanol.	
Order **Resedaceæ.**				
Reseda.				
R. odorata L. Flowers.				When greatly diluted, it has the odor of fresh mignonette. Distilled with geraniol (1 : 500) the flowers yield "Reseda geraniol."
Roots.	1.010–1.084	+1°30′	Phenyl ethyl mustard oil.	
Order **Hamamelidaceæ.**				
Liquidambar.				
L. orientale Mill.	0.89–1.1	—3° to 38°	Styrene, styrocamphene, ethyl, benzyl, phenyl propyl- and cinnamyl cin, namates.	Oil of storax.
L. styraciflum, L. "Gum."		+16°33′	Styrene, phenylpropyl, and cinnamyl cinnamates.	
Leaves.	0.872	—38°45′	Borneol (?), bornyl acetate (?), terpenes (?).	
Altingia.				
A. excelsa Nor.			Ketone.	Rasamala wood oil.
Order **Rosaceæ.**				
Ulmaria.				
U. Ulmaria (L.) Barnh.				
Flowers.			Salicylic aldehyde, methyl salicylate, heliotropin, vanillin, terpene (?), salicylic acid, paraffin.	
Roots.			Methyl salicylate.	
Herb.			Salicylic aldehyde.	
Spiræa.				
S. palmata Pall. Herb.			Salicylic aldehyde.	
S. lobata Jacq. Herb.			Salicylic aldehyde.	
S. filipendula L. Herb.			Salicylic aldehyde.	
S. Japonica L. Leaves.			Hydrocyanic acid.	
S. sorbifolia L. Herb.			Hydrocyanic acid.	
Aruncus.				
A. Aruncus (L.) Karst.				
Flowers.			Salicylic aldehyde.	
Herb.			Hydrocyanic acid.	
Rosa.				
R. damascena Mill.				See *Oil of Rose.*

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Rosaceæ.**				
Rosa.				
R. alba L.	. . . . .	. . . . .	. . . . .	In Bulgaria a white rose is planted to indicate the divisions of the rose fields. It is said to yield an oil of poorer quality which is richer in stearoptene.
R. centifolia L.	0.8727	+0°49′		
Prunus.				
P. amygdalus amara DC.	. . . . .	. . . . .	. . . . .	See *Volatile Oil of Almond.*
P. Persica Stokes. Leaves, twigs, and seeds.	. . . . .	. . . . .	Benzaldehyde, hydrocyanic acid.	Peach kernel oil, Comp. bitter almond oil.
P. laurocerasus L.	. . . . .	. . . . .	Benzaldehyde, hydrocyanic acid, benzaldehyde cyanhydrin, benzyl alcohol (?).	
P. serotina Ehrh.	1.045–1.050	. . . . .	Benzaldehyde, hydrocyanic acid.	
P. Padus L. Bark, leaves, flowers, seeds.	. . . . .	. . . . .	Benzaldehyde, hydrocyanic acid.	
P. Cerasus L. Seeds, pulp.	. . . . .	. . . . .	Benzaldehyde, hydrocyanic acid.	Cherry.
P. domestica L. Seeds.	. . . . .	. . . . .	Benzaldehyde, hydrocyanic acid.	Plum.
P. spinosa L. Young leaves and flowers.	. . . . .	. . . . .	Benzaldehyde, hydrocyanic acid.	
Order **Leguminosæ.**				
Copaiba.				
C. officinalis Jacq. *C. Guajanensis* (Desf.) Kuntze. *C. coriacea* (Mart.) Kuntze. *C. Langsdorffia* (Desf.) Kuntze. *C. confertiflora* (Benth.) Kuntze. *C. oblongifolia* (Mart.) Kuntze.	. . . . .	. . . . .	. . . . .	See *Oil of Copaiba.*
C. species (?)	0.917–0.918	+20°42′	. . . . .	"African copaiba balsam" oil.
Cæsalpinia.				
C. Sappan L.	0.825	+37° to 50°	Phellandrene.	Sappan-leaf oil has a pepper-like odor.
Myrocarpus.				
M. fastigiatus Allem.	0.9283	—8°29′	. . . . .	Cabriuva wood oil.
Toluifera.				
T. balsamum L.	0.945–1.09	—0°58′ to +0°54′	Terpene, benzyl benzoate and cinnamate.	
T. Pereiræ (Royle) Baill.				
Leaves.	0.874			
Bark.	0.924–1.139			
Wood.	0.852			
Indigofera.				
I. galegoides DC.	1.046	. . . . .	Cineol.	
Genista.				
G. tridentata L.	0.9962	—31°15′	Benzaldehyde and hydrocyanic acid. Traces of methyl and ethyl alcohol.	
Order **Geraniaceæ.**				
Pelargonium.				
P. odoratissimum Willd. *P. capitatum* Ait. *P. Radula* (Cav.) Ait.	0.89–0.906	—6° to —16°	Geraniol, geranyl tiglate, citronellol, menthone, acetic, isobutyric, and isovalerianic acids, paraffin.	Oil of rose geranium. The French, Algerian, Réunion, Spanish, and German oils show slight variations.

	Sp. gr.	$(\alpha)_D$	Constituents,	Remarks.
Order **Tropæolaceæ.**				
Tropæolum.				
T. majus L.			Benzyl mustard oil.	Oil of garden nasturtium will vary according to the treatment of the glucoside yielding it. Heat splits off benzyl cyanide, whereas a ferment hydrolizes it to benzyl-isosulphocyanate.
Order **Erythroxylaceæ.**				
Erythroxylon.				
E. Coca Lam.			Methyl salicylate, acetone, methyl alcohol.	Coca leaves contain but traces of oil.
Order **Zygophyllaceæ.**				
Bulnesia.				
B. Sarmienti Lor.	0.965–0.975	—6° to —7°	Sesquiterpene hydrate.	Guaiac wood oil is used in perfumery to produce a tea-rose odor, also as an adulterant of oil of rose. The odoriferous constituents of the oil are not known.
Order **Rutaceæ.**				
Xanthoxylum.				
X. piperitum DC.	0.973		Terpene, crystalline body $C_{10}H_6O_4$, citral.	Japanese oil of pepper.
Fagara.				
F. Hamiltonianum (Wall.) Engl.	0.840			
Ruta.				
R. graveolens L.	0.833–0.840	+0°13′ to +2°10′	Methyl nonyl ketone, methyl heptyl ketone, lauric aldehyde(?).	Whereas in Spanish oil of rue methyl nonyl ketone predominates, in the Algerian oil the methyl heptyl ketone predominates.
Boronia.				
B. polygalifolia Sm.	0.839	+10°		
Barosma.				
B. betulina (Thunb.) Bart. et Wend.				Buchu oil.
B. serratifolia (Curt.) Willd.			Diosphenol, hydrocarbon $C_{10}H_{18}$, menthone (?).	
B. crenulata (L.) Hook.				
Empleurum.				
E. serrulatum Soland.			Methyl nonyl ketone (?).	
Pilocarpus.				
P. Jaborandi Holmes.	0.865–0.895	+3°25′	Dipentene (?), methyl nonyl ketone.	
Cusparia.				
C. Angustura (Rich.) Lyons.	0.93–0.96	—36° to —50°	Pinene (?), sesquiterpene alcohol, cadinene, galipene.	Angostura bark oil.
Toddalia.				
T. aculeata Pers.			Citronellal.	This Indian oil would be useful in perfumery if it could be furnished at a reasonable price.
Citrus.				
C. Limonium Risso.				
Rind.				See *Lemon Oil.*
Leaves, twigs, and unripe fruit.	0.868–0.874	+22° to 34°	Citral.	Petitgrain citronnier. Comp. oil of petitgrain (sweet).
C. Aurantium L.				
Rind.				See *Oil of Orange.*
Flowers.				Oil of sweet orange blossoms of commerce appears to be a mixture of different aurantiaceous oils.
C. amara (L.) Lyons.				
Rind.				Oil of bitter orange. Comp. oil of orange.
Leaves.	0.8910–0.8934	—5° to —6°	50 to 70 per cent. ester.	
Immature fruits, leaves, and twigs.	0.887–0.900	—1° to +3°	Limonene, geraniol, geranyl acetate, linalool, linalyl acetate, sesquiterpene.	Oil of petitgrain.

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Rutaceæ.**				
Citrus.				
C. amara (L.) Lyons.				
Flowers.	0.870–0.890	+0° to +5°	Limonene, linalool, geraniol, linalyl acetate, anthranilic acid methyl ester, paraffin.	Oil of bitter orange flowers, or neroli oil, is obtained principally as a by-product in the manufacture of orange-flower water (see *Aqua aurantii floris*), but should not be used in making an orange-flower water, since it contains less methyl anthranylate than the oil dissolved in the water. It was officinal in the U. S. P. of 1880 and 1890, and is still officinal in several Romanic countries and Austria. The oil is used in perfumery.
C. Bergamia Risso.	0.882–0.886	+8° to +20°	Limonene, linalool, linalyl acetate (30–40 per cent.), bergapten, bergaptin.	Bergamot oil is used in perfumery. It is valued according to its linalyl acetate content. According to the U. S. P., 1890, in which it was official, it should be soluble in one-half its volume of alcohol, and not become turbid upon the addition of more alcohol. Upon evaporation on a water-bath it should not leave a residue of more than 6 per cent.
C. medica L.	0.871	+67°8′	Citral.	Commercial cedro oil is reported to be a mixture of lemon oil with other oils.
C. madurensis L.	0.854–0.858	+65° to 75°	Citral, citronellal(?), limonene.	Mandarin oil somewhat resembles lemon oil.
C. acida Pers.				
a. Expressed.	0.873–0.882	+35° to 38°	Citral.	The expressed West Indian limette oil closely resembles oil of lemon, whereas the distilled oil has a terebinthinate odor.
b. Distilled.	0.865–0.868	+38°52′		
C. Limetta Risso.				
Rind.	0.872	+58°19′	Limonene, linalyl-acetate, linalool, limettin.	Italian limette oil resembles bergamot oil, but contains less ester (26 per cent.) and more limonene.
Leaves.	. . . . .	. . . . .	Limonene, methyl-nonyl ketone(?).	
C. Decumana Murr.	0.860	+94°30′	. . . . .	Shaddock or grape-fruit oil.
"*C. oleifera.*"	0.870–0.880	1° to 5°		
Order **Burseraceæ.**				
Commiphora.				
C. Myrrha (Nees) Engl.	0.988–1.007	—67° to 90°	. . . . .	Herabol myrrh oil.
C. species.	0.8836	—14°20′	Terpene.	Bisabol myrrh oil.
C. Kataf Eng.	0.870–0.905	—10° to 12°	. . . . .	The present opoponax oil of commerce, not the oil from true opoponax.
Boswellia.				
B. Carterii Birdw.	0.875–0.885	—10° to 17°	Pinene, dipentene, phellandrene.	Oil of olibanum or frankincense.
Canarium.				
C. species.	0.87–0.91	+44°3′	Dipentene, phellandrene, polyterpene.	Elemi oil.
Protium.				
P. heptaphyllum.	. . . . .	. . . . .	Conimeme.	Oil of conima resin or Hyawa gum.
Bursera. *B. aloexylon* Eng. *B. Delpechiana* Poiss.	0.875–0.880	—5° to —12°	Linalool, geraniol, methyl heptenone, sesquiterpene, terpene.	Mexican linaloe oil. This is the linaloe oil of commerce, which is used extensively in perfumery.

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Meliaceæ.**				
Cedrela.				
C. species.				
From Corinto.	0.906	—17°23′	. . . . .	About twelve species of this genus, indigenous to America, yield a pleasantly odoriferous wood, which is used for making cigar and sugar boxes. It is incorrectly called cedar wood. Volatile oils have been distilled from a number of these woods, the botanical sources of which are unknown.
From Cuba.	0.923	+18°6′	Cadinene.	
From La Plata.	0.928	. . . . .	. . . . .	
From Punta Arenas.	0.915	—5°53′	Cadinene.	
From Porto Alegre.	0.9348	—0°22′	. . . . .	
Order **Polygalaceæ.**				
Polygala.				
P. Senega L.	. . . . .	. . . . .	Methyl salicylate, valerianic ester.	Traces of methyl salicylate are also contained in *P. variabilis* H. B. K., *P. albiflora* DC., *P. oleifera* Heckel, *P. jarana* DC., *P. vulgaris* L., *P. calcarea* Schlz., *P. depressa* V.
Order **Euphorbiaceæ.**				
Croton.				
C. Eluteria Benn.	0.890–0.925	+2° to 5°	Dipentene (?), sesquiterpene (?).	Cascarilla oil.
Stillingia.				
S. silvatica Muell.				
Order **Anacardiaceæ.**				
Pistacia.				
P. Lentiscus L.	0.858–0.868	+22° to 28°	Pinene (?).	Oil of mastiche.
P. Terebinthus L.	0.868–0.869	+12° to 19°	Pinene.	Oil of Chios turpentine.
Schinus.				
S. molle L.	0.850	+46°4′	Phellandrene, pinene, carvacrol.	
Order **Vitaceæ.**				
Vitex.				
V. vinifera L.	0.875–0.885	. . . . .	Ethyl and amyl esters of caprinic and caprylic acids.	Cognac oil is not a volatile oil proper.
Order **Tiliaceæ.**				
Tilia.				
T. Europæa L.	. . . . .	. . . . .	. . . . .	Oil of linden flowers possesses the odor of the flowers in a high degree.
Order **Malvaceæ.**				
Hibiscus.				
H. Abelmoschus L.	0.900 at 25°–35°		Palmitic acid (?).	Oil of ambrette seeds is used in perfumery. The commercial oil is often mixed with cedarwood or copaiba balsam oil.
Order **Theaceæ.**				
Thea.				
T. Chinensis L.	0.866	—0°11′	Alcohol $C_6H_{12}O$, methyl salicylate, methyl alcohol.	
Order **Dipterocarpaceæ.**				
Dryobalanops.				
D. aromatica Gærtn.	0.882–0.909	. . . . .	Borneol (?), dipentene (?), camphene (?), cadinene (?).	Oil of the Borneo camphor tree.
Dipterocarpus.				
D. turbinatus Gærtn. *D. incanus* Roxb. *D. alatus* Roxb.	0.915–0.930	—35° to 130° or dextrogyrate.	Sesquiterpene.	Oil of gurjun balsam is, on account of its weak odor, a dangerous adulterant of other oils. Its high b. p., its strong rotary power, and its sparing solubility in alcohol usually render its detection possible.

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Cistaceæ.**				
Cistus.				
C. Creticus L.				
C. Ladaniferus L.	0.925	. . . . .	. . . . .	Ladanum resin oil.
Order **Canellaceæ.**				
Canella.				
C. alba Murray.	0.920–0.935	+1°8′	Pinene, eugenol, cineol, caryophyllene.	
Order **Turneraceæ.**				
Turnera.				
T. aphrodisiaca Ward. / *T. diffusa* Ward.	. . . . .	. . . . .	. . . . .	Various plants have supplied the damiana leaves of commerce, hence nothing definite about this oil is known.
Order **Lythraceæ.**				
Lawsonia.				
L. inermis L.	. . . . .	. . . . .	. . . . .	Henna oil is said to resemble that of the tea rose.
Order **Myrtaceæ.**				
Myrtus.				
M. communis L.	0.890–0.915	+10° to 30°	Cineol, pinene, dipentene, linalool (?).	Oil of myrtle was formerly much used in the preparation of myrtol, fraction 160°–180° of the oil, which evidently consisted largely of cineol (eucalyptol), to which the antizymotic and deodorizing properties of the preparation were, no doubt, largely due.
M. Cheken Spr.	0.8795	. . . . .	Cineol, pinene.	Oil of cheken leaves.
Pimenta.				
P. Pimenta (L.) Lyons.				
Unripe berries.	. . . . .	. . . . .	. . . . .	See *Oil of Allspice.*
P. species.				
Leaves.	0.882	—0°37′	Citral.	Oil of Trinidad pimenta leaves.
P. acris (Swz.) Wight.	. . . . .	. . . . .	. . . . .	See *Oil of Bay.*
Eugenia.				
E. aromatica (L.) Kuntze.				
Fruit.	. . . . .	. . . . .	. . . . .	See *Oil of Cloves.*
Stems.	1.040–1.065	up to —1°10′	Eugenol, caryophyllene, methyl alcohol, furfurol, methyl amyl ketone (?).	Oil of clove stems, though richer in eugenol than oil of cloves, is less fine in flavor and should, therefore, not be used in perfumery and pharmacy. Comp. oil of cloves.
Cajuputi.				
C. viridiflora (Gærtn.) Lyons.	. . . . .	. . . . .	. . . . .	See *Oil of Cajuput.*
Niaouli of New Caledonia.	0.908–0.922	. . . . .	Pinene, cineol, terpineol, valeric aldehyde (?), benzaldehyde (?), limonene (?), terpineol, terpinyl valerianate, acetic and butyric acid esters.	"Gomenol" or oil of niaouli.
C. leucadendron. var. *lancifolia.*	0.955	—3°38′	Cineol.	
C. acuminata (Muell.) Rusby.	0.892	—15°20′	Cineol.	Odor reminds slightly of juniper berries.
C. decussata (R. Br.) Rusby.	0.938	. . . . .	. . . . .	Odor and taste very similar to those of cajuput oil.
C. ericifolia (Sm.) Lyons.	0.899–0.902	. . . . .	. . . . .	Similar to cajuput oil.
C. genistifolia (Sm.) Rusby.				
C. linarifolia (Sm.) Rusby.	0.898–0.903	. . . . .	. . . . .	Odor cajuput-like, but somewhat resembling that of mace and mint.
C. squarrosa (Sm.) Rusby.	. . . . .	. . . . .	. . . . .	Oil has an unpleasant taste.
C. uncinata (R. Br,) Rusby.	0.925	+1°40′	Cineol, terpineol (?).	Cajuput-like, also resembling that of spike and rosemary.
C. Wilsonii (Muell.) Rusby.	0.925			
Eucalyptus.				
E. globulus Lab.	. . . . .	. . . . .	. . . . .	See *Oil of Eucalyptus.*
E. odorata Behr.	0.899–0.925	. . . . .	Cineol, cuminic aldehyde.	Victoria and N. S. Wales.
E. oreorifolia DC.	0.899–0.923	—4°14°		

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Myrtaceæ.**				
Eucalyptus.				
E. oleosa F. v. Muell.	0.906–0.926	+4° to 5°	Cineol, cuminic aldehyde.	Official in 1890 U. S. P. See *Oil of Eucalyptus.*
E. dumosa A. Cunn.	0.884–0.915	+0°6′ to 6°30′	Cineol.	
E. amygdalina Lab.	0.850–0.886	—25° to 70°	Cineol, phellandrene.	White and brown peppermint tree oil. Comp. oil of eucalyptus.
E. rostrata Schl.	0.912–0.925	—1°8′ to +13°	Cineol, valeric aldehyde.	
E. populifolia Hook.	. . . . .	. . . . .	Cineol, cuminic aldehyde.	Has an odor suggesting cajuput.
E. corymbosa Sm.	0.881	. . . . .	Cineol.	Smells slightly of lemon.
E. resinifera Sm.	0.893	—17°8′	Cineol, phellandrene.	
E. Baileyana F. v. Muell.	0.940	. . . . .	Cineol.	
E. microcorys F. v. Muell.	0.896–0.935	. . . . .	Cineol, eudesmol.	
E. Risdonia Hook.	0.915–0.916	—4°49′	Cineol, phellandrene.	
E. leucoxylon F. v. Muell.	0.915–0.927	+0.5° to 2.7°		
E. hemiphloia F. v. Muell.	. . . . .	. . . . .	Cineol, cuminic aldehyde.	
E. crebra F. v. Muell.	. . . . .	. . . . .	Cineol.	The oil, resembling that of *E. globulus*, is rich in cineol.
E. macrorrhyncha F. v. Muell.	0.924–0.927	. . . . .	Cineol, phellandrene, eudesmol.	Red stringy bark oil.
E. capitellata Sm.	0.9153	. . . . .	Cineol, phellandrene.	Brown stringy bark oil.
E. eugenioides Lieb.	0.907–0.908	+3.7° to 5.2°	Cineol.	
E. obliqua L'Herit.	0.899	. . . . .	Cineol, phellandrene.	
E. punctata DC.	0.9122–0.9205	—2.52° to +4.44°	Cineol.	
F. loxophleba. Benth.	0.8828	+5°	Cineol, phellandrene, aldehydes or ketones.	York gum oil.
E. dextropinea Baker.	0.8743–0.8763	. . . . .	Cineol, pinene.	
E. lævopinea Baker.	0.8732	. . . . .	Cineol, pinene.	Silver-top stringy bark oil.
E. Smithii.	. . . . .	. . . . .	Eudesmol, pinene.	
E. maculata Hook.	0.900			
E. citriodora Hook.	0.870–0.905	up to +2°	Citronellal, geraniol(?), citronellol(?).	This oil is used extensively as a perfume for soap.
E. dealbata A. Cunn.	0.871–0.885	. . . . .	Eudesmol, citronellal.	
E. Planchoniana Muell.	. . . . .	. . . . .	Citronellal.	
E. Staigeriana Muell.	. . . . .	. . . . .	Citral, fenchene.	
E. hæmastoma Sm.	. . . . .	. . . . .	Cineol, an ester, fenchene, methone (?).	
E. piperita Sm.	. . . . .	. . . . .	Cineol, phellandrene, eudesmol.	
E. diversicolor Muell.				
E. fissilis.				
E. goniocalyx Muell.				
E. gracilis Muell.				
E. Lehmanni Preiss.				
E. longifolia Lk.				
E. occidentalis Endl.				
E. pauciflora Sieb.				
E. Stuartiana Muell.	. . . . .	. . . . .	Cymene.	
E. tereticornis Sm.				
E. tessellaris Muell.				
Backhousia.				
B. citriodora Muell.	0.900	. . . . .	Citral.	

	Sp. gr.	(α)D	Constituents.	Remarks.
Order **Umbelliferæ.**				
Coriandrum.				
C. sativum L.				
Fresh flowering plant.	0.853	+1°2′	. . . . .	Has an unpleasant, bedbug-like odor.
Fresh herb with immature fruit.	0.866	+7°10′	. . . . .	Odor coriander-like accompanied by a slight bedbug-like odor.
Mature fruit.	0.876	+10°48′	. . . . .	See *Oil of Coriander.*
Cuminum.				
C. cyminum L.	0.893–0.93	+4° to 8°	Cuminic aldehyde, cymene, terpene.	
Apium.				
A. graveolens L.				
Seed.	0.870–0.895	+67° to 79°	Limonene, sesquiterpene, palmitic acid, guaiacol, phenol $C_{16}H_{20}O_3$, sedanolid, sedanonic acid anhydride.	
Leaves.	0.848–0.850	+48° to 52°		
A. Petroselinum L.				
Fruit.	1.05–1.10	. . . . .	Apiol, pinene (?).	
Root.	1.049	. . . . .	Apiol (?).	
Leaves.	0.900–0.925	+0°16′ to 3°10′	Apiol.	
Cicuta.				
C. virosa L.				
Fruit.	. . . . .	. . . . .	Cuminic aldehyde, cymene.	
Roots.	0.870	. . . . .	Pinene (?), phellandrene (?).	
C. maculata L.				
Fruit.	0.840–0.855	. . . . .	Terpenes.	
Carum.				
C. carui L.	. . . . .	. . . . .	. . . . .	See *Oil of Caraway.*
Ptychotis.				
P. copticum DC.	0.900–0.930	. . . . .	Terpene (?), cymene, thymol.	Ajowan oil is an important source for thymol. The oil left after the removal of thymol is sold as "thymene" as a soap perfume. Thymene is a cheap source for cymene.
Pimpinella.				
P. Anisum L.	. . . . .	. . . . .	. . . . .	See *Oil of Anise.*
P. Saxifraga L.	0.959			
Fœniculum.				
F. Fœniculum (L.) Karst.	. . . . .	. . . . .	. . . . .	See *Oil of Fennel.*
F. dulce DC.	0.976–0.980	+7° to 16°	Anethol.	Sweet or Roman fennel oil cultivated in southern France. It has a high anethol content but no fenchone.
Macedonian.	0.970–0.980	+5° to 12°	Limonene, phellandrene, anethol.	Macedonian fennel oil has a purely sweet taste, a high anethol content, and is devoid of fenchone.
Wild bitter.	0.905–0.925	+48°	Phellandrene, fenchone.	In wild bitter fennel oil anethol appears to be absent or present in small amount only.
F. Panmorium DC.	0.968–0.973	+21°	Anethol, fenchone.	Indian fennel oil.
	0.975–0.976	+10° to 16°	Anethol, fenchone.	Japanese anise oil is very similar to German fennel oil.
F. piperitum Sweet.	0.951	. . . . .	. . . . .	Sicilian donkey fennel contains little or no anethol.
	0.987	. . . . .	. . . . .	Oil of fennel from Asia Minor.
	0.972	. . . . .	. . . . .	Oil from Syrian fennel.
	0.977	+14°	. . . . .	Oil from Persian fennel.
	0.967	+23°	. . . . .	Oil from Russian fennel.
Meum.				
M. Athamanticum Jacq.	0.999	. . . . .	. . . . .	"Baerwurzöl" resembles lovage oil.
Silaus.				
S. flavescens Bernh.	0.982	+0°7′	Stearoptene.	
Œnanthe.				
Phellandrium Poir.	0.85–0.89	+12° to 15°	Phellandrene.	Oil of water fennel is the original source of phellandrene, of which it contains about 80 per cent.

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Umbelliferæ.**				
Levisticum.				
L. Levisticum (L.) Lyons.				
Root.	1.000–1.040	Up to +5°	Terpene, terpineol.	Lovage is cultivated as a kitchen spice.
Fruit	0.935			
Herb.	0.904–0.940	+16° to 46°		
Anethum.				
A. Sowa Roxb. E.L.	0.948–0.970	+41° to 47°	Dill-apiol	Oil of East Indian and Japanese dill.
Japanese.	0.964	+50°30′		
Angelica.				
A. refracta Schmidt.	0.910	. . . . .	Oxypentadecylic acid.	Japanese angelica oil resembles somewhat musk.
A. Archangelica L.				
Root.	0.857–0.918	+16° to 32°	Pinene(?), cymene(?), phellandrene, sesquiterpene (?), oxypentadecylic acid.	The odor is aromatic, pepper like, with an admixture of musk.
Seed.	0.856–0.890	+11° to 12°	Phellandrene, methyl ethyl acetic acid, oxymyristic acid.	
Herb.	0.870–0.890	+8° to 21°		
Ferula.				
F. fœtida (Bunge) Regel.	0.975–0.990	—9°15′	Pinene, $C_7H_{14}S_2$, $C_{11}H_{20}S_2$, $(C_{10}H_{16}O)^n$, $C_8H_{16}S_2$, $C_{10}H_{18}S_2$.	
F. rubricaulis Boiss. / *F. galbaniflua* G. Schaïr.	0.910–0.940	+20° to —10°	Pinene, cadinene.	Galbanum oil.
F. Sumbul Hook.	0.954–0.964	. . . . .	. . . . .	Oil of sumbul has a musk-like odor.
Dorema.				
D. Ammoniacum Don.	0.891	. . . . .	. . . . .	Oil of gum ammoniac resembles the gum resin as to odor; also angelica.
Peucedanum.				
P. Oreoselinum (L.) Moench.	0.843	. . . . .	Terpene.	"Bergpetersilienöl" has a strong aromatic odor somewhat resembling juniper.
P. officinale L.	0.902	+29°4′	. . . . .	Oil from root.
P. Ostruthium Koch.	0.877	. . . . .	. . . . .	The oil from the root resembles angelica oil as to odor.
P. graveolens B. et H.	0.895–0.915	+75° to 80°	Carvone, limonene, phellandrene, pinene (?), dill-apiol, paraffin.	
P. grande Clark.	0.9008	+36°	. . . . .	The oil from the fruit resembles carrot oil.
P. sativum Benth.	0.87–0.89	—0°15′ to —0°30′	Propionic acid (?), octyl ester of butyric acid, ethyl alcohol.	The oil of the fruit of parsnip appears to differ materially with the degree of maturity of the fruit.
Heracleum.				
H. sphondylium L.	0.80–0.88	+0°15′ to 0°16′	Ethyl butyrate, hexyl acetate, octyl acetate, capronate and laurinate, methyl and ethyl alcohols.	
H. giganteum L.	. . . . .	. . . . .	Ethyl butyrate, methyl and ethyl alcohols.	
Daucus.				
D. Carota L.	0.870–0.923	—13° to —37°	Pinene (?).	Carrot oil from the fruit.
Washingtonia.				
W. longistylis (Torr.) Britton.	1.0114	. . . . .	Anethol.	Sweet cicely or sweet anise oil.
Order **Pirolaceæ.**				
Hypopitys.				
H. hypopitys (L.) Small.	. . . . .	. . . . .	Methyl salicylate.	
Order **Ericaceæ.**				
Ledum.				
L. palustre L.	0.93–0.96	. . . . .	Ledum camphor.	

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Ericaceæ.**				
Gaultheria.				
G. procumbens L.	. . . . .	. . . . .	. . . . .	See *Oil of Gaultheria.*
G. fragrantissima Wall.	. . . . .	. . . . .	Methyl salicylate.	
G. leucocarpa Bl.	. . . . .	. . . . .	Methyl salicylate.	
Order **Primulaceæ.**				
Primula.				
P. veris L.	. . . . .	. . . . .	Primula camphor.	
Order **Convolvulaceæ.**				
Convolvulus.				
C. scoparius L.	. . . . .	. . . . .	. . . . .	Oil of rosewood of commerce is often a mixture of the oils of rose, sandalwood, and cedar. Nothing definite is known about the true oil.
C. floridus L.				
Order **Verbenaceæ.**				
Lippia.				
L. citriodora H.B.K.	0.900	—12°38′	Citral.	
Lantana.				
L. Camara L.	0.952	— 0°24′		
Vitex.				
V. trifolia L.	. . . . .	. . . . .	Cineol.	
Order **Labiatæ.**				
Rosmarinus.				
R. officinalis L.	. . . . .	. . . . .	. . . . .	See *Oil of Rosemary.*
Lavandula.				
L. dentata L.	0.926	. . . . .	Cineol.	"Holy rosemary" oil is used as a domestic remedy in Spain for washing wounds.
L. Stœchas L.	0.942	. . . . .	Cineol.	
L. angustifolia (L.) Mill.	. . . . .	. . . . .	. . . . .	See *Oil of Lavender.*
L. Spica Cav.	0.905–0.915	+3° to 7°	Cineol, camphor, linalool, geraniol (?), borneol, terpineol (?), pinene (?), camphene, sesquiterpene (?).	Spike oil is used as such, and is a common adulterant of oil of lavender.
L. pedunculata, Cav.	0.939	—44°54′	Cineol, thujone (?), esters.	
Mosla.				
M. Japonica Maxim.	0.820	. . . . .	Thymol, cymene (?).	
Nepeta.				
N. Cataria L.	1.041	. . . . .	. . . . .	Catnip oil.
Glechoma.				
G. hederacea L.	0.925	. . . . .	. . . . .	Ground ivy oil.
Agastachi.				
A. anethiodora (Nutt.) Britton.	0.943	—7°10′		
Salvia.				
S. Sclarea L.	0.907–0.928	—19° to —24°	Linalyl acetate (?).	Muscatel sage oil has a lavender-like odor.
S. officinalis L.	0.915–0.925	+10° to 25°	Cineol, camphor, thujone, borneol, pinene, cedrene (?).	Commercial distinctions are made between English, German, and Dalmatian oil of sage.
Monarda punctata L.	0.930–0.940	. . . . .	Limonene, thymol, cymene, carvacrol, thymoquinone, hydrothymoquinone, linalool (?).	Horsemint oil was formerly official in the U. S. P.
M. fistulosa L.	0.916–0.941	. . . . .	Carvacrol, limonene, cymene, thymoquinone, hydrothymoquinone.	Wild bergamot oil.
M. didyma L.	. . . . .	. . . . .	No phenols.	Oswego tea oil.
Melissa.				
M. officinalis L.	0.894–0.924	. . . . .	Citronellal (?), citral (?).	Commercial oil of balm is possibly oil of lemon distilled over balm, *Oleum Melissæ citratum.*
Hedeoma.				
H. pulegioides Persoon.	. . . . .	. . . . .	. . . . .	See *Oil of Pennyroyal.*
Satureja.				
S. Thymbra L.	0.905	. . . . .	Thymol, terpineol, bornyl acetate, pinene, dipentene, cymene.	

Order **Labiatæ.**	Sp. gr.	(α)D	Constituents.	Remarks.
Satureja.				
S. hortensis L.	0.900–0.925	. . . . .	Carvacrol, terpene, cymene.	"Pfefferkrautöl."
S. montana L.	0.939	—2° to —3°	Carvacrol, terpene.	
Hyssopus.				
H. officinalis L.	0.925–0.94	—17° to —23°	Thujone (?).	Oil of hyssop.
Cunila.				
C. origanoides (L.) Britton.	0.915	. . . . .	Thymol (?).	Oil of dittany resembles thyme oil.
Majorana.				
M. Majorana (L.) Rusby.	0.89–0.91	+5° to 18°	Terpineol, camphor (?), borneol (?), terpinene, terpin hydrate or pinol hydrate (?), sesquiterpene hydrate (?).	The nature of the substance that produces the peculiar odor of sweet marjoram is unknown.
Origanum.				
O. Onites L.	0.915–0.945	—3° to —13°	Linalool, cymene, carvacrol.	Cretian origanum oil is an important source for carvacrol.
O. hirtum Link.	0.94–0.98	. . . . .	Carvacrol, terpene(?), cymene.	
O. vulgare L.	0.870–0.910	—34.4°	Carvacrol (?), stearoptene (?).	
Thymus.				
T. vulgaris L.	. . . . .	. . . . .	. . . . .	See *Oil of Thyme.*
T. Serpyllum L.	0.890–0.920	—10° to 21°	Cymene, carvacrol, thymol.	Oil of wild thyme. As *Essence de Serpelot* mixtures of origanum, pennyroyal, and thyme oils are sometimes sold.
T. capitatus Hoffm. et Lk.	0.915	. . . . .	Bornyl acetate, pinene, dipentene, thymol, cymene, carvacrol (?).	
Koellia.				
K. incana (L.) Kuntze.	0.935			
K. Virginiana (L.) MacM.	0.918–0.936	+11°	Pulegone, carvacrol.	Resembles pennyroyal oil very closely.
Lycopus.				
L. virginicus Michx.	0.924	. . . . .	. . . . .	Oil of bugle weed.
Mentha.				
M. citrata Ehrh.	0.880	—2°14′	Pulegone (?).	Oil of watermint.
M. arvensis L.	0.857	—2°44′		
M. Pulegium L.	0.930–0.960	+17° to 23°	Pulegone.	European pennyroyal oil. Comp. *Oil of Pennyroyal.*
Russian.	0.934	. . . . .	Pulegone.	Russian pennyroyal oil.
M. spicata L.	. . . . .	. . . . .	. . . . .	See *Spearmint Oil.*
M. Canadensis L.	0.943	+16° to 20°	Pulegone, thymol or carvacrol.	Oil of wild mint.
M. crispa L.	. . . . .	. . . . .	Carvone.	German spearmint oil.
M. species.	0.883–0.885	—23°12′	Linalool, cineol, carvone, limonene.	Russian spearmint oil has an odor resembling but slightly that of spearmint.
M. piperita L.	. . . . .	. . . . .	. . . . .	See *Oil of Peppermint.*
Pogostemon.				
P. Heyneanus Benth.	0.970–0.995	—50° to —68°	Patchouly camphor, sesquiterpene, azulene.	Oil of patchouly is used in perfumery.
P. comosus Miq.	0.960	. . . . .	Acetone.	"Flowering patchouly" oil.
Ocimum.				
O. basilicum L.	0.905–0.930	—6° to —22°	Cineol, camphor, linalool, pinene, terpinhydrate, methyl chavicol.	French, German, and Réunion oils of sweet basil differ somewhat in composition.
O. b. var. *Selasish* Mekah.	. . . . .	. . . . .	Eugenol.	
Order **Rubiaceæ.**				
Chione.				
C. glabra DC.	. . . . .	. . . . .	*o*-hydroxyacetophenone, indol (?), body m.-p. 82° C.	
Order **Caprifoliaceæ.**				
Sambucus.				
S. nigra L.	. . . . .	. . . .	. . . . .	A concrete oil which, when greatly diluted, has an intensive elder blossom odor.

	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Order **Valerianaceæ.**				
Valeriana.				
V. officinalis L.	0.93–0.96	—8° to —13°	Borneol, bornyl formate, acetate, butyrate, and valerianate, bornyl oxide (?), terpineol (?), pinene, camphene, limonene (?), sesquiterpene, sesquiterpene hydrate.	Oil of valerian.
V. mexicana DC.	0.949		Isovalerianic acid (89 per cent.).	Mexican oil of valerian.
V. augustifolia DC.	0.990–0.996	. . . . .	Borneol, bornyl acetate and isovalerianate, kessyl acetate, terpineol, camphene, pinene, dipentene, sesquiterpene, valerianic aldehyde (?).	Kesso root oil.
V. Celtica L.	0.967			
Nardostachys.				
N. Jatamansi (Roxb.) DC.	0.9748	—19°5′	. . . . .	The odor suggests musk and patchouly.
Order **Compositæ.**				
Eupatorium.				
E. capillifolium (Lam.) Small.	0.935	+17°50′	Phellandrene.	Oil of dog fennel.
Ageratum.				
A. conyzoides L.	1.015	—2°45′	Sesquiterpene (?).	
Solidago.				
S. odora Ait.	0.963	. . . . .	Phellandreue, dipentene, borneol, bornyl acetate, cadinene, pinene.	Golden rod oil.
S. Canadensis L.	. . . . .	. . . . .		
S. rugosa Mill.	0.859	—11°10′		
Leptilon.				
L. Canadense (L.) Britton.	. . . . .	. . . . .	. . . . .	See *Oil of Erigeron.*
Blumea.				
B. balsamifera DC.	. . . . .	. . . . .	Borneol.	Of interest principally for the reason that it yields Borneo camphor, used for ritualistic and medicinal purposes in the Orient.
B. lacera DC.	0.9144	—66°	Borneol (?).	
Helichrysum.				
H. Stœchas DC.	. . . . .	. . . . .	Pinene (?).	
Inula.				
I. Helenium L.	. . . . .	. . . . .	Alanto-lactone, alantolic acid, alantol $(C_6H_8O)_x$.	Oil of elecampane is solid at ordinary temperature. It is used principally for the preparation of alanto-lactone, the helenin of Gerhardt.
Osmitopsis.				
O. asteriscoides Cass.	0.931	. . . . .	Camphor (?), cineol (?).	The odor suggests that of cajuput oil.
Ambrosia.				
A. artemisiifolia L.	0.870	—26°	. . . . .	Ragweed oil.
Anthemis.				
A. nobilis L.	0.905–0.915	+1° to 3°	Isobutyl, amyl, and hexyl esters of butyric, angelic, and tiglic acids, methycrylic acid (?), anthemol, paraffin.	Roman chamomile oil.
A. Cotula L.	0.858	. . . . .	Acid, m.-p. 58° C.	
Achillea.				
A. millefolium L. Flowers.	0.905–0.925	. . . . .	Cineol, azulene.	Oil of milfoil.
Roots.	. . . . .	. . . . .	Sulphur compound.	
A. nobilis L.	0.970			
A. moschata Jacq.	0.932–0.934	. . . . .	Cineol.	
A. tanacetifolia Allen.	0.924	. . . . .	. . . . .	Odor is suggestive of tansy.
A. ageratum L.	0.849	. . . . .	$C_{26}H_{44}O_3$ (?).	
Matricaria.				
M. Chamomilla L.	0.930–0.940	. . . . .	Paraffin, cœrulein, caprinic acid.	Oil of German chamomile.

Order **Compositæ.**	Sp. gr.	$(\alpha)_D$	Constituents.	Remarks.
Chrysanthemum.				
C. Parthenium (L.) Pers.	0.908–0.960	. . . . .	Borneol, camphor, terpene.	Oil of feverfew.
C. balsamita L.	0.943–0.949	—43° to —53°	Paraffin (?).	
Tanacetum.				
T. vulgare L.	0.925–0.940	+30° to 45°	Borneol, camphor, terpene(?), thujone, thujyl alcohol (?).	Oil of tansy is said to be poisonous, producing *la rage tanacetique.*
Pyrethrum.				
P. indicum Cass.	0.885	. . . . .	. . . . .	Kiku oil is used in Japan as a popular remedy.
Artemisia.				
A. vulgaris L.				
Herb.	0.907	. . . . .	Cineol.	
Root.	. . . . .	. . . . .	. . . . .	The root oil is semisolid.
A. Dracunculus L.	0.900–0.945	+2° to 9°	Methyl chavicol.	Oil of estragon.
A. pauciflora (Ledeb.) Webb.	0.915–0.940	. . . . .	Cineol, terpene.	Oil of Levant wormseed is obtained as a by-product in the manufacture of santonin.
A. Absinthium L.	0.925–0.955	. . . . .	Thujone, thujyl alcohol, thujyl acetate, isovalerianate and palmitate, pinene (?), phellandrene, cadinene, blue oil.	Wormwood oil, used in the preparation of absinthe, possesses toxic properties.
A. gallica Willd.	. . . . .	. . . . .	Camphor (?).	
A. Barrellieri Bess.	0.923	. . . . .	Thujone.	
A. glacialis L.	0.964	. . . . .	Fatty acid, m.-p. 16°C.	
Erechtites.				
E. hieracifolia (L.) Raf.	0.838–0.855	—1° to +2°	Terpene.	Oil of fireweed.
Petasites.				
P. Petasites (L.) Karst.	0.944	+2°18′	. . . . .	"Pestwurzöl."
Arnica.				
A. montana L.				
Root.	0.990–1.000	—1°58′	Caprylic and capronic acids (?), isobutyric and formic acids, phloryl isobutyrate, phlorol methyl ether, hydrothymoquinone methyl ether.	Arnica root oil.
Flowers.	0.897–0.906	. . . . .	Palmitic and lauric acids, paraffin (?)	A butyraceous mass.
Saussurea.				
S. Lappa Clark.	0.982–0.987	+15° to 16°	Phenol (?).	Oil of costus root resembles elecampane and violet.
Carlina.				
C. acaulis L.	1.030	. . . . .	Sesquiterpene (?), sesquiterpene hydrate (?), stearoptene.	Oil of carline thistle.
Spæranthus.				
S. indicus L.				

Constituents of Volatile Oils.—The impossibility of classifying the volatile oils chemically has been alluded to. Although but five elements, viz., carbon, hydrogen, oxygen, sulphur, and nitrogen, have been found in volatile oils thus far, a special classification of their constituents is impracticable. In this brief discussion of the chemical constituents they have been arranged according to a rational classification of organic chemical substances at large. The hydrocarbons, as basal compounds, are taken up first, and the numerous series are arranged in groups according to their degree of saturation. Of halogen derivatives of the hydrocarbons, there are none. The oxygenated compounds are again considered primarily according to the degree of saturation of the underlying hydrocarbons, and secondarily in series of the genetically related tribes of alcohols, aldehydes, ketones, acids, etc. Of sulphur and nitrogen derivatives, there are but few thus far.

For detailed information concerning these compounds, the reader should consult the larger hand-books on organic chemistry and the special monographs by Heusler, *Die Terpene* (1896), which has been translated into English and brought up to date by Pond in his *Chemistry of the Terpenes* (1902).

Hydrocarbons.—1. Of the formula of saturation C_nH_{2n+2}. This formula is represented by but one series, namely, the limit, or paraffin, or marsh-gas, or methane series. Unless

the stearoptene from rose oil, and like stearoptenes from other oils, prove to be very complex mixtures, this series is at present but sparingly represented in volatile oils. The lowest member thus far obtained and identified is the *n*-heptane, C_7H_{16}, which is the principal constituent of the oil of *Pinus Sabiniana* Douglas, the digger's pine of California. This coniferous oil differs, therefore, materially from the oils of its congeners, which contain largely pinene, $C_{10}H_{16}$, and related compounds. Besides rose oil, the oils of wintergreen and sweet birch, and some others, are known to contain minute quantities of solid paraffin hydrocarbons.

2. Of the formula of saturation C_nH_{2n}. Of this formula, one unsaturated chain series (ethylene) and several saturated cyclic series, the polymethylene series, are known. No definitely established representatives of any of these are to be found in volatile oil literature, although derivatives of such are among the most important constituents—*e. g.*, menthol, an alcohol of the hydrocarbon menthane, $C_{10}H_{20}$, a member of the hexamethylene series.

3. Of the formula of saturation C_nH_{2n-2}. Series of chain hydrocarbons with a triple bond (acetylene), two double bonds (propadiene series); unsaturated, monocyclic series with one double bond (cyclopropene, cyclobutene, etc., series), and saturated dicyclic series (dicyclobutane, etc.), are known as such or through their derivatives. In volatile oils neither the acetylene nor the propadiene series are represented thus far, though derivatives of the latter are known as important constituents—*e. g.*, the alcohols geraniol and linalool, the aldehyde citral, all of which are derived from chain hydrocarbons $C_{10}H_{18}$. Menthene, a monocyclic, unsaturated hydrocarbon $C_{10}H_{18}$, possibly occurs in peppermint oil. A dicyclic, unsaturated hydrocarbon has not yet been identified, although borneol and camphor are now generally regarded as being derived from such a hydrocarbon. The hydrocarbons of this class are sometimes known as dihydroterpenes, $C_{10}H_{16} + H_2$. According to the Geneva Congress nomenclature, the designation terpene ($\approx$ menthene) is given to such hydrocarbons of this class which can be regarded as tetrahydrocymenes or at least have a similar general configuration.

4. Of the formula of saturation C_nH_{2n-4}. This formula is represented by numerous series. That group of hydrocarbons with 10 carbon atoms, namely, $C_{10}H_{16}$, irrespective of the series to which they belonged, has been designated by the group name terpene. According to the Geneva Congress nomenclature, some of these terpenes are terpadienes, the designation terpene, according to that style of nomenclature, being restricted to certain hydrocarbons, $C_{10}H_{18}$. The camphenes, terpilenes, etc., of older authors are lesser groups of hydrocarbons, $C_{10}H_{16}$.

It is noteworthy that practically all hydrocarbons of this formula of saturation found in volatile oils contain 10 carbon atoms. In the literature of volatile oils they have played so important a rôle that its chemical chapters have commonly been regarded as synonymous with the literature of the terpenes (old style) and their derivatives (camphors, etc.).

According to series, this group of terpenes can be classed into chain hydrocarbons with three double bonds (*e. g.*, myrcene) or their structural equivalent; into monocyclic hydrocarbons with two double or one treble bond (*e. g.*, the terpinolenes); into dicyclic hydrocarbons with one double bond (*e. g.*, pinene, limonene, camphene); and into saturated tricyclic hydrocarbons. The last, though stable, would probably be characterized by chemical indifference and therefore escape detection. The first is characterized, on the other hand, by great instability. Its representatives might be expected to undergo decomposition even in the process of distillation of the oil, hence the only probable representative, myrcene, is of recent discovery. It and its more immediate isomers have also been designated aliphatic terpenes.

Many of the representatives of the terpene group exist in different optical modifications, namely, dextrogyrate and lævogyrate. Mixtures of equal quantities of these are inactive. In some instances there may be optical inactivity by inner compensation (dipentene?). On account of this isomerism, subgroups of terpenes are commonly referred to. Such subgroups are:

Pinene.—This is liquid and widely distributed. The principal source of dextropinene is American turpentine oil, that of lævo-pinene French turpentine oil. It is characterized by its hydrochloride, $C_{10}H_{16}.HCl$, the artificial camphor of older literature, and by its nitrosochloride, $C_{10}H_{16}NOCl$, and nitrolamine bases. From the nitrosochloride it can be regenerated in the optically inactive form. When pure it boils at about 155° C. (311° F.).

Camphene.—Although solid, it has been isolated as such but from one oil (*Abies Sibirica*). By its conversion into isoborneol its presence in other oils has been ascertained (citronella oil, camphor oil, lemon oil, ginger oil, and Japanese valerian oil). Artificially it can be obtained from pinene hydrochloride, $C_{10}H_{16}.HCl - HCl = C_{10}H_{16}$. It melts at about 48°–49° C. (118.4°–120.2° F.) and boils at about 160°–161° C. (320°–321.8° F.). There are two optical modifications.

Fenchene.—Though not yet isolated from volatile oils, it is supposed to be a constituent of several turpentine oils. It is liquid, boils at about 155°–156° C. (311°–312.8° F.), and exists in two optical modifications.

Limonene.—Like pinene, it formerly had a different name for each occurrence—*e. g.*, carvene, the *d*-limonene of caraway oil, citrene, the same hydrocarbon in lemon oil, etc. Next to pinene, it is the most widely distributed terpene in nature. Dextrogyrate limonene constitutes the bulk of the oils of orange, lemon, and erigeron, about 50 per cent. of caraway oil, etc. Lævogyrate limonene constitutes the bulk of a pine-needle oil and about 50 per cent. of American spearmint oil. The inactive modification is generally designated

Dipentene, which also has been found in many oils and named according to source—*e. g.*, cinene, cajuputene, etc. The hydrocarbons of this group are liquid, boil at about 175° C. (347° F.), and are characterized by their tetrabromides, $C_{10}H_{16}Br_4$, and by their nitrosochlorides and nitrolamine derivatives.

Sylvestrene, known thus far only in its dextrogyrate modification, is found in the Swedish and also the Russian turpentine oil. It is liquid, and boils at about 176°–177° C. (348.8°–350.6° F.). It is characterized by its nitrosochloride and nitrolamine base. Carvestrene, obtained artificially by the distillation of carvylamine hydrochloride, is supposed to be identical with optically inactive sylvestrene. It exists in two stereo-isomeric forms, ortho-carvestrene and pseudo-carvestrene.

Terpinolene has not yet been found in nature. It is exceedingly unstable and has not been prepared in pure form. It boils at about 185°–190° C. (365°–374° F.). It is characterized by its tetrabromide.

Phellandrene derives its name from *Phellandrium aquaticum*, in which dextro-phellandrene was first found. The lævogyrate variety is quantitatively an important constituent of therapeutically inferior eucalyptus oils (*E. amygdalina*, etc.). It is liquid, boils at about 170° C. (338° F.), and is characterized by its so-called nitrosite, $C_{10}H_{16}.N_2O_3$. See test under Eucalyptus Oil.

Terpinene has been identified in cardamom oil and in marjoram oil by means of its nitrosite, yet there exists doubt as to its pre-existence in oils. It is formed from pinene by the action of sulphuric acid (see Terebene). By some it is regarded as the pseudo form of limonene. It boils at about 179°–181° C. (354.2–357.8° F.) and is optically inactive.

Other representatives of this group are thujene or tanacetene; the readily resinifiable terpene from the resin of Indian hemp; the hydrocarbon from pulegol ($C_{10}H_{18}O - H_2O = C_{10}H_{16}$); fenchelene; euterpene; tricyclene; bornylene; sabinene.

The close relationship of many of these hydrocarbons finds expression in the readiness with which some of them are converted into their isomers. Thus, pinene can be converted indirectly into camphene, limonene, terpinene, and terpinolene.

Though quantitatively among the most important constituents of volatile oils, from the standpoint of therapeutics and flavor they can be regarded generally as diluents rather than essential constituents. Thus the eucalyptus oils are regarded as superior in the proportion in which cineol predominates and phellandrene is reduced in quantity. For liquors and essences, the terpenes are frequently removed because of their sparing solubility in dilute alcohol. These products are designated concentrated or terpeneless oils—*e. g.*, concentrated oil of caraway for the manufacture of "Kuemmel," and terpeneless oil of lemon for the manufacture of essence of lemon.

5. Of the formula of saturation C_nH_{2n-6}. The best-known series of this formula is a monocyclic series with three double bonds, the benzene series. Of this series, a single representative, the cymene $C_{10}H_{14}$, has been found in the oils of several species of *Thymus*, *Monarda*, etc. It is of interest as such, and because it is the hydrocarbon underlying the two isomeric phenols thymol and carvacrol; also because of its structural relation to some of the terpenes, which as a class have been designated dihydrocymenes. With most terpenes, however, this relation is empirical but not structural.

A group of hydrocarbons, the sesquiterpenes, $C_{15}H_{24}$ (= one and a half terpene = $C_{10}H_{16} + C_5H_8$), also come under this formula of saturation. As is the case with the terpenes, this name is applied to all hydrocarbons $C_{15}H_{24}$ irrespective of the series to which they may belong. The following types, however, should be distinguished: (*a*) chain compounds with 4 double bonds or their equivalents (the sesquiterpene from citronella oil is a possible representative); (*b*) monocyclic hydrocarbons with 3 double bonds (zingiberene); (*c*) dicyclic hydrocarbons with 2 double bonds (cadinene, caryophyllene, etc.); (*d*) tricyclic hydrocarbons with 1 double bond. (clovene, etc.); (*e*) tetracyclic saturated hydrocarbons. Like the saturated members of the terpene group, those of the sesquiterpene group have no marked chemical characteristics and have thus far failed of detection if they exist in volatile oils. Those of type *a* being very unstable, may decompose at least in part during the process of distillation of the oil. Most of the numerous sesquiterpenes, known by fanciful names, and not characterized chemically, are in all probability representatives of the series under *c* and *d*.

Cadinene derives its name from oil of cade. If its hydrochloride is characteristic of this hydrocarbon, it occurs widely distributed. It may be, however, that other compounds yield cadinene dihydrochloride when treated with hydrochloric acid. Characteristic of this hydrocarbon appears to be its nitrosochloride.

Caryophyllene derives its name from oil of cloves, of which it constitutes about 10 per cent. It is also found in the oil of *Canella alba* and oil of pepper. It is readily characterized by its blue nitrosite.

Humulene has been isolated from oil of hops and is characterized by its nitrosochloride.

Other sesquiterpenes are clovene, obtained by the dehydration of caryophyllene hydrate, $C_{15}H_{25}OH$; cedrene, obtained in like manner from cedrol, also preëxisting in cedarwood oil; α- and β- santalene.

The sesquiterpenes are all liquid, so far as known; have high boiling-points, 240°–260° C. (464°–500° F.); and as a rule are difficultly soluble in alcohol. Though formerly regarded as useless and objectionable constituents in many volatile oils, some are greatly appreciated in perfumery as giving body to an aroma; others are important as giving rise to hydrates or camphors—*e. g.*, cubeb camphor in old cubebs exposed to a moist atmosphere, etc.

6. Of the formula of saturation C_nH_{2n-8}. Of the numerous series of hydrocarbons, but a single series appears thus far to be represented by a single member, viz., styrene, $C_6H_5CH{=}CH_2$, a hydrocarbon with a benzene nucleus and an unsaturated side chain. It is characterized by its dibromide, $C_6H_5CHBrCH_2Br$. It occurs in storax oil and xanthorrhœa resin oil. Possibly it does not preëxist in the plant, but is a decomposition-product of cinnamic acid.

7. Of the formula of saturation C_nH_{2n-10}. Here also but a single representative can be mentioned, and that one of recent discovery, viz., naphthalene.

8. Of still less saturated hydrocarbons, the diterpenes $C_{20}H_{32}$, the triterpenes $C_{30}H_{48}$, and the tetraterpenes $C_{40}H_{64}$, need only be mentioned. Very little is known about them and their existence in volatile oils is still doubtful. If they occur in oils, they are more likely to be polymerization-products of lesser hydrocarbons than plant products isolated from plant organs by steam or water distillation. Amyrin is regarded as a hydrate of a triterpene.

Oxygen Derivatives of Hydrocarbons.—Halogen derivatives have thus far not been found among volatile plant products, hence the presence of chlorine in a commercial oil of bitter almonds may serve as a means of detecting an impure artificial product.

Of the hydroxy substitution-products of hydrocarbons and their dehydration-products—alcohols, aldehydes, ketones, acids, esters, lactones, oxides—a very large number have been isolated from volatile oils, thoroughly studied and characterized. Many of them are quantitatively significant—*e. g.*, menthol in peppermint oil; others, though quantitatively not so important, are regarded therapeutically essential—*e. g.*, cineol in eucalyptus and other oils, thymol, etc.; still others, which play quantitatively an insignificant rôle, are of greatest importance as flavoring agents. Thus, lemon oil was not long ago classed with the so-called hydrocarbon oils supposed to be free from oxygenated constituents. To-day certain manufacturers regard the 90 per cent. of limonene as worse than worthless, and desire the remaining 10 per cent. of citral and other oxygenated constituents of the oil The peculiar flavor of rose oil is due in part to a very small percentage of constituents as yet unknown.

1. Hydroxy Substitution-products of the Paraffin Hydrocarbons (Hydrocarbons C_nH_{2n+2}) and their Dehydration-products.

Number of carbon atoms.	R′OH	R″(OH)$_2$—H$_2$O		R‴(OH)$_3$—H$_2$O	R⁗(OH)$_4$, etc.
	Alcohols.	Aldehydes.	Ketones.	Acids.	Miscellaneous.
1	CH_3OH Methyl	. . . . .	. . . . .	HCOOH Formic	
2	C_2H_5OH Ethyl	CH_3CHO Acetic	. . . . .	CH_3COOH Acetic	
3	. . . . .	. . . . .	CH_3COCH_3 Dimethyl	C_2H_5COOH Propionic	
4	C_4H_9OH Butyl	C_3H_7CHO Butyric	. . . . .	C_3H_7COOH Butyric	$CH_3COCOCH_3$ Diacetyl
5	$C_5H_{11}OH$ Amyl	C_4H_9CHO Valerianic	. . . . .	C_4H_9COOH Valerianic	
6	$C_6H_{13}OH$ Hexyl	$C_5H_{11}CHO$ Caproic	. . . . .	$C_5H_{11}COOH$ Caproic	$C_4H_8(COOH)_2$ Dimethyl succinic acid
7	. . . . .	. . . . .	$CH_3COC_5H_{11}$ Methyl amyl	$C_6H_{13}COOH$ Heptoic	
8	$C_8H_{17}OH$ Octyl	. . . . .	. . . . .	$C_7H_{15}COOH$ Caprylic	
9	. . . . .	. . . . .	$CH_3COC_7H_{15}$ Methyl heptyl	$C_8H_{19}COOH$ Pelargonic	
10	. . . . .	. . . . .	. . . . .	$C_9H_{19}COOH$ Capric	
11	. . . . .	. . . . .	$CH_3COC_9H_{19}$ Methyl nonyl		
12	. . . . .	$C_{11}H_{23}CHO$ Lauric	. . . . .	$C_{11}H_{23}COOH$ Lauric	
13					
14	. . . . .	. . . . .	. . . . .	$C_{13}H_{27}COOH$ Myristic	$C_{13}H_{26}(OH)COOH$ Oxymyristic acid
15	. . . . .	. . . . .	. . . . .	. . . . .	$C_{14}H_{28}(OH)COOH$ Oxypentadecylic acid
16	. . . . .	. . . . .	. . . . .	$C_{15}H_{31}COOH$ Palmitic	

The above table clearly reveals the incorrectness of the statement that most of the constituents of volatile oils contain 10 carbon atoms ; in other words, are terpenes or their immediate derivatives.

These compounds can be studied as representatives of homologous series—*e. g.*, the alcohols, aldehydes, etc. ; or they can be studied in groups of compounds having the same number of carbon atoms—*i. e.*, butyl alcohol, butyric aldehyde, butyric acid.

Inasmuch as but few, if any, deductions can be drawn as yet from the occurrence of members of the same homologous series in the same or related plants, this plan will not be adopted here, though chemically the simpler one. On the other hand, a simple relation between butyric alcohol, aldehyde, and acid manifests itself at once, and the occurrence of any two of them or of all three can easily be explained from the original formation of one by the plant.

(1 and 2) The question whether methyl and ethyl alcohols exist as such in the plants is still an open question. They enter the oil in but minute traces, since most volatile oils are made by distillation with steam or water, and these alcohols are more readily soluble in the water than in the oil.

As myristic ester, methyl alcohol occurs in orris oil ; as salicylate it is widely distributed in nature, though but few plants produce it in sufficient quantity to yield commercial oils, namely, gaultheria and sweet birch (see Oil of Wintergreen). An assay of senega root was at one time based on its methyl salicylate content, but was found unsatisfactory.

Ethyl alcohol has been isolated from a number of aqueous distillates of plants, notably of *Heracleum* species, in which it is found as butyric ester. As oxymyristic and veratric esters it occurs in *Sabadilla officinalis*, as cinnamic ester in *Liquidambar orientalis.*

Acetic aldehyde has been found in several oils ; and acetic acid is widely distributed as ester : hexyl, octyl, menthyl, linalyl, geranyl, bornyl, terpinyl, etc., acetates. These will receive attention under the respective alcohols.

(3) On account of its ready solubility in water, acetone is found in traces only; propionic acid has been found as such and as ester.

(4) Isobutyl alcohol occurs as isobutyrate and as angelic ester in Roman chamomile. A butyric aldehyde has been isolated from a commercial eucalyptus oil, from which it should be removed before the oil is used medicinally, because of the irritation it produces when inhaled. Butyric acid has been isolated from a number of oils, free and as ester: hexyl, octyl, linalyl, terpinyl esters. Isobutyric acid has also been found as ester.

(5) Traces of amyl alcohol have been found in a eucalyptus oil and in American peppermint oil. Valerianic aldehyde has been found in eucalyptus and cajuput oils. Valerianic acid occurs as hexyl and octyl esters in male fern, as geranyl and linalyl esters in sassafras, as bornyl ester in several plants.

(6) Hexyl alcohol occurs as acetate, butyrate, valerianate, caproate, caprylate, pelargonate, as tiglate and angelate—*e. g.*, in heracleum, arnica, male fern, and Roman chamomile (see these oils for respective constituents). Like some of the lower aldehydes, caproic aldehyde has been found in eucalyptus oil. Caproic acid has been found as such and as hexyl, octyl, etc., esters.

(7) Methyl amyl ketone has been isolated from clove oil, to which it is supposed to impart the finer clove aroma.

(8) Octyl alcohol has been found as acetate, butyrate, valerianate, caproate, œnanthate, caprylate, caprinate, and laurinate in much the same oils in which the corresponding hexyl esters occur. Caprylic acid is found with caproic acid.

(9) Methyl heptyl ketone and methyl nonyl ketone are found in oil of rue; the former predominates in the Algerian oil, the latter in the Spanish. Pelargonic acid has been found as ethyl, amyl, hexyl, and octyl esters.

(10) Capric acid occurs as ethyl, amyl, and octyl esters.

(11) See paragraph (9).

(12) Lauric aldehyde has been found in rue; lauric acid as such and as octyl ester.

(14) Myristic acid occurs as such and as methyl ester in orris oil. Oxymyristic acid in the oil of *Archangelica officinalis*, its ethyl ester in *Sabadilla officinalis*.

(15) Oxypentadecyclic acid also occurs in *Archangelica officinalis*.

(16) Palmitic acid has been obtained from several oils.

2. Oxygen Derivatives of Hydrocarbons C_nH_{2n}.—*a*. The number of oxygen derivatives of the olefine series of hydrocarbons found thus far in volatile oils is not large. In the order of the number of carbon atoms, the following individuals and groups should here be mentioned: methacrylic acid, $CH_2{:}C(CH_3)COOH$, which occurs as an ester in Roman chamomile; the two stereoisomeric angelic and tiglinic acids, $CH_3CH{:}C(CH_3)COOH$, which also occur in the same plant; methyl heptenone, $CH_3C(CH_3){:}CHCH_2CH_2COCH_3$ (methyl-2-heptene-2-one-6), which has been isolated from several andropogon oils; citronellol, $C_9H_{17}CH_2OH$, and its corresponding aldehyde, citronellal, $C_9H_{17}CHO$, the former being a constituent of the oil of *Andropogon schœnanthus*, rose oil, and rose geranium oil, the latter of two andropogon oils, of several eucalyptus oils, of several oils of the *Citrus* genus, etc.; finally, oleic aldehyde, $C_8H_{17}CH{:}CH[CH_2]_7CHO$, and its corresponding acid, oleic acid, both being found in orris oil.

b. Of the hexamethylene series a still smaller number of compounds are known to occur in volatile oils, but two of these are of the greatest interest. The alcohol menthol, $C_{10}H_{19}OH$, and its corresponding ketone, the menthone, $C_{10}H_{18}O$, occur in peppermint oil, the former both as free alcohol and as ester. The finer aroma, and hence the greater commercial value, of peppermint oil is supposed to be largely due to the percentage of esters present. For menthol assay, free and as ester, see Oil of Peppermint.

The diatomic alcohol terpin, $C_{10}H_{18}(OH)_2$, or rather its hydrate, the terpin hydrate of the U. S. P., is occasionally met with in pinene-containing oils. It is not supposed to have distilled over with the oil from the plant, but to have formed in the distilled oil by hydration, viz., $C_{10}H_{16} + 3H_2O = C_{10}H_{18}(OH)_2.H_2O$. The terpin hydrate of the market, however, is not obtained from these oils, in which its formation appears to be largely accidental, but by the indirect hydration of pinene (turpentine oil) with water and nitric acid. A dehydration-product of the terpin $C_{10}H_{18}(OH)_2 - H_2O = C_{10}H_{18}O$, the cineol or eucalyptol, is widely distributed. It is the principal constituent which gives medicinal value to the eucalyptus oils. Its presence in larger percentage in English lavender oil causes this to be more sought as a perfume by English-speaking people than the French

oil, which contains much more linalyl acetate. Cineol or eucalyptol is also official as such (see Eucalyptol).

c. There are several oxygen derivatives of hydrocarbons C_nH_{2n} that have not yet been subclassified—*e. g.*, hedeomol.

3. Oxygen Derivatives of Hydrocarbons C_nH_{2n-2}.—*a.* Of the chain series, only that one with two double bonds is represented, and this only by the two isomeric alcohols, $C_{10}H_{17}OH$, geraniol and linalool, and by citral, $C_{10}H_{16}O$, the aldehyde corresponding to the former. All these compounds, though comparatively new in volatile oil literature, are found to be fairly widely distributed. Geraniol derives its name from oil of rose geranium, from which it was first obtained, linalool from oil of lignaloe. Both are found as such and as ester. Linalyl acetate is regarded as the principal constituent of bergamot oil, which is assayed and valued according to its linalyl acetate content. French lavender oil is also rich in this ester, whereas the English oil contains but a small per cent., yet the latter oil has a greater commercial value.

Citral is found to the extent of 70 to 80 per cent. in lemongrass oil, which is the principal source of the commercial article. With citronellal it is found in lemon oil, of which it is an essential constituent, though present in but small quantity. Being more soluble in dilute alcohol than limonene, it enters largely into the water-soluble extracts of lemon. It is also a principal constituent of the concentrated and terpeneless oils of lemon. As a lemon flavor, however, it cannot be displaced by citral from lemongrass oil, since the peculiar lemon flavor is not due to citral alone. Moreover, lemongrass oil appears to contain other aldehydes than citral, which are not readily separated, and which influence the odor of the commercial citral obtained from this source.

b. Of monocyclic unsaturated compounds, the isomeric terpineols should be mentioned. These alcohols, $C_{10}H_{17}OH$, derive their name from terpin hydrate, from which one of them is obtained artificially on a commercial scale: $C_{10}H_{18}(OH)_2—H_2O = C_{10}H_{17}OH$. (Compare the corresponding reaction resulting in the formation of cineol.) It is used in the preparation of artificial lilac and other perfumes. The four isomeric terpineols occur in a variety of oils, both free and as ester, principally as acetate.

To this group belongs the ketone, pulegone, $C_{10}H_{16}O$, the principal constituent of pennyroyal oil; possibly also dihydrocarvone.

c. To the group of dicyclic saturated compounds belong the alcohol borneol, $C_{10}H_{17}OH$, and its corresponding ketone camphor, $C_{10}H_{16}O$; also thujyl alcohol and thujone, isomeric with the former. Borneol occurs both as such (*Dryobalanops camphora*—Borneo camphor) and as ester, principally as acetate. In the latter form it is a principal constituent of the pine-needle oils. The artificial ester is sold as artificial pine-needle oil (*Tannennadelöl*). Camphor is the principal constituent of the oil of *Laurus camphora*, but enters the market principally as such, having been isolated from the oil. Its artificial production on a large scale from turpentine oil is promised in the near future. All the above related compounds are found widely distributed both in their dextrogyrate and lævogyrate modifications.

Isomeric with camphor is also fenchone, a ketone found in fennel oil, from which it derives its name.

d. A heterocyclic compound, the furol or furfuric aldehyde, $C_4H_3O.CHO$, remains to be mentioned. It was first found in oil of cloves, and, since it has the property of gradually becoming darker, it has been surmised that the darkening of oil of cloves is due to the presence of this unsaturated aldehyde.

e. There are also several compounds that cannot be subclassified—*e. g.*, sedanolid, etc.

4. Oxygen Derivatives of Hydrocarbons C_nH_{2n-4}.—*a.* None of the several series of chain hydrocarbons are thus far represented among the known constituents from volatile oils. Like myrcene, the so-called aliphatic terpene, they are, in all probability, rather unstable, and hence will either be decomposed in the preparation of the volatile oil or by the reagents used in their study.

b. A monocyclic compound with two double bonds is the diketone thymoquinone, $C_{10}H_{12}O_2$. It occurs as such in the monarda oils; also, combined with hydrothymoquinone, as thymoquinhydrone, a pigment which dissolves in the phenols of these oils with a reddish-brown color. The color of red oil of thyme is probably also due to the same pigment.

c. Dicyclic, with one double bond, is carvone according to Baeyer's formula. This ketone, $C_{10}H_{14}O$, in its dextrogyrate modification is the principal constituent of caraway

oil; its lævogyrate modification occurs in spearmint oil. Under the name of *Oleum Carvi*, carvone is official in the P. G.

d. Among the unclassified substances of this group are kessyl alcohol, $C_{10}H_{15}OH$, and its isomer sabinol, formerly supposed to have the formula $C_{10}H_{17}OH$. The former is found as such and as valerianic ester in the oil of kesso root, the latter as such and as acetate in oil of savin (*Juniperus sabina*), of which the ester is regarded as the principal constituent.

An important group of constituents belonging here are the sesquiterpene hydrates, most of which appear to be alcohols: $C_{15}H_{24} + H_2O = C_{15}H_{25}OH$. These are evidently widely distributed, but few are as yet well characterized. Santalol, the principal constituent of the oil of *Santalum album*, is possibly the most important of this group from a pharmaceutical point of view. Some of these, possessing crystalline form, are known as camphors. Thus, ledum camphor from *Ledum palustre*, and cubeb camphor from oil of cubebs. The latter is found primarily, if not exclusively, in the oil from old cubebs, and is supposed to be the product of hydration of the sesquiterpene formed by long storage of the berries.

5. Oxygen Derivatives of Hydrocarbons C_nH_{2n-6}.—Of the large number of chain and cyclic series of hydrocarbons of this formula of saturation, oxygen derivatives of but one series, viz., the benzene series, are known.

a. Of the hydroxy derivatives of the benzene nucleus, the phenols, the isomers thymol and carvacrol are widely distributed. Thymol derives its name from *Thymus vulgaris*, but the principal commercial source is ajowan oil, at times horsemint oil. Carvacrol, which derives its name from the isomeric ketone carvone, from which it can readily be obtained, is found principally in oil of wild bergamot belonging to the same genus with horsemint.

Of diatomic phenols, hydrothymoquinone has been found as such and in the form of the pigment thymoquinhydrone (comp. thymoquinone) in the monarda oils. As dimethyl ether it has been found in arnica root oil, as ethyl ether in star-anise oil.

Of the phenols with a lesser number of carbon atoms, *p*-cresol has been found as methyl ether in ylang-ylang oil; phlorol, as isobutyric ester and also as methyl ether in arnica root oil.

b. The oxygen compounds, in which the oxygen is connected with the saturated fatty side chain, are more numerous. They are mostly aldehydes and acids. The simplest representative, the benzaldehyde, is formed whenever amygdalin-containing drugs are submitted to distillation after maceration to permit hydrolysis of the glucoside. Amygdalin is very widely distributed, but not often present in sufficient quantity to yield sufficient benzaldehyde to separate as oil from the aqueous distillate. The principal natural sources for commercial benzaldehyde (bitter almond oil) are the kernels of the bitter almond, the peach, and the apricot. Inasmuch as benzaldehyde is very prone to oxidation, oils containing it are apt to contain benzoic acid as well, especially when old and exposed to air.

Hydroxy benzoic aldehyde or salicylic aldehyde is found in spiræa oil. Salicylic acid is especially widely distributed as methyl ester, mostly the product of hydrolysis of a glucoside. In commercial quantities it was first obtained from wintergreen leaves, hence oil of wintergreen. At present the principal oil, consisting almost entirely of methyl salicylate, is oil of sweet birch. Most plants, however, do not contain sufficient glucoside to yield commercial oils.

Cuminic or *p*-isopropyl benzaldehyde occurs in cicuta and eucalyptus oils.

Anisic or *p*-methoxybenzaldehyde occurs in old anise and fennel oils in which, together with anisic acid, it is formed by the oxidation of anethol. Vanillin or *m*-methoxy-p-hydroxybenzaldehyde results upon oxidation of coniferyl alcohol, a product of hydrolysis of the glucoside coniferin. Heliotropin, the methylene ether of a diatomic phenol of benzaldehyde (1 : 2 : 3), and vanillin occur as such in spiræa oil.

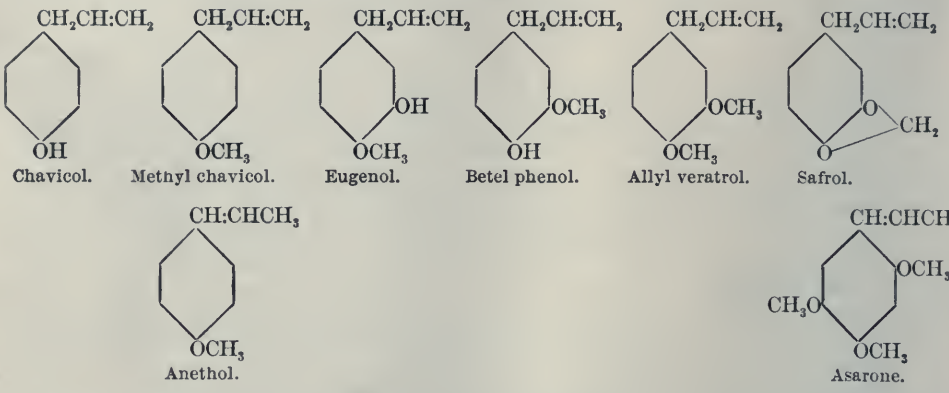
The only ketone of the benzene series thus far found in a volatile oil is the anisic ketone, $C_6H_4.OCH_3[^1],CH_2CO.CH_3[^1]$, reported to occur in anise and fennel oils.

In addition to the acids of this series already referred to, namely, benzoic, salicylic, and anisic acids, veratic acid, $C_6H_3(OCH_3)_2COOH$, found in cevadilla seed oil, should be mentioned.

6. Oxygen Derivatives of Hydrocarbons C_nH_{2n-8}.—Here also oxygen deriva-

tives of but one series of hydrocarbons, namely, of those containing a benzene nucleus with an unsaturated side chain, are known to exist in volatile oils.

a. Those of the nature of phenols and phenol ethers are the more numerous and important. Their relationship is best expressed by the following formulas:



Heated with alcoholic potassium hydroxide solution the allyl compounds (upper series) are converted into the corresponding propenyl compounds (lower series), thus methyl chavicol into anethol, eugenol into isoeugenol, etc., but whereas the latter are more stable toward this reagent, their occurrence in the vegetable kingdom does not appear to be so common.

Chavicol occurs in betel-leaf oil from Java and in bay oil. Methyl chavicol (estragol) was first found in anise-bark oil and later in estragon oil. Accompanying its isomer, anethol, it occurs in the oils of anise, star-anise, and fennel.

Eugenol is found in considerable amount in oil of cloves and oil of clove stems, in the former also as acetic ester. It appears to be fairly widely distributed, the oils of allspice and bay being rich in this phenol. Commercially it has also been obtained from camphor oil after the camphor had been removed. It is frequently accompanied by its methyl ether, the allyl veratrol, thus, *e. g.*, in bay oil. Its isomer, betel phenol, is the principal constituent of betel-leaf oil.

Safrol, a methylene ether, is the principal constituent of sassafras oil and, like eugenol, has been obtained on a commercial scale from camphor oil. It is also a constituent of cinnamon-leaf oil, star-anise oil, and massoy-bark oil.

Asarone is a constituent of the oil of *Asarum Europæum* and of matico oil.

As derivatives of a tetratomic phenol the isomeric apiols, $C_6H.C_3H_5.O_2CH_2.(OCH_3)_2$, should be mentioned. The common apiol is contained in parsley-seed oil and in Venezuelan camphor-wood oil. Its isomer, the dill apiol, has been found in East Indian dill oil.

b. Of the oxygen derivatives of the olefinic benzene hydrocarbons which have the oxygen in the side chain, cinnamic aldehyde and acid are the principal compounds to be enumerated. The former constitutes a large part of cassia oil, which is valued according to its aldehyde content. It is also an important constituent of cinnamon oil, which, however, contains numerous other substances that render it more valuable than cassia oil. Like benzaldehyde, cinnamic aldehyde is readily oxidized, hence oils containing this aldehyde are apt to contain this acid also, especially when exposed to the air.

In this connection there may also be mentioned the *o*-methoxy cinnamic aldehyde (*o*-cumaric aldehyde methyl ether) found in cassia oil, and cumarin.

Sulphur Derivatives of Hydrocarbons.—Of sulphur compounds corresponding to alcohols, aldehydes, ketones, acids, and esters, none has thus far been found in volatile oils. However, a few compounds corresponding to the ethers have been observed thus far, viz., dimethyl sulphide, $(CH_3)_2S$, in American oil of peppermint; vinyl sulphide, $(C_2H_3)_2S$, in the oil of *Allium ursinum;* allyl sulphide, $(C_3H_5)_2S$, was formerly supposed to be the principal constituent of the oils of garlic and onion. According to Semmler, however, the constituents are a disulphide $C_6H_{12}S_2$ (allyl propyl disulphide = $C_3H_5S.SC_3H_7$), a disulphide $C_6H_{10}S_2$, a trisulphide $C_6H_{10}S_3$, and even higher polysulphides.

When fresh herbs and seeds, rich in albuminous substances, are distilled, the forma-

tion of hydrogen sulphide is not infrequently observed. Small amounts of carbon disulphide have been found in the oil of black mustard.

NITROGEN DERIVATIVES.—Of simple amido compounds, none have been found thus far. Of mixed compounds, *o*-amido benzoic or anthranilic acid has been found recently as methyl ester in oil of orange flowers, in which it plays an important rôle as perfume. Whereas the oil extracted from orange-flower water contains as much as 16 per cent. of this ester, and the commercial oil, which is obtained as a by-product in the distillation of orange-flower water, less than 1 per cent., it becomes apparent that commercial oil of orange flowers should not be used in making orange-flower water.

Of nitriles several are known to occur in oils. Hydrocyanic acid, the nitrile of formic acid, occurs widely distributed in nature in the form of a glucoside (comp. Benzaldehyde). The nitrile of phenyl acetic acid has been found in the oils of *Tropæolum majus* and *Lepidium sativum*, the nitrile of phenyl propionic acid in the oil of *Nasturtium officinale*. Gadamer, however, has shown that these substances are formed only when the material is not treated properly before distillation. These nitriles are decomposition-products due to the action of heat on glucosides contained in the plants. If ferments are allowed to act on these glucosides before distillation, mustard oils result as they do in related plants.

Mixed Sulphur and Nitrogen Compounds.—The mustard oils, the esters of isothiocyanic acid, are obtained from a number of cruciferous plants when properly treated, and are characterized by their extremely pungent odor. The common mustard oil or allyl isosulphocyanate is obtained from *Brassica nigra* and *B. juncea*. It has also been found in the following plants: *Alliaria officinalis, Capsella bursa pastoris, Cardamine officinale, Sisymbrium officinale, Cochlearia armoracia*, and *Thlaspi arvense*. Secondary butyl mustard oil constitutes the principal constituent of oil of spoonwort; *p*-hydroxybenzyl mustard (sinalbin mustard) oil is obtained from the seeds of *Sinapis alba;* phenyl ethyl mustard oil from mignonette root; benzyl mustard oil from *Tropæolum majus* and *Lepidium sativum;* phenyl ethyl mustard oil from *Nasturtium officinale*.

The Examination of Volatile Oils.—The criteria by which oils are most commonly judged are appearance, odor, and taste. The latter qualities are of greatest importance to the perfumer, the confectioner, and manufacturer of liquors. When used as flavoring agents for galenicals, they are equally important to the pharmaceutical manufacturer. The physiological standards by which experts judge oils are, however, difficult of exact description. The standards will also vary with different experts. For this reason physical standards were ascertained and used at an early date in the manufacture and sale of these oils. Among these the specific gravity and solubility test in alcohol have possibly played the more important rôle. With an increasing knowledge of the chemical constituents of the oils, chemical methods have become more prominent.

As a rule no great changes result in the volatile constituents of plants when the latter are transplanted from their native habitat and cultivated. Differences in climate, season, soil, and cultivation, however, do bring about changes, and even different conditions of temperature and humidity will produce qualitative and quantitative changes on the same plantation in different years. As a result of these studies, the limits of constants are now widened, when comparatively few years ago they were being drawn rather sharply.

Besides, skilful adulteration often makes detection absolutely impossible. Thus, no one can detect by chemical or other means the presence of pure, artificial methyl salicylate in oil of wintergreen, or of pure, artificial benzaldehyde in oil of bitter almond. The nose of the expert perfumer may detect a slightly foreign odor in an artificial oil of lemon made by adding citral from a grass oil to washed lemon oil, but such a mixture may defy chemical proof of adulteration.

Nevertheless, both physical and chemical methods, particularly a combination of both, will often enable the detection of practices of gross adulteration. By adulteration is to be understood, not only the addition of inferior or cheaper articles (turpentine or alcohol), but also the withdrawal of some of the more valuable constituents—*e. g.*, menthol from oil of peppermint. Changes in specific gravity may indicate, *e. g.*, the addition of turpentine oil to peppermint oil or the withdrawal of menthol. By chemical means the exact amount of menthol in the oil can be ascertained.

DETERMINATION OF PHYSICAL PROPERTIES.—*Specific Gravity.*—Whereas some manufacturers and jobbers still use the hydrometer, this instrument is scarcely of sufficient

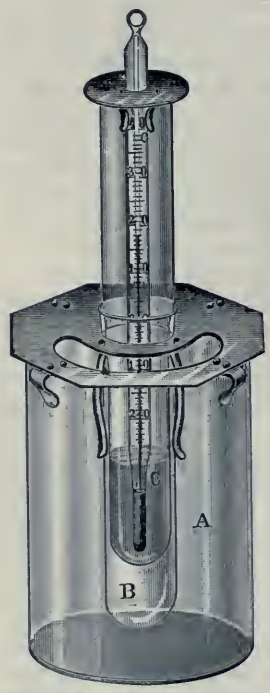
accuracy and requires large amounts of material. For a rapid determination with a very fair degree of accuracy the Mohr-Westphal balance or any of its modifications is to be recommended. For very small quantities and greater accuracy a pycnometer of convenient size and construction should be used.

The specific gravity of oils is mostly recorded at 15° C. (59° F.) with the exception of such oils as congeal entirely or in part at this temperature. For such oils a higher temperature has to be taken. On account of the fact that average room temperature, both in winter and summer, is nearer 25° C. (77° F.) than 15° C. (59° F.), the new edition of the U. S. P. has adopted 25° C. (77° F.) as the standard temperature. The differences in specific gravity of volatile oils due to a difference of 1 degree in temperature are but slight when the weight of a given volume of oil is compared with the weight of a like volume of water at the same temperature. For U. S. P. oils this difference has been determined by O. Schreiner.

Optical Rotation.—The importance of this factor as a means of determining the purity of an oil or the general nature of its adulteration, has been recognized by the new edition of the U. S. P. The data given are usually those for a column of oil 100 mm. in length. Colored oils may necessitate the use of shorter tubes or dilution of the oil with an optically inactive solvent. Inasmuch, however, as the action of the solvent on the oil is not always well understood, its use should be avoided whenever possible. The constants recorded are either α_D, the observed angle of rotation in a 100 mm. tube with sodium light, or $[\alpha]_D$, the specific rotation, calculated from the formula $[\alpha]_D = \frac{\alpha}{l.\,d.}$, where α is the observed angle of rotation, l the length of the tube in millimeters, and d the specific gravity of the oil.

Boiling Temperature.—Inasmuch as the volatile oils are mixtures of substances with different boiling-points, it is improper to refer to their boiling-point. The intervals in temperature between which an oil boils may be designated its boiling temperature. Sometimes it is important to note that the bulk of the oil distils between certain degrees, or that none of it distils below or little above a certain temperature, when other conditions would indicate contamination or withdrawal.

Fig. 287.



Beckmann's apparatus for determining the congealing-point of oils.

Congealing-point.—With certain oils, especially anise, star-anise, fennel, and rue oils, the congealing-point gives a good basis for judging the quality With the first three oils a high congealing-point shows a large content of anethol, with rue oil one of methyl nonyl ketone.

The determination of the congealing-point can be very well performed with Beckmann's well-known apparatus for the determination of molecular weights by the lowering of the freezing-point. A few slight changes make it especially suited for this purpose. These consist principally in discarding the cork connections, which hinder the free inspection of the mercury column of the thermometer. The battery jar *A* serves as the receptacle for the cooling liquid or freezing mixture. The glass tube *B* hanging in the metal cover serves as an air jacket for the freezing-tube *C* and prevents premature congealing of the oil to be tested. The freezing-tube *C* is wider at the top and becomes narrower at the point where it rests on the edge of the tube *B*. In order to retain *C* in a fixed position three glass projections are fastened on the inside of the tube *B*, about 5 Cm. below its upper edge. The thermometer, which is graduated into half degrees, is held in position in a metal plate by three springs which allow of sliding the thermometer up or down.

In conducting the determination with anise and star-anise oil the battery jar is filled with cold water and pieces of ice, but with fennel oil a freezing-mixture of ice and salt is used. Then pour into the freezing-tube so much of the oil to be tested that it stands at a height of about 5 Cm. in the tube and bring the thermometer,

which must not touch the sides of the tube at any place, into the liquid. During the cooling the overcooled oil is to be protected from disturbances, which would produce premature congelation.[1] When the thermometer has sunk about 10 degrees below the congealing-point (with anise and star-anise oil to about 6 to 8 degrees), crystallization is to be induced by rubbing and scratching the thermometer against the sides of the tube. If this proceeding should not prove successful, a small crystal of congealed oil or some solid anethol is brought into the liquid, when congelation will take place with liberation of heat. Solidification is hastened by continued stirring with the thermometer, the mercury column of which rapidly rises and finally reaches a maximum which is called the congealing-point of the oil.

FIG. 288.

Graduated cylinder.

Solubility.—The volatile oils are, as a rule, readily soluble in the common organic solvents, such as alcohol, ether, chloroform, benzene, acetic ether, carbon disulphide, glacial acetic acid, petroleum ether, etc., but for testing purposes 90 per cent., 80 per cent., and 70 per cent. (by volume) alcohol are used almost exclusively, for, although all oils are readily soluble in absolute alcohol, only some of them are entirely soluble in dilute alcohol. For the last class this property becomes a practical and rapid means of examination. The presence of the difficultly soluble turpentine oil can, for instance, be readily shown in this manner in the oils soluble in 70 per cent. alcohol. The solubility determination is very simple.

Bring into a small graduated cylinder (Fig. 288) ½–1 Cc. of the oil to be tested and add small portions of the alcohol at a time until, with vigorous shaking, solution is effected.

If an oil which is soluble under normal conditions does not dissolve, it is sometimes possible to draw conclusions as to the adulterant from the character of the turbidity and the separation of the insoluble part. Petroleum floats on 70 per cent. alcohol, whereas fatty oil settles in drops at the bottom.

Dowzard[2] suggests that the "solubility value" be determined by dissolving 5 Cc. of an oil in 10 Cc. of alcohol, specific gravity 0.799, and diluting with water from a burette until the solution becomes turbid. By multiplying the number of Cc. of water by 100 the "solubility value" is obtained.

Duyk[3] recommends the use of a solution of sodium salicylate in water 1 : 1. The alcohols, aldehydes, and ketones are much more soluble than the sesquiterpene hydrates, phenol ethers and esters. The hydrocarbons are practically insoluble. In special cases this solution may prove valuable.

Chemical Methods of Testing.—The older chemical methods of testing volatile oils, such as the fulminating test with iodine and the various color reactions, have been dropped more and more with a better understanding of the chemical composition of these oils. The application of methods, serviceable in the examination of fatty oils, have mostly proved useless because the analogy between fatty and volatile oils is physical rather than chemical.

Even the following methods, that have proved very serviceable, should be used with such caution as the imperfections of the knowledge of the chemical composition of any particular oil to which they are applied demand.

Saponification.—Through scientific investigation it has been established that many volatile oils contain ester-like compounds, the components of which are alcohols, usually of the composition $C_{10}H_{18}O$ or $C_{10}H_{20}O$, on the one hand, and acid radicals of the fatty series, on the other.

The esters, which are almost without exception of a pleasant odor, are often to be considered as the most important constituents of the oils. Thus, linalyl acetate is the carrier of the odor in bergamot oil. The esters of borneol, found in the different pine-needle oils, play an important part in the formation of the pine aroma. Menthyl acetate is found in the peppermint oils and the geranyl ester of tiglic acid in the different geranium oils. The quantitative estimation of the ester is always valuable for judging the oils, even when the esters are of little consequence to the odor.

[1] A premature congelation often takes place when the oil has not been filtered clear, as suspended dust particles may give rise to congelation.
[2] Chemist and Druggist, 53, p. 749.
[3] Bull. de l'Acad. roy. de Méd. de Belgique, 1899, p. 503; Ann. de Pharm., 5, p. 348.

Kremel distinguishes acid number (S. Z.), ester number (E. Z.), and saponification number (V. Z.). The acid number expresses how many milligrammes of KOH are necessary to neutralize the amount of free acid contained in 1 Gm. of oil. The ester number gives the amount of potassium hydroxide in milligrammes used in the saponification of the ester contained in 1 Gm. of oil. The saponification number is the sum of the acid number and the ester number. As the volatile oils usually contain only a small amount of free acid, this factor may in general be neglected. Only old, partly spoiled oils tend to show somewhat higher acid numbers.

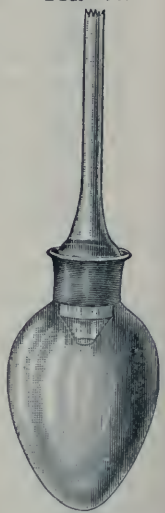
It must be mentioned that in all oils which contain aldehydes the ester determination by saponification cannot be made, as a consumption of alkali takes place which increases with the length of the reaction, due to decomposition of the aldehyde, but which gives no information as to the amount of aldehyde decomposed.

The saponification is conducted in a wide-necked flask of potash glass of 100 Cc. capacity (Fig. 289). A glass tube about 1 meter in length and passing through a stopper serves as a reflux condenser. About 2 Gm. of oil are weighed accurately to within 0.010 Gm. into such a flask and 10 to 20 Cc. of a seminormal alcoholic potassium hydroxide solution are added. Previous to this the oil should be tested for free acid, an alcoholic solution of phenolphtalein being used as indicator. The flask provided with the condensing-tube is heated for half an hour on a steam-bath, and after cooling, the contents are diluted with about 50 Cc. of water and the excess of alkali titrated back with seminormal sulphuric acid.

Fig. 289.

Saponification flask.

Fig. 290.



Acetylization flask.

Acetylization.—Many volatile oils contain as important constituents alcohols of the formulas $C_{10}H_{18}O$ and $C_{10}H_{20}O$; for instance, borneol, geraniol, terpineol, linalool, thujylalcohol, menthol, and citronellol. For the quantitative estimation their behavior toward acetic acid anhydride, with which they form acetic esters when heated, may be used. The reaction takes place according to the equation: $C_{10}H_{18}O + (CH_3CO)_2O = C_{10}H_{17}OCOCH_3 + CH_3COOH$. The reaction is quantitative with borneol, geraniol, and menthol, and makes an accurate determination of these bodies possible. Less favorable are the conditions with linalool and terpineol, as these on boiling with acetic acid anhydride are partly decomposed by splitting off water with the formation of terpenes.

Acetic acid anhydride acts differently on aldehydes. While citronellal is converted quantitatively into isopulegol acetate, with citral there are formed indefinite amounts of saponifiable products as yet unknown.

For the quantitative acetylization 10 to 20 Cc. of the oil, mixed with an equal volume of acetic acid anhydride and 1 to 2 Gm. of dry sodium acetate, are boiled uniformly from 1 to 2 hours in a small flask provided with a condensing-tube which is ground into the neck of the flask (Fig. 290). After cooling, water is added to the contents of the flask and the mixture then heated from $\frac{1}{4}$ to $\frac{1}{2}$ hour on a water-bath, to decompose the excess of the acetic acid anhydride. The oil is then separated in a separating funnel, and washed with sodium hydroxide solution and water until the reaction is neutral. Of the acetylized oil, dried with anhydrous sodium sulphate, 2 Gm. are saponified according to the method described above.

Aldehyde Determination.—The quantitative determination of cinnamic aldehyde depends on its property to form a water-soluble addition-product with an excess of sodium bisulphite. When a known amount of an oil containing cinnamic aldehyde is shaken sufficiently long with a hot concentrated bisulphite solution, the aldehyde content of the oil is about equal to the decrease in volume. Citral behaves similarly to cinnamic aldehyde, and is able to form a water-soluble bisulphite addition-product. The same method, is, therefore, applicable to oils rich in citral, as, for instance, lemongrass oil.

A method devised by Kremers and Schreiner specially for the estimation of carvone will be discussed under Oleum Cari.

Phenol Determination.—For an approximately accurate phenol determination in volatile oils, the property of the phenols to combine with alkalies to form compounds which are soluble in water, is used. If a measured quantity of an oil is shaken with a solution of alkali, the content of phenols can be approximately determined from the diminution in volume. The sodium hydroxide solution should be of 5 per cent. strength. A greater concentration is not allowable, as stronger phenol-alkali solutions take up relatively large amounts of the remaining constituents of the oil, and thus give results which are too high. The technique of such a determination is described under OLEUM THYMI.

According to Thoms (1891), eugenol is quantitatively changed to benzoyl eugenol and weighed as such. This method is especially to be recommended with clove oil and the oil of cinnamon leaves, as shaking out with alkali gives results which are too high. The details of Thoms' method for estimating eugenol may be found in the special works treating of volatile oils and previously referred to.

The Detection of Some of the more common Adulterants.—Turpentine Oil.—Turpentine oil may be considered as the adulterant most often used. Very often it can be recognized by its characteristic odor, especially in those oils which contain no pinene, as this is the main constituent of turpentine oil. In general, its presence causes changes in the specific gravity, solubility, boiling temperature, and optical rotation. It must here be remembered that there are dextrogyrate as well as lævogyrate turpentine oils.

The positive proof of the presence of turpentine oil in oils, which in their pure state contain no pinene, is furnished by the isolation of characteristic derivatives of pinene. The constituents boiling in the neighborhood of 160° C. (320° F.) are fractionated out and the pinene nitrosochloride, as well as pinene nitrolbenzylamine or pinene nitrolpiperidine, is prepared.

If pinene is a normal constituent of the oil, the addition of turpentine oil can be recognized by a comparison of the physical properties of the lowest boiling fractions of the adulterated oil with the corresponding portions of the pure oil.

Cedar Wood, Copaiba, and Gurjun Balsam Oils.—On account of their cheapness and faint odor, these three oils belong to the most favored and the most dangerous of adulterants. They may, however, be detected without difficulty in most cases by means of their physical properties, which differ from those of many of the volatile oils, namely, their difficult solubility in 70 to 90 per cent. or even stronger alcohol, their high specific gravity (above 0.900), their high boiling temperature (above 250° C.), and, finally, their rotatory powers.

All three oils turn the plane of polarized light more or less to the left. With copaiba oil the angle of rotation, α_D, lies between —7° and —35°, with cedar wood oil between —30° and —40°, and with gurjun balsam oil between —35° and —130°.

Alcohol.—The addition of alcohol to a volatile oil always results in a lowering of the specific gravity. When an oil containing alcohol is dropped into water, the drops do not remain clear and transparent, as is the case with pure oils, but become opaque and milky.

For the definite identification of alcohol the suspected oil is heated until it just begins to boil, and the first few drops that come over are collected in a test-tube and filtered, to remove any oil-globules which may also have come over, through a filter moistened with water. The filtrate is made strongly alkaline with dilute potassium hydroxide solution, and treated, after heating to 50°–60° C. (122°–140° F.), with a solution of iodine in potassium iodide until the solution remains slightly yellow. If alcohol be present, small crystals of iodoform will separate in a short time at the bottom of the liquid. It must here be remembered that other bodies, such as aldehydes, acetone, and acetic ether, also yield iodoform under the given conditions.

Larger amounts of alcohol may be removed from volatile oils by shaking with water, from which the alcohol may again be removed by distillation and identified by the iodoform reaction. If the shaking out is done in a graduated cylinder, the increase of the watery layer corresponds approximately to the amount of the alcohol.

According to Hager, it is advantageous to use glycerin, because with this the two layers separate better, and a more accurate reading is possible.

The alcohol content may also be calculated approximately if the specific gravity is determined before and after shaking with water.

Fatty Oil.—The volatile oils adulterated with fatty oil leave a permanent fatty stain when evaporated on paper. With high boiling and difficultly volatile oils, however,

similar residues are left, which may give rise to mistakes. Fatty oil is insoluble in 90 per cent. alcohol.[1] For the separation of the fatty oil from the volatile oil the latter is distilled off by steam distillation or removed by evaporation in an open dish on a water-bath, but it must be remembered that some volatile oils, as bergamot, lemon, orange, anise, and star-anise oil, leave a residue of several per cent. even when they are not adulterated.

The presence of the fat may be shown qualitatively in the residue by heating with potassium bisulphate in a test-tube, Penetrating odors of acrolein show its presence. By igniting the residue on a platinum foil the characteristic odor of burning fat is noticed.

As the fatty oils give saponification numbers which lie between 180 and 200, the amount of the fat added can be determined quantitatively either directly in the volatile oil itself or in the distillation residue, by saponification.

Oils that have been adulterated with cocoanut oil solidify wholly or in part in a freezing-mixture. Cocoanut oil has been found in cananga oil, citronella oil, and palmarosa oil, and detected in this manner.

Mineral Oil, Petroleum.—Mineral oil, paraffin oil, kerosene, petroleum, and petroleum fractions are insoluble in alcohol and can, therefore, be detected without difficulty in volatile oils; besides, they are often easily recognized by their low specific gravity. Palmarosa oil to which some mineral oil has been added is only partly soluble in 70 per cent. alcohol. If the insoluble portion is successively treated with 90 per cent. and absolute alcohol, an oil remains, which in the beginning, it is true, is colored brown by sulphuric or nitric acid, but in general resists the action of these acids and also of alkalies, and on saponification with alcoholic solution of potassium hydroxide gives no saponification number.

The mineral oils have different boiling-points. The hydrocarbons of illuminating oil boil at about the same temperature as the terpenes. Lower boiling fractions are said to be sometimes used for adulterating turpentine oil. A higher boiling mineral oil, about 250° C. (482° F.), has been found in citronella and in gingergrass oils. The petroleum fractions of a lower boiling-point are easily volatile with water vapor, the higher fractions not at all, or at least to a small degree only.

A method for the quantitative estimation of mineral oils consists in weighing the residue left after having removed the volatile oil by oxidation with fuming nitric acid, as described under OLEUM TEREBINTHINÆ (which see). Attention should be called to the fact that some volatile oils, such as rose oil, chamomile oil, orange-flower oil, and others, contain larger or smaller amounts of paraffins as natural constituents.

Chloroform.—This body, which has been found occasionally in volatile oils (for instance, in cognac oil and sandalwood oil), can be isolated by distillation on a water-bath and identified by the isonitrile reaction. This consists in treating a small amount of the suspected distillate with a few drops of aniline and alcoholic sodium hydroxide solution, and gently heating. In the presence of chloroform the noxious and exceedingly disagreeable smelling vapors of phenylisonitrile are formed.

OLEATA.—Oleates.

Oléates, Oléés, Fr.; *Oleate*, G.

This class of preparations was first proposed by Lhermite (*Jour. Phar. Chimie*, Oct., 1854, p. 301), but did not attract attention until recommended by Prof. John Marshall (1872). They are combinations of oleic acid with metallic bases or alkaloids, but as medicinally employed they are usually mixtures of the true or normal oleates with oleic acid, olive oil, lard, or some other diluent. In the case of the alkaloids the respective oleates are prepared by direct solution in oleic acid, to facilitate which a moderate degree of heat may be employed. The U. S. P. defines the official alkaloidal oleates as solutions of the respective alkaloids in oleic acid in excess, and containing, except in the case of quinine oleate, about 50 per cent. of olive oil as a diluent. In the case of metallic oleates, however, mutual decomposition is frequently resorted to, for which purpose either a specially prepared sodium or potassium oleate is employed, or a solution of castile soap, which latter, being a sodium oleo-palmitate, will of course yield also an impure oleate; but for all practical purposes this slight impurity may generally be disregarded, particularly in the case of lead, zinc, and copper. The proportion of alkaloid or metallic oxide to be dissolved in oleic acid may vary to suit the particular views of the practi-

[1] Only castor oil is soluble in 90 per cent., but is insoluble in 70 per cent. alcohol.

tioner, but since the union of oleic acid with the base results in a definite chemical compound, the limit set by nature cannot be exceeded; this limit represents the following proportions of base represented by normal oleates, calculated for anhydrous alkaloids and metallic oxides, respectively: aconitine 69.57 per cent., atropine 50.6 per cent. cocaine 51.8 per cent., morphine 50.3 per cent., quinine 53.46 per cent., strychnine 54.22 per cent., bismuth 22.2 per cent., copper 12.7 per cent., lead 29 per cent., iron (ferric) 8.9 per cent., mercury (mercuric) 28.4 per cent., zinc 12.9 per cent. The solutions of alkaloidal oleates are usually made of the strength of 2 per cent., except morphine and cocaine (usually 5 per cent.) and quinine (25 per cent.). In the case of metallic oleates the use to which they are to be put must be considered in the choice of proper diluents; for mercuric oleates and all those intended for endermatic medication only oleic acid should be employed, as it is more readily absorbed than fats and solid hydrocarbons; for those oleates intended for use in skin diseases, petrolatum or benzoinated lard may be used. The more nearly oleic acid is saturated with mercuric oxide the better will the preparation keep, and hence either the normal or the official oleate should be kept in stock for dilution as wanted, the necessary oleic acid being readily incorporated. 10 parts of normal mercuric oleate diluted with 18.4 parts of oleic acid will produce the 10 per cent. oleate, and if diluted with 46.8 parts of acid the 5 per cent. oleate will be obtained.

Although a solution of castile soap has been strongly recommended for the preparation of normal metallic oleates, a purer product can be obtained by using sodium or potassium oleate prepared direct from oleic acid, as follows: Warm in a capacious vessel 2000 grains of purified oleic acid (U. S. P. 1900) to about 60° or 66° C. (140°–150.8° F.), and add slowly a solution of 316 grains of sodium hydroxide, or 443 grains of potassium hydroxide (U. S. 90 per cent.), in a mixture of 1½ fluidounces of alcohol and 4 ounces of water, stirring constantly until the acid is neutralized, and a small portion of the resulting soap dissolved in alcohol yields but a faint pink tint on the addition of a few drops of alcoholic solution of phenolphtalein. The soap is then dissolved in 6 pints of warm water and filtered; this neutral solution may be used for the decomposition of metallic salts, and will yield very satisfactory normal oleates; for instance, to the above quantity (6 pints) may be added, slowly and with constant stirring, a warm solution of 884 grains of cupric sulphate in 2 pints of water, or of 1350 grains of pure lead acetate in 4 pints of warm water, etc. More extended information, together with working formulas for the various oleates, will be found in the *Amer. Jour. Pharm.* for 1881 and 1889, and *Drugg. Circ.*, 1885.

Ointments of the Oleates.—Manufacturers have for some time offered a class of preparations under the name of ointments of the various oleates, in regard to which some confusion exists, since the base used by different manufacturers varies, as well as the proportion of oleate; physicians may therefore find these ointments of varying composition and consistence, as either benzoinated lard or petrolatum (soft or hard) has been used in their preparation. The term "ointment of any oleate, 5 or 10 per cent." can have but one meaning as far as the active ingredient is concerned—namely, that the finished product contains 5 or 10 parts of the respective normal oleates in every 100 parts of the ointment, and not 5 or 10 parts of the alkaloid or metallic oxide, as is frequently supposed; this, of course, makes a considerable difference in the strength of the oleate ointments, and should be borne in mind whenever they are prescribed. Ointments of oleates are recognized as such in one instance in the U. S. P. and in two instances in the Br. P., ointment of zinc oleate being official in both pharmacopœias, and ointment of mercuric oleate only in the British, although the ointments of aconitine, atropine, cocaine, and veratrine of the latter pharmacopœia are also ointments of the respective alkaloidal oleates, since the alkaloids are directed to be dissolved in oleic acid and then mixed with lard. Physicians may save themselves and pharmacists much annoyance when prescribing ointments of oleates, by designating the amount of oleate (normal or of a stated percentage strength), as well as the kind of vehicle (lard or petrolatum) to be used, or by specifying the name of the manufacturer whose product they may desire.

OLEATUM ATROPINÆ, *U. S.*—Oleate of Atropine.

Atropinum oleicum.—Oléate d'atropine, Fr.; *Atropinoleat*, G.

Preparation.—Atropine, 2 Gm.; alcohol, 2 Cc.; oleic acid, 50 Gm.; olive oil, sufficient to make 100 Gm. Triturate the atropine in a tared mortar with the alcohol, then add about an equal quantity of oleic acid and, after warming the water, stir until the

alcohol has evaporated, add the remainder of the oleic acid, and continue stirring until the atropine is dissolved; then add sufficient olive oil to make the product weigh 100 Gm.—U. S.

The use of alcohol, no doubt added to facilitate solution of the alkaloid in the oleic acid, seems to us quite unnecessary, since solution can be readily effected without this addition by application of moderate heat. Since each minim of this 2 per cent. oleate weighs about $\frac{4}{5}$ grain, 100 grains of it will measure about 2 fluidrachms.

Action and Uses.—Oleate of atropine may be locally employed for its anodyne properties. (See BELLADONNA.)

Allied Preparations.—OLEATE OF ACONITINE, OLEATE OF MORPHINE, and OLEATE OF STRYCHNINE may be prepared in exactly the same manner as oleate of atropine. If a higher percentage strength is desired, which is sometimes the case with oleate of morphine, it is only necessary to increase the amount of alkaloid to correspond to the percentage indicated.

OLEATUM COCAINÆ, *U. S.*—Oleate of Cocaine.

Cocainum oleicum.—Oléate de cocaine, Fr.; *Cocainoleat*, G.

Preparation.—Cocaine, 5 Gm.; alcohol, 5 Cc.; oleic acid, 50 Gm.; olive oil, sufficient to make 100 Gm. Triturate the cocaine in a tared mortar with the alcohol, then add about an equal volume of the oleic acid, and, after warming the mortar, stir until the alcohol has evaporated, add the remainder of the oleic acid, and continue stirring until the cocaine is dissolved; then add sufficient olive oil to make the product weigh 100 Gm.—U. S.

Cocaine alkaloid dissolves readily in warm oleic acid, and hence heating the alkaloid with the acid in a small dish on a water-bath, without the alcohol, will produce satisfactory results. A fluidounce of this 5 per cent. oleate weighs 423 grains. 100 grains of it will therefore measure very nearly 2 fluidrachms.

Action and Uses.—This solution may be employed in the eye and urethra as a local anæsthetic. (See COCA.)

OLEATUM HYDRARGYRI, *U. S.*—Oleate of Mercury.

Hydrargyri oleas, Br.; *Hydrargyrum oleicum.—Mercuric oleate*, E.; *Oléate mercurique*, Fr.; *Quecksilberoleat, Mercurioleat*, G.

Preparation.—Yellow mercuric oxide, in very fine powder, 25 Gm.; distilled water, 25 Cc.; oleic acid, 70 Gm. or sufficient to make 100 Gm. Triturate the yellow mercuric oxide with the distilled water in a tared mortar; add the oleic acid, and mix thoroughly; warm the mortar (not exceeding 50° C.), stir occasionally until the water has evaporated, then add, if necessary, oleic acid to make 100 Gm. and mix thoroughly. Avoid contact with metallic utensils; preserve the oleate in tightly stoppered wide-mouth bottles.—U. S.

To prepare 1 avoirdupois ounce of the official mercuric oleate, use 110 grains each of yellow mercuric oxide and distilled water, and 330 grains of oleic acid, and proceed as directed above.

Take of mercuric chloride, 1 ounce; powdered hard soap, 2 ounces; oleic acid, 1 fluidrachm; boiling distilled water, a sufficient quantity. Dissolve the mercuric chloride in 10 ounces of the distilled water. Triturate the oleic acid with the hard soap, and dissolve the product in 11 ounces of the distilled water. Mix the solutions; boil for 10 minutes; set aside for the mercuric oleate to deposit; decant the supernatant liquid; wash the precipitated oleate with hot distilled water until the decanted liquid affords little or no reaction for chloride, and then dry it on a water-bath.—Br.

The U. S. preparation constitutes what is commonly called a 25 per cent. oleate, referring to the proportion of mercuric oxide present as oleate. The amount of true mercuric oleate contained in the finished product amounts to 88.25 per cent., the remainder being oleic acid with traces of water. It is of firm butter consistence and has a yellowish color; when made by mutual decomposition between potassium oleate and mercuric nitrate, as first suggested by Louis Dohme in 1873, it is of a pale-cream color. The mercuric oleate of the Br. P. is the normal oleate, having the formula $Hg(C_{18}H_{33}O_2)_2$, mixed with a very small proportion of mercuric palmitate, since the soap used is not pure sodium oleate, but an oleopalmitate. The grayish-yellow color of the British

preparation is no doubt due to partial reduction caused by the heat employed, as precipitated mercuric oleate, made without heat, has a cream color or at most a yellow tint. The object of adding oleic acid to the soap is to prevent the presence of free alkali, caused by hydrolysis of the soap when brought into solution.

Mercuric oleate is readily decomposed at temperatures above 50° C. (122° F.), but keeps well for a long time in a cool place if protected against light and air. Metallic spatulas should never be used in preparing or dispensing mercuric oleate, and only glass or porcelain utensils be employed.

The so-called 5, 10, or 20 per cent. oleates of mercury can be readily prepared from the official (U. S. P.) oleate by diluting the same with oleic acid as follows: 1 part of official oleate with 4 parts of oleic acid to make the 5 per cent., 1 part of the official oleate with 1½ parts of oleic acid to make the 10 per cent., and 1 part of the official oleate with ¼ part of oleic acid to make the 20 per cent.

Action and Uses.—Oleate of mercury may be employed for the same purposes as UNGUENTUM HYDRARGYRI (which see). When employed by inunction, it is thought by some to be more effective, as it is absorbed with greater rapidity. Its principal use is in the treatment of hereditary syphilis, indurations following abscesses, and chronic skin diseases. The amount employed for the treatment of syphilis in children is from 10 to 15 grains (0.60–1 Gm.), twice daily for several days.

OLEATUM QUININÆ, *U. S.*—Oleate of Quinine.

Chininum oleicum.—Oléate de quinine, Fr.; *Chininoleat*, G.

Preparation.—Quinine, 25 Gm.; oleic acid, sufficient to make 100 Gm. Triturate the quinine in a warm water with a small quantity of the oleic acid to a smooth paste. Then add the remainder of the oleic acid, previously warmed, and stir frequently until the quinine is dissolved.—U. S.

The solution of quinine alkaloid can be readily effected by triturating the same with about twice its weight of oleic acid in a porcelain capsule on a water-bath, using a thick glass rod as a stirrer. A fluidounce of the above (25 per cent.) oleate weighs about 410 grains, and therefore contains about 102 grains of quinine alkaloid, or 163.5 grains of quinine oleate, which is equivalent to about 140 grains of the ordinary quinine sulphate.

Action and Uses.—Oleate of quinine may be employed both internally and externally. For its uses see QUININA.

OLEATUM VERATRINÆ, *U. S.*—Oleate of Veratrine.

Veratrinum oleicum. Oléate de veratrine, Fr.; *Veratrinoleat*, G.

Preparation.—Veratrine, 2 Gm.; oleic acid, 50 Gm.; olive oil, sufficient to make 100 Gm. Triturate the veratrine in a tared mortar with about 5 Cc. of olive oil, and, after warming the mortar, add the oleic acid, and continue stirring until the veratrine is dissolved; then add sufficient olive oil to make the product weigh 100 Gm.—U. S.

Since each minim of this 2 per cent. oleate weighs about ⅘ grain, 100 grains of it will measure about 2 fluidrachms.

Action and Uses.—Oleate of veratrine may be locally employed for the relief of superficial neuralgias. Care should be taken not to apply it over too large an area or to an abraded surface, lest absorption of the drug take place.

OLEATUM ZINCI.—Oleate of Zinc.

Zincum oleicum. Oléate de zinc, Fr.; *Zinkoleat*, G.

Preparation.—Make 6 pints of neutral soap solution from pure oleic acid and sodium hydroxide (see page 1047), warm to 43° C. (109.4° F.), and to it add slowly a solution of 1100 grains of zinc sulphate in 2 pints of water, stirring constantly; collect the precipitate on a moist filter, wash thoroughly with water, and dry on bibulous paper at a temperature not exceeding 38° C. (100° F.). It is important that the temperature during precipitation be maintained between 38° and 43° C. (100°–110° F.), so that the

oleate when dry may be obtained in white friable masses which can easily be passed through a hair-cloth sieve. Oleate of zinc is an impalpable, unctuous, slippery powder, with slight saponaceous odor, which upon exposure to air gradually becomes offensive. It should be preserved in tightly stoppered bottles in a cool place.

The above formula was first suggested by Geo. M. Beringer, and in our experience yields a satisfactory product.

Action and Uses.—Oleate of zinc is intended to be mixed with some ointment-base and applied externally. The impalpable powder, which is largely used, may be employed locally in the treatment of chronic skin affections.

OLEORESINÆ.—Oleoresins.

Oléo-résines, Extraits éthérés, Fr.; *Oelharze, Aetherische Extrakte*, G.

These preparations consist mainly of fixed or volatile oils associated with resin and some other constituents, and are directed to be prepared by exhausting the powdered drug with acetone. The great volatility of this solvent renders it necessary to percolate in a well-closed apparatus, in which the pressure is equalized by connecting the receiving vessel with the top of the percolator by means of a tube. The tincture is afterward transferred to a suitable still, and the acetone distilled off on a water-bath with a moderate heat. Various apparatuses have been constructed to accomplish the exhaustion with the smallest possible quantity of acetone by using the same liquid over again until the material has been exhausted; for this purpose the recipient is placed in water of about 70° C. (158° F.); the acetone vapors ascending through the connecting tube mentioned above are condensed in a suitable refrigerator, and the acetone is again passed into the percolator, the operation being repeated as often as required.

Formerly oleoresins were prepared altogether by extracting the drug with ether, but, as pointed out by Beringer in 1892, acetone is an equally good solvent and yields products which are completely soluble in ether. Acetone can now be had of great purity (99.5 per cent.) at a cost considerably below that of pure ether, and as its boiling-point is at least 18° or 20° C. above that of ether, it has been wisely selected by the Pharmacopœia to replace the more volatile solvent. Our experience in the use of acetone for making the official oleoresins has been very satisfactory.

The usual directions for the preparation of oleoresins are to continue percolation of the drug to complete exhaustion, but, as pointed out by Procter nearly 40 years ago, the first portions of percolate contain practically the whole of the oleoresinous constituents, and hence 2 Cc. of percolate for each Gm. of drug operated upon would appear sufficient: in the case of capsicum even less (1.5 Cc.) has been found advantageous, in order to avoid the extraction of large quantities of fat.

OLEORESINA ASPIDII, *U. S.*—Oleoresin of Aspidium.

Oleoresina filicis, Extractum filicis liquidum, Br.; *Extractum filicis*, P. G.; *Oleum filicis maris.—Oleoresin or Liquid extract of male fern*, E.; *Extrait éthéré (Huile) de fougère mâle*, Fr.; *Wurmfarnextrakt, Wurmfarnöl*, G.

Preparation.—Aspidium, recently reduced to a No. 40 powder, 500 Gm.; acetone, a sufficient quantity. Put the aspidium into a cylindrical glass percolator, provided with a stopcock, and arranged with cover and receptacle suitable for volatile liquids. Press the drug firmly, and percolate slowly with acetone, added in successive portions, until the drug is exhausted. Recover the greater part of the acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a capsule, allow the remaining acetone to evaporate spontaneously. Keep the oleoresin in a well-stoppered bottle.

Note.—Oleoresin of aspidium usually deposits, on standing, a granular-crystalline substance. This should be thoroughly mixed with the liquid portion before use.—*U. S.*

The processes of the other pharmacopœias are essentially identical with the above, except that ether is used as a menstruum and that maceration, instead of percolation, is directed by the P. G. It should be remembered that only that portion of the rhizome is to be used which has still a greenish color; the oleoresin will then have a greenish or brownish-green color, while the entire rhizome with the stipes yields a brown preparation, which not infrequently forms a jelly, probably from the separation of pectin compounds.

The official oleoresin separates a granular deposit of filicic acid, which must be well mixed with the liquid portion on dispensing. The yield is about 10 to 15 per cent.

The oleoresin, well stirred and diluted with glycerin, should not show any starch-granules when examined under the microscope.—P. G.

Action and Uses.—Oleoresin of male fern is largely employed for the expulsion of the tapeworm. It may produce nausea, vomiting, and severe griping; but as a rule usually operates without producing these untoward effects. The patient should not partake of any food for at least 12 hours, and the bowels should be thoroughly evacuated before its administration. The dose is from 1 to 2 fluidrachms (4–8 Cc.), best administered in capsules in divided doses every 15 minutes. This may be followed in 3 or 4 hours by a saline purge. Castor oil should not be given, as it may aid in the absorption of the oleoresin.

OLEORESINA CAPSICI, *U. S.*—Oleoresin of Capsicum.

Oléorésine (Extrait éthérée) de capsique, Fr.; *Spanischpfeffer-Oelharz, Aetherisches Spanischpfeffer-extrakt*, G.

Preparation.—Capsicum, in No. 40 powder, 500 Gm.; acetone, a sufficient quantity. Put the capsicum into a cylindrical glass percolator, provided with a stopcock, and arranged with cover and receptacle suitable for volatile liquids. Press the drug firmly, and percolate slowly with acetone, added in successive portions, until the drug is exhausted. Recover the greater part of the acetone from the percolate by distillation on a water-bath, and having transferred the residue to a capsule, allow the remaining acetone to evaporate spontaneously. Now pour off the liquid portion, transfer the remainder to a strainer, and when the separated fatty matter (which is to be rejected) has been completely drained, mix the liquid portions together. Keep the oleoresin in a well-stoppered bottle.—U. S.

Oleoresin of capsicum is a dark brown-red rather thick liquid, separating on standing a granular deposit of fat. The average yield is about 12 per cent., but as much as 15 per cent. has been obtained. The oleoresin has little odor, but possesses an extremely hot and fiery taste.

Action and Uses.—Oleoresin of capsicum may be locally employed as an ingredient of a plaster or liniment for the purpose of producing counterirritation. Internally it may be added to other remedies to aid in their absorption in cases of gastric atony and flatulence. The dose is from $\frac{1}{4}$ to 1 minim (0.015–0.05 Cc.), best administered in pill-form.

OLEORESINA CUBEBÆ, *U. S.*—Oleoresin of Cubeb.

Extractum cubebarum, P. G.; *Extractum cubebæ œthereum.—Oléorésine de cubébe*, Fr.; *Kubebenextrakt*, G.

Preparation.—Cubeb, in No. 30 powder, 500 Gm.; alcohol, a sufficient quantity. Put the cubeb into a cylindrical glass percolator, pack the powder firmly, and percolate slowly with alcohol, added in successive portions, until the cubeb is exhausted. Recover the greater part of the alcohol from the percolate by distillation on a water-bath, and, having transferred the residue to a capsule, allow the remaining alcohol to evaporate, with constant stirring, in a warm place. Keep the product in a well-stoppered bottle.

Note.—Oleoresin of cubeb deposits, after standing for some time, a waxy and crystalline matter, which should be rejected, only the liquid portion being used.—U. S.

The use of alcohol in place of acetone or ether for the manufacture of oleoresin of cubeb was first suggested by the late E. R. Squibb, and has been found to exhaust the drug completely and to yield an entirely satisfactory preparation.

The oleoresin, as prepared by the above formula, is of a brown-green, or sometimes of a grass-green, color, the difference being due to the presence of more or less chlorophyll. On standing, it deposits some waxy matter and cubebin, which are removed by decantation. The remaining liquid, amounting to between 18 and 25 per cent. of the cubebs used, consists mainly of fixed and volatile oils, the active resins, and chlorophyll.

Action and Uses.—This preparation is employed for its action upon the genito-urinary and respiratory tracts. It may be used with advantage in the later stages of gonorrhœa and in subacute and chronic bronchitis. The dose is from 2 to 20 minims (0.10–1.3 Cc.), 3 times daily. It may be given either in emulsion or capsule.

OLEORESINA LUPULINI, *U. S.*—Oleoresin of Lupulin.

Oleoresina lupulinæ, Extractum lupulini æthereum.—Oléorésine de lupuline, Fr.; *Aetherisches Lupulinextrakt*, G.

Preparation.—Lupulin, 100 Gm.; acetone, a sufficient quantity. Put the lupulin into a cylindrical glass percolator, provided with a stopcock, and arranged with cover and receptacle suitable for volatile liquids. Press the drug *very lightly*, and percolate slowly with acetone, added in successive portions, until the drug is exhausted. Recover the greater part of the acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a capsule, allow the remaining acetone to evaporate spontaneously. Keep the oleoresin in a well-stoppered bottle.—U. S.

The yield is variable, often amounting to 50 or 60 per cent. It is of a dark reddish-brown color and semifluid in consistence, and has the odor and taste of the drug.

Action and Uses.—Oleoresin of lupulin is said to possess all the medicinal properties of Humulus (which see). It is usually administered in pill or capsule in doses of from 10 to 30 grains (0.6–2 Gm.).

OLEORESINA PIPERIS, *U. S.*—Oleoresin of Pepper.

Oléorésine de poivre noir, Fr.; *Aetherisches Pfefferextrakt*, G.

Preparation.—Pepper, in No. 40 powder, 500 Gm.; acetone, a sufficient quantity. Put the pepper into a cylindrical glass percolator, provided with a stopcock, and arranged with a cover and receptacle for volatile liquids. Press the drug firmly, and percolate slowly with acetone, added in successive portions, until the drug is exhausted. Recover the greater part of the acetone from the percolate by evaporation on a water-bath, and, having transferred the residue to a capsule, set this aside until the remaining acetone has evaporated, and the deposition of crystals of piperin has ceased. Lastly, separate the oleoresin from the piperin by expression through a muslin strainer. Keep the oleoresin in a well-stoppered bottle.—U. S.

The official process yields from 5 to 6.5 per cent. of a greenish-black oleoresin, consisting of a mixture of volatile and fixed oil holding the pungent resin and some piperin in solution. It is an official substitute for the so-called *oil of black pepper*, which is obtained as a by-product in the manufacture of piperin, and has essentially the same composition, except that the volatile oil is present in small quantities only.

Action and Uses.—Oleoresin of black pepper represents almost entirely the activity of the fruit from which it is prepared. It contains only a small quantity of piperin, but this substance is thought by many to be inert when pure. The oleoresin is to be preferred as a remedy because of its uniform strength. The dose is from $\frac{1}{4}$ to 1 minim (0.015–0.05 Cc.), best administered in pill form.

OLEORESINA ZINGIBERIS, *U. S.*—Oleoresin of Ginger.

Extractum zingiberis æthereum.—Oléorésine (Piperoide) de gingembre, Fr.; *Zingiberin, Aetherisches Ingwerextrakt*, G.

Preparation.—Ginger, in No. 60 powder, 500 Gm.; acetone, a sufficient quantity. Put the ginger into a cylindrical glass percolator, provided with a stopcock, and arranged with cover and receptacle suitable for volatile liquids. Press the drug firmly, and percolate slowly with acetone, added in successive portions, until the drug is exhausted. Recover the greater part of the acetone from the percolate by distillation on a water-bath, and having transferred the residue to a capsule, allow the remaining acetone to evaporate spontaneously. Keep the oleoresin in a well-stoppered bottle.—U. S.

Coated ginger yields between 8 and 12 per cent., and the uncoated (Jamaica) ginger between 6 and 10 per cent. of oleoresin, which, as prepared from the latter, is lighter in color, rather more limpid, and perhaps more agreeable in flavor. The appellation *piperoid* originated with Beral.

Action and Uses.—Oleoresin of ginger may be employed in medicine for the same purposes as the powdered drug (see Zingiber). The dose is from $\frac{1}{4}$ to 1 minim (0.015–0.05 Cc.).

OLEUM ADIPIS, *U. S.*—Lard Oil.

Huile de graisse, Fr.; *Schmalzöl, Specköl*, G.

A fixed oil expressed from lard at a low temperature.

Preparation.—Lard, enclosed in strong canvas bags, is kept for some time near the freezing-point of water, and then subjected to a gradually increased pressure. About 60 or 62 per cent. of oil is obtained.

Properties and Tests.—Lard oil is a colorless or pale-yellow oily liquid, having a peculiar, slightly fatty, odor and a bland taste. Its specific gravity ranges from 0.910 to 0.920 at 15° C. (59° F.) or from 0.905 to 0.915 at 25° C. (77° F.), depending somewhat on the temperature at which the oil has been expressed. It is almost insoluble in cold alcohol and only slightly soluble in boiling alcohol, but is readily soluble in chloroform, ether, carbon disulphide, and benzene. At a temperature a little below 10° C. (50° F.) it usually commences to deposit a white, peculiar fat, and at or near 0° C. (32° F.) it forms a solid white mass. If 5 Cc. of the oil be thoroughly shaken in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of deodorized alcohol, and adding 2 drops of nitric acid), and the mixture heated for about 5 minutes on a water-bath, the oil should remain nearly or quite colorless, not acquiring a reddish or brown color (absence of more than 5 per cent. of cottonseed oil). The oil should be completely saponifiable with alcoholic potassium hydroxide solution, and the resulting soap should be completely soluble in water, without separation of an oily layer (absence of mineral oils). If 2 Cc. of lard oil be mixed in a test-tube with 2 Cc. of equal volumes of amyl alcohol and carbon disulphide containing 1 per cent. of sulphur in solution, and the test-tube be immersed to $\frac{1}{3}$ or $\frac{1}{2}$ of its depth in boiling salt water, no reddish color should develop in from 10 to 15 minutes (absence of cottonseed oil or of certain other fats). Lard oil saponified by alcoholic potassium hydroxide test-solution should show a saponification value of 195–197. If 0.3 Gm. of lard oil be dissolved in 10 Cc. of chloroform and placed in a 250 Cc. flask with 25 Cc. of a mixture of equal parts of alcoholic iodine test-solution and alcoholic mercuric chloride test-solution, and after standing for 4 hours protected from the light, 20 Cc. of potassium iodide test-solution be added, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate solution, an iodine figure of not less than 56 nor more than 74 should be obtained.—U. S.

When brought in contact with concentrated sulphuric acid (oil, 50 Gm.; acid, 10 Cc.), a dark reddish-brown color is instantly produced, and the temperature of the mixture rises 47 degrees C. (116 degrees F.).

Uses.—This is a bland oil practically never employed in medicine. It is used as an illuminating oil and in the manufacture of pharmaceutical preparations.

OLEUM ÆTHEREUM, *U. S.*—Ethereal Oil.

Ethereal oil is a volatile liquid consisting of equal volumes of heavy oil of wine and ether.—U. S.

Preparation.—Alcohol, 1000 Cc.; sulphuric acid, 1000 Cc.; distilled water, 25 Cc.; ether, a sufficient quantity. Add the acid slowly to the alcohol, mix them thoroughly, and allow the mixture to stand in a closed flask for 24 hours; then pour the clear liquid into a tubulated retort of such capacity that the mixture shall nearly fill it. Insert a thermometer through the tubulure so that the bulb shall be deeply immersed in the liquid, and having connected the retort with a well-cooled condenser, and also having connected with the receiver a bent glass tube for conducting the uncondensed gases into water, distil, by means of a sand-bath, at a temperature between 150° and 160° C. (302° and 320° F.), until the liquid ceases to come over or until a black froth begins to rise in the retort. Separate the yellow ethereal liquid from the distillate, and expose it to the air for 24 hours in a shallow capsule. Then transfer it to a wet filter, and, when the watery portion has drained off, wash the oil which is left on the filter with the distilled water, which should be as cold as possible. When this also has drained off, transfer the oil to a graduated measure, and add to it an equal volume of ether.—U. S.

Properties and Tests.—Ethereal oil should be transparent and nearly colorless. It has the peculiar, aromatic, ethereal odor of heavy oil of wine, and should be neutral

to litmus. Although heavy oil of wine, when freshly prepared, is neutral, it is reputed to become acid on standing. The specific gravity of ethereal oil is required to be 0.905 at 25° C. (77° F.); the heavy oil of wine, prepared according to official directions, having a specific gravity varying between 1.15 and 1.47.

Composition.—Heavy oil of wine, prepared as above directed, contains 44 to 48 per cent. of ester calculated as diethyl sulphate. Ethereal oil should therefore contain about one-half as much. Of the other constituents we have no satisfactory knowledge.

Ethereal oil is not a volatile oil as its name would indicate, but an artificial product. It serves as an ingredient of Compound Spirit of Ether. The only commercial article that apparently corresponds to the pharmacopœial product is that of the manufacturer who is reported to have supplied the process to the Revision Committee. Inasmuch as this article is stated to give satisfaction therapeutically, and since modifications in the process appear to result in changes in the product which are but little understood, about the only comment that can be passed on this article is to prepare it strictly in accordance with the directions of the Pharmacopœia.

While the assay of ethereal oil based on its ethyl sulphate content will guard against the substitution of cognac oil, it may not exclude preparations to which ethylsulphuric acid has been added.

Action and Uses.—In moderate doses ethereal oil acts as a circulatory stimulant increasing the heart's action and raising blood-pressure. Overdoses depress the heart and the muscular coats of the bloodvessels. This remedy is only employed as an ingredient in the compound spirit of ether, and it is thought to increase the activity and to be less fleeting in its action than a mixture of alcohol and ether.

OLEUM AMYGDALÆ AMARÆ, *U. S.*—Oil of Bitter Almond.

Oleum amygdalæ volatile; Oleum amygdalarum æthereum.—Volatile oil of almond, E.; *Essence d'amandes amères*, Fr.; *Bittermandelöl*, G.

A volatile oil obtained from bitter almond and other seeds containing amygdalin, yielding, when assayed as directed below, not less than 85 per cent. of benzaldehyde, and not less than 2 per cent. nor more than 4 per cent. of hydrocyanic acid. It should be kept in small, well-stoppered, amber-colored, completely filled bottles, protected from light and air.—U. S.

The designation oil of bitter almond was formerly restricted to the volatile products obtained by steam distillation after the hydrolysis of the glucoside amygdalin originally found in the bitter almond *Prunus amygdalus* var. *amara*. With the introduction of other rosaceous seeds, containing sufficient amygdalin, into commerce, the source of the commercial oil has not been restricted to the bitter almond. The seed of the peach, *Prunus Persica* Stokes, and especially those of the apricot, *Prunus Armeniaca* L., which enter the European market from Asia Minor as "peach kernels," yield much of the commercial oil. Few manufacturers distinguish between the oils from the several sources. The same name is also extensively applied to commercial benzaldehyde made from toluene.

The designation "artificial" bitter almond oil having formerly been applied to nitrobenzene, $C_6H_5NO_2$ (oil of mirbane), which has in common with benzaldehyde, C_6H_5CHO, only a crude resemblance in odor, the designation artificial is mostly avoided in connection with benzaldehyde from toluene, the *oleum amygdalarum æthereum sine acido prussico*. This was formerly prepared from the crude oil by the removal of the hydrocyanic acid by means of milk of lime and a ferrous salt.

Preparation and Composition.—Previous to the distillation of the volatile oil the seeds must be deprived of their fatty oil. They are ground to a coarse powder and the oil is expressed by means of hydraulic presses, a pressure of 350 atmospheres being applied. Upon cold expression, bitter almonds yield about 50 per cent., apricot seeds about 25–38 per cent. fatty oil.

The press-cakes are finely ground and are then ready for the manufacture of the volatile oil. This is not present as such in the seeds, but is formed by a process of fermentation similar to that producing mustard oil and oil of wintergreen. In the presence of water, the glucoside amygdalin which is contained in these seeds is decomposed by a ferment known as emulsin into benzaldehyde, hydrocyanic acid, and dextrose, according

to the following equation: $C_{20}H_{27}NO_{11}$ (amygdalin) + $2H_2O$ (water) = C_6H_5CHO (benzaldehyde) + CNH (hydrocyanic acid) + $2C_6H_{12}O_6$ (dextrose).

Inasmuch as the emulsin coagulates at the boiling temperature of water, and thereby loses its activity, the fermentation must be completed before the distillation is begun. The powder is, therefore, mixed with 6–8 parts of water of about 50°–60° C. (122°–140° F.) and the mixture set aside for about 12 hours. The oil formed is then distilled over with water vapor.

Properties.—Oil of bitter almond is a clear or yellowish, thin, and strongly refractive liquid, having a peculiar aromatic odor, and a bitter, burning taste. Specific gravity 1.045 to 1.060 at 25° C. (77° F.). Boiling-point about 180° C. (356° F.). Optically inactive. Soluble in 300 parts of water at 25° C. (77° F.), and in alcohol or ether in all proportions, and in an equal volume of 70 per cent. alcohol; soluble in nitric acid at ordinary temperatures without the evolution of nitrous vapors. In the fresh state the oil is neutral to litmus, but when kept for some time it assumes an acid reaction, due to the formation of benzoic acid, which, when isolated and purified, should correspond to the tests given under Acidum Benzoicum. Oil of bitter almond containing a notable quantity of crystals of benzoic acid should not be dispensed. If 10 drops of the oil, dissolved in a little alcohol, be shaken with a few drops of solution of sodium hydroxide, then with a little ferrous sulphate test-solution, and finally mixed with a slight excess of hydrochloric acid, a blue precipitate will be produced (presence of hydrocyanic acid).—U. S.

Tests.—If the looped end of a piece of clean copper wire be held in a non-luminous flame until it glows, then cooled, and the loop dipped into benzaldehyde, ignited, and held so that the liquid burns outside of the flame, then if the loop be slowly brought in contact with the outer edge of the flame, no green tinge should be discernible (absence of chlorinated products). If a small strip of filter paper be folded in the form of a taper, saturated with oil of bitter almond, placed in a small porcelain dish, and if a clean beaker, moistened on the inner surface with distilled water, be inverted over the smaller dish, after igniting the taper a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate test-solution, or if a slight turbidity appears, it should entirely disappear upon boiling the liquid (absence of artificial oils containing chlorinated products).—U. S.

Assay of Oil of Bitter Almond.—For Benzaldehyde.—The Pharmacopœia directs that the percentage of benzaldehyde present in the oil shall be determined by the method of assay given under Benzaldehydum (see page 288), using 12 drops of oil of bitter almond for each assay.

For Hydrocyanic Acid.—Mix in a 100 Cc. flask 1 Gm. of the oil of bitter almond to be tested with sufficient water and magnesium oxide (free from chlorides) to make an opaque mixture of about 50 Cc. Add to this 2 or 3 drops of potassium chromate test-solution, and then from a burette tenth-normal silver nitrate solution until a red tint is produced which does not again disappear by shaking (each Cc. of tenth-normal silver nitrate solution consumed corresponding to 0.002684 Gm. of hydrocyanic acid).—U. S.

In the official assay for hydrocyanic acid not less than 7.45 Cc., nor more than 15 Cc., of tenth-normal silver nitrate solution will be required to show that the amount of acid present is within the limits demanded.

The presence of alcohol, oil of turpentine, and other low-boiling adulterants can be detected by means of fractional distillation. To detect nitrobenzene, 2 Cc. of oil are shaken with 34 Cc. of 45 per cent. alcohol and the mixture set aside for 24 hours. At the expiration of this time nitrobenzene will have settled to the bottom of the tube.

For the detection of chlorine, which would indicate the presence of impure benzaldehyde from toluene, the following methods may be employed:

Detection of Chlorine as C_6H_4ClCHO, *etc.*—A small quantity of the oil to be examined is oxidized with a warm alkaline solution of potassium permanganate, any excess of the latter being decomposed by the addition of alcohol. The mixture is filtered and the filtrate acidified with pure dilute sulphuric acid. Upon cooling, the separated benzoic acid—which contains the chlorine substitution-products of the benzene ring in the form of chlorinated benzoic acid—is thrown on a filter and carefully washed. The benzoic acid is dissolved in pure potassium hydroxide solution, a little nitre added, the solu-

tion evaporated to dryness, and finally heated in a platinum dish. The incinerated residue is dissolved in water, the solution acidified with nitric acid, filtered, and tested for chlorine with silver nitrate.

Detection of Alkyl Chlorides, $C_6H_5CH_2Cl$, *etc.*—5 to 10 Gm. of the oil are heated to boiling in a distilling flask and the first 10 to 12 drops of the distillate are caught in 5 per cent. alcoholic potassium hydroxide solution. The alcoholic liquid is heated for a time in a flask connected with a reflux condenser. The alcohol is then volatilized, the residue treated with water, and the oily constituents (benzyl alcohol, etc.) removed by shaking out with ether. The aqueous liquid, strongly acidulated with nitric acid, is warmed for a short time in a dish. When cold the separated benzoic acid is removed by filtration, and the filtrate tested for chlorine.

Action and Uses.—The employment of oil of bitter almond and the symptoms and treatment of poisoning are fully described under ACIDUM HYDROCYANICUM DILUTUM (which see). The dose is from ¼ to 1 minim (0.015–0.05 Cc.).

OLEUM AMYGDALÆ EXPRESSUM, *U. S.*—Expressed Oil of Almond.

Oleum amygdalæ, Br.; *Oleum amygdalarum*, P. G.; *Oleum amygdalæ dulcis.*—*Almond oil, Oil of sweet almond*, E.; *Huile d'amande (douce)*, Fr.; *Mandelöl, Süssmandelöl*, G.

The fixed oil expressed from the seed of *Prunus Amygdalus*, var. *amara* or *dulcis*, L.—Fam. *Rosaceæ*. The fixed oil expressed from Bitter or Sweet Almond, U. S., Br., P. G.

Preparation.—To obtain an unobjectionable oil, the almonds are freed from adhering dust by agitating them upon a sieve and removing discolored pieces, after which they are ground or well bruised in an iron or stone mortar, enclosed in canvas bags, and subjected to considerable pressure between polished steel plates, which should not be heated beyond about 30° C. (86° F.). The oily edges of the press-cake may be powdered and again expressed, when an additional quantity of oil will be obtained. The yield is 40 to 54 per cent. from sweet, and 35 to 38 per cent. from bitter, almonds. Expressing the residue at a higher temperature will yield more oil, which, however, is of inferior quality. The expressed turbid oil is set aside in a cool place, and then decanted from the sediment, which may be filtered. The commercial oil is made principally from bitter almonds prior to preparation of the volatile oil.

Properties.—Expressed oil of almond is nearly colorless or of a pale-straw color (due to the episperm of the kernel), almost inodorous, and has a bland slightly nutty taste. It is a thin oily fluid having a specific gravity of 0.914–0.920 at 15° C. (59° F.) or 0.910–0.915 at 25° C. (77° F.). The oil is but slightly soluble in alcohol (24 parts, Allen), but soluble in all proportions in other fixed oils, ether, chloroform, benzene, and carbon disulphide. It remains clear at —10° C. (14° F.), but begins to congeal at —20° C. (—4° F.), whereby the presence of other oils may be detected, olive and lard oils congealing at —5° C. (22° F.) and apricot- and peach-kernel oils remaining fluid even at —20° C. (—4° F.). Almond oil belongs to the non-drying oils, and when exposed to air readily becomes rancid, acquiring an acrid taste.

Composition.—Expressed oil of almond consists chiefly of triolein, varying from 75 to 85 per cent., mixed with tripalmitin. Some authorities claim that trilinolein and tristearin are also present, but according to Gusserow the last-named fat is never found in the oil.

Adulterations.—Among the adulterations met with in almond oil may be mentioned olive, lard, sesame, ground-nut, poppyseed, cottonseed, apricot- and peach-kernel oils. The two last named are said to be frequently entirely substituted for almond oil.

Tests.—If 2 Cc. of the oil be vigorously shaken with 1 Cc. of fuming nitric acid and 1 Cc. of water, a whitish not red or brownish mixture should be produced, which, after standing for some hours at about 10° C. (50° F.), should separate into a solid, white mass, and a scarcely colored liquid (distinction from apricot- and peach-kernel oils, which give a *red*, and sesame and cottonseed oils, which give a *brown* coloration). If 10 Cc. of the oil be mixed with 15 Cc. of a 15 per cent. solution of sodium hydroxide and 10 Cc. of alcohol, the mixture allowed to stand at a temperature of 35° to 40° C. (95° to 104° F.), with occasional agitation, until it becomes clear, and then diluted with

100 Cc. of water, the clear solution thus obtained, upon the subsequent addition of an excess of hydrochloric acid, will separate a layer of oleic acid. This, when separated from the aqueous liquid, washed with warm water, and clarified on a water-bath, will remain liquid at 15° C. (59° F.), although sometimes separating particles of solid matter and becoming turbid. 1 part of this oleic acid, when mixed with 1 volume of alcohol, should afford a clear solution, which, at 15° C. (59° F.), should separate no fatty acids, nor become turbid on the further addition of 1 volume of alcohol (distinction from olive, arachis, cottonseed, sesame, and other fixed oils). Oil of almond, when saponified by means of alcoholic potassium hydroxide test-solution, should show a saponification value of 191–200. If 0.3 Gm. of almond oil be dissolved in 10 Cc. of chloroform and placed in a 250 Cc. flask with 25 Cc. of a mixture of equal parts of alcoholic iodine test-solution and alcoholic mercuric chloride test-solution, and after standing for 4 hours protected from the light, 20 Cc. of potassium iodide test-solution be added, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate solution, an iodine figure of not less than 95 nor more than 100 should be obtained.—U. S. Saturated zinc chloride solution (Maben's reagent) produces no color reaction with pure almond oil, but develops a purplish-brown coloration with apricot- and peach-kernel oils. The presence of cottonseed oil may be detected by the Halphen and Becchi tests, and sesame oil by the furfurol test (see OLEUM GOSSYPII and OLEUM SESAMI). The spectrum of almond oil shows no absorption bands (distinction from other vegetable oils).

Action and Uses.—Expressed oil of almond may be given in the form of an emulsion for its demulcent properties. The dose is from 1 to 8 fluidrachms (4–30 Cc.).

OLEUM ANETHI, *Br.*—Oil of Dill.

Essence d'aneth, Fr.; *Dillöl*, G.

The volatile oil obtained by steam distillation from the fruit of *Anethum graveolens* L.—Fam. *Umbelliferæ*. Yield about 3–4 per cent. East Indian and Japanese dill oil is obtained from *Anethum sowa* DC. and differs both physically and chemically from the oil official in the Br. P.

Properties.—According to the Br. P., the oil should have a pale-yellow color, its odor should be that of the fruit, the taste sweet and aromatic. The specific gravity may vary between 0.905 and 0.920; the angle of rotation $= +70°$. According to other authorities, the specific gravity varies between 0.895 and 0.915; the angle of rotation $= +75°$ to $+80°$. Dill oil forms a clear solution with 5–8 parts of 80 per cent. alcohol.

Composition.—Like caraway oil, dill oil contains *d*-carvone, $C_{10}H_{14}O$ (40–60 per cent.) and *d*-limonene, $C_{10}H_{16}$. English and Spanish oils appear to contain appreciable amounts of phellandrene, whereas German oil contains but traces. Dill apiol, which is found in the East Indian oil, does not appear to be contained in the European oils. The German variety appears to contain paraffin.

The amount of carvone, the principal constituent of the oil, can be determined by the carvoxime assay method (see OLEUM CARI).

Action and Uses.—Oil of dill may be given internally as a carminative in doses of from 2 to 10 minims (0.10–0.6 Cc.). When locally employed, it is said to possess anodyne properties.

OLEUM ANIMALE ÆTHEREUM.—Animal oil.

Oleum animale Dippeli, Oleum corni cervi rectificatum.—Dippel's animal oil, E.; *Huile animale de Dippel*, Fr.; *Dippelsches Thieröl*, G.

Preparation.—When bones and other animal substances are subjected to dry distillation, a fetid, brown, thick, oily liquid is obtained to which the names *Oleum animale fœtidum, Oleum cornu cervi; Bone oil, Crude animal oil*, E.; *Rohes oder stinkendes Thieröl, Hirschhornöl*, G., are applied. This crude oil is purified for medicinal use by distilling it in a retort or flask, heated on a sand-bath as long as a thin oil passes over, which is then mixed with 4 times its weight of water, and rectified in a metallic still as long as the distillate is colorless or but slightly yellow. The oily liquid is separated from the water, and at once put into small vials, well corked, and preserved in a dark place.

Properties.—Rectified animal oil is a colorless or yellowish thin, oily liquid, of 0.75–0.85 specific gravity. It has a very penetrating peculiar but not fetid odor, and a pungent, acrid, afterward cooling and bitter taste. It shows a slight alkaline reaction toward litmus-paper, is soluble in 80 parts of water, and mixes clear with alcohol, ether, and fixed and volatile oils in all proportions. Exposed to light and air, it rapidly darkens and acquires a thicker consistence.

Constituents.—This is a very complex mixture, containing pyrrol, pyridine, picoline, lutidine, and collidine; also methylamine, propylamine, and others.

Action and Uses.—Animal oil is practically never employed in medicine at the present time. It was formerly given internally in doses of from 10 to 30 minims (0.60–2 Cc.) as a tæniacide, a diffusible stimulant in typhoid states, and a remedy for hysteria and other nervous disorders. It has also been locally applied in the treatment of sciatica and chronic rheumatic conditions.

OLEUM ANISI, *U. S., Br., P. G.*—Oil of Anise.

Essence d'anis, Fr.; *Anisöl*, G.

According to the U. S. P. and Br. P., oil of anise is the volatile oil distilled from the fruit of *Pimpinella anisum* L.—Fam. *Umbelliferæ*, or from the star-anise, the fruit of *Illicium verum* Hook. fil.—Fam. *Magnoliaceæ;* the P. G. applies the term "Oleum anisi" to anethol and defines it as "the oxygenated constituent of the volatile oil of anise."

Commercially a distinction is not often made between the oils of anise and of star-anise. The numerous varieties of anise not only afford a different yield, but also afford oils that differ slightly in odor and specific gravity, and consequently in composition.

Properties.—At temperatures above its congealing-point, 15° to 19° C. (59°–66.2° F.), anise oil is a colorless, highly refractive liquid of characteristic anise-like odor and sweet taste. In the cold it congeals to a snow-white, crystalline mass. Before being dispensed, anise oil which has congealed entirely or in part should be completely liquefied and thoroughly mixed. The specific gravity of the liquid oil is 0.975–0.985 at 25° C. (77° F.); the angle of rotation $= -1°\ 50'$. It is soluble in 1.5 to 5 parts of 90 per cent. alcohol.

Composition.—The principal constituent of anise oil is anethol, also known as *p*-propenylanisol ($C_{10}H_{12}O$ or $C_6H_4.C_3H_5.OCH_3$), which is present to the extent of 80–90 per cent. Exposed to air this is oxidized to anisic aldehyde and acetic aldehyde, the former also to anisic acid. Exposed to light, anethol is polymerized to photoanethol. All these substances are found in old oil, especially when not properly kept. Besides anethol, anise oil contains its liquid isomer, methyl chavicol, and terpenes.

Star-anise oil contains much the same constituents found in anise oils (anethol 80–90 per cent.). The terpenes in this case have been identified as *d*-pinene and *d*-phellandrene. In addition it contains traces of the ethyl ether of hydroquinone and possibly safrol.

Japanese star-anise oil, which is distilled from the leaves, contains but 25 per cent. of anethol, eugenol, safrol, and terpenes. Fennel oil contains, besides 50–60 per cent. of anethol, *d*-fenchone, and pinene. Bitter fennel oil contains anethol, methyl chavicol, fenchone, pinene, and possibly anise ketone, phellandrene, and cymene.

Adulterations.—The substitution of star-anise oil for anise oil is not regarded as adulteration. Fair dealing, however, demands that both oils be sold under their proper label. Adulteration in connection with this oil is chiefly practised by removing part of the anethol, or by the addition of oil from which the anethol has been removed. Other anethol-containing oils are likewise used *in toto* or in part for this purpose. In addition the common, more crude adulterants, such as alcohol, petroleum, etc., have been observed.

Tests.—Many of the crude adulterants, such as alcohol, turpentine oil, etc., are indicated by variations from the standard physical constants. Anise oil being rich in oxygenated constituents, its solubility in alcohol is of importance.

Whereas some chemists maintain that anise oil should be valued by its combined phenol ether content (anethol and its isomer methyl chavicol to be determined jointly by a methoxy determination), it is generally valued according to its anethol content.

The U. S. P. gives the following tests to show the quality of oil of anise: The oil should be slightly lævogyrate, up to —2°, at a temperature of 25° C. (77° F.) (absence of

oil of fennel, etc.). It should be soluble in an equal volume of alcohol, forming a clear solution, also in 5 volumes of 90 per cent. alcohol (absence of petroleum, of most fixed oils, and of oil of turpentine). An alcoholic solution of oil of anise is neutral to litmus-paper, and should not assume a blue or brownish color on the addition of a drop of ferric chloride test-solution (absence of some volatile oils containing phenols). When the oil is shaken with water in a narrow graduated cylinder, its volume should not be diminished (absence of alcohol). When tested according to the following method, the congealing-point of oil of anise should not be below 15° C. (59° F.): Transfer about 10 Cc. of the oil to a test-tube, placed in water cooled with ice; insert a thermometer at once into the oil, and allow it to remain undisturbed until its temperature has fallen to about 6° C. (42.8° F.). Induce crystallization either by scratching the inner wall of the test-tube with the thermometer, or by the addition of a particle of solid anethol, and stir continuously during the solidification of the oil. The highest temperature reached during the crystallization is regarded as the congealing-point.—U. S.

Action and Uses.—Oil of anise is a carminative and stimulant in the treatment of flatulent colic. It may also be combined with purgatives to prevent griping. The dose is from 1 to 5 minims (0.05–0.3 Cc.).

OLEUM ANTHEMIDIS, *Br.*—Oil of Chamomile.

Oleum chamomillæ romanæ.—Essence de camomille romaine, Fr.; *Römisch Kamillenöl*, G.

The volatile oil obtained by steam distillation from the flowers of *Anthemis nobilis* L.—Fam. *Compositæ*. At the present time the oil is distilled principally in Mitcham, near London, where the plant is cultivated. The dried flowers yield about 0.8–1 per cent. of oil.

Properties.—According to the British Pharmacopœia, the oil is pale-blue or greenish-blue when freshly distilled, but gradually becomes yellowish-brown due to the influence of light and air. It should have the aromatic taste and odor of the flowers. Specific gravity, 0.905 to 0.915; angle of rotation = +1° to +3°. Usually the oil has a faintly acid reaction; saponification number, 250–300. As a rule it forms a clear solution with 6 parts of 70 per cent. alcohol, but occasionally a larger paraffin content renders it less soluble.

Composition.—This oil consists principally of a mixture of isobutyl, amyl, and hexyl esters of butyric acid, methacrylic acid, and the isomeric angelic and tiglinic acids. It also contains an isomer of camphor, termed anthemol, and possibly paraffin.

Action and Uses.—Oil of chamomile is antispasmodic, stimulant, and carminative. It may be given to expel flatus or moderate the griping of purgative drugs. The dose is from 1 to 5 minims (0.05–0.3 Cc.).

OLEUM AURANTII CORTICIS, *U. S.*—Oil of Orange-peel.

Oleum aurantiorum.—Essence of orange, E.; *Essence d'orange*, Fr.; *Pomeranzenschalenöl*, G.

Oil of orange-peel is a volatile oil obtained by expression from the fresh peel of the sweet orange, *Citrus Aurantium* L.—Fam. *Rutaceæ*.

In accordance with the source, commercial distinction is made as to sweet and bitter orange oil:

1. Oleum Aurantii Dulcis (*Oil of sweet orange*, E.; *Essence d'orange*, Port., Fr.; *Süsses Pomeranzenschalenöl, Süsses Orangenschalenöl, Apfelsinenschalenöl*, G.).—This is the official oil.

2. Oleum Aurantii Amari (*Oil of bitter orange*, E.; *Essence d'orange bigarade*, Fr.; *Bitteres Pomeranzenschalenöl*, G.).—This is derived from *Citrus amara* (L.) Lyons (*C. vulgaris* Risso), and was likewise official in the 1890 Pharmacopœia. Though chemically indistinguishable thus far from the sweet orange oil, it is regarded as having a superior flavor. However, but a very small amount is produced, and this is often adulterated with sweet orange oil. Most pharmacopœias, recognizing this fact, direct the use of the fresh bitter rind in place of the oil for flavoring purposes.

Preparation.—Like the other citrus fruit oils, oil of orange is not obtained by steam distillation, but by mechanical process (comp. oil of lemon). The principal

centre of production of these oils is southern Italy and Sicily. In Jamaica an oil is prepared by distillation, but it is much inferior.

Properties.—Oil of orange is a pale yellow to yellowish-brown liquid of a characteristic orange odor, and a mild, aromatic, not bitter taste. The oil from bitter orange-peel differs by its somewhat bitter taste. Specific gravity, 0.848–0.852 at 15° C. (59° F.), or 0.842–0.846 at 25° C. (77° F.); angle of rotation = + 96° to + 98° at 20° C. (not less than 95° in a 100-Mm. tube, at a temperature of about 25° C. (77° F.), U. S. P.). Between 175° and 180° C. (347° and 356° F.) about nine-tenths of the oil distil over. On account of the presence of wax-like, non-volatile substances of unknown composition, which separate in part upon standing, the oil as a rule does not form a clear solution with 90 per cent. alcohol. The U. S. P. demands that it be soluble in 4 volumes of alcohol, the solution being neutral to litmus-paper. The oil is also soluble in an equal volume of glacial acetic acid, and in all proportions of absolute alcohol.

Composition.—Limonene constitutes more than 90 per cent. of the oil. About 5 per cent. of the oil constitutes the principal odor-bearers, among which citral, citronellal, and the methyl ester of anthranylic acid have been identified. Other substances are present. Of the so-called stearoptene, which finds its way into the oil by the expression of the rind, and which remains in the residue when the oil is distilled, nothing is known. Inasmuch as some of the principal odor-bearers are at least in part destroyed by steam distillation, oil of orange that has acquired a terebinthinate odor upon standing should not be rectified by steam distillation.

Adulterations.—Distilled oil of orange is colorless, but its addition in small amounts to expressed oil may scarcely be detected unless by the highly developed sense of smell of the expert. The same holds true of the terpene wastes resulting in the manufacture of concentrated or terpeneless oils of orange.

Alcohol can readily be detected in the usual manner, but owing to the high terpene content of oil of orange, the addition of turpentine oil is not indicated by the alcohol-solubility test nor by the specific gravity. Turpentine oil and some other possible adulterants, however, affect the angle of rotation materially. Whenever the angle of rotation of a given oil comes near the lower limit, it may be necessary to make corrections for differences in temperature, about 14′ for each degree in temperature. To determine the presence of oil of turpentine, the Pharmacopœia directs that when subjected to careful fractional distillation, any oil coming over below 170° C. (338° F.) should not yield pinene nitrosochloride and nitrosopinene when tested in the following manner: Dissolve 5 Cc. of the fraction coming over below 170° C. (338° F.) in ½ its volume of glacial acetic acid, add 5 Cc. of amyl nitrite, cool thoroughly in a freezing mixture, and add, very gradually, 5 Cc. of a mixture of equal volumes of hydrochloric acid and glacial acetic acid. If pinene is present, crystals of pinene nitrosochloride will separate after a time from the blue or greenish liquid. Collect these on a force filter and wash them with a little alcohol. Transfer the crystals to a flask, add 5 Cc. of alcoholic potassium hydroxide test-solution, and heat on a water-bath 15 minutes. Pour the solution into cold water, collect the precipitate, and wash it with cold water. Recrystallize the dried precipitate from alcohol and determine the melting-point of the crystals. Nitrosopinene melts at 132° C. (269.6° F.), whereas nitrosolimonene or carvoxime (from limonene, one of the normal constituents of oil of orange-peel) melts at 72° C. (161.6° F.).

Action and Uses.—Oil of orange-peel is employed in medicine only as a flavoring agent. Persons employed in its manufacture frequently suffer from papular or vesicular eruptions of the skin, headache, neuralgia, and mental confusion.

OLEUM BERGAMOTTÆ.—Oil of Bergamot.

Oleum Bergamii.—Essence de bergamotte, Fr.; *Bergamottöl,* G.

Oil of bergamot is a volatile oil obtained from the fresh rind of the fruit of *Citrus Bergamia* Risso et Poit (*C. Aurantium Bergamia* W. et A.—Fam. *Aurantiaceæ*), the Bergamot Orange or Bergamot Lemon. The botanical origin of this so-called species is very obscure. It is unknown in a wild state and, to the best of our knowledge, originated abruptly from cultivated plants. It is variously regarded as a variety of *C. Limetta* or of *C. Limonum,* or a hybrid of *C. medica* and *C. Aurantium.* The latter

origin appears to us the most probable. The fruit is of a lemon-yellow color, and its juice has a bitter and acrid taste.

Preparation and Properties.—Oil of bergamot is usually obtained by cold expression in a machine so constructed that while the fruit is kept in a rotatory motion, the oil-vessels contained in the rind are ruptured with slight pressure; the oil thus obtained deposits on standing a waxy matter, from which it is decanted. An inferior quality of oil is obtained by distilling the crushed rind with steam. The oil varies in color from brownish-yellow to green, and has a very pleasant odor and a bitterish aromatic taste. Its specific gravity ranges from 0.882 to 0.886 at 15° C. (59° F.), and its boiling-point lies between 180° and 195° C. (356° and 383° F.). It has a neutral or slightly acid reaction to test-paper and deflects polarized light to the right. Oil of bergamot is soluble in one-quarter or one-half of its volume of 90 per cent. alcohol, and the addition of larger quantities of the alcohol does not cause turbidity. Some samples of the oil have been found to form clear solutions with 80 per cent. alcohol, while others, especially rich in ester-content, produce turbid mixtures. Upon evaporation on a boiling water-bath a residue of a waxy nature is obtained amounting to 5 or 6 per cent. and identical with the waxy deposit often found in the commercial oil, which is composed chiefly of bergaptene (see *Composition*).

Composition.—Oil of bergamot owes its value in perfumery chiefly to its content of linalyl acetate, of which ester from 30 to 40 per cent., and at times even 45 per cent., is present. In addition it contains linalool, some dextro-limonene, and 5–6 per cent. of bergaptene, an odorless compound which has been shown to be the lactone of bergaptenic acid, and has the composition $C_{12}H_8O_4$. Bergaptene has been obtained in the form of delicate, white, silky needles, which are tasteless and at ordinary temperature also odorless, and which melt at 188° C. (370.4° F.).

Adulterations.—Oil of bergamot has been adulterated with oil of orange, oil of turpentine, and inferior oils of bergamot obtained by distillation of the partly exhausted rind or of the leaves with water. The decreased solubility in alcohol and an increase or deficiency in the weight of residue obtained by evaporation of the oil at 100° C. (212° F.) will serve to detect adulteration.

Action and Uses.—Oil of bergamot possesses aromatic and stimulating properties, and is employed as a flavoring agent in hair tonics and to disguise the unpleasant odor of certain drugs in dusting-powders and ointments.

OLEUM BETULÆ, *U. S.*—Oil of Betula.

Oleum betulæ volatile, U. S., 1890; *Oleum betulæ lentæ.—Oil of sweet birch*, E.; *Essence de betula*, Fr.; *Birkenrindenöl*, G.

A volatile oil obtained by distillation from the bark of the sweet birch, *Betula lenta* L.—Fam. *Betulaceæ*, after the bark has been macerated for about 12 hours in order to admit of the hydrolysis of the glucoside gaultherin into methyl salicylate and a sugar.

This oil is commonly known as oil of wintergreen, or in recent years as natural wintergreen oil, in order to distinguish it from artificial methyl salicylate. Commercially it is not often distinguished from true wintergreen oil, from *Gaultheria procumbens*, which it resembles closely.

Properties.—Oil of sweet birch is colorless when rectified, a reddish colored oil indicating contact with metal (iron) from the still or containers. As to odor and taste, it cannot readily be distinguished from pure methyl salicylate, somewhat more readily from true wintergreen oil. Its specific gravity varies between 1.180 and 1.187. Like methyl salicylate, it is optically inactive, differing in this respect slightly from fresh true wintergreen oil.

Composition.—Its similarity in odor and taste with true wintergreen oil was recognized early in the nineteenth century. Procter (1843) regarded it identical with true wintergreen oil. The U. S. P. of 1890, in which it was first made official, pronounced it as identical with methyl salicylate, and as "nearly identical" with true wintergreen oil. According to Power and Kleber, it consists of about 99.8 per cent. of methyl salicylate, the remaining fraction of 1 per cent. consisting of paraffin and an ester, $C_5H_9COOC_8H_{15}$, to which it owes its slight difference in odor from methyl salicylate.

Tests.—The most common admixture is artificial methyl salicylate. If perfectly pure, this defies detection; if impure, it may be detected by means of its impurities (see

METHYLIS SALICYLAS). Most adulterants will be indicated physically by changes in the specific gravity, angle of rotation, and boiling-point (the boiling-point of methyl salicylate is given as 224° C. (435.2° F.) corrected). Chemically they are often indicated by the incomplete solubility in aqueous alkali (comp. methyl salicylate). Substances soluble in water, like alcohol, or soluble in aqueous alkali, like the phenols, are not indicated in this way. Turpentine oil and petroleum, the crude adulterants formerly used more extensively, are readily separated in this manner, and can be identified by their physical and chemical properties.

For the purpose of ascertaining the amount of methyl salicylate with an approximate degree of accuracy, its solubility in an aqueous solution of potassium hydroxide can be made use of, a graduated cylinder being employed; provided, however, such soluble substances as alcohol and phenols have been found absent. For a greater degree of accuracy the amount of methyl salicylate can be ascertained titrimetrically by saponification with standard alkali and back titration of the excess of alkali with standard acid.

Action and Uses.—Oil of sweet birch is employed for the same purposes and in the same doses as OLEUM GAULTHERIÆ (which see).

OLEUM BUBULUM.—Neat's-foot Oil.

Oleum pedum tauri, Axungia pedum tauri.—Huile (Graisse) des pieds du gros bêtail, Fr.; *Klauenöl, Ochsenklauenfett*, G.

Preparation.—Neat's-foot oil is obtained by boiling neat's feet, deprived of their hoofs, with water, skimming off the oil which rises to the surface, and keeping it for some time on warm water. After the impurities have settled it is ready for use.

Properties.—Neat's-foot oil is a pale-yellow and (when of good quality) nearly inodorous and bland, liquid oil, which has the specific gravity 0.915 at 15° C. (59° F.), is but slightly thickened on exposure, does not readily turn rancid, and requires to be cooled to below the freezing-point of water before it congeals to a soft white mass. It consists mostly of olein, containing according to Coste and Parry (1898) about 3.5 per cent. of free fatty acid, and is soluble in the usual solvents of fixed oils. Its reactions with sulphuric acid, nitric acid, and the elaïdin test simulate those of lard oil. Its saponification value is 189–197; its iodine value is 65.3 to 72.4; and its thermal value (Maumené test) 47–48 degrees C.

Action and Uses.—Neat's-foot oil has been employed in medicine as a substitute for codliver oil, but because of its disagreeable odor and tendency to cause diarrhœa is rarely prescribed. The dose is from 1 to 2 fluidrachms (4–8 Cc.).

OLEUM CADINUM, *U. S., Br.*—Oil of Cade.

Oleum juniperi empyreumaticum.—Juniper tar oil, E.; *Huile de cade*, Fr.; *Kadeöl, Radiöl*, G.

Oil of cade is an oily product obtained by the destructive distillation of the wood of *Juniperus Oxycedrus* L.—Fam. *Pinaceæ* or *Coniferæ*, the African, Spanish, or Prickly Cedar or Large Brown-fruited Juniper, a species of the Mediterranean region, quite similar to *J. communis* and *J. Sabina*.

Oil of cade was made official in the 1890 edition of the U. S. P. and in the 1898 edition of the Br. P. It is official in all pharmacopœias with the exception of the Italian, Japanese, and Russian.

As a product of destructive distillation it is not classed with the volatile oils proper. The empyreumatic oil resulting from the destructive distillation of ordinary juniper wood is said to be substituted in the market for the pharmaceutical article. This may account for some of the differences that have been observed.

Properties.—Oil of cade is a brown, clear, thick liquid possessing a tarry odor and an empyreumatic, burning, somewhat bitter taste. Its specific gravity at 15° C. (59° F.) is about 0.990. In water it is almost insoluble, but imparts to it an acid reaction. In alcohol it dissolves only partially, but ether, chloroform, and carbon disulphide dissolve it completely.

Composition.—Some commercial oils are rich in cadinene, whereas others appear to contain but little. Inasmuch as the oil is used principally in the treatment of skin dis-

eases, its cadinene content may be of little consequence. Of the phenols, which apparently should be regarded as the more important constituents, but little is known.

Action and Uses.—Oil of cade may be employed in the treatment of favus, psora, eczema, psoriasis, and other chronic skin lesions. It is usually incorporated with an ointment base, or it may be mixed with some fixed oil and saponified with sodium hydroxide. Either the ointment or the soap should be applied at night and allowed to remain until morning.

OLEUM CAJUPUTI, *U. S., Br.*—Oil of Cajuput.

Oleum cajeputi.—Oil of cajeput, E.; *Essence de cajeput,* Fr.; *Cajeputöl,* G.

Oil of cajuput is a volatile oil obtained by water or steam distillation from the fresh leaves and twigs of *Cajuputi viridiflora* (Gærtn.) Lyons (*Melaleuca v.* Gærtn.; *M. Leucadendron* L.; *M. Cajuputi* Roxb.)—Fam. *Myrtaceæ.* The Cajuput is a small and beautiful tree of the East Indies, Australia, etc., somewhat resembling the Allspice and Jamaica Bay. It is said that a portion of the oil of commerce is distilled from other species, of the same region, *C. ericifolia* (Sm.) Lyons (*M. ericifolia* Sm.) being specially named. Whereas the oil from *C. acuminata* has an odor resembling slightly that of juniper berries, and the oil from *C. uncinata* yields a fraction with a decided rosemary odor, the majority of these oils resemble cajuput oil as to odor. Commercially they do not always appear to be kept distinct. The U. S. P. demands that oil of cajuput, when assayed by the process given below, shall yield not less than 55 per cent. of cineol.

The oil is official in most pharmacopœias, but not in the latest editions of the pharmacopœias of Germany and Austria. It is, however, enumerated in the unofficial supplement to the P. G. published by the German Apothecaries' Society.

Cineol (eucalyptol or cajuputol), quantitatively and possibly therapeutically, the principal constituent of the cajuput oils, is likewise official in the U. S. P. The new Swedish Pharmacopœia has made cineol official in place of cajuput oil.

Origin.—The oil does not appear to have been brought to Europe until the beginning of the seventeenth century, when the Dutch took possession of the Moluccas. Up to 1730 it was rare and expensive. Since then larger quantities come into the European market through Amsterdam. In Germany it was first called *Oleum Wittnebianum.* In France and England it does not appear to have been used until the beginning of the nineteenth century.

Oil of cajuput is obtained in a primitive manner by the natives of some of the Molucca Islands. The oil is shipped in empty wine and beer bottles, 25 of which are packed in a crate. Macassar on Celebes is the principal commercial center. The total export from this place in 1897 was 78,543 kilos, of which Amsterdam received but 2100. Hamburg and London are the other ports of import. Most of the oil is consumed in the orient, especially in British India.

Properties.—Oil of cajuput is a light, thin liquid. The crude oil is mostly greenish, presumably due to the presence of copper. The rectified oil is colorless. It has a peculiar, rather agreeable, distinctly camphoraceous odor (cineol), and an aromatic bitterish taste. The U. S. P. allows a range in specific gravity of from 0.915 to 0.925 at 25° C. (77° F.). It should be miscible with alcohol in all proportions, and the alcoholic solution should be neutral to litmus. It is also soluble in 1 part of 80 per cent. alcohol. Acidity might be due to oxidation of the aldehydes of an unrectified oil. The oil is lævogyrate, and its angle of rotation should not exceed —2° in a 100-Mm. tube at a temperature of 25° C. (77° F.). The presence of the proper amount of cineol may be determined by combining the latter with phosphoric acid, as follows: "Introduce into a beaker a solution prepared by dissolving 10 Cc. of oil of cajuput in 50 Cc. of purified petroleum benzin; immerse the beaker in a freezing mixture and add phosphoric acid, drop by drop, with constant stirring, until the white magma of cineol phosphate formed begins to assume a yellowish or pinkish tint; then transfer the magma to a force filter, wash it with cold purified petroleum benzin, and then dry it by pressure between two porous plates. Transfer the precipitate (cineol phosphate) to a narrow graduated cylinder and add warm water, which will cause separation of the cineol. The volume in cubic centimeters of the separated oily liquid, multiplied by 10, represents the volume per cent. of cineol."—U. S.

Composition.—The principal constituent of this oil was analyzed correctly by Blanchet as early as 1833. Its identity with cineol, $C_{10}H_{18}O$, was first established by Wallach in 1884. An isomer of this oxide, the crystalline alcohol terpineol, $C_{10}H_{17}OH$,

was found free and as acetic ester by Voiry. Quantitatively this ranks second. Of the terpenes present to a small extent, lævopinene was identified. Voiry also separated aldehydes which are possibly identical with valerianic and benzoic aldehydes. These upon oxidation may impart an acid reaction, especially to a non-rectified oil. The possible presence of traces of copper in the crude oil has been alluded to.

Adulterations.—To what extent the oils from other species are added to commercial oils, it is difficult to state and equally difficult to determine experimentally. Inasmuch as lævorotatory pinene is a constant constituent of the oil, the detection of lævogyrate (*e. g.*, French) turpentine oil is rendered especially difficult. The presence of larger amounts, however, could be detected in the usual manner. On shaking 5 Cc. of the oil with 5 Cc. of water containing 1 drop of diluted hydrochloric acid, a reddish-brown color should not be produced in the acid liquid separated from the oil if a drop of potassium ferrocyanide test-solution be added (absence of copper).

Action and Uses.—Full doses of oil of cajuput produce a sensation of warmth in the gastro-intestinal tract, increase the force and rapidity of the heart's action, and in some cases cause excessive sweating. If given internally in overdose, it produces severe gastro-intestinal irritation. Like other similar volatile oils, it may be locally applied in the treatment of pediculus pubis, tinea tonsurans, pityriasis, psoriasis, and acne rosacea. It has also been recommended as a valuable addition to liniments in the treatment of chronic gouty and rheumatic pains and in neuralgia. Because of its anæsthetic properties it may be inserted upon a pledget of cotton into the cavity of a carious tooth for the relief of toothache. This remedy has been given internally in the treatment of serous diarrhœa, flatulent dyspepsia, choleraic conditions, chronic vesical catarrh, and chronic bronchitis. Oil of cajuput has also been employed as a vermifuge. The internal dose is from 5 to 20 minims (0.3–1.30 Cc.). When used externally, it may be added to camphor liniment or diluted with an equal amount of olive oil.

OLEUM CALAMI, *P. G.*—Oil of Calamus.

Essence de calamus, Fr.; *Kalmusöl, Calmusöl*, G.

Oil of calamus is obtained by steam distillation from *Acorus Calamus* L.—Fam. *Araceæ*.

Properties.—Calamus oil is somewhat viscid in consistence, of a yellow to brownish-yellow color, possesses an aromatic, camphor-like odor and a bitter taste. Its specific gravity, according to the P. G., varies between 0.960 and 0.970; its angle of rotation = +10° to +31°; saponification number 16–20, after acetylization 40–50. It is readily soluble in 90 per cent. alcohol. According to the P. G., a mixture of 1 Gm. of oil with 1 Gm. of alcohol should be colored a dark reddish-brown by 1 drop of ferric chloride test-solution.

Composition.—Next to nothing is known about the chemistry of the oil. It possibly contains pinene and a sesquiterpene. One of the higher fractions is blue in color, and the highest fraction apparently contains a phenol (compare the test above).

Action and Uses.—See CALAMUS, the properties of which are almost entirely due to its volatile oil.

OLEUM CARI, *U. S., Br., P. G.*—Oil of Caraway.

Oleum carui, Br.; *Oleum carvi*, P. G.—*Essence de carvi*, Fr.; *Kümmelöl*, G.

Oil of caraway is obtained by steam distillation from the fruit of *Carum carui* L.—Fam. *Umbelliferæ*. In the P. G. the caraway oil proper is no longer official, but under the same name its principal constituent, the ketone carvone, is recognized. Commercially this is also known as "Kümmelöl, extra stark." The *Oleum carvi* of the P. G., however, should not be confounded with a merely concentrated or terpeneless caraway oil. It is supposed to be chemically pure carvone.

Rectified caraway oil is, properly speaking, an oil improved by redistillation with steam. It is reported that the term "rectified" is sometimes applied to an oil from which a part of the carvone has been removed, evidently by fractional distillation with steam. Such an oil would correspond more or less therefore to "light" caraway oil. This residue, after the carvone has been removed, also enters the market under the designation "carvene." It consists principally of limonene.

Properties.—Oil of caraway should be colorless or pale-yellow in color, possess an

odor characteristic of caraway, and a mild spicy taste. The specific gravity requirements of the U. S. P. are 0.905 to 0.915 at 25° C. (77° F.); those of the Br. P. 0.910 to 0.920 at 15.5° C. (60° F.). A normal oil with a lighter specific gravity can easily be brought up to this requirement by removal of part of the limonene. If the carvone content is naturally low, such an oil is possibly as objectionable as a richer one from which part of the carvone has been removed. The specific gravity requirement of the P. G., viz., 0.960, is that of pure carvone. Oil of caraway is soluble in an equal volume of alcohol; also in from 3 to 10 volumes of 80 per cent. alcohol.—U. S.

Carvone boils at 223°–224° C. (433.8–435.2° F.), limonene at 175°–176° C. (347°–348.8° F.). The angle of rotation of the oil varies between +70° and +80°, or as high as +85°; for carvone it is +62.5°, and for limonene about +125°. The rotatory power of the oil will therefore increase with a diminished carvone content.

Composition.—The principal constituents of caraway oil are *d*-carvone and *d*-limonene in about equal amounts. There appear to be present an alcohol, $C_{10}H_{17}OH$, and other substances more prone to decomposition, which are removed, at least in part, in the process of rectification. In the aqueous distillate of the oil, methyl alcohol, acetaldehyde, furfurol, and diacetyl have been found. Hydrogen sulphide is also found in considerable amount at the beginning of the distillation.

Tests.—Inasmuch as caraway oil is valued almost entirely in accordance with its carvone content, a carvone assay is of importance. Fractionation has been resorted to: not more than 25 per cent. should distil below 185° C. (365° F.), and at least 55 to 65 per cent. above 200° C. (392° F.), a considerable fraction—40 to 50 per cent.—being obtained at from 220° to 230° C. (428° to 446° F.).

This method, however, is somewhat unsatisfactory. The carvoxime method yields not only more accurate results, but also a definite chemical compound in crystalline form.

To a solution of 10 Gm. of oil, dissolved in 25 Cc. of alcohol, 5 Gm. of hydroxylamine hydrochloride and 6.5 Gm. of sodium bicarbonate are added. This mixture is boiled on a water-bath for half an hour in a flask connected with a reflux condenser, 25 Cc. of water are then added, and the alcohol is distilled off on the water-bath. Steam is then passed through the liquid until traces of carvoxime come over. The last portions of the distillate are collected separately in test-tubes, and when traces of crystals of carvoxime appear on the surface the operation is interrupted. The tube of the condenser is washed with a little hot water, and this, as well as the last collected distillate, containing some carvoxime, is returned to the flask. The contents of the flask are allowed to cool, and after the carvoxime has completely solidified, it is removed from the sides of the flask by means of a loop of stiff wire, thrown upon a force filter, washed, and dried by suction. The air-dried carvoxime is transferred to a tared glass dish and heated for 1 hour on a water-bath, and when cool weighed. To the weight thus obtained 0.100 Gm. is added, as this is about the quantity lost during heating. From the weight of the carvoxime that of the carvone may be readily calculated, 164.67 parts of the former corresponding to 149.66 parts of the latter, or the weight of carvoxime obtained, expressed in Gm., when multiplied by 0.9088, gives the weight of the equivalent amount of carvone.

Action and Uses.—Oil of caraway is stimulant and carminative, and may be employed in the treatment of flatulent colic. It is used to impart an agreeable flavor to other remedies and to prevent the griping of purgative drugs. The dose is from 1 to 10 minims (0.05–0.6 Cc.).

OLEUM CARYOPHYLLI, *U. S., Br., P. G.*—Oil of Cloves.

Oleum caryophyllorum.—Essence de girofle, Fr.; *Nelkenöl*, G.

The term oil of cloves is commonly used to designate the volatile oil from the unexpanded flowers of *Eugenia aromatica* (L.) O. Kuntze—Fam. *Myrtaceæ*. The German Pharmacopœia, however, applies it to eugenol, the principal oxygenated constituent of this oil. The U. S. P. requires that oil of cloves, when assayed by the process given below, shall contain not less than 80 per cent. of eugenol. Oil of clove stems, although closely related, is not official, neither is the oil of clove bark, derived from a different plant.

Zanzibar and Pemba cloves, which appear to be used almost exclusively for the distillation of the commercial oil, yield about 15 to 18 per cent.

Properties.—Freshly distilled oil of cloves is yellowish or almost colorless, but it

darkens with age. The specific gravity of a normal oil may vary between 1.040 and 1.060 at 25° C. (77° F.) (U. S.). According to the Br. P., it should not fall below 1.050. The specific gravity requirement of the P. G., viz., 1.072 to 1.074, is that of eugenol, one of the heaviest constituents of the oil. It is soluble in an equal volume of alcohol, this solution being slightly acid to litmus-paper; also soluble in 2 parts of 70 per cent. alcohol, but older oils do not always form a perfectly clear solution. If 2 drops of the oil be dissolved in 4 Cc. of alcohol and a drop of ferric chloride test-solution added, a bright green color will be produced; and if the same test be made with a drop of diluted ferric chloride test-solution, prepared by diluting the test-solution with four times its volume of water, a blue color will be produced, which soon changes to yellow (U. S.). Inasmuch as the bulk of the oil consists of a phenol, it is in large part soluble in aqueous caustic alkali (hence the former name, eugenic acid, for eugenol).

Composition.—Quantitatively, and finally also therapeutically, the principal constituent of oil of cloves is eugenol, a phenol, of which from 70 to 85 per cent. is present. In addition to free eugenol, there appears to be present aceteugenol, its acetic ester; also the eugenol ester of acetsalicylic acid. Quantitatively second in importance is the sesquiterpene caryophyllene. Other minor constituents are methyl amyl ketone, vanillin, furfurol (to which some ascribe the darkening of the oil), and methyl alcohol. The fatty ketone is said to impart to the oil its peculiar fruity odor as distinguished from the more heavy eugenol odor (distinction from clove stem oil).

Tests and Adulterations.—Oil of cloves may be sophisticated by the abstraction of eugenol or by the addition of eugenol from other sources—*e. g.*, clove stem oil. Whereas crude adulterants, such as alcohol, turpentine oil, petroleum, cinnamon oil, etc., may be detected with comparative readiness, the addition of clove stem oil cannot well be proved, though the nasal expert may suspect its presence. Shaken with hot water, the oil should not impart to the aqueous solution an acid reaction (probably cinnamic acid), nor should the presence of phenol in the filtered solution be indicated by ferric chloride.

Although clove stem oil contains more free eugenol than oil of cloves, the latter is commonly valued according to its eugenol content. The Pharmacopœia directs the following method of assay: Introduce into a narrow graduated cylinder 10 Cc. of the oil of cloves and 100 Cc. of potassium hydroxide test-solution, shake the liquids together for five minutes. When the fluids have separated completely, note the volume of the residual oil, which should not measure more than 2 Cc., indicating the presence of at least 80 per cent. of eugenol. Inasmuch as the non-phenol constituents of the oil are soluble in the aqueous solution of alkali phenylate, a mere shaking of the oil in a graduated cylinder with aqueous alkali yields too high results. Crude adulterations with petroleum and turpentine oil may, however, be indicated in this way, but not the addition of alcohol or carbolic acid.

Better quantitative results are obtained by Thom's method,[1] according to which eugenol is converted into its solid benzoic ester and weighed.

Action and Uses.—Oil of cloves is employed internally as a stimulant and carminative. It may be locally applied as a parasiticide, counterirritant, and anæsthetic. It is given internally to overcome flatulence and to prevent griping. This remedy has also been employed for the purpose of allaying the cough and decreasing the expectoration in pulmonary tuberculosis. For the latter condition it is employed both hypodermatically and by the mouth. It has been locally applied for the purpose of destroying parasites, such as *Pediculus pubis;* and when introduced into the cavity of an aching tooth frequently relieves the pain. Because of its counterirritant properties, it is frequently added to liniments and employed in the treatment of muscular rheumatism. The dose is from 2 to 5 minims (0.10–0.3 Cc.).

OLEUM CHENOPODII, *U. S.*—Oil of Chenopodium.

Oil of American wormseed, E.; *Essence de chénopode anthelmintique*, Fr.; *Chenopodiumöl, Americanisches Wurmsamenöl*, G.

Oil of chenopodium is a volatile oil distilled from the fruit of *Chenopodium ambrosioides* L., var. *anthelminticum* Gray (Fam. *Chenopodiaceæ*).

[1] The Volatile Oils, by Gildemeister, Hoffmann and Kremers, p. 516.

Oil of chenopodium has always been official in the U. S. P., but does not appear to have received official recognition elsewhere.

Most of this oil is distilled in Maryland, and since Baltimore is the commercial centre of that state, this oil is commonly known as Baltimore oil in distinction from western (Missouri) oil, which has at times played a rôle in the market.

Properties.—Oil of wormseed is colorless or yellowish, has a peculiar, penetrating, somewhat camphoraceous odor, and a pungent, bitter taste. Its specific gravity is about 0.965–0.985 at 25° C. (77° F.). It should be soluble in 5 volumes of 70 per cent. alcohol. The oil is lævogyrate; its angle of rotation should not exceed — 5° in a 100 Mm. tube at 25° C. (77° F.).—U. S.

Composition.—Garrigues (1854) obtained a terpene (probably pinene) and a fraction $C_{10}H_{16}O$. The property of recent commercial oil to decompose with explosive violence when distilled renders these claims doubtful.

Action and Uses.—Oil of chenopodium is employed for the expulsion of round worms. The dose for a child is from 5 to 10 minims (0.3–0.6 Cc.), twice daily for 3 or 4 days, after which an active purgative should be given. The oil has been recommended in the treatment of malaria, chorea, hysteria, and other nervous diseases, but is of little benefit in such conditions.

OLEUM CINNAMOMI, *U. S.*, *Br.*, *P. G.*—Oil of Cinnamon.

Oleum cinnamomi cassiæ. Oil of cassia, Oil of Chinese cinnamon, E.; *Essence de cannelle de Chine*, Fr.; *Zimmtöl, Zimmtkassienöl*, G.

A volatile oil distilled from Cinnamomum Cassia (Fam. *Lauraceæ*), yielding, when assayed by the process given below, not less than 75 per cent., by volume, of cinnamic aldehyde.—U. S.

By the above title different articles are designated. While the Br. P. calls for the oil of Ceylon cinnamon, the U. S. P. and the P. G. refer to the oil from the cheaper Chinese cinnamon or cassia. Inasmuch as cinnamic aldehyde is quantitatively the principal constituent of both oils, the U. S. P. of 1880 admitted both oils under the above designation. The result was, no doubt, that the cheaper oil took the place of the more expensive kind, and in 1890 oil of cassia was made official exclusively. The 1900 Pharmacopœia having admitted cinnamic aldehyde, the principal constituent of oil of cassia, it seems a pity that the latter was not dropped and in its stead the oil of Ceylon cinnamon introduced on account of its very much finer flavor. The descriptions of the U. S. P. and the P. G., therefore, stand for the same oil, namely, oil of cassia, whereas that of the Br. P. stands for the more fragrant oil of Ceylon cinnamon.

For the distillation of oil of cassia the leaves, with possibly some waste from the bark, are chiefly used. The commercial cassia oil, therefore, is not the oil demanded by the U. S. P. or by the P. G., according to their definitions. Moreover, in China cassia oil is distilled over a free flame, so that the commercial oil never has the aldehyde content obtained from the same material by steam distillation. Oil of Ceylon cinnamon is chiefly obtained from the waste that results from the peeling of the bark, commonly designated as "chips," the yield being about 0.5–1 per cent. The oil from Ceylon is reported frequently to contain leaf oil as well.

Properties.—Oil of cassia is a yellowish or brownish liquid, becoming darker and thicker by age and exposure to the air, having the characteristic odor of cinnamon, and a sweetish, spicy, and burning taste. Its specific gravity ranges from 1.045 to 1.055 at 25° C. (77° F.). The oil (or if it be dark, its distillate) should be optically almost inactive; it should not be more than 1 degree dextrogyrate or lævogyrate when viewed through a 100 Mm. tube. It is soluble in 2 volumes of 70 per cent. alcohol, and when shaken with a saturated solution of sodium bisulphite, it solidifies to a crystalline mass. If 4 drops of oil of cassia, contained in a test-tube, be cooled to 0° C. (32° F.) and then shaken with 4 drops of fuming nitric acid, crystalline needles or plates will be formed. —U. S.

Oil of Ceylon cinnamon is a yellow liquid when freshly distilled, but gradually becomes reddish, and has the agreeable, delicate odor of the bark, also the characteristic taste of the latter. The specific gravity varies from 1.025 to 1.035 at 15.5° C. (60° F.) —Br. The oil is slightly lævorotatory, up to —1° in a 100 Mm. tube, and is soluble in 3 parts of 70 per cent. alcohol.

Oil of cinnamon leaf is of light color, rather mobile, and has a mixed odor of cloves and cinnamon. Its specific gravity is higher than that of the preceding oils, ranging from 1.044 to 1.065 at 15° C. (59° F.). The oil yields a clear solution with 3 times its volume of 70 per cent. alcohol.

Composition.—The chief constituent of oil of cassia is cinnamic aldehyde (which see under CINNALDEHYDUM), of which from 70 to 80 per cent. and over is present, and next in importance is cinnamyl acetate, a liquid of extremely unpleasant acrid taste. Besides these, phenylpropyl acetate, orthocumaric aldehyde, and cinnamic acid are met with.

Oil of Ceylon cinnamon owes its value chiefly also to cinnamic aldehyde, of which, however, rarely more than 65 to 70 per cent. is present. Eugenol is an invariable constituent, as much as 8 per cent. having been found. In addition, the presence of phellandrene and other bodies has been reported. The particular cause of the fragrant aroma has not yet been discovered, and it is probably due to a combination of several constituents.

Cinnamon-leaf oil contains but a small proportion of cinnamic aldehyde, but is rich in eugenol (70 to 90 per cent.). Safrol, benzaldehyde, benzoic acid, and terpenes are also present.

Adulterations and Tests.—Oil of cassia has been frequently and grossly adulterated with a mixture of petroleum and rosin. The U. S. P. gives the following test for their detection: If 1 Cc. of the oil be mixed with 3 Cc. of a mixture of 3 volumes of alcohol and 1 volume of water, a clear solution should result; and if to this solution there be added gradually 2 Cc. of a saturated solution of lead acetate in a mixture of 3 volumes of alcohol and 1 volume of water, no precipitate should be produced (absence of petroleum and of rosin). If a portion of oil of cassia be shaken with hydrogen sulphide test-solution, it should not assume a dark color (absence of lead and copper).—U. S. A drop of ferric chloride solution added to a solution of 4 drops of oil of cassia in 10 Cc. of alcohol should not cause a green or blue coloration (absence of eugenol).—P. G. The Br. P. directs the following test for detection of cinnamon-leaf oil in oil of Ceylon cinnamon: The addition of ferric chloride test-solution to a solution of 1 Cc. of oil in 5 Cc. of alcohol should afford a pale-green, but not a decided blue coloration.

The requirements for a definite cinnamic aldehyde content vary for different pharmacopœias, thus: The U. S. P. demands not less than 75 per cent., the P. G. not less than 70 per cent., and the Br. P. at least 50 per cent.

For the assay a special flask (cassia flask, aldehyde flask) of about 100 Cc. capacity is used. The neck of the flask is about 13 Cm. long, has an inner diameter of 8 Mm., and is calibrated into $\frac{1}{10}$ Cc. The neck has a capacity of about 6 Cc. The zero mark is fixed slightly above the point where the flask is narrowed into the neck.

Assay for Cinnamic Aldehyde.—Introduce into a cassia flask, by means of a measuring-pipette, 10 Cc. of the oil of cinnamon, add 10 Cc. of a 30 per cent. solution of sodium bisulphite, shake the flask, and heat it in a water-bath containing boiling water until the contents are liquefied; add successive portions (10 Cc. each) of the bisulphite solution, shaking and heating as before, after each addition, until the flask is three-fourths filled. Continue to heat in the water-bath until the odor of cinnamic aldehyde is no longer perceptible, cool the flask to about 25° C. (77° F.), add enough of the bisulphite solution to raise the lower limit of the oily layer to the zero mark of the scale. The residual liquid should not measure more than 2.5 Cc., corresponding to at least 75 per cent. of cinnamic aldehyde by volume.—U. S.

Accurately speaking, percentage by volume and not percentage by weight is determined in this manner. Inasmuch, however, as the specific gravity of the aldehyde and the non-aldehyde constituents is almost the same, the two are practically identical.

The chemical reactions involved can be explained by means of the following equations; at first the insoluble aldehyde addition-product is formed:

$$\underset{\text{Cinnamic aldehyde.}}{C_6H_5.CH{:}CH.CHO} + \underset{\text{Acid sulphite of sodium.}}{NaHSO_3} = \underset{\text{Cinnamal hydroxy sulphonate of sodium.}}{C_6H_5.CH{:}CH.CHO.NaHSO_3}$$

When boiled with water, two molecules of this addition-product break up into a molecule of cinnamic aldehyde and one of sulpho-cinnamal hydroxy sulphonate of sodium.

$$\underset{\text{Cinnamal hydroxy sulphonate of sodium.}}{2C_6H_5.CH{:}CH.CHO.NaHSO_3} = \underset{\text{Cinnamic aldehyde.}}{C_6H_5.CH.CH.CHO} +$$

$$\underset{\text{Sulpho-cinnamal hydroxy sulphonate of sodium.}}{C_6H_5CH_2.CH(SO_3Na).CHO.NaHSO_3}$$

In order to convert all of the aldehyde into the second compound soluble in water it is necessary to use an excess (2 molecules) of sodium acid sulphite. The salts of the sulpho-cinnamal hydroxysulphonic acid are readily soluble in water and not decomposed by boiling water. They are decomposed by destructive distillation or when heated with caustic soda or sulphuric acid.

Action and Uses.—Oil of cinnamon is usually employed as an adjuvant to other remedies. It prevents the griping of drastic drugs, aids in the absorption of medicines, and disguises their taste. It has been recommended in atony of the stomach, flatulent colic, and uterine hemorrhage. The dose is from 1 to 3 minims (0.05–0.20 Cc.).

OLEUM COCOIS.—Coconut Oil.

Oleum Cocos.—Cocoanut butter, Cocoanut oil, E.; *Beurre de coco,* Fr.; *Kokosnussöl, Kokosöl, Kokosbutter,* G.

A mixture of liquid and solid fats, obtained from the fruit of the coco-palm, *Cocos nucifera* L. (Fam. *Palmaceæ*).

The coco-palm tree is now met with in all tropical countries, growing to a height of from 50 to 100 feet. It has at the apex a tuft of leaves, which are 3.6 M. (12 Ft.) or more long, and have numerous narrow rigid and long leaflets. The yellowish-white flowers produce the well-known coconuts, often as many as 120 on a single tree, which in their unripe state contain a sweetish liquid. The kernels contain much oil, which is obtained by cold or hot expression, or by decoction of the crushed seed in water. The kernels of *Cocos butyracea* L., of Brazil, yield a similar oil. Under the name *coprah,* the dried kernels are imported into Europe, where large quantities of the oil are expressed and known as *coprah oil.* Commercially the Cochin oil, prepared in Cochin (Malabar), ranks first, after which the Ceylon oil comes next, and the East Indian oil last.

Properties.—The best quality of coconut oil occurs as a white to pearl-white fat of the consistence of lard, and has a peculiar quite characteristic odor and taste. Ordinarily on exposure to the air it becomes rancid and acquires an acrid taste. The refined oil (treated with alcohol and animal charcoal, Schlich's process) remains sweet for a considerable time.

The melting-point of coconut oil varies from 22° to 28° C. (71.6°–82.4° F.) and congeals at 18°–12° C. (64.4°–53.6° F.). The cold-pressed oil melts at 20° C. (68° F.) and congeals at 13°–12° C. (55.4°–53.6° F.). After having been heated to 240° C. (464° F.) it remains liquid for several days. It is quite soluble in alcohol, 2 parts of 90 per cent. at 60° C., and very soluble in ether, chloroform, and carbon disulphide. It is characterized by its Reichert value 2.5 to 3.7, by its high saponification number (258), by the low iodine value 8 to 9.5, and the melting- (24.6°–27° C.) and congealing- (15°–20° C.) points of the fatty acids. These data distinguish it from butter, lard, and similar fats. It saponifies readily, the soap being capable of holding 40 to 60 per cent. of water, and is not easily precipitated by salt brine, whence its use as a "marine soap."

Composition.—Coconut oil contains chiefly trilaurin and trimyristin, besides triolein and a considerable percentage of the glycerides of capric, caproic, and caprylic acids. By cold pressure the solid fats may readily be separated from the liquid.

Action and Uses.—Coconut oil was employed formerly as a substitute for codliver oil. It is quite palatable, easily digested, and not prone to disorder the stomach. The dose is 4 fluidrachms (16 Cc.). It is used quite largely in the manufacture of soap, and to some extent is substituted for lard in the preparation of ointments.

Coconut oil in recent years in a refined condition (freed from free fatty acids) is used as a substitute for butter, being known as "Mannheim coconut butter," "Vegetable butter," "Vegetaline," "Lactine," "Laureol," "Nucoline," etc.

The exportations of coconut oil from Ceylon have amounted to 16,500 tons per annum; from British India, 6600 tons; from Dutch Indies, 1430 tons; while the total exportation of *coprah* from Ceylon, Samoa, Singapore, and Tahiti have amounted to 17,600 tons per annum.

OLEUM COPAIBÆ, *U. S., Br.*—Oil of Copaiba.

Oleum balsami copaivæ.—Essence de copahu, Fr.; *Copaivaöl,* G.

A volatile oil distilled from Copaiba.

Copaiba is distinguished according to the ports of export. The Para variety, which

yields 60 to 90 per cent. of oil, is for this reason preferred for distillation. Maracaibo and Maranhão copaibas yield about 40 per cent.

Properties.—Oil from Para and Maracaibo copaibas is a colorless, yellowish or bluish liquid possessing the characteristic pepper-like odor of the oleoresins, and a bitter, acrid, and persistent taste. The specific gravity, according to the U. S. P., may vary between 0.895 and 0.905 at 25° C. (77° F.); according to the Br. P., between 0.900 and 0.910. Its angle of rotation varies from —7 to —35°. Equal parts of absolute alcohol will usually effect solution, but the oil is not completely soluble in 90 per cent. alcohol. The Pharmacopœia states that oil of copaiba is soluble in 2 volumes of alcohol.

Composition.—The only known constituent of copaiba oil is the sesquiterpene caryophyllene.

Adulteration.—Copaiba oil is more frequently used as an adulterant than adulterated itself. As an adulterant Gurjun balsam oil, however, comes into consideration. This is indicated by its higher specific gravity (0.915–0.930) and by its greater angle of rotation (—35° to —130°). However, whereas most Gurjun balsam oils are lævogyrate, dextrogyrate oils have also been observed. Oil from African copaiba has a specific gravity of 0.917–0.918, and an angle of rotation equal to +20°; and is not soluble in an equal volume of absolute alcohol.

Action and Uses.—The action and uses of oil of copaiba are identical with those of COPAIBA (which see). The dose is from 5 to 10 minims (0.3–0.6 Cc.).

OLEUM CORIANDRI, *U. S.*, *Br.*—Oil of Coriander.

Essence de coriandre, Fr.; *Corianderöl*, G.

A volatile oil distilled from Coriander.

Coriander oil is distilled from the fruit which has been crushed between rollers. For the distillation on a large scale, the coriander from Moravia, Thuringia, and Russia is almost exclusively used, the yield being 0.8–1.0 per cent.

Properties.—Coriander oil is colorless or slightly yellowish, and possesses a characteristic coriander-like odor and an aromatic mild taste. Specific gravity, according to the U. S. P., is 0.863–0.878 at 25° C. (77° F.); according to the Br. P., 0.870–0.885 at 15.5° C. (60° F.). Its angle of rotation varies from +8° to +13°. The oil is soluble in 3 parts of 70 per cent. alcohol; also soluble in all proportions in 80 and 90 per cent. alcohol.—U. S.

Constituents.—The oil consists of about 90 per cent. of dextrogyrate linalool, formerly designated coriandrol, about 5 per cent. of *d*-pinene, and other unknown substances which impart to the oil its peculiar aroma.

Adulteration.—Turpentine oil, cedarwood oil, and sweet orange oil are indicated by their lesser solubility in 70 per cent. alcohol. Oil of cubebs is also mentioned as having been used occasionally.

Action and Uses.—Oil of coriander, like the fruit from which it is obtained, is employed in the treatment of flatulent colic, and to prevent the griping and mask the taste of other remedies. It is also said to relieve the pain of muscular rheumatism and neuralgia. The dose is from 1 to 5 minims (0.05–0.3 Cc.).

OLEUM CUBEBÆ, *U. S.*, *Br.*—Oil of Cubeb.

Oleum cubebarum.—Oil of cubebs, E.; *Essence de cubèbe*, Fr.; *Cubebenöl*, G.

A volatile oil distilled from cubeb.

Comminuted cubebs upon distillation with water vapor yield 10–18 per cent. of oil.

Properties.—Cubeb oil is a viscid colorless, light-green or greenish-yellow liquid. The last portions of the distillate being blue may render the otherwise yellowish oil colorless. It possesses the characteristic cubeb odor and a warm, camphor-like taste, which finally becomes acrid. Specific gravity 0.905–0.925 at 25° C. (77° F.).—U. S. Its angle of rotation varies from —25° to —40°. Its solubility in 70 per cent. alcohol varies greatly. Some oils, presumably from old cubebs, are soluble in an equal part, others require 10 parts to effect solution.

Composition.—The bulk of the oil consists of sesquiterpenes, cadinene, and a second one which has not yet been identified. Small amounts of terpenes, namely, dipentene, and probably pinene and camphene, are also present. Whereas oil from fresh cubebs

appears to consist almost entirely of hydrocarbons, the oil from old berries has been found to contain cubeb camphor, a sesquiterpene hydrate. This hydrate is supposed to be formed by the action of the moisture of the atmosphere on the sesquiterpene in the berries.

Action and Uses.—The properties of oil of cubeb are analogous to those of CUBEBA (which see). It is probably less efficient than the powdered drug, but may be substituted for the latter in doses of from 10 to 15 minims (0.6–1 Cc.).

OLEUM ERIGERONTIS, *U. S.*—Oil of Erigeron.

Oleum erigerontis canadensis.—Oil of fleabane, E.; *Essence d'erigeron*, Fr.; *Erigeronöl*, G.

A volatile oil distilled from the fresh flowering herb of *Leptilon Canadense* (L.) Britton.—(Fam. *Compositæ*).

Fleabane, horseweed or butterweed, is a common American weed, frequently found in peppermint fields. The fresh herb yields upon distillation 0.2–0.4 per cent. of oil, which finds limited medical application in the United States and which was made official in the U. S. P. of 1890.

Properties.—When fresh, erigeron oil is a colorless or light-yellow, mobile liquid. Exposed to the air it rapidly resinifies, becoming viscid and darker. It has a peculiar, aromatic, persistent odor, and an aromatic, slightly pungent taste. Its specific gravity ranges from 0.845–0.865 at 25° C. (77° F.); its angle of rotation equals about +50°. With an equal volume of 94 per cent. alcohol it forms a clear solution (distinction from oil of fireweed and oil of turpentine).—U. S.

Composition.—The bulk of erigeron oil consists of *d*-limonene. Terpineol has also been obtained from the oil, but whether this exists as such in the oil or whether it is a product of decomposition, due to the heat applied during fractional distillation, remains undetermined.

Action and Uses.—Oil of erigeron has been employed successfully in the treatment of oozing hemorrhages from the uterus, epistaxis, and other passive hemorrhages. It has been recommended also for hemorrhage of the intestines in enteric fever, and is said to do good in diarrhœa and dysentery. It may be employed as a substitute for the oils of cubeb and copaiba in the treatment of gonorrhœa. The dose is from 10 to 30 minims (0.6–2 Cc.), which amount may be repeated in from 2 to 4 hours.

OLEUM EUCALYPTI, *U. S., Br.*—Oil of Eucalyptus.

Oil of eucalyptus globulus, E.; *Essence d'eucalyptus*, Fr.; *Eucalyptusöl*, G.

The volatile oil distilled from the fresh leaves of *Eucalyptus*, and rectified by steam distillation, yielding, when assayed by the process given below, not less than 50 per cent. of cineol (eucalyptol).—U. S.

According to Hirsch, eucalyptus oil is official in the following pharmacopœias: Belg., Br., Gall., Hung., Japon., Norv., Rom., U. S. In the U. S. P. it has been official since the 1880 edition. Though not official in the P. G. IV., it has been adopted in the "Arzneimittel, etc.," which is commonly regarded as a supplement.

Like the U. S. P. of 1880, the Br. P. admits the oil of other species; the P. G., Suppl. II., however, admits the oil from the one species only.

Since the cultivation of eucalyptus and the distillation of eucalyptus oils have been established on so scientific a foundation by the efforts of the Technological Museum of Sydney, N. S. W., there is no excuse for an indiscriminate definition.

According to their chemical composition, the numerous eucalyptus oils have been classified into the following groups:

I. Cineol-containing oils.
II. Citronellal-containing oils.
III. Citral-containing oils.
IV. Oils with a peppermint-like odor.
V. Oils less known and of indefinite odor.

Inasmuch as cineol or eucalyptol is generally regarded as the constituent of prime medicinal value, the first group alone need receive consideration. Of this group possibly only those oils enumerated in the table below may be regarded as probable substitutes for *E. globulus* oil because they meet the twofold requirement of containing a fair amount of cineol and being distilled in sufficient quantity to be of commercial importance.

Owing to the rapid growth of the trees of this genus it is impossible to deny future commercial importance to any of these and possibly others.

Although the genus *Eucalyptus* has possibly been more systematically studied for its oils than any other genus, the knowledge which we possess of individual oils is insufficient and sometimes uncertain. The following table will give some idea of the present chemical knowledge of the medicinally more important oils:

	Constituents.				
E. globulus	Cineol	*d*-Pinene	Eudesmol[1]	. . .	. . .
	(and possibly camphene, butyric, valeric, and capronic aldehydes, also fatty acids and ethyl and amyl alcohols).				
E. odorata	Cineol	Pinene	. . .	Aromadendral[2]	. . .
E. cneorifolia	Cineol	Pinene	. . .	Aromadendral	. . .
E. oleosa	Cineol	Pinene	. . .	Aromadendral	Sesquiterpene
E. dumosa	Cineol	Pinene	. . .	Aromadendral	. . .
E. amygdalina	Cineol	Pinene	Eudesmol	. . .	. . .
	(phellandrene, peppermint, ketone, methyl, ethyl, isobutyl, and amyl alcohols).				

The above tabulation shows the known differences between the oils of *E. globulus* and *E. amygdalina* on the one hand and of the four remaining oils on the other hand. It also shows that the oil of *E. amygdalina* contains phellandrene, a hydrocarbon found extensively in oils containing but little or no cineol. Baker and Smith state that "by a proper system of distillation and rectification an oil containing 35 to 40 per cent. of eucalyptol can be obtained from this species."

In this connection attention ought to be called to the necessity of rectifying eucalyptus oil so as to remove obnoxious aldehydes, etc., since they make themselves unpleasantly noticeable in the crude oil by their tendency to produce coughing.

The oil of *E. globulus* is the most valued of all the medicinal eucalyptus oils of commerce, not only because of its high cineol content, but also because it has been characterized by a constancy of constituents and general characters mostly wanting in the commercial oils from the other species.

E. odorata yields but a small amount of oil which at times has been found rich in cineol, but according to the Australian authorities contains only 20–25 per cent.

The oil of *E. cneorifolia*, containing as much as 50–75 per cent. of cineol, is stated to conform to the requirements of the British Pharmacopœia, but it contains cuminic aldehyde and, owing to the comparatively large amount of high boiling constituents, is a somewhat heavy oil.

The oils of *E. oleosa* and *E. dumosa* are fairly rich in cineol.

E. amygdalina yields over 3 per cent. of oil. Formerly it came into the market in great quantities, but has recently been displaced by oils richer in cineol. Whereas at one time this oil was much esteemed on account of its low cineol content, it has fallen into disfavor and now commands a very low price.

Properties.—Oil of eucalyptus, when rectified for the purpose of removing objectionable aldehydes, is colorless. It has an aromatic camphoraceous odor, and a pungent, spicy, and cooling taste. Specific gravity 0.905–0.925 at 25° C. (77° F.); angle of rotation varies from +1° to +15°; according to the U. S. P. it should not be more than +10°. The Br. P. limits the rotation to not more than 10° in either direction in a 100 Mm. tube. When exposed to a mixture of ice and salt, oils rich in cineol congeal to a white crystalline mass.

In the following table are the specific gravities of the principal cineol-containing oils as recorded by the authorities mentioned:—

	B. et S.	G.-H.-K.	Parry.	C.-D.-P.
E. globulus	0.9130	0.910–0.930	0.910–0.930	0.910–0.930
E. odorata	0.9042	0.899–0.925	0.900–0.925	0.907
E. cneorifolia	0.9287	0.899–0.923	0.915–0.925	. . .
E. oleosa	0.9250	0.906–0.926	. . .	. . .
E. dumosa	0.9016–0.9151	0.844–0.915	0.900–0.912	. . .
E. amygdalina	0.9012–0.9050	0.850–0.886	0.855–0.890	0.874–0.897

The specific gravity of eucalyptol is 0.930, whereas that of phellandrene, according to Wallach, is 0.8465 at 19° C. There are, however, other constituents than cineol that tend to increase the specific gravity of the oil.

[1] A substance, $C_{10}H_{16}O$, possibly a ketone, m. p. 79-80° C.
[2] An aldehyde, $C_{10}H_{14}O$, resembling cumin aldehyde in odor.

The U. S. P. states that oil of eucalyptus is soluble in all proportions of alcohol and in 3 volumes of 70 per cent. alcohol. The Br. P. does not give a solubility test in alcohol. The following solubility constants are recorded by the several authorities mentioned:—

	B. et S.	G.-H.-K.	Parry.
E. globulus	1½ volumes 70 per cent.	3 volumes 70 per cent.	. . .
E. odorata	1 volume 80 per cent.	. . .	. . .
E. cneorifolia	1½ volumes 70 per cent.	. . .	. . .
E. oleosa	1¼ volumes 70 per cent.	. . .	. . .
E. dumosa	1¾ volumes 70 per cent.	. . .	. . .
E. amygdalina	1¼ to 2 vols. 70 per cent.	6 volumes 90 per cent.	. . .

The following table records the angle of rotation, $(\alpha)_D$, as given by different authorities:—

	B. et S.	G.-H.-K.	Parry.	G.-D.-P.
E. globulus	+9.2°	+ 1° to +15°	+ 1° to +10° (rarely up to 15°)	+ 1° to + 20°
E. odorata	+2.43°	slightly l.	. . .	. . .
E. cneorifolia	—5.82°	—4° to —14°	±4° to ±5°	. . .
E. oleosa	—1.62°	+4° to +5°	. . .	. . .
E. dumosa	+2.44° to +6.34°	+6°6′ to +6°30′	. . .	. . .
E. amygdalina	—11.37° to —13.53°	—25° to —70°	—25° to —80°	—24° to —120° —27° to —68°

The more cineol an oil contains, . . . the lower its rotatory power. Cineol is optically inactive, whereas phellandrene exists in two varieties, viz., dextrogyrate and lævogyrate.

Cineol, the principal constituent of medicinal import, boils at 177° C. and pinene at 155°–156° C. Eudesmol melts at 79°–80° C. and sublimes at 100° C. Phellandrene, quantitatively the principal constituent of oils poorer in cineol, boils at 171°–172° C.

Cineol Assay.—The phosphoric acid method apparently gives fairly satisfactory results for a commercial assay. The following are the official directions: "Introduce into a beaker a solution prepared by dissolving 10 Cc. of oil of eucalyptus in 50 Cc. of purified petroleum benzin; immerse the beaker in a freezing mixture and add phosphoric acid, drop by drop, with constant stirring, until the white magma of cineol phosphate formed begins to assume a yellowish or pinkish tint; then transfer the magma to a force filter, wash it with cold purified petroleum benzin, and then dry it by pressure between two porous plates. Transfer the precipitate (cineol phosphate) to a narrow graduated cylinder, and add warm water, which will cause separation of the cineol. The volume, in cubic centimeters, of the separated oil, multiplied by 10, represents the volume per cent. of cineol (eucalyptol). This should correspond to the properties and tests given under EUCALYPTOL."—U. S.

Test for Phellandrene.—If 2 Cc. of the oil be mixed with 4 Cc. of glacial acetic acid, and 3 Cc. of a saturated aqueous solution of sodium nitrite be gradually added, the mixture, when gently stirred, should not form crystals of phellandrene nitrite (absence of eucalyptus oils containing much phellandrene).—U. S. According to F. B. Power the reaction can be made more delicate by mixing the oil first with 5 Cc. of petroleum benzin, then adding the sodium nitrite solution, and lastly the glacial acetic acid, drop by drop, with vigorous agitation after each addition. If the oil be rich in phellandrene, the entire liquid solidifies to a pasty mass.

Action and Uses.—The properties of this oil are fully described under EUCALYPTUS (which see). The dose is from 1 to 5 minims (0.05–0.3 Cc.).

OLEUM FŒNICULI, *U. S., P. G.*—Oil of Fennel.

Essence de fenouil, Fr.; *Fenchelöl*, G.

Oleum fœniculi is the volatile oil distilled from Fennel.

Oil of fennel is official in all pharmacopœias except the British and the Italian.

The fruit of the fennel cultivated in various countries differs not only externally but also in the quantity and character of oil it yields upon distillation. The yield from the principal varieties, namely, the Saxon (Lützen), Galician, Moravian, and Roumanian, varies from 4 to 6.5 per cent. The lower yield of other varieties, no doubt, accounts in part for their non-use. Besides this difference in yield, there are likewise differences in composition.

Properties.—At medium temperatures oil of fennel is a colorless or slightly yellow liquid possessing the odor of fennel and a taste which, though at first bitter and cam-

phor-like, is afterward sweet. According to the U. S. P., its specific gravity ranges from 0.953–0.973 at 25° C. (77° F.); according to the P. G., between 0.965 and 0.975; its angle of rotation varies from +12° to +24°. The congealing-point of a normal fennel oil lies between +3° and +6° C. It is soluble in an equal volume of alcohol, the solution being neutral to litmus-paper, and in 10 volumes or less of 80 per cent. alcohol.—U. S.

Composition.—The constituent on which the value of this oil is supposed largely to depend is anethol, which crystallizes out in the cold. The oil also contains an isomer of this phenol ether, viz., chavicol; further, fenchone, an isomer of camphor and closely related to it; anise ketone; and, like all anethol-containing oils, anisic aldehyde and anisic acid. Of hydrocarbons, the presence of *d*-pinene and dipentene has been proved. Cymene and phellandrene are possibly also present.

While the four varieties of fennel mentioned above and the Japanese are distinguished by the bitter-tasting fenchone, this ketone is not found in the sweet Roman (French) and Macedonian fennel. Anethol, on the other hand, is either entirely absent or present only in traces in the wild bitter fennel.

As to hydrocarbons, the Saxon oil contains pinene and dipentene, the wild bitter fennel oil phellandrene, and Macedonian fennel oil limonene.

Under fennel oil there may be understood, therefore, in different countries different products. Oil of fennel of the U. S. P. and P. G. is the oil obtained from the commercial varieties of *Fœniculum capillaceum*, mentioned above.

Examination.—Whereas most authorities agree that the value of a fennel oil can be estimated by its anethol content, 50–60 per cent., some claim that the methyl ether content, viz., anethol plus its isomer methyl chavicol = 60 to 70 per cent., should be used for assay purposes. However, the congealing-point, which is characteristic of the anethol content, is commonly used as the test. It is fixed by the U. S. P. at not below 5° C. (41° F.), to be determined as follows: Transfer about 10 Cc. of the oil to a test-tube placed in a freezing mixture; insert a thermometer at once into the oil, and allow it to remain undisturbed until its temperature has fallen to about —5° C. (23° F.). Induce crystallization either by scratching the inner-wall of the test-tube with the thermometer or by the addition of a particle of solid anethol, and stir continuously during the solidification of the oil. The highest temperature reached during the crystallization is regarded as the congealing-point.

Besides the ordinary adulterants, oil of fennel is sophisticated by the abstraction of anethol. The addition of turpentine oil or of oils deprived of anethol will be indicated by a lower congealing-point, as well as the partial abstraction of anethol from an oil otherwise not tampered with.

Action and Uses.—Oil of fennel may be employed to overcome flatulence and to mitigate the action of severe purges. It is thought to possess emmenagogue and galactagogue properties. The dose is from 5 to 15 minims (0.3–1 Cc.).

OLEUM GAULTHERIÆ, *U. S.*—Oil of Gaultheria.

Oil of wintergreen, E.; *Essence de gaulthérie*, Fr.; *Wintergrünöl, Bergtheeöl*, G.

Oil of gaultheria is the volatile oil distilled from the leaves of *Gaultheria procumbens* L.—(Fam. *Ericaceæ*), rectified, if necessary, by steam distillation.—U. S.

True wintergreen oil, of which but a small amount is produced, is distilled mostly in a primitive manner by farmers in the mountainous districts of New York, New Jersey, Pennsylvania, Virginia, and Maryland. The oil exists in the plant not as such, but evidently in the form of a glucoside, which must be hydrolyzed before distillation. Sweet birch bark is often distilled with wintergreen leaves. Compare oil of sweet birch, which is commonly designated as "natural oil of wintergreen" in the market.

Properties.—Owing to the primitive methods of distillation, crude wintergreen oil is commonly colored red, but loses its color upon rectification. The oil, when properly prepared, is colorless or yellowish, and possesses a characteristic spicy odor in addition to that of methyl salicylate. Its specific gravity ranges from 1.172 to 1.180 at 25° C. (77° F.) and its boiling-point varies from 218° to 221° C. (424.4°–429.8° F.).—U. S. When fresh, it is slightly lævogyrate: the angle of rotation ranging from —0° 25′ to —1°. With 6 parts of 70 per cent. alcohol it yields a clear solution at 20° C. (68° F.).

Composition.—True wintergreen oil consists of about 99 per cent. of methyl salicylate. The composition of the 1 per cent. plus is rather complex, paraffin hydrocarbons, an aldehyde or ketone, an alcohol, $C_8H_{16}O$, corresponding to the aldehyde or

ketone, and an ester have been isolated. The ester consists of the above alcohol, $C_5H_{16}O$, and an acid, $C_6H_{10}O_2$, which likewise results upon the oxidation of the above ketone or aldehyde. The alcohol and the ester possess the very penetrating odor which characterizes the true wintergreen oil.

Tests.—While the expert may readily distinguish pure samples of gaultheria oil, sweet birch oil, and artificial methyl salicylate by the nasal test, it is impossible in this manner to detect the addition of sweet birch oil or methyl salicylate. Even after the methyl salicylate odor has been removed by the solution of the phenol ester in aqueous potassium hydroxide solution, it may be impossible to detect such additions by the nasal test. Inasmuch as all these products consist almost exclusively of methyl salicylate, their physical constants are very closely related. The lævorotation of gaultheria oil may at times be serviceable, but the angle is small at best, and varies considerably for its size. Moreover, true gaultheria oil may become optically inactive in the course of time.

In other respects it has the same properties and conforms to the reactions and tests given under METHYLIS SALICYLAS.

Action and Uses.—In medicinal doses, oil of wintergreen may be employed as a substitute for ACIDUM SALICYLICUM (which see). Like many other volatile oils, it may be used also as an antiseptic, analgesic, flavoring agent, and carminative. Added to liniments, it is quite largely employed in the treatment of muscular rheumatism, lumbago, sciatica, and similar complaints. The pure oil is locally applied upon lint over swollen joints in acute articular rheumatism, and is said to be efficacious also in the treatment of tic douloureux. In overdose it produces drowsiness, followed by cerebral congestion and delirium. Excessive gastric irritability, vomiting, purging, gastro-intestinal pain, rapid pulse, hot dry skin, and difficult respiration are the principal symptoms resulting from the administration of toxic doses of this drug. The poisonous effects of the remedy should be combated by rapidly acting diffusible stimulants, such as ether, alcohol, and ammonia. The beginning dose of the oil is from 5 to 10 minims (0.3–0.6 Cc.) every 4 hours. This amount may be increased, providing digestion is not impaired, until the full effect of the remedy is produced.

OLEUM GOSSYPII SEMINIS, *U. S.*—Cotton Seed Oil.

Oleum gossypii.—*Cotton oil*, E.; *Huile de coton, Huile de semences de cotonnier*, Fr.; *Baumwollsamenöl, Cottonöl*, G.

A fixed oil expressed from the seed of *Gossypium herbaceum* L. and of other species of *Gossypium* (Fam. *Malvaceæ*), and subsequently purified.—U. S.

Origin and Preparation.—(For remarks on the cotton-plant, see page 736.) After the seeds have been deprived of the cotton they are about 8 Mm. ($\frac{1}{3}$ In.) in length and 4 Mm. ($\frac{1}{6}$ In.) in width, of an irregular ovoid shape, have a brown, hard, somewhat brittle testa with a prominent raphe along its entire length, and contain a whitish embryo with large folded cotyledons and numerous blackish resin-glands imbedded in its tissue. For obtaining the oil the testa is crushed in a suitable machine and removed by winnowing; the kernels are then ground and, enclosed in bags, are subjected to hydraulic pressure. Raw cotton yields about 40 per cent. of seeds, which in turn produce 2 gallons of oil per bushel. 100 pounds of seeds yield on an average 14.5 pounds of oil, 44.5 pounds of hulls, 1 pound of lint, and 40 pounds of residuary oil-cake. Cottonseed oil-cake contains about 7.5 per cent. of oil and 20 per cent. of albuminoids.

Purification.—The crude oil is of a more or less deep-brown color, turbid, thickish, and contains a large percentage of albuminous matter. On standing, a portion of the impurities subside, and the oil, now termed "clarified," becomes clear and of an orange color. On treating it with boiling water or superheated steam the albuminous constituents are coagulated, and a still lighter colored oil is obtained. The final bleaching is effected by agitating the oil well with a weak solution of caustic soda, whereby the characteristic coloring-matter of the oil is removed and a black soapy deposit settles to the bottom. The loss by this process amounts to about 4 to 7 per cent., and sometimes to more than twice as much, and the resulting purified oil is known as *refined oil*.

Properties.—Bleached cottonseed oil is perfectly transparent, and has a reddish-yellow to pale straw-yellow color; it is without odor and has a bland, nut-like taste and

a neutral reaction. Its specific gravity varies from 0.920 to 0.926 at 15° C. (59° F.), or from 0.915 to 0.921 at 25° C. (77° F.). While readily soluble in ether, chloroform, benzene, and carbon disulphide, it is very sparingly soluble in alcohol. Exposed to the air, the oil gradually thickens, but does not solidify. On cooling the oil to a temperature below 12° C. (53.6° F.) particles of solid fat separate. At about 0° to —5° C. (32° to 23° F.) the oil becomes nearly or quite solid. If sulphuric acid of 1.6 to 1.7 specific gravity be added to the oil, preferably diluted by solution in carbon disulphide, a reddish-brown color is rapidly produced. If 6 Gm. of the oil be thoroughly shaken in a test-tube for about 10 minutes with a mixture of 1.5 Gm. of nitric acid and 0.5 Gm. of water, then heated on a boiling water-bath for not more than 15 minutes, the oil will assume an orange or reddish-brown color, and after standing for 12 hours at the ordinary temperature, will form a semisolid mass. If 5 Cc. of the oil be thoroughly shaken in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol and adding 2 drops of nitric acid), and the mixture heated for about 5 minutes on a water-bath, the oil will assume a red or reddish-brown color. If 2 Cc. of the oil be mixed in a test-tube with 2 Cc. of a mixture of amyl alcohol and carbon disulphide containing 1 per cent. of sulphur in solution, and the test-tube then immersed to the depth of one-third to one-half in boiling salt water, in from 10 to 15 minutes a red color will develop.—U. S. Nitric acid of 1.375 specific gravity gives a deep-brown coloration with cottonseed oil, but the reaction is not equally intense with all samples of the oil, the coloration being more or less vitiated if the oil has been heated above 240° C. (464° F.). The oil is readily saponified by strong solutions of alkali, with the exception of a bright-yellow coloring-matter, which may be obtained by agitating the soap with benzin.

Chemical Composition.—Cottonseed oil consists chiefly of olein, palmitin, and linolein, together with small quantities of the glyceride of linolenic acid. From that portion of the oil saponified in the bleaching process a pigment, known as cottonseed blue and stated by Kuhlmann (1861) to have the composition $C_{17}H_{24}O_4$, has been obtained by heating the soapy sediment with 4 per cent. of sulphuric acid for several hours to 100° C. (212° F.), washing with water, and dissolving in alcohol. This pigment is amorphous, readily destroyed by oxidizing agents, insoluble in water, diluted acids, and alkalies, sparingly soluble in chloroform and carbon disulphide, soluble in 77 parts of alcohol and in 8.4 parts of ether. It dissolves with a purple color in sulphuric acid and is bleached on exposure to light and air.

Tests.—Cottonseed oil saponified by alcoholic potassium hydroxide test-solution should show a saponification-value of from 191 to 196. If 0.3 Gm. of cottonseed oil be dissolved in 10 Cc. of chloroform, and placed in a 250 Cc. flask with 25 Cc. of a mixture of equal parts of alcoholic iodine test-solution and alcoholic mercuric chloride test-solution, and after standing for 4 hours protected from the light, 20 Cc. of potassium iodide test-solution be added, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate solution an iodine figure of not less than 102 nor more than 108 should be obtained.—U. S. Cottonseed oil differs from all other fixed oils in the high melting-point, 32°–38° C. (89.6°–100.4° F.), and high congealing-point, 34°–27.5° C. (93.2°–81.5° F.), of its fatty acids.

For the detection of cottonseed oil in other oils the following tests may be applied:

Nitric Acid Test.—Equal volumes of oil and nitric acid of 1.375 specific gravity are shaken together and then set aside for 24 hours. Oils containing cottonseed oil assume a distinct brown coloration, whereas pure oils, as olive oil, rape oil, and others, show only a yellowish color (Lewkowitsch). This test is even available in the case of adulterated oils which have been heated to 240° C. (464° F.).

Halphen's Test.—Equal volumes of carbon disulphide holding 1 per cent. of sulphur in solution, amyl alcohol, and the suspected oil, are mixed and heated for 15 minutes in a boiling bath of brine. In the presence of cottonseed oil, an orange to deep-red coloration ensues. If the oil has been exposed to a temperature of 250° C. (482° F.) even for 10 minutes, the color-change does not occur, although a temperature of 210° C. (410° F.) is not hurtful. According to L. M. Tolman, if the cottonseed oil has been previously heated, as is frequently the case, the brine-bath should be kept at a temperature of 112° to 115° C. (233.6°–239° F.) for 1 or 2 hours to insure the proper color-reaction.

It is probable that the nitric acid and Halphen reactions depend upon the same constituent in the cottonseed oil, since it has been found that the previous application of the one test prevents the other reaction, after removal of either the nitric acid or amyl alcohol respectively. The substance causing the color-reaction has not been isolated.

Becchi's Test.—The following solutions are necessary: (*a*) 1 Gm. of silver nitrate dissolved in 200 Cc. of 98 per cent. alcohol, and then mixed with 40 Cc. of ether and 0.1 Gm. (1 drop) of nitric acid; (*b*) 15 Cc. of colza (rapeseed) oil dissolved in 100 Cc. of amyl alcohol.

10 Cc. of the suspected oil are mixed with 1 Cc. of the silver nitrate solution and 10 Cc. of the colza oil solution then added. After active agitation the mixture is divided into two parts, one of which is placed in boiling water for 15 minutes and then compared with the unheated portion. If cottonseed oil be present, the heated mixture becomes brown.

Becchi's test is not applicable to oils that have previously been heated to 200° C. (392° F.) or over. The test is made more delicate by first washing the oil to be tested with an equal volume of hot 95 per cent. alcohol, and after its removal, with dilute (2 per cent.) nitric acid, and then thoroughly with water. Its reliability has been questioned by several authorities, and modifications proposed with, however, unsatisfactory results.—Benedickt and Ulzer.

Uses.—Cottonseed oil is used by the U. S. P. for liniments in the place of olive oil. It has entered largely into consumption as an edible oil, salad oil, and as a constituent of oleomargarine and similar products. It is extensively used in soap-making, and very largely as a substitute and adulterant of more expensive oils.

The amount of cottonseed oil produced in the United States in 1901 amounted to 96,605,600 gallons, valued at over 30 million dollars. Of this quantity, 49,356,741 gallons were exported at a valuation of $16,541,321. Of the total by-product oil-cake produced in the United States, about one-fourth is consumed for fodder and fertilizers. The amount of oil-cake exported during the fiscal year 1901 was 629,343.6 tons, valued at $13,119,968.

OLEUM HEDEOMÆ, *U. S.*—Oil of Hedeoma.

Oil of pennyroyal, E.; *Essence de hedeoma, Essence de puliot américaine*, Fr.; *Pennyroyalöl, Amerikanisches Poleiöl*, G.

A volatile oil distilled from the leaves and flowering-tops of *Hedeoma pulegoides* (L.) Pers. (Fam. *Labiatæ*).

Most of the pennyroyal oil is reported as being distilled in North Carolina and in the southern and eastern sections of Ohio, often in rather primitive stills. This oil is closely related to the Oleum Pulegii of Europe obtained from *Mentha pulegium* L. or *Pulegium vulgare* Mill. A Russian oil is obtained from *Pulegium micranthum* Claus.

Properties.—American pennyroyal oil is a light-yellow liquid of a characteristic minty, sweetish odor, and an aromatic taste. Specific gravity 0.920 to 0.935 at 25° C. (77° F.); angle of rotation varies from +18° to +22°. It is soluble in two volumes of 70 per cent. alcohol, forming a clear solution.—U. S.

Composition.—The principal and only constituent known definitely to exist in the oil is pulegone, a ketone, $C_{10}H_{16}O$, which can be identified by its hydrated oxime.

Action and Uses.—Oil of pennyroyal possesses stimulant, carminative, and emmenagogue properties. Like other volatile oils, it may be employed as an adjuvant and corrective for other medicines. It has been used in the treatment of amenorrhœa. The dose is from 2 to 10 minims (0.10–0.60 Cc.).

OLEUM HYOSCYAMI COMPOSITUM.—Compound Oil of Hyoscyamus.

Balsamum Tranquillans.—Huile de jusquiame composée, Fr.; *Zusammengesetztes Bilsenkrautöl*, G.

Preparation.—Take of oil of absinthe, oil of lavender, oil of rosemary, oil of sage, oil of thyme, of each, 2 drops; infused oil of hyoscyamus, 100 Cc. Mix them.—N. F.

The infused oil of hyoscyamus, designated in the above formula, may be prepared by either of the methods given under Infused Oils, on page 1006.

This preparation is very similar to, but not identical with, the Baume Tranquille (Balsamum Tranquillans) of the French Pharmacopœia. The latter is made as follows:

200 Gm. each of the fresh leaves of belladonna, hyoscyamus, poppy, black nightshade, stramonium, and tobacco are crushed and digested with 5000 Gm. of olive oil over a gentle fire, until the moisture has been completely dissipated; the mixture is then expressed and the liquid filtered. To the clear liquid are finally added 0.50 Gm. each of the oils of absinthe, hyssop, marjoram, mint, rue, rosemary, sage, and thyme.

Action and Uses.—This preparation is employed chiefly as an anodyne in earache. A piece of cotton is saturated with a few drops of the oil and placed in the external auditory canal.

OLEUM JUNIPERI, *U. S., Br., P. G.*—Oil of Juniper.

Oleum fructus (vel baccæ) juniperi.—Oil of juniper berries, E.; *Essence de genièvre* Fr.; *Wachholderbeeröl*, G.

A volatile oil obtained by steam distillation from the fruit of *Juniperus communis* L. (Fam. *Coniferæ*). The oil obtained as a by-product in the manufacture of gin is not a normal oil, neither is that obtained from the young branches as well as the fruit (P. Norv.), nor the oil obtained from unripe fruits (Br.). To what extent, if any, the oil from the berries of *J. phœnicea* and *J. oxycedrus* enter commerce is not known. The former oil is said to correspond in all of its properties with those of the official oil, whereas the latter is quite terebinthinate in odor, reminding but faintly of juniper. The yield varies from 0.5 to 1.5 per cent.

Properties.—Juniper berry oil is colorless or faintly greenish-yellow when fresh. It possesses the characteristic odor of *juniper* and a warm, aromatic, somewhat terebinthinate and bitterish taste. With age, and especially when exposed to air and light, it becomes darker and thicker. Several pharmacopœias specify that such a modified oil should not be used for medicinal purposes.

According to the U. S. P., the specific gravity should vary within 0.860 to 0.880 at 25° C. (77° F.). The oil should be soluble in 10 volumes of 90 per cent. alcohol—most oils are soluble, but the solubility diminishes with age. As to its optical activity, statements are at variance.

Composition.—Oil of juniper contains pinene and cadinene, also "juniper comphor." The constituents imparting to the oil its characteristic odor are unknown. The amount of saponifiable substances is small and does not influence the odor. Neither is the amount of ester-forming alcohols much larger.

Adulteration.—The detection of turpentine oil is difficult, since it changes the physical constants of the oil but little, pinene being a regular constituent of the oil. (Compare also Norwegian oil above.)

Action and Uses.—Oil of juniper is a valuable antiseptic, carminative, and stimulant, and is especially useful in the treatment of dropsy depending upon chronic nephritis. It should not be employed, however, if any acute renal inflammation exists. It is usually administered in the form of Holland gin or compound spirit of juniper. The dose of the oil is from 5 to 15 minims (0.3–1 Cc.). As an antiseptic, it is largely employed for sterilizing catgut.

OLEUM LAURI, *P. G.*—Laurel Oil.

Oleum lauri expressum, Oleum laurinum.—Bayberry oil, E.; *Huile de laurier, Beurre de laurier*, Fr.; *Lorbeeröl, Lorbeerbutter, Lorbeerfett, Loröl, Lorettosalbe*, G.

Source.—Laurel oil is obtained from the crushed fresh or dried berries of the laurel tree, *Laurus nobilis* L. (Fam. *Lauraceæ*), by expression, with the aid of a gentle heat, between iron plates. After subsidence, the oil is decanted and if necessary filtered

Properties.—It occurs as a soft, at times granular, butter-like fat of green color, possessing a bitter taste and a peculiar aromatic odor. The oil is insoluble in alcohol, but yields to that liquid some of the bodies accompanying the fat. It is soluble in ether and benzene. At 40° C. (104° F.) it melts to a dark-green liquid, which congeals again at 24° C. (73.2° F.). Allen gives the saponification factor of laurel oil as 198.9, and according to v. Hübl it is capable of absorbing 49 per cent. of iodine.

Constituents.—Laurel oil consists mainly of trilaurin, $C_3H_5(C_{12}H_{23}O_2)_3$, but contains also trimyristin, $C_3H_5(C_{14}H_{27}O_2)_3$, some resin, chlorophyll, and a volatile oil, which latter can be removed by means of alcohol. It is sometimes adulterated with tallow and lard.

The P. G. requires that if laurel oil be warmed with twice its weight of alcohol, the resulting solution, having been decanted when cold, shall not assume a brown color upon addition of ammonia-water.

Action and Uses.—Bayberry oil is employed locally in the treatment of muscular rheumatism, sprains, contusions, and other local pains. It is rarely if ever employed internally.

OLEUM LAVANDULÆ FLORUM, *U. S., Br., P. G.*—Oil of Lavender Flowers.

Oleum Lavandulæ.—Essence de Lavande, Fr.; *Lavendelöl*, G.

A volatile oil distilled from the fresh flowering tops of *Lavandula officinalis* Chaix. (Fam. *Labiatæ*).

Although derived from the same species, and presumably from the same part of the plant, there are two oils in the market that differ so greatly in price and to such an extent in composition and properties that it is unsatisfactory to describe them under the same heading.

The *French* oil is obtained from the wild plant with the aid of itinerant stills, the distillers moving higher up on the mountains as the season advances. The collection begins with the flowering season in July, and the oil then obtained is regarded as inferior to that distilled toward the end of September at an altitude of 1500 M. It would seem that occasionally at least leaves are used as well as flowers. Most of the commercial oil is French oil.

The *English* oil is obtained exclusively from cultivated plants. The flowering tops alone are reported as being used. Only a small amount of oil is produced, and this, therefore, commands a much higher price than the ordinary commercial or French oil. Englishmen and those who prefer the English oil regard this as sufficient evidence of the superiority of the English oil, whereas Frenchmen do not concede this, and look upon the two oils as distinct products, referring to the differences in composition. Commercially the *English* oil is frequently designated as *oil of garden lavender.*

Properties.—Lavender flower oil is nearly colorless or slightly yellow, with the odor of the flowers. Rectification, which renders it colorless, impairs its odoriferous properties. It is said to improve as to odor when kept in a cool dark place for several years, but after that time deteriorates. The specific gravity according to the P. G. is 0.885–0.895; according to the U. S. P., it is 0.880–0.892 at 25° C. (77° F.); and according to the Br. P., 0.885–0.900. With 3 or more parts of 70 per cent. alcohol it forms a clear solution. Both oils are lævogyrate, not exceeding 10°.

Composition.—*French* oil has been found to contain linalool and geraniol, partly free, partly as ester, principally as acetate, but in small part also as propionate, butyrate, and valerianate. Calculated as linaloyl acetate, the ester content varies from 30 to 40 per cent. French oil has likewise been found to contain small amounts of pinene, although this hydrocarbon could not be isolated from an oil distilled from dry flowers. Cineol is also present in traces.

English oil has been shown to contain but 5–10 per cent. of linaloyl acetate and some free linalool; also limonene and sesquiterpene thus far not found in the French oil. The English oil differs furthermore in the large percentage of cineol present.

Adulterants and Tests.—The ordinary adulterants can be detected by the common methods (compare pages 1045 and 1046). Alcohol should be particularly tested for, since it is reported to be added in small amounts to prevent deterioration after a certain time. Spike lavender is said to be distilled occasionally with true lavender. Spike oil, containing but a small amount of linaloyl acetate, reduces the ester content.

Although an uncompromisable difference of opinion exists as to the relative value of the linaloyl assay as applied indiscriminately to all oils, there appears to be none when this assay is taken as a means of testing French oil, even though it is well known that the esters are not the only constituents of importance. The French oils coming from the highest regions of the Alps are reported to contain 36 per cent. or more of ester. Some oils have an ester content as high as 45 per cent., but oils with an ester content below 30 per cent. may be regarded as suspicious and should be rejected.

For the saponification of volatile oils and the determination of their ester content, see page 1043.

Action and Uses.—Oil of lavender flowers is employed as a perfumer and as a flavoring agent for certain pharmaceuticals. It is rarely employed in medicine alone, but may be used both internally and externally for the relief of nervous headache. The internal dose is from 1 to 5 minims (0.05–0.3 Cc.).

OLEUM LIMONIS, *U. S., Br.*—Oil of Lemon.

Oleum citri, P. G., *Oleum limonum.—Essence de citron*, Fr.; *Citronenöl*, G.

A volatile oil obtained by expression from fresh lemon peel, yielding, when assayed by the process given below, not less than 4 per cent. of aldehyde, calculated as citral.—U. S.

Like orange and bergamot oils, oil of lemon is not obtained by steam distillation—with the exception of inferior oils—but by a mechanical rupture of the oil-cells and the collection of the oil thus liberated. One of three processes is commonly employed: (1) The *spugna* process, in which the rind is quartered and the oil from the ruptured cells is collected by a sponge; (2) the *scorzetta* process, in which the halves of the rind are not broken in the process, the oil being likewise collected with the aid of a sponge; (3) the *machina* process, in which a complicated machine is substituted for the manual labor of expression and collection, especially for bergamot oil. A fourth process, involving the *ecuelle à piquer*, is but little used. Most of the oil of commerce is produced in Sicily and the southern part of Calabria.

Properties.—The pale-yellow color of the expressed oil distinguishes it from the colorless distilled oil, which is inferior and not official. The oil should be fragrant like the peel of the lemon and not possess a terebinthinate odor. The latter odor may either indicate addition of turpentine oil or deterioration of an originally good oil due either to age or improper keeping. Such an oil should not be rectified by distillation, this process being excluded by the pharmacopœias because detrimental to a good oil. The somewhat bitterish taste of the expressed oil is stated to distinguish it from a distilled product, the expressed oil containing non-volatile constituents.

The specific gravity requirements of the Br. P. are 0.857–0.860, those of the P. G. 0.858–0.861; those of the U. S. P. of 1890 were 0.858–0.859 at 15° C. (59° F.), but have been extended to 0.851 to 0.855 at 25° C. (77° F.). According to the Br. P., the angle of rotation should be not less than 59°; according to the U. S. P., not less than 60°, while the P. G. has no such requirement. The angle rarely exceeds 64°. The angle of rotation of the first 10 per cent. of oil obtained by fractional distillation should not differ more than 2° from that of the original oil (U. S.). The solubility of the oil in alcohol is often of questionable utility as a test.

Composition.—While a decade ago oil of lemon was regarded as a typical hydrocarbon oil, consisting to the extent of 90 per cent. of dextrogyrate limonene, it is to-day frequently valued according to its citral content, of which it should contain at least 4 per cent. (?), according to the U. S. P., the other pharmacopœias not having as yet adopted such a standard. Besides limonene and citral, the oil has been found to contain cymene (?), phellandrene, pinene, citronellal, geranyl acetate, a sesquiterpene, octyl aldehyde, nonyl aldehyde, methyl heptenone, terpineol. However, a mixture, in proper proportions, of these numerous constituents will scarcely be acceptable to a connoisseur as a substitute for the natural oil.

Tests and Assay.—While the presence of the proper amount of citral is by no means a guarantee of a pure oil, the citral assay supplements the physical and other tests commonly employed. The crude adulterations with turpentine oil, readily detected with the polariscope, are no longer so common as formerly, but "citrene," the by-product in the manufacture of concentrated and terpeneless lemon oil, is the more dangerous adulterant of to-day. The addition of citral from other sources cannot be detected by the assay unless it has been added in excess.

Assay of Oil of Lemon for Citral.—Introduce into a counterpoised 150 Cc. flask, by means of a pipette, about 5 Cc. of oil of lemon, and note the exact weight, add 5 Cc. of distilled water and a few drops of phenolphthalein test-solution, and then neutralize the solution exactly by the cautious addition of tenth-normal sodium hydroxide solution. Add 25 Cc. of a neutral solution of sodium sulphite (1 in 5), and immerse the flask in a water-bath containing boiling water. From a burette add, as needed, just sufficient half-normal hydrochloric acid to maintain the neutrality of the mixture, keeping the flask continuously heated and

frequently agitated, and adding a drop or two of phenolphthalein test-solution. When a permanent condition of neutrality is reached, note the number of cubic centimeters of half-normal hydrochloric acid consumed. Carry out a blank test, identical with the foregoing, except that the oil of lemon is omitted, and note the amount of half-normal hydrochloric acid consumed. Subtract the number of cubic centimeters required in the blank test from the number required in the original test; each Cc. of this difference corresponds to 0.03802 Gm. of citral. To find the percentage, multiply the above difference by 0.03802, and this product by 100, and divide by the weight of the oil of lemon taken.—U. S.

Besides the official gravimetric method, the following volumetric method may also be employed: Transfer 5 Cc. of the oil with a pipette to a flask with a long narrow graduated neck, add 25 Cc. of a 30 per cent. sodium acid sulphite solution and place the flask in a water-bath at a temperature of 60° C. (140° F.) for 30 minutes, shaking the flask from time to time. After allowing the flask and contents to cool completely, dilute gradually with distilled water, shaking well after each addition, until the flask is filled. The decrease in volume of the oil indicates the quantity of citral originally present, from which the volume percentage can be quickly calculated.

Action and Uses.—Oil of lemon possesses stimulant and aromatic properties, but it is rarely employed in medicine. It is used principally to impart an agreeable odor to medicines.

OLEUM LINI, *U. S.*, *Br.*, *P. G.*—Linseed Oil.

Flaxseed oil, E.; *Huile de lin*, Fr.; *Leinöl*, *Leinsamenöl*, G.

The fixed oil expressed from linseed (Fam. *Linaceæ*). Linseed oil which has been boiled should not be used nor dispensed.—U. S.

Preparation.—This oil is made on the large scale by thoroughly drying the seed with the aid of heat, crushing and forcibly expressing it. The yield by cold pressure is 16 to 20 per cent., by hot pressure 25 to 28 per cent. It is largely manufactured in the United States.

Properties.—Linseed oil, when expressed in the cold, is limpid, neutral to test-paper, of a yellowish color, and has a peculiar, rather unpleasant odor, and a bland taste. For use in the arts, the oil is largely obtained by hot pressure, and is then somewhat thicker, brownish in color, and has more odor and a slightly acrid taste. The U. S. P. gives its specific gravity as 0.930–0.940 at 15° C. (59° F.) or 0.925–0.935 at 25° C. (77° F.). Linseed oil imparts its yellow color to alcohol when shaken with it, and dissolves in 40 parts of cold and 5 parts of boiling alcohol (10 parts of 90 per cent. alcohol, Br.), in 10 parts of absolute alcohol, and in all proportions in chloroform, ether, carbon disulphide, benzin, and oil of turpentine. It does not congeal above —20° C. (—4° F.). When boiled with alkalies, it yields a very soft soap. When exposed to air, linseed oil gradually thickens, assumes a disagreeable odor, and finally solidifies. The solidified varnish-like mass contains linoxyn, formed as the result of oxidation, the increase in weight amounting to 12 to 14 per cent. Heated to 130° C. (266° F.), the oil begins to boil, the temperature gradually rising, and when it has lost about 5 or 8 per cent. of its weight it constitutes boiled linseed oil (see page 1082).

Composition.—Linseed oil consists of 10 to 15 per cent. of a mixture of palmitin, myristin, and stearin, and 85–90 per cent. of the liquid glycerides of oleic acid ($C_{18}H_{34}O_2$), linoleic acid ($C_{18}H_{32}O_2$), linolenic acid ($C_{18}H_{30}O_2$), and isolinoleic acid ($C_{18}H_{32}O_2$), which acids occur in about the respective ratios of 5, 15, 15, and 65 (Hazura and Grüssner, *Jour. Chem. Soc.*, 1888). According to S. Fokin (*Jour. Chem. Soc.*, 1902), the chief constituent of linseed oil is linolic acid, with 22–25 per cent. of linolenic acid and about 5 per cent. of solid fatty acids. Linseed oil contains about 1 per cent. of non-saponifiable matter.

Tests.—If 2 Cc. of linseed oil be shaken with 1 Cc. each of fuming nitric acid and water it should not solidify (not even partially) after standing for one or two days. If spread in a thin layer on a glass plate and allowed to stand in a warm place, linseed oil is gradually converted into a hard transparent resin (absence of non-drying oils). It should not more than slightly redden blue litmus-paper previously moistened with alcohol (limit of acid). The oil should be completely saponifiable with alcoholic potassium hydroxide solution and the resulting soap should be completely soluble in water without leaving an oily residue (absence of mineral oils and rosin oil). If 2 Cc. of the oil be warmed and shaken in a test-tube with an equal volume of acetic anhydride, and to the mixture, after cooling, is added 1 drop of sulphuric acid, a greenish color is produced

(a violet color under these circumstances indicating the presence of rosin and rosin oils). Linseed oil saponified by alcoholic potassium hydroxide test-solution should show a saponification value of from 187–195. If 0.15 Gm. of unboiled linseed oil be dissolved in 10 Cc. of chloroform and placed in a 250 Cc. flask with 25 Cc. of a mixture of equal parts of alcoholic iodine test-solution and alcoholic mercuric chloride test-solution, and after standing for 16 hours protected from the light, 20 Cc. of potassium iodide test-solution be added and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate solution an iodine value of not less than 170 should be obtained.—U. S. The P. G. requires an iodine value of only 150, which appears much too low, since pure linseed oil has frequently been found to absorb from $1\frac{3}{4}$ to $1\frac{9}{10}$ times its weight of iodine. Exposure to air and light causes a gradual lowering of the iodine value of linseed oil; the same change has been observed in old oil.

The world's crop of flaxseed for the year 1900 amounted to 64,466,500 bushels, of which the U. S. produced 31.02 per cent., capable of producing 50,000,000 gallons of oil and about 380,000 tons of oil-cake. The oil is mostly consumed in the home market, only 99,919 gallons having been exported from the U. S. for the fiscal year ending June 30, 1901. The amount of linseed oil-cake exported for the same period amounted to 227,527.4 tons, valued at $5,471,930.

Boiled Linseed Oil.—Although for medicinal purposes raw linseed oil should always be used, there is a large demand for boiled linseed oil for use in the arts, particularly by painters, since the latter variety dries far more rapidly. It is prepared by heating linseed oil to a temperature of 130° C. (266° F.), while a current of air is passed through it, or by incorporating during the heating process such substances as litharge, red lead, manganese dioxide, lead acetate, or manganous borate, whereby the drying properties of the oil are very materially increased. Boiled linseed oil is much darker and thicker than the raw oil, and has a specific gravity of 0.939–0.950.

Action and Uses.—Linseed oil is rarely employed in medicine because of its disagreeable taste. It possesses laxative properties and is said to be efficacious in the treatment of piles. Locally applied in the form of linimentum calcis it is an excellent remedy for the relief of burns and scalds. The internal dose is from 1 to 2 fluidounces (30–60 Cc.).

Other Drying Oils.—The following oils may be conveniently considered here, although they differ materially in their properties. Some of them have been used as adulterants for linseed oil:

Candle-nut Oil.—*Kekune oil, Bankul oil,* E.; *Huile de noix de chandelle,* Fr.; *Bankulnussöl, Kandelnussöl,* G.—The candle-nut-tree, *Aleurites triloba* Forst., s. *A. moluccana* Willd., is extensively cultivated in the islands of the Pacific and Indian Oceans and in India. The whitish kernels have a bland nutty flavor and yield about 60 per cent. of nearly colorless oil, which dries rapidly and is colored dark orange red by nitric acid and yellow to brown by sulphuric acid. It consists of an olein resembling linolein, besides myristin, palmitin, and stearin.

Corn Oil.—*Indian corn oil, Maize oil,* E.; *Huile de mais, Huile de papetons,* Fr.; *Maisöl,* G.—This oil is expressed from the seed of *Zea Mays* L.—Fam. *Gramineæ,* and occurs as a golden-yellow fluid of 0.9213–0.9215 specific gravity. When obtained by extraction the oil has a brownish color. The peculiar odor and taste are said to be due to the presence of a volatile oil (Vulté and Gibson). It is readily soluble in acetone, but with difficulty in alcohol and glacial acetic acid. It contains the glycerides of palmitic, stearic, arachic, oleic, and linolenic acids, and if exposed in thin layers on a glass-plate at 50° C. (122° F.) it dries perfectly in 18 hours. If a drop of sulphuric acid be added to a solution of corn oil in carbon disulphide, a violet coloration occurs after 24 hours, due to the presence of phytosterin (Vulté and Gibson). Its saponification value lies between 191 and 193, and its iodine value between 113 and 120. Subjected to the elaidin test it produces a mass of lard-like consistence.

Grape-seed Oil.—*Huile de raisin,* Fr.; *Traubenkernöl,* G.—The seeds of the different varieties of *Vitis vinifera* L.—Fam. *Vitaceæ,* yield from 10 to 20 per cent. of fixed oil, which is light-yellow or brownish, inodorous, faintly bitter, and congeals near —16° C. (3.2° F.) and has a specific gravity at 15° C. (59° F.) of 0.920. It dries very slowly, and consists, besides palmitin and stearin, chiefly of the glyceride of *erucic acid,* $C_{22}H_{42}O_2$; this acid melts at 34° C. (93.2° F.), and yields acetic and arachic acids on being fused with potassium hydroxide. The oil dissolves readily in glacial acetic acid at 70° C. (158° F.); the solution becoming turbid on cooling to 66.5° C. (151.5° F.). The iodine value of the oil is 94–96.2, and the saponification value 178–179.

Hempseed Oil.—*Huile de chanvre, Huile de chenevis*, Fr.; *Hanföl*, G.—When freshly expressed from the seed of *Cannabis sativa* L.—Fam. *Urticaceæ*, hempseed oil has a pale-green to greenish-yellow color, which slowly changes to brownish-yellow. It has a mild taste and peculiar odor, and dries very readily. The oil is soluble in 30 parts of cold alcohol, and if dissolved in 12 parts of boiling alcohol the solution, upon cooling, separates stearin. Besides the latter, it contains palmitin and linolein. Hempseed oil boiled with a solution of caustic soda of 1.34 specific gravity yields a brownish-yellow hard soap, whereas linseed oil, similarly treated, yields a soft yellow soap. If hempseed oil be mixed with one-fifth of its volume of a mixture of equal parts of fuming nitric acid, concentrated sulphuric acid, and water, a green color is produced, rapidly changing to black, and finally, after 24 hours, becoming reddish brown. The saponification value of hempseed oil lies between 193 and 195, and its iodine value varies from 140.5–166.

Madia Oil.—*Huile de Madia*, Fr.; *Madiaöl*, G.—This oil is obtained from *Madia sativa*, Molina—Fam. *Compositæ*, an annual herb, native of Chile and cultivated in Europe, Africa, and Asia. The brownish-gray, quadrangular, 4-ribbed akenes, which are destitute of pappus, yield about 40 per cent. of fixed oil. This is yellow, bland, of a peculiar odor, and has the specific gravity 0.928 at 15° C. (59° F.), and congeals near —20° C. (—4° F.). On exposure to air it becomes rancid and slowly acquires a soft-solid consistence. By nitric acid it is colored brown red, by sulphuric acid, greenish and brown. Besides palmitin and stearin, it contains an olein, which seems to differ from that of other oils. Its iodine value is 117.5–119.5; its saponification value 192.8 (de Negris and Fabris).

Niger-seed Oil.—*Huile de Niger*, Fr.; *Nigeröl*, G.—Niger-seed oil, *Guizotia oleifera* DC., s. *Verbesina sativa* Roxb.—Fam. *Compositæ*, is indigenous to and cultivated in India and Eastern Africa. The subcylindrical, black, and glossy akenes yield about 40 per cent. of a thin yellow oil, having a nutty flavor and congealing below —10° C. (14° F.). The specific gravity of the oil at 15.5° C. (60° F.) is 0.9270. It is colored orange yellow by nitric acid, and gray green and brown by sulphuric acid, dries to a soft varnish, and consists of myristin, palmitin, and apparently two oleins, one of which is closely related to linolein. The iodine value of the oil is 133–133.5; the saponification value 189–192.

Pumpkinseed Oil.—*Pumpkin oil*, E.; *Huile de semences de calabasse d'Europe*, Fr.; *Kürbiskernöl*, G.—*The seed of Cucurbita Pepo* L.—Fam. *Cucurbitaceæ*, yield by cold expression about 20 per cent. of reddish-colored oil of 0.920–0.925 specific gravity. By extraction with ether the yield may be increased to 30 or 35 per cent. The oil, when fresh has a pleasant odor and taste, and forms a clear solution with ether, chloroform, and carbon disulphide, and 20 parts of absolute alcohol. When exposed to the air, it slowly dries, forming a yellowish transparent film. Its saponification value is given as 188.7 by Schattenfroh, and as 192.5–195.2 by Graham. Pumpkinseed oil congeals at —16° C. (3.2° F.), and is capable of absorbing from 113.4 to 130.7 per cent. of iodine.

Sunflower Oil.—*Huile de tournesol*, Fr.; *Sonnenblumenöl*, G.—The kernels of sunflower seed, derived from *Helianthus annuus* L.—Fam. *Compositæ*, contain about 40 per cent. of a limpid, pale-yellow oil, which upon exposure to air dries slowly. It has the specific gravity 0.924–0.926 (Allen), and possesses a mild taste and rather pleasant odor. It consists of linolein, olein, and palmitin, and congeals between —16° and —18° C. (3.2° and —4° F.). Sunflower oil when shaken with nitric acid of 1.37 specific gravity does not change color, but when mixed with concentrated sulphuric acid a golden-yellow color within a zone of grayish blue is produced. When boiled with caustic alkali solution it yields a soft soap, the saponification value being 193–194. Its iodine value varies from 123–133.

Walnut Oil.—*Nut oil*, E.; *Huile de noix*, Fr.; *Walnussöl*, *Nussöl*, G.—This oil, obtained by expression from the kernels of *Juglans regia* L.—Fam. *Juglandaceæ*, is particularly prized by artists as a drying oil, since the varnish produced by it does not crack like that from linseed oil. The kernels contain from 30 to 40 per cent. of a thin almost colorless or pale greenish-yellow oil of 0.925–0.926 (Allen) specific gravity, and having a pleasant odor and taste. When expressed by aid of heat, the oil is more deeply colored and has a sharp taste. It is soluble in about 100 parts of cold or 60 parts of hot alcohol. Walnut oil is composed of the glycerides of linolic, linolenic, oleic, myristic, and lauric acids, and thickens when cooled to —15° C. (5° F.), but does not congeal until the temperature falls to —27.5° C. (—17.5° F.) (Benedikt-Ulzer, *Analyse d. Fette*, 1903). Its saponification value lies between 188 and 196, and its iodine value is about 142–145. Pure walnut oil is difficult to obtain, according to Kebler, and the bulk of oil sold in this market is said to be a mixture of varying composition. The oil from hickory nuts resembles walnut oil very much and is sold as American Nut Oil. Kebler has found the oil from black walnuts, *Juglans nigra*, to be excellent as a drying oil. The kernels contain about 60 per cent. of oil, of which 25 per cent. can easily be obtained by cold expression. It is limpid, straw yellow, of pleasant odor and taste, has a specific gravity of 0.9215 at 15° C. (59° F.), and becomes turbid when cooled to —12° C. (—10.4° F.). Its saponification value is 190.1–191.5 and its iodine value 141.4–142.7.

Wood Oil.—*Chinese wood oil, Japanese wood oil.*—Under this name the oil of the nut of

the tung tree, *Aleurites cordata* (*Elæococca cordata*, *E. vernicia*, *Dryandra cordata*, *D. vernicia*), is largely used in China and Japan, and thence exported. In China the oil is known as *Pai-Yu*, *Hsin-Yu*, and *Hung-Yu*, and commercially two varieties are sold as Canton oil and Hankow oil, of which the former is considered the better and commands a higher price. The kernels of the nut contain about 58 per cent. of a pale-yellow oil, which becomes darker by exposure, and has a specific gravity of 0.938–0.943 at 15° C. (59° F.). The oil is almost insoluble in cold absolute alcohol, but is soluble in ether, benzin, and chloroform, and when expressed cold from sound kernels the fresh oil has little or no taste, but gradually a characteristic disagreeable odor and taste are developed, especially upon exposure to air. Wood oil remains liquid at —13° C. (8.6° F.), but congeals at —18° C. (—4° F.), and is the strongest drying oil known. Its saponification value is given as 191–196, and its iodine value as 150–165. The oil is known to be poisonous, and hence not suitable for use in pharmacy and medicine, but is very extensively used in the manufacture of varnishes, oil-cloths, etc.

OLEUM MENTHÆ PIPERITÆ, *U. S.*, *Br.*, *P. G.*—Oil of Peppermint.

Essence de menthe poivrée, Fr.; *Pfefferminzöl*, G.

A volatile oil distilled from the fresh or partly dried leaves and flowering tops of peppermint, rectified by steam distillation and yielding, when assayed by the process given below, not less than 8 per cent. of ester, calculated as menthyl acetate, and not less than 50 per cent. of total menthol (free and as ester).—U. S.

The distillation of peppermint oil has developed into an important agricultural industry in Michigan. Considerable oil is also distilled in western New York. While oil is exported, some English and possibly German oil of the finer grades is imported. Japanese oil is largely imported at times, principally for the manufacture of menthol.

Properties.—While the crude oil is yellowish or greenish yellow, the rectified oil is colorless, having the peculiar odor of peppermint. The U. S. P. allows the specific gravity to range between 0.894 and 0.914 at 25° C. (77° F.), and the Br. P. from 0.900 to 0.920 at 15.5° C. (60° F.); whereas the P. G. restricts it to the limits 0.90–0.91. It is soluble in an equal volume of alcohol, and in 4 volumes of 70 per cent. alcohol with at most a trifling opalescence. The angle of rotation may vary from —25° to —33°.

Composition.—American peppermint oil, which has been most carefully examined, has been found to contain amyl alcohol, acetaldehyde, isovaleric aldehyde, acetic acid, isovaleric acid, pinene, phellandrene, limonene, cineol, menthone, menthol, menthyl acetate, menthyl isovalerate, menthyl ester of an acid $C_8H_{12}O_2$, a lactone $C_{10}H_{16}O_2$, cadinene, and dimethyl sulphide. In the English oil pinene (?), phellandrene, and a sesquiterpene (in Japanese oil only a sesquiterpene) have been identified, besides menthone and menthol and esters of the latter. Menthol and its esters are the principal constituents of the oil. The fatty alcohols, aldehydes, and acids, also the dimethyl sulphide, though present only in small quantity, are regarded as objectionable for flavoring purposes, and should therefore be removed by the process of rectification with steam.

Adulterations and Tests.—While occasionally crude adulteration is still met with, the manufacture of menthol on a large scale has thrown upon the market considerable quantities of a more dangerous adulterant than turpentine oil, viz., dementholized oil. Although the lower specific gravity will indicate any considerable amount of such an addition, the menthol assay gives by far the most satisfactory results. While the menthol manufacturer prefers an oil which contains the largest amount of free menthol, peppermint oil rich in menthyl esters is regarded superior for flavoring purposes. Peppermint oil is, therefore, assayed for free menthol and menthol present as ester, the sum of the two yielding the total menthol. The amount of ester is ascertained by saponification, the amount of free menthol by acetylization and subsequent saponification. The older method of freezing out the menthol is unsatisfactory not only because inexact but also because some of the best oils rich in menthyl ester are apt to retain the menthol in solution even at a low temperature, and thus fall short according to this test. "If from 25 Cc. of oil about 1 Cc. be distilled, and the distillate poured on an aqueous solution of mercuric chloride, a white film should not form at the zone of contact after a short time (absence of dimethyl sulphide found in non-rectified oils)."—U. S.

Assay of Oil of Peppermint.—Introduce into a tared flask 10 Cc. of oil of peppermint, and note the exact weight; add 25 Cc. of half-normal alcoholic potassium hydroxide solution,

connect with a reflux condenser, and boil the mixture during 1 hour. After cooling, titrate the residual alkali with half-normal sulphuric acid solution, using phenolphthalein test-solution as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid solution required from the 25 Cc. of half-normal alcoholic potassium hydroxide solution taken multiply the difference by 9.834, and divide the product by the weight of the oil of peppermint taken to find the percentage of menthyl acetate. Wash the residual oil repeatedly with water, transfer it to a flask provided with a ground-glass tube-condenser (acetylization flask), add 10 Cc. of acetic acid anhydride and about 1 Gm. of anhydrous sodium acetate, and boil gently during 1 hour. Allow it to cool, wash the acetylized oil with distilled water, and afterward with sodium hydroxide test-solution, until the mixture is slightly alkaline to phenolphthalein test-solution, and then dry it with the aid of fused calcium chloride, and filter. Transfer to a tared 100 Cc. flask 5 Cc. of the dry acetylized oil, note the exact weight, add 50 Cc. of half-normal alcoholic potassium hydroxide solution, connect with a reflux condenser, and boil the mixture during 1 hour. After cooling, titrate the residual alkali with half-normal sulphuric acid solution, using phenolphthalein test-solution as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid solution required from the 50 Cc. of half-normal alcoholic potassium hydroxide solution taken, multiply the difference by 7.749, and divide the product by the weight of the dry acetylized oil taken, less the above difference multiplied by 0.021 ; the quotient will represent the percentage of menthol in the oil of peppermint.

Note.—The difference referred to above represents the number of cubic centimeters of half-normal alcoholic potassium hydroxide solution consumed by the acetylized oil.—U. S.

The amount of menthone is determined in the following manner : After the menthol content has been determined with a part of the saponified oil, another part is diluted with twice its volume of alcohol and boiled for some time with metallic sodium. Thereby the menthone is reduced to menthol, which may be assayed as described above.

Action and Uses.—Oil of peppermint possesses stimulant, carminative, and anodyne properties. It is employed internally in the treatment of flatulent colic, nausea, and vomiting, and as an adjuvant to purgative remedies. It is also efficacious when locally applied in the treatment of superficial neuralgias and muscular rheumatism. A solution containing from 5 to 10 per cent. in oil or alcohol may be applied for the relief of pruritis. The internal dose is from 2 to 5 minims (0.10–0.30 Cc.).

OLEUM MENTHÆ VIRIDIS, *U. S., Br.*—Oil of Spearmint.

Essence de menthe verte, Fr. ; *Krauseminzöl,* G.

Whereas American spearmint oil is the volatile oil distilled from the fresh or partly dried leaves and flowering tops of *Mentha spicata* L. (Fam. *Labiatæ*), which is regarded as a probable cultural variety of *M. silvestris* L., the German spearmint oil (Krauseminzöl, Essence de menthe crépue) is distilled in small amounts from *M. crispa* L., which is regarded as a cultural variety of *M. aquatica* L. The botanical source of the Russian oil is not known ; the Portuguese oil is stated to be derived from *M. rotundifolia glabra.* Of these oils, only the oil from *M. viridis* comes into consideration in the United States and in England.

Properties.—Crude spearmint oil is a yellowish or greenish-yellow liquid, whereas the rectified oil is colorless. Both possess the odor peculiar to the herb. Its specific gravity may vary between 0.914 and 0.934 at 25° C. (77° F.), according to the U. S. P. The angle of rotation of the commercial oils varies between —36° and —48°. It is soluble in an equal volume of 80 per cent. alcohol, but may become turbid on the addition of more alcohol.

Composition.—American spearmint oil consists principally of about equal portions of *l*-carvone and *l*-limonene (see Oil of Caraway) and possibly a small amount of an unidentified alcohol $C_{10}H_{17}OH$. To what substances it owes its peculiar odor is not known.

Tests.—Inasmuch as spearmint oil can be adulterated with cheaper oils so as to correspond with pure oil as to specific gravity and rotatory power, the carvone assay is one of the best tests of its purity (see Oil of Caraway). While the lessened solubility in alcohol may indicate such adulteration, the assay will reveal the extent of the adulteration as well.

Action and Uses.—The employment of this oil is practically the same as that of Oleum Menthæ Piperitæ (which see). The dose is from 2 to 5 minims (0.10–0.30 Cc.).

OLEUM MORRHUÆ, *U. S., Br.*—Codliver Oil.

Oleum jecoris aselli, P. G.; *Oleum hepatis morrhuæ.—Cod oil*, E.; *Huile de morue, Huile de foie de morue*, Fr. Cod.; *Lebertran, Dorschlebertran, Stockfischlebertran, Kabliaulebertran*, G.; *Aceite de higado de bacalao*, Sp.

A fixed oil obtained from the fresh livers of *Gadus Morrhua* L., and of other species of *Gadus* (Class *Pisces;* Ord. *Teleostia;* Fam. *Gadidæ*).

The oil extracted from the fresh liver of the cod, *Gadus Morrhua* L. (Brandt and Ratzeburg, *Med. Zoöl.*, vol. ii., tab. ix., Fig. 3), by the application of a temperature not exceeding 82.2° C. (180° F.), and from which solid fat has been separated by filtration at about —5° C. (23° F.).—Br.

Origin.—The *common cod*, formerly called *Asellus major*, inhabits the Northern Atlantic, and is frequently met with on the North American coast on and near the Banks of Newfoundland, where it seems the *hake, G. Merluccius* L., s. *Merluccius communis* Cuvier, *pollack, G.* (*Merlangus* Cuvier) *pollachius* L., and *haddock, G. æglifinus* L., are likewise used to some extent for the same purpose. On the Norwegian coast, according to de Jongh (1843), codliver oil is mainly produced from the *dorse, G. Callarius* L., but also from the *pollack*, the *coal-fish, G.* (*Merlangus* Cuvier) *carbonarius* L., the *whiting, Merlangus vulgaris* Cuvier, s. *G. Merlangus* L., and the *ling, Gadus* (*Lota* Cuvier) *Molva* L.

The Norwegian cod fisheries are chiefly located on the Lofoten Islands, where annually in the neighborhood of 400,000 gallons of oil are produced. This oil is considered by many to be the best in the world, although oil of equally fine quality can be produced on this continent, mainly on the coast of Newfoundland. New England fishermen go in large numbers to the Banks of Newfoundland, where they are allowed to secure their supply of codfish outside the 3 mile limit from the coast. Considerable literature has been published on the subject of codliver oil, beginning with the researches of de Jongh in 1843 and leading up to very recent times.[1]

Preparation.—On the coast of Norway the carefully cleaned livers are placed in baskets or barrels exposed in a sunny place, where the oil slowly exudes, and is removed and filtered; or the livers are slowly heated in a steam- or water-bath, or sometimes boiled with water, the oil being skimmed from the surface. A patented process is in use in Norway for rendering the oil from codlivers in an atmosphere of carbon dioxide, whereby it is claimed all danger of oxidation is prevented and the oil obtained in its natural pure state. On the coast of North America codliver oil is now generally very carefully prepared. The introduction of ice as a means of preserving has developed the business of transporting codfish fresh to the inland cities during the catching season, from December to March, and likewise that of the proper preparation of codliver oil from fresh livers on shore by means of gradually applied steam-heat, whereby the oil is separated from the tissues, the watery portion subsiding; the oil is placed in butts in the cooling-room until it freezes solid, when it is put into canvas bags and expressed; the hard, yellowish residue, consisting of fish-stearin and liver débris, is sold to soapmakers, while the clear oil is bottled or put into dry barrels.

The pale oil thus obtained is known as *shore oil.* A second quality varying in color from brownish yellow to pale brown, is known among fishermen as *straits oil.* It is procured by throwing the livers, when taken from the fish and cleaned, into barrels or tanks where gradual decomposition takes place, and the first oil rising to the surface is removed. After putrefaction has advanced, a dark-brown oil of inferior grade, and known as *banks oil*, is collected, which is unfit for medicinal purposes, having a marked acid reaction, disagreeable odor, and an acrid, bitter taste.

The yield of codliver oil varies much from year to year. In 1898 the Newfoundland catch of 171 ships amounted to 28,691.2 tons of fish, producing about 3835 barrels of medicinal oil. The mean annual yield for 1893 to 1900 for the Lofoten Islands, from which the best Norwegian oil is obtained, averaged 13,168 barrels of oil (E. Lepinos, *J. S. C. I.*, 1901).

Properties.—The purest codliver oil is of a pale-yellow color, never quite colorless unless artificially bleached; it is limpid, has a slight fishy but not rancid odor, a bland slightly fishy taste, and a faint acid reaction; but if prepared at a high temperature, or

[1] Those interested are referred to the excellent monograph by F. Peckel Möller, entitled Codliver Oil and Chemistry, London, 1895, and also articles in the Proc. Amer. Pharm. Assoc. for 1875, 1876, 1895, 1903, and 1904, the Western Druggist for 1897, and Merck's Report for 1899.

if the livers are allowed to putrefy more or less, it has a more decided reaction and a pale or darker reddish-brown color, the darkest varieties being transparent only in thin layers, and having a repulsive fishy odor and a bitterish, acrid taste. The acridity and fishy smell are less marked in the light-brown oil, and still less in the yellow or white oil, which is nearly bland. The specific gravity of codliver oil is given as 0.920–0.930 (Br. 0.922–0.927 at 15° C. (59° F.) or 0.918–0.922 at 25° C. (77° F.) (U. S.), and 0.926–0.931 (P. G.). Cold alcohol dissolves not over 2.5 per cent. from the yellow, but about 6 per cent. from the dark-brown, codliver oil; boiling alcohol dissolves 1 or 2 per cent. more. It is scarcely soluble in alcohol, but readily soluble in ether, chloroform, or carbon disulphide; also in 2.5 parts of acetic ether (U. S.). At temperatures below 0° C. (32° F.) a granular crystalline deposit is separated from codliver oil, being in largest proportion from the dark-colored oil, and at 10° C. (4° F.) the oil congeals. On the addition of sulphuric acid to the oil, a violet color, gradually changing to brown red, is produced, due to the presence of biliary compounds; this color is even observed if a glass rod merely moistened with sulphuric acid is drawn through a thin layer of the oil. The violet color is also produced on shaking a solution of 1 drop of codliver oil in 20 drops of chloroform with 1 drop of sulphuric acid, but the color is very transient and becomes pale red and finally brownish yellow. In contact with nitrous acid the oil becomes thicker, but does not solidify. There is a difference in the refractive index between American and Norwegian oils, the former ranging from +42 to +44.5 and the latter from +44 to +48 (E. W. Dowzard).

Adulterations.—American codliver oil is said to be often adulterated with seal oil and menhaden and other fish oils, whereas the Norwegian oil is chiefly admixed with oils from the livers of haddock, ling, and ray or skate, and at times with seal and mineral oils. Lard oil has also been met with as an adulterant.

Tests.—Codliver oil should be only very slightly acid to litmus-paper previously moistened with alcohol (limit of free fatty acids) (U. S., P. G.). Steam-pressed codliver oil contains from 0.3 to 1.5 per cent. of free fatty acids. No solid fat should separate on exposure of the oil to a temperature of 0° C. (32° F.) (Br., P. G.). 1 Gm. of the oil saponified with 20 Cc. of seminormal alcoholic potassium hydroxide solution by boiling under a reflux condenser for one-half hour, should require not less than 13 Cc. of seminormal hydrochloric acid for neutralization, using phenolphthalein as indicator (P. G.). From the dried soap after complete saponification of the oil, not more than 1.5 per cent. of unsaponifiable matter should be extractable by petroleum ether. The development of the violet color mentioned above under *Properties*, when sulphuric acid is added to codliver oil, is characteristic of all fish-oils, but will serve to detect the presence of seal oil. If 2 or 3 drops of fuming nitric acid be allowed to flow alongside of 10 or 15 drops of the oil, contained in a watch-glass, a red color will be produced at the point of contact. On stirring the mixture with a glass rod, this color becomes bright rose red, soon changing to lemon yellow (distinction from seal oil, which shows no change of color at first, and from other fish-oils, which become at first blue and afterward brown and yellow) (U. S.). The value of this latter test appears to be impaired by long keeping of the oil (*Pharm. Centralb.*, 1902, Beda). Although nitric acid is intended to detect the presence of seal oil, it has been shown by Gane (1903) that mixtures of equal volumes of codliver and seal oils readily pass this test. Seal oil is best distinguished by the very disagreeable odor of the soap obtained by boiling some of the oil with alcoholic potassium hydroxide solution, codliver oil and other fish oils yielding a soap of slight herring-like odor. When nitric acid is carefully poured into some of the oil contained in a test-tube, a precipitate of coagulated albumin should be formed at the surface of contact of the two liquids (Br.). This test is intended to show the absence of excessive amounts of free fatty acids, since the amount of albumin present is said to vary with the proportion of free fatty acids, but according to Gane the test is of little value. The U. S. P. requires that codliver oil, saponified by alcoholic potassium hydroxide test-solution, shall show a saponification value of 175 to 185. If 0.3 Gm. of codliver oil be dissolved in 10 Cc. of chloroform and placed in a 250 Cc. flask with 25 Cc. of a mixture of equal parts of alcoholic iodine test-solution and alcoholic mercuric chloride test-solution, and after standing for 4 hours protected from light, 20 Cc. of potassium iodide test-solution be added and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with decinormal sodium thiosulphate solution an iodine figure of not less than 140 nor more than 150 should be obtained (U. S.). This requirement, which is identical with

that of the P. G., is a useful aid in detecting adulterations other than fish-oils. Gane recommends (*Proc. Amer. Pharm. Assoc.*, 1903) that the time allowed for absorption be increased to 6 hours, and states that under these conditions genuine codliver oils will take up from 150 to 171 per cent. of iodine.

The reaction with nitric acid given above and the determination of the free fatty acid are among the most important tests in the examination of codliver oil. The latter may be carried out as suggested by Gane, as follows: Weigh carefully 25 to 50 Gm. of oil into a 200- or 250-Cc. flask and add 100 Cc. of alcohol which has been carefully neutralized. Shake well and raise to the boiling-point by means of a water-bath. Then add a few drops of phenolphthalein test-solution, and run in very cautiously half-normal sodium or potassium hydroxide solution from a burette until the liquid assumes a permanent pink tint. Note the number of Cc. of alkali solution used, and multiply this by 0.141, which will give the amount of free fatty acid present in the given weight of oil, calculated as oleic acid. Divide the product thus obtained by the weight of oil taken, and multiply the quotient by 100 to find the percentage of free acid.

Composition.—The composition of codliver oil is much affected by the method and care taken in its extraction and subsequent treatment. It is primarily a mixture of glycerides of stearic, palmitic, jecoleic, therapic, and a notable percentage of volatile fatty acids. Heyerdahl estimated the liquid fatty acids to contain 4 per cent. of *palmitic*, 20 per cent. of *jecoleic*, $C_{19}H_{36}O_2$, and 20 per cent. of *therapic*, $C_{17}H_{26}O_2$, acids. *Morrhuic* acid, $C_9H_{13}NO_3$, probably identical with de Jongh's *gaduine*, has been found in codliver oil, and *asellic* acid, $C_{17}H_{32}O_2$, was assumed as one of the constituents of the fatty acids by Fahrion (*J. S. Chem. Ind.*, 1893, p. 935).

Cholesterol, $C_{26}H_{42}.OH$, has been found as a constant constituent, the quantity varying from 0.46 to 1.32 per cent. The putrefactive changes which the livers undergo before the final extraction of the oil contribute to the development of some of the ptomainic bases found in some varieties of oil. The first oil exuding from the livers contains the least of the organic bases, while from the light-brown varieties of codliver oil *Gautier* and *Morgues* have obtained from 0.035 to 0.050 per cent. of organic bases. Among the bases thus far identified the most important are *trimethylamine*, *butylamine*, *iso-amylamine*, *hexylamine*, *dihydrotoluidine*, and the non-volatile bases *aselline*, $C_{25}H_{32}N_4$, and *morrhuine*, $C_{19}H_{27}N_3$. Of the elements, iron, manganese, magnesium, calcium, and sodium, sulphur, chlorine, bromine, iodine, and phosphorus have been found in more or less minute quantities in codliver oil. The phosphorus is mainly a constituent of a lecithin-like substance. Iodine, 0.00138 to 0.004 per cent., occurs as a usual constituent, but the medicinal qualities of codliver oil are attributable more to the peculiar composition and ready assimilability of the glycerides, rather than to the minute quantities of iodine and organic bases. The coloring-matter of the oil belongs to the class of lipochromes. The oil readily turns rancid, free fatty acids being liberated, on which account the pharmacopœias limit the quantity of free acid in medicinal oil.

The so-called fish-stearin present in codliver oil and obtained as a residue when the frozen oil is expressed, is not true tristearin, but consists, according to Heyerdahl, of a mixture of 20 per cent. of glycerides of saturated fatty acids and 80 per cent. of glycerides of unsaturated acids. The exact character of these unsaturated fatty acids has not been determined.

Action and Uses.—Codliver oil possesses certain peculiarities which separate it from other fatty substances which are sometimes employed in medicine. The bile salts which it contains materially aid in its emulsification and in its absorption from the intestine, and the fact that it contains iodine, bromine, phosphorus, and sulphur give it alterative powers which are of value, the patient being supplied not only with a readily assimilated form of fat, but at the same time with drugs which stimulate nutrition and enable the body to utilize the hydrocarbons after they are ingested. It is interesting to note that because of its bile salts, and perhaps of its chemical composition, codliver oil is six or eight times more diffusible through animal membranes than other oils, whether they be vegetable or animal. Taken in moderate quantity, varying from a teaspoonful to two tablespoonsfuls two or three times a day, it rarely produces disagreeable symptoms, but if the digestion is deranged, or if the doses are excessive, it may disorder the stomach and produce an oily diarrhœa. Codliver oil is used in medicine chiefly in cases of impaired nutrition connected with diathetic diseases such as chronic rheumatism, rickets, and anæmia, and in certain acute or subacute infections of which the type may be con-

sidered tuberculosis. In rheumatism it is particularly useful when the sheaths of the muscles and joints are chiefly affected, and when, associated with these conditions, there is marked anæmia and loss of flesh. In rickets it does good by improving nutrition, and often actually increases the appetite. In tubercular infection it finds its chief usefulness in those persons who do not suffer from a very active form of the disease, who possess a fairly good digestion, but who, nevertheless, lose flesh rapidly. It is important to remember that codliver oil cannot cure tubercular infection of any portion of the body, and that it does good only indirectly by improving nutrition and so maintaining, or improving, vital resistance. It is of greater importance that the patient shall eat good meals and have fresh air than that he shall take codliver oil, and if the oil disorders digestion, it is not only of no value, but harmful. In that form of chronic modified tubercular infection which at one time was designated scrofula or struma, codliver oil is often exceedingly useful. In some cases of chronic bronchitis which do not yield to ordinary remedies, the administration of codliver oil is followed by the most excellent results. Children can usually take larger doses of codliver oil in proportion to their size than adults, and often become very fond of it. As a rule its use is contra-indicated in all diseases if fever is present.

Codliver oil may be given in one of three ways: In soluble elastic capsules containing about 2½ grammes, in emulsion, and by placing it in a feeding cup with a long nozzle which will reach well back into the mouth, thereby conveying the oil past the lips and the tip of the tongue, which are the parts of the gustatory apparatus which are capable of noticing its taste. In this manner, too, its odor is not so well perceived by the olfactory nerves. Many other methods of administration have been resorted to, but are not particularly advantageous. One of these consists in placing it on top of some whisky in a glass and tossing it down the throat in such a way that only the whisky comes in contact with the mucous membrane of the mouth. The dose varies from a teaspoonful (4 Cc.) to 2 tablespoonsfuls (30 Cc.) 3 times a day for adults. In cases of marasmus occurring in children, whether due to syphilis or tuberculosis, codliver oil sometimes does great good, particularly in the former condition, when given by inunction. The infant should be anointed about the axillary spaces, abdomen, and the inside of the thighs with the oil, the nurse sitting with the child in front of a warm fire so that the circulation in the skin may be active, and then using massage to urge the oil through the epiderm. The disadvantages of this method is that it soils the child's clothes, and it is difficult to keep the patient clean. Small quantities of bile salts, over and above the quantity which it normally contains, mixed with the oil, may aid in the rapidity of its absorption when it is given by inunction.

Under the name of "Morrhuol," a proprietary preparation which is said to represent the active principles of codliver oil, is sometimes employed. It is useful in bronchitis, but does not possess the value of the oil itself.

Allied Oils.—OLEUM SQUALI.—*Shark oil*, E.; *Huile de requin, de selache*, Fr.; *Haileberthran*, G.—It is obtained from the liver of the shark, *Squalus Carcharias* L., and one or two allied species, and is the lightest of the fish-oils, its density at 15° C. (59° F.) being 0.870 to 0.880. It is light yellow, has an acrid taste, and remains limpid at —6° C. (21.2° F.).

OLEUM RAJÆ.—*Ray oil, Skate oil*, E.; *Huile de raie*, Fr.; *Rochenthran*, G.—It is obtained from the liver of *Raja, Batis*, L., and is employed in France and Belgium. The oil is pale or bright yellow, neutral, has the specific gravity 0.928 at 15° C. (59° F.), a slight fishy odor and taste, and dissolves in 2 parts of ether. It is stated to contain more iodine than codliver oil. Oil is also extracted from the liver of the American *stingray, Pastinaca hastata* De Kay.

Fish Oils.—These are in part obtained from different fishes, like the *Alosa Menhaden* Cuvier, which is caught on the New England coast and yields *menhaden oil*, principally employed in leather-dressing. But among fish oils are also included the so-called *train oils*, obtained from the fleshy parts of different cetacean mammals; the principal ones are:

OLEUM CETI.—*Sperm oil*, E.; *Huile de cachalot*, Fr.; *Pottfischthran*, G.—From *Physeter macrocephalus* L.; it is yellow or brown yellow, of specific gravity 0.920, and in the cold deposits spermaceti and stearin.

OLEUM BALÆNÆ.—*Whale oil*, E.; *Huile de baleine*, Fr.; *Walfischthran*, G.—From *Balœna mysticetus* L., and *B. australis* Desmoulins, the Greenland or right, and the cape or southern, whale. The oil has a peculiar fishy odor and unpleasant taste, a density of 0.926, and begins to deposit a sediment at about 10° C. (50° F.).

DUGONG OIL, from *Halicore Dugong* Cuvier, which inhabits the waters of Eastern Australia and the Indian Archipelago, has been used in place of codliver oil in Australia.

CANDLEFISH OIL.—*Eulachon Oil.*—A fixed oil obtained from the bodies of *Thaleichthys pacificus* (Richardson) Girard. This small fish is found in immense numbers in the waters of the northwestern coast of North America. It is a delicious food-fish, and the oil is extracted and used as a winter food by the Indians. The name "candle-fish" is derived from the ability to burn the dried body as a torch candle. The oil has been recommended as a substitute for codliver oil, being much more palatable, but it has not found favor. The dose is the same as that of codliver oil.

OLEUM MYRCIÆ.—Oil of Myrcia.

Oil of Bay, E.; *Essence de bay*, Fr.; *Bayöl*, G.

The volatile oil distilled from the leaves of *Pimenta acris* (Swz.) Wight (Fam. *Myrtaceæ*), which was official in the U. S. P. of 1890. The bay leaves of commerce are apparently not always derived from the same plant, but from different species yielding similar leaves. The oil is distilled partly from fresh material in the West Indies, partly from dried leaves in New York.

Properties.—Bay oil is a yellow liquid, which soon becomes brown on exposure to the air. Its odor suggests cloves and its taste is spicy. The specific gravity of the normal oil varies between 0.965 and 0.985, and, as a rule, is above 0.970. It is but slightly lævogyrate up to —2°. While the fresh oil yields a clear solution with 90 per cent. alcohol, upon standing the oil loses its solubility.

Composition.—The oil, which consists of from 60 to 65 per cent. of eugenol, also contains its isomer chavicol; further, methyl eugenol, methyl chavicol, citral, and the hydrocarbons phellandrene and myrcene, the latter of which is very unstable, and possibly causes the change of solubility of the oil in alcohol upon standing.

Adulterations and Tests.—Inasmuch as oil of bay apparently contains no pinene, the addition of turpentine oil can be detected by distilling the first fifth of the oil over, and testing it for pinene by means of the nitrosochloride reaction. The amount of phenols present can be ascertained approximately by shaking them out with 5 per cent. potassium hydroxide solution (see page 1047).

Action and Uses.—Because of its fragrance, oil of bay is used as a perfume. The drug is rarely if ever employed in internal medicine.

OLEUM MYRISTICÆ, *U. S., Br.*—Oil of Nutmeg.

I. *Oleum myristicæ æthereum, Oleum nucis moschati.—Volatile oil of nutmeg*, E.; *Essence de muscade*, Fr.; *Aetherisches Muskatnussöl*, G.; *Essencia de nuez moscada*, Sp.

II. *Oleum macidis.—Volatile oil of mace*, E.; *Essence de macis*, Fr.; *Macisöl, Muskatblüthenöl*, G.

Myristica fragrans Houttuyn (Fam. *Myristicaceæ*) yields two drugs:

a. The nutmeg, the seed of *M. f.* deprived of its testa; and *b.* The mace, the arillus.

The volatile oil of the former is designated Oleum myristicæ æthereum by continental writers in order to distinguish it from the fatty oil obtained by expression. So far as is known, oil of nutmeg and oil of mace contain the same constituents, but the former contains a larger percentage of terpenes than the latter, nevertheless the P. G. recognizes the oil from nutmeg under the title of oil of mace. Upon distillation, nutmegs yield 8–15 per cent., mace 4–15 per cent., of volatile oil.

Properties.—Oils of nutmeg and mace are colorless or yellowish, darkening with age, and possess the peculiar odor of the drugs from which they are obtained. The specific gravity of oil of nutmeg varies between 0.865 and 0.920, that of mace between 0.890 and 0.930. The specific gravity requirement of the U. S. P. is 0.862–0.910 at 25° C. (77° F.), that of the Br. 0.870–0.910, and that of the P. G. 0.890–0.930. Such wide limits are unfortunate, since the specific gravity is one of the principal criterions of the oil, but appear to be demanded, in part owing to the variable composition of the oil, in part to the changes which it is apt to undergo. The angle of rotation of oil of nutmeg varies between +14° and +28°, that of oil of mace between +10° and +20°. Both oils form a clear solution with 3 parts of 90 per cent. alcohol.

Composition.—The known constituents of both oils are pinene, dipentene, myristicol, myristicin or its isomer, a phenyl ether, and more or less of myristinic acid, according to the duration of the process of distillation. As stated above, oil of nutmeg contains a larger percentage of terpenes than does oil of mace.

Tests.—When 2 or 3 Cc. of this oil are evaporated in a capsule on a water-bath, no residue should be left which crystallizes on cooling, resembling the fatty oil of nutmeg.

Action and Uses.—This oil may be employed for the same purpose as nutmeg. It is rarely used in medicine. The dose is from 1 to 3 minims (0.05–0.20 Cc.).

OLEUM NUCISTÆ, *P. G.*—Expressed Oil of Nutmeg.

Oleum myristicæ expressum, Butyrum myristicæ, Butyrum nucistæ. Nutmeg butter, E.; *Beurre de muscade,* Fr.; *Muskatnussöl, Muskatbutter,* G.; *Manteca de nuez moscada,* Sp.

A mixture of the fixed and volatile oils of nutmeg, together with coloring-matter.

Preparation.—This oil is obtained in the East Indies by beating nutmegs into a paste, which is expressed between heated plates. The yield is about 28 per cent., and the annual importation into the United States is usually between 300 and 500 pounds. It is often incorrectly called *oil of mace.*

Properties.—It is found in commerce in the shape of blocks about 6 Cm. (2½ In.) thick and 25 Cm. (10 In.) long, and is wrapped in palm-leaves. It is solid and firm, unctuous to the touch, of a mottled appearance, orange-brown and whitish in color, of specific gravity 0.995, and has the fragrance and aromatic but bland taste of nutmegs. It melts at about 45° to 51° C. (113°–123.8° F.), and is soluble in 2 parts of warm ether and 4 parts of boiling strong alcohol (Lecanu).

Constituents.—Cold alcohol dissolves about 6 per cent. of volatile oil and 24 per cent. of fat, accompanied by brown-yellow resinous matter, which has not been further examined. The remaining pulverulent white fat is *myristin*, $C_3H_5(C_{14}H_{27}O_2)_3$, which crystallizes from hot alcohol or ether and fuses at 55° C. (131° F.). Schmidt and Rœmer (1883) found 3 to 4 per cent. of free myristic acid, with a little stearic acid.

Adulterations.—Artificial mixtures made from animal fats are not soluble in the same amount of hot alcohol, and the portion insoluble in cold alcohol would be more or less greasy.

Pharmaceutical Preparation.—*Balsamum nucistæ* (P. G.). Melt together yellow wax 1 part, olive oil 2 parts, and expressed oil of nutmeg 6 parts; pour into paper capsules and cut into square cakes.

Action and Uses.—Expressed oil of nutmeg may be employed as a vehicle for more active remedies. It is occasionally employed alone as an embrocation in the treatment of chronic rheumatism.

Allied Fats.—Becuiba Tallow is expressed from the seeds of *Myristica Becuhyba* Schott, s. *M. officinalis* Mart., which is indigenous to Brazil. The fat resembles the official article, but has a sharp, acidulous taste, melts at 47° C. (116.6° F.), and on treatment with cold absolute alcohol leaves 45 per cent. of yellow pulverulent residue undissolved.

Otoba Butter is prepared from *Myristica Otoba* Humb. et Bonpl., indigenous to Northwestern South America. It is yellowish, becomes brown by age, melts at 38° C. (100.4° F.), and has then an unpleasant odor. Its myristin melts at 46° C. (114.8° F.), and contains *otobit*, which is sparingly soluble in cold alcohol, crystallizes in colorless, inodorous, and tasteless prisms, and melts at 133° C. (271.4° F.) (Uricoechea, 1854).

Virola Tallow, Ocuba Wax, is prepared from *Virola* (*Myristica* Swartz) *sebifera* Aublet, indigenous to Guiana. The fat is yellowish, somewhat crystalline, completely soluble in alcohol, and melts at 45°–50° C. (113°–132° F.).

OLEUM OLIVÆ, *U. S., Br.*—Olive Oil.

Oleum olivarum, P. G.—*Sweet oil,* E.; *Huile d'olive,* Fr.; *Olivenöl,* G.; *Aceite de olivas,* Sp.

The fixed oil expressed from the ripe fruit of *Olea europæa* L. (Fam. *Oleaceæ*).

Origin.—In its wild state the olive is almost shrubby, much branched, and thorny, but under cultivation it is a medium-sized tree. It is indigenous to Western Asia, particularly Syria, and has been cultivated for a long time in the countries bordering on the Mediterranean. It has been introduced into the Southern United States, California, and several South American and other countries. The tree has evergreen, opposite, shortly petiolate leaves, which are lanceolate, acute at both ends, entire and revolute on the margin, and densely scaly, silvery gray, brownish or glaucous green beneath. The numerous small white flowers are in axillary racemes, diandrous, have a 2-celled and 4-ovuled superior embryo, and produce a purplish-black ovate drupe with a greenish, firm sarcocarp and an obliquely oblong-keeled putamen containing a single albuminous seed.

The leaves and bark have been employed in France as a febrifuge. De Luca (1861, etc.) found the leaves and green fruit to contain mannite, which diminishes in the latter as the fruit ripens, and disappears entirely when it becomes perfectly ripe. It contains then the largest amount of oil, equal in weight to nearly 70 per cent. of the sarcocarp.

Fig. 291.

Olea europæa L.

The "Pigale," "Verdale," "Rouget," "Picholine," "Sayern," "Pendoulier," and "Cailletier" are the principal varieties of olive tree grown for the production of olive oil in France.

Preparation.—The finest quality of olive oil is obtained by crushing the recently collected ripe olives in a suitable mill to a pulpy mass, care being taken in some districts not to break the putamen containing the seed; the pulpy mass is then subjected to moderate pressure, the oil, called *virgin oil* (*Huile vierge*, Fr.; *Jungfernöl*, G.), being collected in cisterns containing water, from the surface of which it is subsequently skimmed. The press-cakes are afterward thoroughly mixed with water and the marc again expressed, using an increased pressure, whereby a second quality of oil is obtained; in some places cold water is first used for softening the press-cakes, and is followed by hot water. However, with the improvements in the construction of powerful presses this portion of the process is much simplified, and a larger yield of oil of fine quality is obtained. The oil still remaining in the marc is said to amount to between 9 and 12 per cent., and is extracted by means of carbon disulphide; or the marc is thrown into cisterns, which in southern France are called *enfer*, and where an oil called *huile d'enfer*, having a disagreeable odor, separates upon the water. A larger amount of oil, but much inferior in quality, is yielded by expressing olives which have been kept in heaps and undergone a kind of fermentation; this oil is known in France as *huile fermentée;* and a still more inferior oil is prepared by again mixing the residue with boiling water and expressing. Though the seeds have a bitterish taste, Flückiger found the oil to be quite bland, to be a non-drying oil, and, if extracted with the oil of the fruit, to constitute about one-fortiêth of the latter.

Robert P. Skinner ("Olives and Olive Oil in France," adv. sheets of Consular Reports, No. 1639, May 6, 1903) summarizes the production of olive oil as follows: "1. Olives picked late yield a white oil of inferior quality. 2. Olives gathered at the precise moment of maturity give a maximum quantity of oil and the quality is normal. 3. Olives gathered a little before complete maturity produce a fine amber-colored oil, of superior quality, fruity in flavor, but diminished in quantity." To produce an oil combining perfume, finesse, and sweetness, "the product must be stored until the strong flavor has disappeared, the fruity flavor remaining dominant. To do this it is necessary to choose fruit that is but slightly ripe, and to place upon the market an oil that has been manufactured 6 or 8 months." (M. Anastay.)

The virgin oils are the product of the first or lightest pressure applied to the cold pulp.

Olive oil enters commerce put up in bottles of various sizes, also in stone jugs and in barrels.

Properties.—Olive oil is a pale-yellow or greenish-yellow oily liquid, having a neutral reaction, a slight agreeable odor and a bland taste, leaving, even in its freshest condition, a slight sense of acridity, which is somewhat increased on keeping. Its specific gravity at 15° C. (59° F.) is from 0.915 to 0.918 (P. G.), 0.914 to 0.919 (Br.), and at 25° C. (77° F.) 0.910 to 0.915 (U. S.). At and below 10° C. (50° F.) olive oil separates white crystalline granules; near 2° C. (35.6° F.) it is of a butyraceous consistence; and it congeals completely at or below the freezing-point of water, yielding, however, by strong pressure, from 67 to 72 per cent. of liquid oil, which remains fluid at —10° C. (14° F.), and is nearly pure *olein.* The solid portion fuses between 20° C. (68° F.) (Pelouze and Boudet) and 28° C. (82.4° F.) (Lecanu), and is easily soluble in ether. Olive oil is sparingly soluble in alcohol, freely soluble in ether, soluble in all proportions in chloroform, benzene, benzin, and carbon disulphide, and in about 5 parts of acetic ether. It does not readily become rancid, and belongs to the non-drying oils.

When heated to 120° C. (248° F.) it becomes lighter, and at 220° C. (428° F.) nearly colorless, and at the same time rancid; it commences to boil at about 315° C. (600° F.).

Inferior qualities of olive oil are of a deeper hue, become cloudy, and congeal more easily, have a more decidedly acrid after-taste, and turn rancid on exposure.

The German Pharmacopœia recognizes two qualities of olive oil—the one intended for internal use and for ointments, the other used for the preparation of plasters:

Oleum Olivarum, s. Oleum Provinciale.—*Best olive oil*, E.; *Huile d'olive fine*, Fr.; *Provenceröl*, G.—It is the oil described above.

Oleum Olivarum Commune.—*Olive oil*, E.; *Huile d'olive ordinaire*, Fr.; *Baumöl*, G.—This is the second quality of salad oil, has a brownish-yellow or green-yellow color, and, except a somewhat less pleasant odor and taste, agrees with the preceding.

Composition.—Olive oil is composed of about 72 per cent. of liquid glycerides (a mixture of linolein 6 and olein 94 per cent.) and about 28 per cent. of solid glycerides, consisting chiefly of palmitin with small quantities of arachin. Besides these, it is said by Holde and Stange (*Ber. d. D. Chem. Ges.*, 1901, p. 2402) to contain about 1.5 per cent. of a solid glyceride having an iodine value of 30 and a saponification value of 196.1. Stearic acid is stated by Hehner and Mitchell not to exist in olive oil. The unsaponifiable matter present, formerly supposed to be cholesterin, has been shown by Bomer and Soltsien (1901) and Gill and Tufts (*J. A. Ch. S.*, 1903) to consist of phytosterin. The greenish color of the oil is due to chlorophyll derived from the olive fruit.

Adulterations.—Olive oil has been found adulterated with groundnut oil, cottonseed oil, rapeseed oil, sesame oil, and at times with poppyseed oil. The absence of the properties mentioned above, together with the tests given below, will serve to detect these adulterations, which are rarely present in less quantity than 25 per cent. L. M. Tolman (*Proc. Amer. Pharm. Assoc.*, 1904, p. 382) recommends that, inasmuch as olive oil contains an impurity which interferes with the tests for cottonseed oil and sesame oil, it should be treated as follows: Place 25 to 30 Cc. of the oil in a separatory funnel and shake thoroughly with hot alcohol, allow to separate, remove the alcohol, and wash with hot water, and use this oil for the tests. The exact nature of the impurity removed by this method has not yet been determined. The same writer suggests that in making the test for cottonseed oil with a mixture of carbon disulphide and amyl alcohol, as recommended by the U. S. P., the salt-water bath should boil at from 112° to 115° C., and the test kept at this temperature for from 1 to 2 hours. Cottonseed oil, which has been heated, responds to this test only after 1 or 2 hours, and would escape detection during the shorter period of time directed in the official test.

Tests.—If 2 Cc. of olive oil be shaken vigorously with an equal volume of nitric acid of 1.37 specific gravity, the oil should retain a light-yellow color, not becoming orange or reddish brown, and after standing for 6 hours should change into a solid yellowish-white mass and an almost colorless liquid (absence of appreciable quantities of cottonseed oil and most other seed oils). If 5 Cc. of the oil be thoroughly shaken in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol and adding 2 drops of nitric acid) and the mixture heated for about 5 minutes on a water-bath, the oil should retain its original pale color, not becoming reddish or brown, nor should a dark color be produced at the line of contact of the two liquids (absence of more than about 5 per cent. of cottonseed oil). If 2 Cc. of the oil be mixed in a test-tube with 2 Cc. of a mixture of amyl alcohol and carbon disulphide containing 1 per cent. sulphur in solution, and this test-tube be immersed to a depth of $\frac{1}{3}$ to $\frac{1}{2}$ in boiling salt water, no reddish color should develop in from 10 to 15 minutes (absence of cottonseed oil). If 2 Cc. of the oil are mixed with 1 Cc. of hydrochloric acid (1.18 specific gravity) containing 1 per cent. of sugar, and the mixture shaken for $\frac{1}{2}$ minute and allowed to stand for 5 minutes, and then 3 Cc. of water added and again shaken, the acid layer should not show a pink color (absence of sesame oil). Olive oil, saponified by alcoholic potassium hydroxide test-solution, should show a saponification value of 191 to 195. If 0.3 Gm. of olive oil be dissolved in 10 Cc. of chloroform and placed in a 250-Cc. flask with 25 Cc. of a mixture of equal parts of alcoholic iodine test-solution and alcoholic mercuric chloride test-solution, and after standing for 4 hours protected from light, 20 Cc. of potassium iodide test-solution be added and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate solution, an iodine value of not less than 80 nor more than 88 should be obtained.—U. S. If 1 part of olive oil be agitated with 2 parts of a cold mixture

prepared from equal volumes of strong sulphuric acid and of nitric acid of 1.185 specific gravity, and the mixture set aside for ½ hour, the supernatant oily layer should not have a darker tint than yellowish or slightly greenish; sesame oil under the same conditions turns reddish or red; groundnut oil, reddish brown; cottonseed oil, dark red; sunflower oil, orange yellow.

Peanut, or groundnut, oil is perhaps more extensively used than some other oils to adulterate olive oil, and its presence is more difficult to detect since its physical and chemical constants are very similar to those of olive oil, and there is no color-reaction for its detection in small amounts. The following method used in the Bureau of Chemistry of the Agricultural Department at Washington, D. C., is said by Tolman to give very satisfactory results:

Weigh 20 Gm. of oil into an Erlenmeyer flask. Saponify with alcoholic potash, neutralize exactly with dilute acetic acid, using phenolphthalein as indicator, and wash into a 500-Cc. flask containing a boiling mixture of 100 Cc. of water and 120 Cc. of a 20 per cent. lead acetate solution. Boil for 1 minute, and then cool the precipitated soap by immersing the flask in water, occasionally giving it a whirling motion to cause the soap to stick to the sides of the flask. After the flask has cooled, the water and excess of lead can be poured off and the soap washed with cold water and with 90 per cent. (by volume) alcohol. Now add 200 Cc. of ether, cork the flask, and allow to stand for some time until the soap is disintegrated, then heat on the water-bath, using a reflux condenser, and boil for about 5 minutes. In the case of oils most of the soap will be dissolved, while in lards, which contain so much stearin, part will be left undissolved. Cool the ether solution of soap down to from 15° to 17° C., and let stand until the insoluble soaps have crystallized out—about 12 hours are required.

Filter and thoroughly wash the precipitate with ether. The soaps on the filter are washed back into the flask by means of a stream of hot water acidified with hydrochloric acid. Add an excess of dilute hydrochloric acid, partially fill the flask with hot water, and heat until fatty acids form a clear, oily layer. Fill the flask with hot water, allow the fatty acids to harden and separate from the precipitated lead chloride; wash, drain, repeat washing with hot water, and dissolve the fatty acids in 100 Cc. of boiling 90 per cent. (by volume) alcohol. Cool down to 15° C., shaking thoroughly to aid crystallization. From 5 to 10 per cent. of peanut oil can be detected by this method, as it effects a complete separation of the soluble acids from the insoluble, which interfere with the crystallization of the arachidic acid. Filter, wash, and precipitate twice with 10 Cc. of 90 per cent. (by volume) alcohol, and then with alcohol of 70 per cent. (by volume). Dissolve off the filter with boiling absolute alcohol, evaporate to dryness in a weighed dish, dry, and weigh. Add to this weight 0.0025 Gm. for each 10 Cc. of 90 per cent. alcohol used in the crystallization and washing, if done at 15° C.; if done at 20° C., 0.0045 Gm. for each 10 Cc. The melting-point of arachidic acid obtained in this way is between 71° and 72° C. 20 times the weight of arachidic acid will give the approximate amount of peanut oil present.

The best qualities of olive oil are imported from France. The total importations into the United States have been on a constant increase during the past few years, the importations being as follows:

	1899.	1900.	1901.	1902.	1903.[1]
Gallons	930,042	967,702	983,059	1,339,097	1,247,281
Valued at	$1,090,250	$1,170,871	$1,266,293	$1,579,409	$1,440,991

Action and Uses.—Olive oil is one of the blandest of vegetable oils, and is constantly used as a food and sometimes as a medicine. In the dose of from 1 to 2 ounces (30–60 Cc.) it acts as a mild laxative, but its use for this purpose is usually confined to infants, to which class of patients it is commonly given in the dose of from 1 to 2 teaspoonsful (4–8 Cc.). Because of its bland qualities and pleasant taste, it may be given when it is desired to fatten a patient, providing his digestion is capable of dealing with oils. Certain practitioners have great confidence in the value of olive oil in the treatment of gall-stones. Under these circumstances the dose is from ½ to 1 pint, and it is claimed that these quantities will often cause a discharge of gall-stones which have been giving the patient much trouble. How the oil acts under these circumstances is not known. It is very doubtful whether the instances in which it has seemed to do

[1] For the 10 months of the fiscal year 1903 ending April.

good have not been cases of coincidence rather than actual therapeutic activity. Olive oil is sometimes dropped into the external ear for the purpose of destroying insects which have entered the meatus. It is also applied externally as a soothing application to burns and various forms of cutaneous irritation. Mixed with lime-water in equal parts it forms the so-called "Carron oil" or *linimentum calcis.* Some cases of constipation derive much benefit by the injection into the bowel of from 4 to 8 ounces (120–240 Cc.) of olive oil at bedtime, the oil being retained until the next morning, during which period of retention it softens the feces. It is interesting to note that at one time surgeons were in the habit of dipping surgical instruments in hot olive oil before making an incision, with the idea that the oil exercised some curative property, but we now know that the heat in the oil sterilizes the knife, and that the oil itself has no curative effect.

OLEUM PALMÆ.—Palm Oil.

Huile (Beurre) de palme, Fr.; *Palmöl, Palmbutter,* G.; *Aceite de palma,* Sp.

A fixed oil obtained from the fruit of *Elæis guineensis* Jacq. (Fam. *Palmæ*).

Origin.—The oil-palm is a tall tree indigenous to Western Africa and introduced into other tropical countries. It has large pinnate leaves with spiny petioles and long, narrow linear leaflets. The fruit is a yellow mottled drupe about 25 Mm. (1 In.) long, and contains a leathery very oily sarcocarp, from which the fat is obtained by pressure or by boiling with water. The kernel yields likewise a bland oil which is white and melts at 25° C. (77° F.).

Properties.—Palm oil is solid at low temperatures, butyraceous, of a reddish-yellow color, and when fresh of an agreeable violet-like odor, and fuses at 27° C. (80.6° F.). On keeping, it becomes lighter in color and acquires a rancid odor, a portion of the fat being decomposed into free acids and glycerin, the fusing-point rising at the same time, sometimes to 42° C. (107.6° F.). When rapidly heated to 240° C. (464° F.) it is bleached. It is partly soluble in alcohol, but entirely so in ether. Its specific gravity is 0.945.

Composition.—It consists chiefly of tripalmitin and triolein, and contains a peculiar ferment, inducing its decomposition. The solid fatty acids consist of 98 per cent. of palmitic, 1 per cent. of stearic, and 1 per cent. of a heptadecylic acid, $C_{17}H_{34}O_2$ (Nördlinger, 1892). It is largely used in the preparation of soap; and to obtain the latter white, the oil is bleached by treating it with a solution of potassium dichromate and adding sufficient sulphuric and hydrochloric acids to form potassium sulphate and chromic chloride. The bright-reddish-yellow coloring-matter quite characteristic of palm oil is *lipochrome.* The iodine value of the fat is 51 to 52.5. The melting-point of the fatty acids is 47.8° to 50° C. (118°–120° F.) and the congealing-point is 45° to 36° C. (113°–96.8° F.).

Action and Uses.—It has recently come into use for coloring oleomargarine.

Other Palm Oils.—(See also OLEUM COCOIS.) MACAJA BUTTER, obtained from the seeds of *Cocos aculeata* Jacquin, of tropical America, has a yellowish color and a violet-like odor.

TUCUM OIL, from the fruit of *Astrocaryum vulgare* Mart., of South America, has a bright-red color and an agreeable odor.

OLEUM PAPAVERIS, *P. G.*—Poppy Oil.

Poppyseed oil, Maw oil, E.; *Huile de pavot, Huile d'œilette, Huile blanche,* Fr.; *Mohnöl,* G.

Source.—Oil of poppyseed is obtained by expression from the seed of *Papaver somniferum* L. (Fam. *Papaveraceæ*), which yields about half its weight of oil, the greater part ($\frac{2}{3}$) being obtainable without heat.

Properties.—Poppy oil, when expressed cold, is colorless or of faint-yellow color, almost odorless, and possesses an agreeable taste. It belongs to the drying oils and thickens when exposed to the air in thin layers. The oil remains clear when cooled to 0° C. (32° F.), but congeals at —18° C. (—0.4° F.). It is soluble in its own weight of ether, in 8 parts of boiling or 30 parts of cold alcohol. Its saponification factor is 192 to 195 and its specific gravity at 15° C. (59° F.) is 0.924 to 0.937. If pure poppy

oil be mixed with half its weight each of sulphuric and nitric acids, the mixture assumes a brick-red color.

Constituents.—Poppy oil consists of the glycerides of oleic, palmitic, stearic, linolenic, and linolic acids, chiefly the last named. It is rarely adulterated, but if so, probably with sesame oil, which may be detected by means of the furfurol test (see OLEUM SESAMI).

The P. G. requires that 2 Cc. of poppy oil mixed with 1 Cc. each of fuming nitric acid and water shall not congeal even after long standing, and that the oil shall absorb not less than 130 nor more than 150 per cent. of iodine.

Uses.—The chief use of poppy oil is for culinary purposes, although it is also used in the preparation of emulsions, liniments, etc., on account of its bland taste and stability.

OLEUM PHOSPHORATUM, *Br., Fr. Cod.*—Phosphorated Oil.

Huile phosphorée, Liniment phosphoré, Fr.; *Phosphorhaltiges Oel*, G.

Preparation.—The British Pharmacopœia directs expressed oil of almond to be heated in a porcelain dish to about 149° C. (300° F.) and kept at this temperature for about 15 minutes, after which it is allowed to cool and then filtered through paper. Of the oil so prepared, 99 parts by weight are put into a stoppered bottle capable of holding a little more than this quantity, and to it is added 1 part of dry phosphorus. The bottle is immersed in hot water until the contents have acquired the temperature of 82.2° C. (180° F.), the stopper being removed several times to allow the expanded air to escape, after which the bottle is shaken until the phosphorus is entirely dissolved.

The French Codex directs 1 part of phosphorus to be dissolved in 95 parts of expressed oil of almond after the manner indicated above, after which 4 parts of ether are to be added. These directions are very similar to those given in the U. S. P. of 1890, except that the latter authority required the almond oil to be heated in a flask on a sand-bath to 250° C. (482° F.) and kept at that temperature for 15 minutes; after filtration 1 part of phosphorus is dissolved in 90 parts of the prepared oil and 9 parts of ether then added. When almond oil is thus heated, at first air and moisture are given off; afterward certain organic matters are destroyed, the oil becoming nearly colorless and separating, on cooling, a little flocculent matter, which is separated by filtration. It is important that translucent phosphorus be selected, and after weighing out the required quantity the same should be quickly dried between bibulous paper.

Phosphorated oil should be recently prepared and preserved in a dark, cool place, for in the course of time, and particularly if unduly exposed, oxidation of the phosphorus takes place.

Properties.—Phosphorated oil is a clear yellowish liquid having the characteristic odor of phosphorus, and in the case of the French and former U. S. P. preparation, also of ether. The British oil phosphoresces in the dark and produces white vapors in contact with air, which is not observed with the French oil on account of the presence of ether.

Action and Uses.—The oil forms a convenient method for exhibiting the phosphorus. It may be administered either in capsules or in emulsion. The dose is from 1 to 5 minims (0.05–0.3 Cc.).

OLEUM PICIS LIQUIDÆ, *U. S.*—Oil of Tar.

Huile (Essence) de goudron, Fr.; *Theeröl, Pechöl*, G.; *Esencia de alquitran*, Sp.

A volatile oily liquid distilled from wood-tar.

Preparation.—Wood-tar is subjected to distillation, and that fraction of the distillate which is lighter than water collected by itself.

Properties.—Oil of tar, recently distilled, is colorless, but gradually darkens, becoming yellowish, brownish, and dark red brown, and depositing a black product. The oil has a strong tar-like odor and taste, an acid reaction, and a density of about 0.965 at 25° C. (77° F.); these properties are, however, subject to variation from differences in the composition of the tar. Alcohol readily dissolves it, yielding an acid solution.

Composition.—The oil is a mixture of various hydrocarbons and phenols of acetic and other acids, and of undetermined empyreumatic products present in tar; prepared from tar of coniferous woods, the oil consists largely of oil of turpentine.

Action and Uses.—The uses of this oil are practically the same as those of tar. In the form of an ointment, or diluted with some fluid oil, it is largely employed in the treatment of dry, scaly skin diseases.

OLEUM PIMENTÆ, *U. S., Br.*—Oil of Pimenta.

Oleum amomi; Oil of pimento (Br.), *Oil of allspice*, E.; *Essence de piment*, Fr.; *Pimentöl, Nelkenpfefferöl*, G.

The volatile oil distilled from *Pimenta officinalis* Lindl. (Fam. *Myrtaçeæ*), yielding, when assayed by the process given below, not less than 65 per cent. of eugenol.—U. S.

Allspice consists of the unripe berries, the ripe fruit containing a sweet jelly, but little or no aromatic substances. Upon distillation it yields 3 to 4.5 per cent. of oil.

Properties.—Oil of pimenta is a colorless, yellow, or reddish liquid (yellow or yellowish red when recently distilled, but gradually becoming darker, Br.). It has a strong, aromatic odor of allspice and a pungent spicy taste. Specific gravity: 1.033 to 1.048 at 25° C. (77° F.) (not below 1.040, Br.).—U. S. According to other authorities, its specific gravity varies between 1.024 and 1.050. The oil is slightly lævogyrate, and is miscible with 90 per cent. alcohol in all proportions; it also forms a clear solution with twice its volume of 70 per cent. alcohol.

Composition.—Pimenta oil contains eugenol and probably a sesquiterpene. Of the other constituents that give it its peculiar allspice odor nothing is known.

Tests.—When mixed with an equal volume of a concentrated solution of sodium hydroxide (strong solution of ammonia. Br.), it should form a semisolid mass. Its eugenol content can be ascertained by the following method of assay: "Introduce into a flask with a long neck (graduated in $\frac{1}{10}$ Cc.) 10 Cc. of the oil of pimenta and 100 Cc. of potassium hydroxide test-solution, and shake the mixture for 5 minutes. When the liquids have separated completely, add sufficient potassium hydroxide test-solution to raise the lower limit of the oily layer to the zero mark of the scale, and note the volume of residual liquid, which should not measure more than 3.5 Cc., indicating the presence of at least 65 per cent. of eugenol."—U. S.

Action and Uses.—The properties of this oil are those of an aromatic stimulant and carminative. The dose is from 3 to 5 minims (0.3–0.6 Cc.).

OLEUM PINI, *Br.*—Oil of Pine.

Pine needle oil.—Latschenkieferöl, Krummholzöl, G.

The oil obtained by steam distillation from the leaves of *Pinus pumilio* Hænke (Fam. *Coniferæ*).

Of the several pine-needle oils, that of *Pinus sylvestris*, the true Scotch fir, was official in the Br. P. of 1885, but has been replaced in the new edition by that of *Pinus pumilio*, which is distilled on a commercial scale in the Tyrolese Alps.

Properties.—According to the Br. P., this oil should be colorless or nearly so and possess a pleasant aromatic odor and pungent taste. Specific gravity 0.865 to 0.870; angle of rotation = —5° to —10°.

Composition.—The oil contains but little *l*-pinene; also *l*-phellandrene, sylvestrene, bornyl acetate, and cadinene.

Tests.—According to the Br. P., not more than 10 per cent. should distil below 165° C. (329° F.). About 70 per cent. distils between 170° and 180° C. (338° and 356° F.). The amount of ester, calculated as bornyl acetate (compare saponification test on page 1043), is reported to vary between 5 and 7 per cent.

Action and Uses.—Oil of pine has been applied locally and given internally in the treatment of chronic rheumatic affections. Its principal employment is as an inhalant in bronchial affections. When added to ether it is said to allay the irritation and diminish the bronchial secretion which frequently become excessive during, or after, the production of anæsthesia by the latter drug.

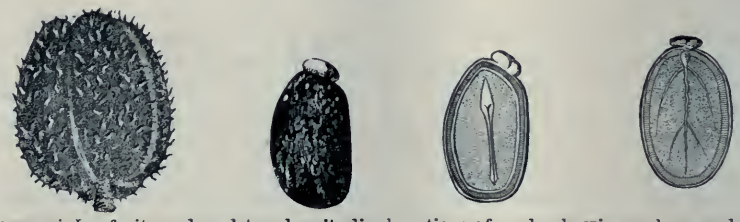
OLEUM RICINI, *U. S., Br., P. G.*—Castor Oil.

Oleum e semini ricini, Fr. Cod.; *Oleum Palmæ Christi.—Huile de ricin*, Fr.; *Ricinusöl*, G.; *Aceite de ricino*, Sp.

The fixed oil expressed from the seeds of *Ricinus communis* L.; *R. vulgaris* Mill.; *R. medicus* Forsk.; *Cataputia minor* Ludw. (Fam. *Euphorbiaceæ*).

Origin.—The castor-oil plant appears to be indigenous to Southern Asia, but was early introduced into all tropical and subtropical countries, in many of which it has become naturalized. It is often cultivated in temperate countries for ornament and other purposes, growing as a large annual. Numerous varieties are now known, differing from one another in size and color of the stem and foliage, as well as of the fruit and seeds. The leaves are alternate, peltate, palmately 7- or 9-lobed; the inflorescence is paniculately spicate, terminal, finally axillary; the flowers are monœcious, apetalous, the staminate ones at the base of the panicle. The fruit is a subglobular, somewhat triangular, and grooved tricoccous capsule, which is sometimes nearly smooth, but mostly spinescent; each cell encloses a single oval or elliptic seed, which is from 8 to 16 Mm. ($\frac{1}{3}$ to $\frac{2}{3}$ In.) long, 4 to 8 Mm. ($\frac{1}{6}$ to $\frac{1}{3}$ In.) broad, flattened on one side, smooth, shining, of a gray color variegated with yellowish, brown, or reddish spots and lines, with a slightly-raised raphe along the flattish side and a prominent caruncle near one end; this, when detached, leaves a slight depression above the hilum. The testa is hard, but brittle; the inner seed-coat is thin, white, and has a brownish chalaza; the embryo is

FIG. 292.



Ricinus communis L.: fruit, seed, and two longitudinal sections of seeds, showing embryo and albumen; natural size.

straight, white, has broad, foliaceous heart-shaped cotyledons, and is imbedded in an oily albumen having a bland scarcely acrid taste.

Preparation.—Nearly all the oil which is at the present time consumed in the United States is manufactured from seeds grown in the country or imported. The seeds, after having been crushed and freed from integuments, particular care being taken to remove all of the dark skin, are dried and expressed at a temperature not exceeding 60° C. (140° F.). The expressed oil is heated with water to remove albuminous matter, and when clear is drawn off into barrels or other suitable vessels. In India the best oil is produced by expression by means of hand-screws, the hydraulic presses giving a higher yield, but poorer quality (see *Proc. Am. Pharm. Assoc.*, 1900). Considerable quantities of castor oil of superior quality, being free from the usual unpleasant odor and taste, are produced in Italy. The secret of superiority is said to lie in the fact that only fresh seeds are used, and these are carefully freed from the integuments before being warmed and expressed. Over 300,000 bushels of castor beans and nearly 4000 gallons of castor oil were imported into this country during 1902. The yield is stated to be between 38 and 45 per cent., by cold pressure 25 to 30 per cent. More oil, but of inferior quality, is obtained by again expressing the marc and using a higher temperature and greater power; the additional yield is 6 to 8 per cent. Cold-pressed castor oil is nearly transparent, and requires no further purification. If opaque, the oil is clarified by filtration after treatment with fullers' earth, or a mixture of magnesia and purified animal charcoal. The press-cake resulting from the operation of extracting the oil is used principally as a fertilizer. It amounts to about 60 per cent. of the seed. Attempts are being made to utilize it as a cattle-food by first extracting the poisonous principle, *ricin*, by means of a 10 per cent. solution of salt, and drying the washed cake. Ricin is peculiar in being very poisonous to mankind but quite harmless to chickens.

Properties.—Castor oil is a viscid, transparent, almost colorless or pale-yellowish or greenish-yellow liquid, having a faint, mild, mawkish, but not repulsive odor, and a bland, afterward slightly acrid, and generally offensive taste. Its specific gravity at 15° C. (59° F.) varies between 0.950 and 0.970 (Br., P. G.) and between 0.945 and 0.965 at 25° C. (77° F.) (U. S.). At a low temperature it becomes thicker and turbid, depositing white granules or crystalline flakes at 0° C. (32° F.), and near

—18° C. (—0.4° F.) it congeals to a yellowish mass. It is soluble in its own volume of alcohol, and in all proportions of absolute alcohol or glacial acetic acid (U. S.); also soluble in 5 volumes (3 parts by weight, P. G.) of 90 per cent. alcohol (Br.). It yields with an equal volume of petroleum benzin a turbid mixture at 15° C. (59° F.), but a clear solution at 17° C. (65.6° F.) (U. S.), and is miscible with 1½ times its volume of petroleum or mineral oil (Draper). The oil has a neutral reaction to test-paper, but when exposed to the atmosphere in thin layers it becomes acid, and slowly dries to a transparent varnish-like film. In contact with nitrous acid castor oil becomes much thicker, and finally congeals, requiring a longer time than the non-drying oils, and when agitated with equal weights of nitric acid and water it yields a whitish mixture turning yellow in the presence of nitrous acid.

Adulterations.—Castor oil may be found adulterated with other fatty oils, such as cottonseed oil, rapeseed oil, and sesame oil, as well as mineral oils; their presence may be detected by decreased solubility in alcohol and the tests given below.

Tests.—If 3 Cc. of castor oil be shaken for a few minutes with 3 Cc. of carbon disulphide and 1 Cc. of sulphuric acid, the mixture should not acquire a blackish-brown color (absence of foreign oils). The oil is soluble at 15° C. (59° F.) in 3 times its volume of 92.5 per cent. alcohol (absence of more than about 5 per cent. of most other fixed oils). If 0.3 Gm. of castor oil be dissolved in 10 Cc. of chloroform and placed in a 250-Cc. flask with 25 Cc. of a mixture of equal parts of alcoholic iodine test-solution and alcoholic mercuric chloride test-solution, and after standing for 4 hours protected from light, 20 Cc. of potassium iodide test-solution be added, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate solution, an iodine figure of not less than 86 nor more than 89 should be obtained (U. S.). The iodine value of castor oil is remarkably constant, and, according to Benedickt and Ulzer, is somewhat lower than that given by the U. S. P., being stated as 82–84. When castor oil is saponified with alcoholic solution of potassium hydroxide it will show a saponification value of 176–180 (U. S.).

Composition.—Castor oil consists principally of triricinolein ($C_3H_5(C_{18}H_{33}O_3)_3$), together with considerable ricinisolein (Hazura and Grüssner, *J. S. C. I.*, 1888), palmitin, and dihydroxystearin (H. Meyer, *J. C. S.*, 1897). According to Thoms and Fendler (*Archiv d. Pharm.*, 1901), the distillation of castor oil yields undecenoic acid and heptaldehyde, the temperature rising to 280° C. (536° F.), and when about one-half has distilled over, the residue suddenly swells, the mass acquiring the consistence of India-rubber.

Among other constituents besides the oil, such as water, nitrogenous matter, fibre, and mineral substances, castor beans or seed contain two substances that are deserving of more than passing notice, namely *ricin* and *ricinine.*

Ricin.—Attention was first called to this substance by Kobert and Stillmark, who designated it as an unorganized ferment belonging to the group of toxalbumins. Ricin is present in the seed to the extent of 2.8 or 3 per cent., and may be obtained from fresh decorticated and strongly expressed seed by percolation with a 10 per cent. salt solution, in which it is soluble. The percolate is filtered and saturated at 20° or 22° C. (68° or 72.6° F.) with magnesium and sodium sulphates, and set aside in a cool place. The resulting white precipitate is separated from the crystallized salts and subjected to dialysis for several days, in a cool room so as to prevent decomposition, the water being frequently renewed. As thus obtained, ricin is a white, odorless, strongly toxic, ash-yielding powder. It is insoluble in alcohol, ether, and chloroform. Its solution in salt solution gives the characteristic albumen reactions. Ricin is not affected by dry heat, but if heat be applied to its solution its toxic properties disappear. When taken internally, it acts as a violent irritant upon the gastro-intestinal tract, causing inflammation of the same and also of the mucous membrane of the biliary duct and of the bladder and kidneys. As little as 0.00003 Gm. per kilo of body-weight has been known to kill a dog. The lethal dose for man is supposed to be 0.030 Gm. by the mouth or 0.003 Gm. subcutaneously.

Ricinine.—In 1864 Tuson announced the discovery of a poisonous base in the seed of the castor-oil plant, to which the name ricinine was given, and which was further investigated by Marco Soave in 1875, who determined its composition to be $C_{17}H_{18}N_4O_4$. Ricinine is present to the extent of 0.15 per cent. in the seed-coats, and 0.03 per cent. in the oil-cake left as residue after expression of the seeds. It may be extracted as

follows: The material is extracted with boiling water, the resulting solution evaporated to dryness, and the residue exhausted with alcohol. After recovery of the alcohol, the dry extract is treated with very dilute sodium hydroxide solution for removal of certain impurities, and the residuary ricinine obtained in the form of rectangular prisms or plates by crystallization from hot water or alcohol. Ricinine melts at 194° C. (381.2° F.) and congeals at 175° C. (347° F.); it sublimes without decomposition, has a decidedly bitter taste, and is optically inactive. It readily dissolves in water, alcohol, chloroform, benzene, and ether, the solutions having a neutral reaction. When heated with potassium hydroxide, ammonia is evolved. Ricinine dissolves without color in cold sulphuric acid, but the addition of a few grains of potassium dichromate to the solution causes a yellowish-green color, which soon changes to intense green, whereby even traces of the substance may be detected. Hot sulphuric acid forms a red solution with ricinine. Mercuric chloride solution and Wagner's reagent (iodized potassium iodide solution) precipitate solutions of ricinine, but other alkaloidal reagents are without effect. Ricinine is not capable of forming salts with acids, and when treated with oxidizing agents yields ricinic acid, $C_{13}H_{12}(CO_2H)_2N_4$, a dibasic acid melting at 295° C. (563° F.); the same acid, together with methyl alcohol, is obtained if ricinine be saponified with sodium hydroxide, and hence ricinine is to be looked upon as the dimethyl ester of ricinic acid. Ricinine has recently been again investigated by Philippe and Maquerme, who assign the formula $C_8H_8N_2O_2$ to the purified base (*Proc. Amer. Pharm. Assoc.*, 1904, p. 950).

Besides its extensive use for medicinal purposes, castor oil is extensively employed for the manufacture of the so-called Turkish-red oil, used in calico dyeing and printing. Turkish-red oil is made by adding, very slowly, concentrated sulphuric acid drop by drop to 4 times its weight of castor oil contained in a capacious vessel surrounded by ice-water to prevent a rise of temperature. The mixture is stirred during the addition of the acid, and after 12 hours' rest is carefully washed with cold water, and after separation of the oily layer the latter is washed with 10 per cent. salt solution previously warmed to about 65° C. (149° F.), and finally nearly but not quite neutralized with ammonia-water or sodium hydroxide solution. The finished product is a thick yellow or yellowish-brown oily fluid, miscible with water in the form of an emulsion, from which oily drops separate only after long standing. It consists of a mixture of sulphoricinoleic acid ($C_{18}H_{33}O_2.OSO_3H$), free fatty acids, undecomposed oil. The French Pharmacopœia recognizes a similar preparation under the name *Linimentum sulforicinatum* or *Topique sulforicine*, which differs from the crude article in being completely dried by agitation with anhydrous potassium carbonate after removal of the aqueous layer, and is then filtered through paper: moreover, sodium hydroxide solution only is used as the neutralizing agent. This purer article is commercially also known as *polysolve*.

Under the name Castor Oil for Lubricating Purposes a mixture is offered for sale, containing no castor oil at all, which is merely a ropy mixture of mineral oil with the residue of cottonseed expression.

Action and Uses.—Castor oil owes its purgative properties somewhat to its oily character, chiefly, however, to the small amount of ricin it contains. It produces purgation in from 4 to 6 hours, accompanied, as a rule, by but little griping or tenesmus.

Because its action is so bland and unirritating it is the purgative of choice to unload the bowels of food which, through its decomposition, is causing inflammation attended by abdominal cramp or diarrhœa. It possesses the advantage over other purges used in irritative diarrhœa, in that after having swept the bowel of the mucus and offending material, it produces constipation and is frequently, therefore, the only remedy necessary. This after-constipating effect of the oil, and the fact that it tends to produce hemorrhoids if employed constantly, detract from its usefulness in chronic constipation.

In the constipation occurring in infants and children, and that following acute diseases, it is very efficacious. The idea that it decreases the severity of labor more than any other purge, if given previous to parturition, is erroneous.

Many methods have been devised to mask the unpleasant taste of castor oil. Certainly the most successful way is to administer it in soft capsules when these can be swallowed; each capsule to contain from 1 to 4 drachms (4–16 Cc.) of the oil. Some prefer it suspended in sarsaparilla soda water, others in milk or cream, or in the froth of beer or porter. A few drops of any of the aromatic oils, as peppermint, cinnamon, etc., disguise the taste fairly well, and possess the additional advantage of preventing the griping that may otherwise occur. For the latter purpose a teaspoonful of paregoric

or a few drops of laudanum, of tincture of belladonna, are frequently employed. The dose of castor oil for an infant is from 1 to 2 drachms (4–8 Cc.), for an adult, ½ to 1 ounce (16–30 Cc.).

Allied Oils.—Omphalea Oil.—The fixed oil expressed from the seed of *O. megacarpa* Hemsl. is found by Hart to be a valuable substitute for castor oil as a mild purgative. The seed possesses a hard, rough, black, rather brittle testa and a bland and fatty kernel, and is enclosed in a fruit-pulp which is very starchy. The flavor of the kernel is pleasant, and it is said that half of the oil extracted from one seed is effective, and that it does not gripe.

The oil of *O. oleifera* Hemsl. is similarly used in Central America under the name *Tamboe Oil.*

OLEUM ROSÆ, *U. S., Br., P. G.*—Oil of Rose.

Oleum rosarum.—Attar or otto of roses, E.; *Essence de rose,* Fr.; *Rosenöl,* G.

A volatile oil distilled from the fresh flowers of *Rosa damascena* Müller (Fam. *Rosaceæ*), having, when assayed by the process given below, a saponification value of not less than 10 nor more than 17. It should be kept in well-stoppered, amber-colored vials in a cool place, protected from light. When dispensed it should be completely liquefied by warming, if necessary, and well mixed by agitation.—U. S.

The oleum rosarum, ol. rosatum, or ol. rosaceum, of the ancients, was not a volatile oil, but a fatty oil perfumed with rose-petals. Rose-water has for a long time played an important rôle in Oriental hygiene and medicine. The first reference to volatile oil of rose possibly dates back as far as the tenth century. During the sixteenth century it found a place in continental tax ordinances. The cultivation of roses in Bulgaria, which for a long time has been supplying the European and American markets, was begun about the beginning of the seventeenth century. In recent years roses have been cultivated successfully on a large scale in France and Germany. In Bulgaria the rose-petals are distilled with water, 3000 kilos of flowers yielding about 1 kilo of oil. The cultivation in Germany (Miltitz) was begun in 1883. From 5000 to 6000 kilos of flowers yield about 1 kilo of oil, the most modern apparatus and methods being used.

Properties.—Bulgarian oil of rose is light yellow in color, sometimes possessing a greenish tint. Between 21° and 25° C. (69.8° and 77° F.) it is of the consistence of sweet almond oil; below this temperature acicular crystals or shining laminæ separate out, which, on account of their lighter specific gravity, collect in the upper portion of the oil. When cooled, it congeals to a translucent soft mass, which is again liquefied by the warmth of the hand. It has a strong odor of fresh roses.

The specific gravity varies, as a rule, between 0.855 and 0.870 at 20° C. (68° F.), being lowered by an increasing stearoptene content. The specific gravity requirement of the U. S. P. is 0.855–0.865 at 25° C. (77° F.), that of the Br., 0.856–0.860 at 30° C. (86° F.); the P. G. states no such requirement. It is slightly lævogyrate, the angle of rotation = up to —4°. The congealing-point lies between 15° and 22° C. (59° and 71.6° F.), mostly between 17° and 21° C. (62.6° and 69.8° F.); U. S., 18° to 22° C. (64.4°–71.6° F.); Br., 19.4° to 22.2° C. (67°–72° F.); P. G., 18° to 21° C. (64.4°–69.8° F.).

The addition of 70 per cent. alcohol precipitates the paraffin hydrocarbons of the oil, but forms a clear solution with its other constituents, the solution being slightly acid to litmus test-solution. The acid number of the oil varies between 0.5 and 3, the saponification number between 10 and 17.

On account of its larger stearoptene content, German oil of rose, the odor of which is said to be stronger and more persistent, is at ordinary temperature a greenish mass intermingled with crystals. The congealing-point lies between 27° and 37° C., the specific gravity between 0.845 and 0.855 at 30° C. (86° F.); its angle of rotation = +1° to —1°.

French oils of 1895 and 1896 are reputed to have had the following properties: specific gravity 0.8225–0.8407 at 30° C. (86° F.); angle of rotation at 30° C. (06° F.) = —6° 45′ to —8° 3′.

Composition.—The first constituent of rose oil to be studied was the stearoptene, which was recognized as paraffin hydrocarbon by Flückiger. It evidently consists of a mixture of hydrocarbons. From the so-called eleoptene geraniol, *l*-linalool, citral, *l*-citronellol, *n*-nonylic aldehyde, and the solid phenyl ethyl alcohol (melting-point 80° C.) have been isolated thus far. On account of the greater solubility of this benzene alcohol

in water, the oil which separates from the water (commercial rose oil) contains much less of this substance than the oil extracted from rose-water with ether. The oil evidently also contains terpenes.

Adulteration and Tests.—The danger of adulteration of so expensive an oil as oil of rose has always been great, hence a large number of empirical tests have been suggested, the value of most of which is exceedingly problematic. The principal adulterants are palmarosa oil and true geranium oil, oils which have one or more constituents (geraniol) in common with oil of rose. The addition of these, either to the leaves before distillation or to the finished product, reduces the congealing-point. This can be brought up to the normal standard by the addition of spermaceti. Hence, in addition to the congealing-point, the determination of the absence of spermaceti in the stearoptene may become necessary. Another recent adulterant of importance is the guaiac wood oil.

Assay of Oil of Rose.—Place in a weighing bottle about 2 Cc. of the oil of rose, and weigh it accurately. Transfer it, with the aid of a little alcohol, to a 100-Cc. flask, and add 20 Cc. of half-normal alcoholic potassium hydroxide solution. Connect the flask with a reflux condensor, and boil the mixture during 30 minutes on a water-bath. When cool, add 50 Cc. of distilled water and a few drops of phenolphthalein test-solution, and titrate with half-normal sulphuric acid. Subtract the number of Cc. of half-normal sulphuric acid required from 20 (the 20 Cc. of half-normal alcoholic potassium hydroxide solution taken), multiply the difference by 27.87, and divide by the weight of the oil to obtain the saponification value.—U. S.

The saponification number of a good commercial oil varies from 10 to 17, the acid number from 0.8 to 2.7. Palmarosa oil, according to Gildemeister and Stephan, has a saponification number of 30–50, the genuine geranium oils 45–100. Additions of the latter may, therefore, become noticeable.

Congealing-point.—With reference to rose oil, it is that point at which the first crystals separate when the oil is slowly cooled.

About 10 Cc. of rose oil are introduced into a test-tube of about 15 Mm. diameter. A thermometer is so inserted that it touches neither the bottom nor the sides of the tube, but floats freely. The oil in the tubes is warmed 4–5 degrees C. above the saturation-point by means of the hand and well shaken. The tube is then securely supported and the oil allowed to cool spontaneously until the first crystals appear. At this point the temperature is read, and the operation repeated for confirmation.—U. S.

Stearoptene Assay.—50 Gm. of oil are heated to 70° to 80° C. (158°–176° F.) with 500 Gm. of 75 per cent. alcohol. When cooled to 0° the stearoptene separates almost quantitatively. It is separated by filtration, again treated with 200 Gm. of 75 per cent. alcohol, and the operation repeated until it has become perfectly odorless. As a rule two such treatments of the crude stearoptene suffice.

The spermaceti content of the stearoptene can be determined in a simple manner by saponifying the separated stearoptene with alcoholic solution of potassium hydroxide of known strength and titrating back with $\frac{N}{2}$ sulphuric acid. The saponification number of spermaceti is 108.

Acetylization.—In order to make the examination of the oil complete, it will often be advisable to ascertain the alcohol content (geraniol and citronellol) by acetylization. The amount present will be inversely proportional to the percentage of stearoptene present. Umney found 70–72.5 per cent. (calculated as geraniol) in good rose oil. Palmarosa oil contains 76–92 per cent. of geraniol.

As latest adulterant, guaiac wood oil from *Bulnesia sarmienti*, which has an agreeable, tea-rose-like odor, has been employed in Bulgaria. It can be recognized by the microscopic examination of the form of the crystals of guaiol which separate from the oil upon cooling. Guaiol forms needle-shaped crystals which are characterized by a channel-like middle line. The crystals of the rose oil paraffin are smaller and thinner and possess less sharply outlined forms.

The positive presence of guaiac wood oil in rose oil should be established by the isolation of guaiol melting at 91° C. The new adulterant increases the specific gravity and the optical rotation, and raises the congealing-point of the oil; it lowers the saponification number but very little, and upon evaporation leaves a resinous residue.

Action and Uses.—Oil of rose is employed in medicine for the purpose of perfuming cerates, ointments, and lotions.

OLEUM ROSMARINI, *U. S., Br., P. G.*—Oil of Rosemary.

Oleum anthos.—Essence de rosmarini, Fr.; *Rosmarinöl*, G.

A volatile oil distilled from the fresh flowering tops of *Rosmarinus officinalis* L. (Fam. *Labiatæ*), yielding, when assayed by the process given below, not less than 5 per cent. of ester, calculated as bornyl acetate, and not less than 15 per cent. of total borneol.—U. S.

There are two principal commercial varieties of this oil. The Italian, or rather Dalmatian oil, is distilled after the flowering season is over. The French, which possesses a finer odor, is distilled principally from the flowering tops. The English oil, which is obtained in small amounts from cultivated plants, and the Spanish oil, play a minor role commercially, though the former is highly esteemed by some, and commands a high price.

Properties.—Oil of rosemary is colorless or slightly greenish yellow in color, possessing the peculiar odor of rosemary. The specific gravity requirements are 0.894–0.912 at 25° C. (77° F.), U. S., 0.890–0.910, P. G., and 0.900–0.915, Br. All genuine oils are reported to have a specific gravity of more than 0.900, sometimes as high as 0.920. The oil should be dextrogyrate, but not more than +15° in a 100-Mm. tube at a temperature of 25° C. (77° F.), U. S. A greater rotation indicates American turpentine; but French turpentine reduces the angle of rotation or renders the oil lævogyrate, hence the first 10 per cent. of the distillate should be dextrogyrate as well. The oil should be soluble in one-half volume of 90 per cent. alcohol and in 2–10 parts of 80 per cent. alcohol.

Composition.—Of the constituents of rosemary oil, pinene, camphene, cineol, camphor, and borneol have been identified. The total amount of borneol present is 16–18 per cent.; about 5–6 per cent. are present as ester, calculated as acetate.

Tests.—The estimation of esters and free alcohols by saponification and acetylization with a second saponification yields valuable information. The results are expressed as borneol and bornyl acetate. The following method of assay is given in the U. S. P. The evaporation test may reveal the presence of high-boiling petroleum fractions. The detection of French turpentine has been alluded to. Larger yields than 15–20 per cent. distilling below 170° C. would indicate either French or American turpentine oil.

Assay of Oil of Rosemary.—Introduce into a tared flask 10 Cc. of oil of rosemary, and note the exact weight; add 25 Cc. of half-normal alcoholic potassium hydroxide solution, connect with a reflux condenser, and boil the mixture during 1 hour. After cooling, titrate the residual alkali with half-normal sulphuric acid solution, using phenolphthalein test-solution as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid solution required from the 25 Cc. of half-normal alcoholic potassium hydroxide solution taken, multiply the difference by 9.734, and divide the product by the weight of the oil of rosemary taken to find the percentage of bornyl acetate. Wash the residual oil repeatedly with water, transfer it to a flask provided with a ground-glass tube-condenser (acetylization flask), add 10 Cc. of acetic acid anhydride and about 1 Gm. of anhydrous sodium acetate, and boil gently during 1 hour. Allow it to cool, wash the acetylized oil with distilled water, and afterward with sodium hydroxide test-solution, until the mixture is slightly alkaline to phenolphthalein test-solution, and then dry it with the aid of fused calcium chloride, and filter. Transfer to a tared 100-Cc. flask 5 Cc. of the dry acetylized oil, note the exact weight, add 50 Cc. of half-normal alcoholic potassium hydroxide solution, connect with a reflux condenser, and boil the mixture during 1 hour. After cooling, titrate the residual alkali with half-normal sulphuric acid solution, using phenolphthalein test-solution as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid solution required from the 50 Cc. of half-normal alcoholic potassium hydroxide solution taken, multiply the difference by 7.649, and divide the product by the weight of the dry acetylized oil taken, less the above difference multiplied by 0.021; the quotient will represent the percentage of borneol in the oil of rosemary.

Note.—The difference referred to above represents the number of cubic centimeters of half-normal alcoholic potassium hydroxide solution consumed by the acetylized oil.—U. S.

Action and Uses.—In moderate amounts oil of rosemary acts as a stimulant, aromatic and carminative. It may be given internally to relieve flatulent colic, promote menstruation, and to overcome nervous depression. As a local application it is said to do good in the treatment of chronic rheumatism, sprains, etc. An ointment containing the oil may also be tried as a remedy for alopecia. The internal dose is from 1 to 3 minims (0.05–0.20 Cc.).

OLEUM SABINÆ, *U. S.*—Oil of Savin.

Essence de sabine, Fr.; *Sadebaumöl*, G.

Commercial savin oil is distilled from the fresh tops of Savin. The yield varies between 3 and 5 per cent., according to the time of collection and the freshness of the material. According to the present edition of the U. S. P., it is defined as being derived from the fresh tops of savin. It was formerly official in the Br., but was dropped from the last edition. Most of the oil is distilled in Tyrol. That distilled in France is reported to be obtained from *J. phœnicea*.

Properties.—Oil of savin is colorless or yellowish, and possesses a peculiar terebinthinate odor, and a pungent, bitterish, camphoraceous taste. Specific gravity varies from 0.903–0.923 at 25° C. (77° F.), and the angle of rotation between + 40° and + 60° in a 100-Mm. tube at the same temperature. It is soluble in about one-half of its volume of 90 per cent. alcohol.—U. S.

Composition.—The principal constituent is sabinol, an alcohol, $C_{10}H_{15}OH$, which is present in the free state to the extent of 10 per cent., and as ester to the extent of 40–44 per cent. The oil also contains a sesquiterpene and an aldehyde, possibly cuminic aldehyde.

Adulteration and Tests.—The most common adulterant is turpentine oil. At times other leaves are apparently substituted. Not more than 25 per cent. should distil over below 200° C. (392° F.). The ester number also ought to prove valuable, but it is claimed that the saponification numbers usually given (115–125) are based on insufficient data.

Action and Uses.—Oil of savin is a powerful uterine stimulant, and is said to be of value in the treatment of amenorrhœa, dysmenorrhœa, menorrhagia, and leucorrhœa. The dose is from 2 to 10 minims (0.10–0.6 Cc.).

OLEUM SANTALI, *U. S., Br., P. G.*—Oil of Santal.

Oleum ligni santali.—Oil of sandalwood, E.; *Essence de santal*, Fr.; *Ostindisches Sandelholzöl*, G.

The volatile oil distilled from the wood of *Santalum album* L. (Fam. *Santalaceæ*), yielding, when assayed by the process given below, not less than 90 per cent. of alcohols, calculated as santalol.—U. S.

The white sandalwood is a rather small tree indigenous to the mountains of India. It either grows wild or is cultivated in dry open places, rarely in forests, and is much used in cabinet-work. The territory which produces sandalwood is a strip 250 miles long, extending from the Nilgiri Mountains northward to Canares. Sandalwood is also produced in eastern Java and other islands (Macassar wood). The trees are the property of the State, and are cultivated in the government plantations of British India, the collection of the wood being controlled by legal provisions. The sap-wood is sometimes removed by cutting, sometimes by exposing it for several months to the attacks of termites. Owing to the difficulty of getting a pure oil of native distillation, large quantities of the wood are now imported for distillation in this country. It occurs in billets of a dirty light-brown color, the surface often irregular from the marks of the axe employed in hacking off the sap-wood. Occasionally it is imported in the form of chips or splinters, in which case much of the sap-wood is apt to be included. It is very heavy, hard, and tough-splintery. When rubbed or heated it exhales the delightful fragrance of its oil. If of fine quality, the splinters exhibit a pinkish-yellow tint which distinguishes them from the whitish sap-wood. It is then often designated as "Red Sandalwood," not to be mistaken for *Santalum Rubrum* or *Red Saunders*.

East India sandalwood yields from 3 to 5 per cent. of oil, the Macassar wood from 1.6 to 3 per cent.

Properties.—East Indian sandalwood oil is a rather viscid, yellowish liquid of peculiar faint but persistent odor, and of an unpleasant, resinous, harsh taste. The specific gravity of oil of santal varies from 0.965–0.975 at 25° C. (77° F.) U. S., 0.975–0.980, Br., 0.975–0.985, P. G. Its angle of rotation should not be less than —16° nor more than —20° in a 100-Mm. tube (showing the absence of other varieties of sandalwood oil), U. S., Br. It is soluble in from 5 to 6 parts of 70 per cent. alcohol.

The Indian oils usually are darker and have a higher specific gravity. But little of this oil is said to enter the European and American markets.

Composition.—The principal constituent or constituents of sandalwood oil are alcoholic in nature, and amount to 90 per cent. and more. These are commonly known as santalol, and the formula $C_{15}H_{25}OH$ is generally assigned to them. The oil is, likewise, supposed to contain an aldehyde santalal and a sesquiterpene or sesquiterpenes. The presence of several acids is also claimed by some investigators.

Adulterants and Assay.—The specific gravity, angle of rotation, and solubility tests are best supplemented by a santalol assay by means of acetylization and subsequent saponification. The effect of the more common adulterants upon the assay is best indicated by their acetylization numbers calculated as per cent. santalol: cedarwood oil, 8 to 12 per cent.; copaiba oil, 5 to 8 per cent.; gurjun balsam oil, 7 to 10 per cent. Castor oil, which is sometimes added as adulterant, has a very high saponification number.

Assay of Oil of Santal.—Introduce 10 Cc. of oil of santal into a flask provided with a ground-glass tube-condenser (acetylization flask), add 10 Cc. of acetic acid anhydride, and about 2 Gm. of anhydrous sodium acetate, and boil the mixture gently during 1½ hours. Allow it to cool, wash the acetylized oil with distilled water, and afterward with sodium hydroxide test-solution, until the mixture is slightly alkaline to phenolphthalein test-solution, and then dry it with the aid of fused calcium chloride, and filter. Transfer to a tared 100-Cc. flask 3 Cc. of the dry acetylized oil, note the exact weight, add 50-Cc. of half-normal alcoholic potassium hydroxide solution, connect with a reflux condenser, and boil gently during 1 hour. After cooling, titrate the residual alkali with half-normal sulphuric acid solution, using phenolphthalein test-solution as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid solution required from the 50 Cc. of half-normal alcoholic potassium hydroxide solution taken, multiply the difference by 11.026, and divide by the weight of the dry acetylized oil taken, less the above difference multiplied by 0.021; the quotient will represent the percentage of santalol in the oil of santal.

Note.—The difference referred to above represents the number of cubic centimeters of half-normal alcoholic potassium hydroxide solution consumed by the acetylized oil.—U. S.

The presence of chloroform may be detected in the following manner: If a small strip of filter-paper be folded in the form of a taper, saturated with oil of santal, placed in a small porcelain dish, and if a clean beaker, moistened on the inner surface with distilled water, be inverted over the smaller dish, after igniting the taper a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate test-solution (absence of chlorinated products).—U. S.

Action and Uses.—Oil of sandalwood is used to some extent as a perfume. When given internally in moderate amounts it acts as a stimulant to the respiratory and genito-urinary mucous membranes, but in overdose is extremely irritating to the genito-urinary tract. It is used quite largely in gonorrhœa after the acute inflammatory condition has subsided. The remedy may also be successfully employed in subacute bronchitis and certain forms of asthma. The dose is from 5 to 20 minims (0.3–1.3 Cc.), given in capsule; the latter amount, however, may produce considerable lumbar pain.

OLEUM SASSAFRAS, *U. S.*—Oil of Sassafras.

Essence de sassafras, Fr.; *Sassafrasöl*, G.

A volatile oil distilled from the root, especially the root-bark, of *Sassafras variifolium* (Salisb.) O. Kuntze (Fam. *Lauraceæ*).—U. S.

The distillation of sassafras oil is an American industry. The principal States producing the oil are Virginia, Maryland, and Pennsylvania. During and after the civil war (1861–1865) considerable oil was also distilled in New Jersey, New York, Ohio, Indiana, Tennessee, and the New England States, until the practical extinction of the tree rendered the industry unprofitable.

Properties.—Sassafras oil is a colorless (rectified oil), yellowish, or reddish liquid (crude oil) having the specific gravity 1.065–1.075 at 25° C. (77° F.). The oil is dextrogyrate, but should not deviate the ray of polarized light more than +4° in a 100-Mm. tube at a temperature of 25° C. (77° F.). It is soluble in all proportions in 90 per cent. alcohol.—U. S.

Composition.—Safrol, which is likewise official as such, is the principal constituent, about 80 per cent. Pinene and phellandrene constitute about 10 per cent., *d*-camphor about 7 per cent., eugenol 0.5 per cent. The oil possibly also contains sesquiterpenes.

Adulteration.—Sassafras oil is frequently adulterated with camphor oil. A perfectly pure article appears to be of rare occurrence. Inasmuch as camphor oil contains all of the constituents found in sassafras oil, the detection of the former is exceedingly difficult, but its presence may be indicated by strong variations in the specific gravity and other physical properties. Under the name of artificial sassafras oil, fractions of camphor oil having a specific gravity similar to that of true sassafras oil are sold.

Action and Uses.—Oil of sassafras may be employed for the same purposes as the other volatile oils having a similar composition. In overdose it produces vomiting, collapse, and stupor. The dose is from 2 to 10 minims (0.10–0.6 Cc.).

OLEUM SESAMI.—Oil of Sesame.

Benne oil, Gingili oil, Teel oil, E.; *Huile de sésame,* Fr.; *Sesamöl,* G.; *Aceite de ajonjoli,* Sp.

The fixed oil expressed from the seeds of *Sesamum indicum* (Fam. *Pedaliaceæ*).

Origin.—Benne is an annual herb which is indigenous to India, but is now not found in the wild state; it is largely cultivated in most tropical countries and in the warmer portions of the temperate zone. It grows from 0.6 to 1.5 M. (2–5 Ft.) high, and has an erect, branching, bluntly quadrangular, and hairy stem, alternate or sub-opposite leaves, and short-stalked axillary flowers, with large white bell-shaped 5-lobed and somewhat 2-lipped corollas. The fruit is capsular, 2-valved, 4-celled, quadrangular and linear-oblong in shape, and contains numerous seeds, which are small, flattened, oval or ovate, smooth and shining, vary in color between whitish, yellow, reddish brown, and blackish, have a sweetish oily taste, and contain a straight embryo with a short radicle and large plano-convex oily cotyledons.

Fig. 294.

Sesamum indicum L.: *a*, flowering branch; *b*, section of seed.

Sesamum.—*Ajonjolé, Alegnia,* Sp.—*Benne, Sesame leaves,* E.; *Feuilles de sésame,* Fr.; *Sesamblätter,* G.—The leaves are mostly employed in the fresh state. They are long-petiolate, ovate or lance-oblong in outline, narrowed or rounded or somewhat heart-shaped at the base, more or less pointed above, entire on the margin or irregularly toothed, and the lower ones frequently cut into 3-toothed lobes or distinct leaflets. The leaves are prominently veined on the lower surface, are smoothish or somewhat pubescent, and have a mucilaginous taste. Their principal constituent is mucilage, which is precipitated from its aqueous solution by alcohol.

Preparation.—Oil of benne is obtained by subjecting benne-seeds to pressure, the yield being from 47 to 56 per cent. of the weight of seeds. The cold-expressed oil is superior in quality.

Properties.—Benne oil has a yellowish or yellow color, usually of a deeper hue than expressed almond oil, is thinner at ordinary temperatures than most other fixed oils, is nearly inodorous, and has a bland and agreeable peculiar taste, and the specific gravity 0.919–0.923 at 15° C. (59° F.). At —3° C. (26.6° F.) it becomes thick, and congeals usually at about —5° C. (23° F.), while the oil extracted by solvents congeals at about 5° C. (41° F.), forming a yellowish-white mass; when heated to between 150° and 200° C. (302° and 392° F.) it is decolorized. At 300° C. (572° F.) it assumes a brown color and at 335° C. (635° F.) it commences to boil. It is a non-drying oil, and on exposure to air does not readily turn rancid. Concentrated sulphuric acid converts it into a brown-red gelatinous mass; nitric acid, specific gravity 1.18, colors it gradually orange yellow, and when of greater strength, red; with a mixture of nitric and sulphuric acids it is transiently colored green, afterward red and brown red; in contact with nitrous acid it becomes reddish and brown red, and gradually forms a semi-solid mass.

The iodine value of benne oil varies from 103 to 112; its saponification value from 187.6 to 193. The most characteristic reaction for oil of sesame is the crimson color

developed on shaking the oil with sugar and hydrochloric acid, and generally known as the *Baudouin* test. In place of sugar, furfurol may be substituted, and according to F. Breinl (*Chem. Zeit.*, 1899, pp. 23, 647) 3 per cent. alcoholic solutions of vanillin, hydroxybenzaldehyde, or piperonal give equally good results. The Baudouin test is usually applied by dissolving 0.1 Gm. of cane-sugar in 10 Cc. of hydrochloric acid (specific gravity 1.19) in a test-tube, adding 20 Cc. of the oil to be tested, and thoroughly shaking the mixture. If the oil contains oil of sesame, the aqueous layer on separation will show a crimson color immediately or within a minute. The furfurol test is a modification of the Baudouin test, and applied as follows: In a test-tube mix 0.1 Cc. of a 2 per cent. alcoholic solution of furforol with 10 Cc. of the oil and 10 Cc. of hydrochloric acid, specific gravity 1.19 (P. Soltsien recommends acid of 1.125 specific gravity to minimize the danger of developing the red color with furfurol and hydrochloric acid alone), thoroughly shake the mixture, and allow it to separate. The aqueous layer will show an immediate crimson color if the oil contained 1 per cent. of oil of sesame. Purified furfurol should be used and the reagents separately tested to avoid error. Sesame oil heated on a water-bath with stannous chloride gives a permanent red color, which is not discharged on moderate dilution with water (distinction from turmeric) (P. Soltsien, *J. C. S.*, 1899, ii., p. 71). A permanent bluish-black color is developed on shaking equal volumes of sesame oil and the reagent composed of a mixture of 100 Cc. sulphuric acid, 50 Cc. of water, and 10 Cc. of 40 per cent. formaldehyde solution (J. Bellier, 1899). If sesame oil be shaken with an equal volume of concentrated hydrochloric acid, the latter will assume an emerald-green color, especially if the oil has been exposed for some time to the action of air and light (Bishop's reaction).

Composition.—Sesame oil consists of about 75 per cent. of the triglycerides of oleic (principally) and linolic acids, with 20 to 25 per cent. of myristin, palmitin, and stearin. The substance giving the Baudouin reaction is separable by means of animal charcoal, from which it may be recovered by extraction with ether, which upon evaporation leaves a reddish-brown resinous substance capable of giving the Baudouin reaction in a dilution of 1 : 500,000 (Bömer and Winter, *Zeit. Unters. Nahr. u. Genussm.*, ii., pp. 705–709). A crystallizable body having the composition $C_{11}H_{12}O_3$ and to which the name *sesamin* has been given, is a constant constituent of sesame oil, the oil containing from 0.2 to 0.5 per cent. Sesamin is obtainable in the form of colorless crystalline needles. It melts at 120° to 122° C. (248°–251.6° F.), is strongly dextrorotatory, readily soluble in chloroform, and with a mixture of equal parts of glacial acetic acid and sulphuric acid produces a brownish-green changing to cherry-red or reddish-blue coloration. Upon adding sulphuric acid to a chloroform solution of sesamin the acid layer becomes colored cherry red or blue. Sulphuric acid produces a violet coloration with an alcoholic solution of sesamin (Bömer and Winter, *loc. cit.*).

In 1901 (fiscal year) the importations of sesame oil into the United States amounted to 626,189 gallons, valued at $48,637, and in 1902, 707,760 gallons, valued at $57,359.

Action and Uses.—This oil was formerly employed as a food in pulmonary tuberculosis, but it is probably of less value than those which are more easily assimilated; for example, codliver oil and olive oil. Its local uses are practically the same as those of olive oil.

Allied Oils.—The name *German sesame oil* is sometimes applied to the slowly drying bland or slightly pungent oil expressed from the seed of *Camelina sativa* Crantz (*Myagrum sativum* L.).—Fam. *Cruciferæ*; *Wild* or *false flax*, *Camline*, E.; *Leindotter*, G. The seeds are known as dodder-seed and Siberian oil-seed.

Behen Oil or Ben Oil is expressed from the seeds of *Moringa aptera* Gærtn. (*M. Arabica* Pers.).—Fam. *Moringaceæ*. The yield is about 30 per cent. of a yellowish, inodorous, bland oil, which retains its neutral reaction for a long time, and is for that reason used in the East as a cosmetic and lubricant. These seeds are said to yield the true ben oil, while a bitter ben oil is obtained from the seeds of *Moringa pterygosperma* Gærtn. (*M. oleifera* Lam.; *Guilandina Moringa* L.), the horseradish tree of the East Indies.

Groundnut Oil or Peanut Oil.—This oil is obtained by expression from the well-known seeds of *Arachis hypogæa* L.—Fam. *Leguminosæ*, an annual herb indigenous to tropical America and now cultivated throughout the tropics. The peanut contains 9 per cent. of water, 26 of protein, 39 to 49 of fat, 24 of carbohydrates, and 2 of inorganic matter. The oil is pale yellow, thin, has a specific gravity of 0.9167–0.920, a peculiar nutty flavor, becomes turbid at about 3° C. (37.4° F.), and congeals near —5° C. (23° F.). It consists of the glycerides of oleic, linolic, arachic, and lignoceric acids, and has an iodine value of

85.6–101.3. Nitric acid colors the oil reddish, and sulphuric acid grayish yellow, then greenish brown; nitrous acid causes it to congeal to a whitish mass. In India groundnut oil is largely used under the name *katchung oil*, in place of olive oil.

KURUNG OIL, also known as *Kurunj* or *Poona Oil*. Obtained from the seeds of *Galedupa Pongam* Raeusch (*G. Indica* Lam.; *Pongamia glabra* Vent.; *Dalbergia arborea* Roxb.).—Fam. *Leguminosæ*, an East Indian tree, the odorous root and leaves of which are also used medicinally in that country. The oil is a thickish yellow liquid having the specific gravity 0.945 and becoming turbid at 7° C. (44.5° F.).

OLEUM SINAPIS VOLATILE, *U. S., Br.*—Volatile Oil of Mustard.

Oleum sinapis, P. G.; *Ol. sinapis æthereum.—Oil of mustard*, E.; *Essence de moutarde*, Fr.; *Senföl, Aetherisches Senföl*, G.

A volatile oil obtained from black mustard (freed from its fatty oil) by maceration with water and subsequent distillation, yielding, when assayed by the process given below, not less than 92 per cent. of allyl isothiocyanate.

The designation "black mustard" applies also to *Brassica juncea* Hooker fil. et Thomson. The seed which is used in the manufacture of the oil is obtained either from *B. nigra*, which is cultivated in Holland, Apulica, or the Levant, or more frequently from *B. juncea*, which is cultivated on a large scale in Sarepta, Russia, also in East India.

Volatile oil of mustard is not contained as such in the seeds, but is formed by ferment action. The ground mustard seed is deprived of its fatty oil with the aid of hydraulic presses. The press-cakes are mixed with tepid water, allowed to undergo fermentation, and then distilled with water vapor. The yield varies between 0.5 and 0.75 per cent. of the original seed. At a temperature exceeding 70° C. (158° F.) no fermentation takes place, because the myrosin is coagulated and rendered inactive.

The fermentation is brought about by the albuminoid ferment, myrosin, which acts on the glucoside sinigrin in the presence of water, with the formation of mustard oil, dextrose, and potassium acid sulphate: $C_{10}H_{16}NS_2KO_9$ (sinigrin) + H_2O (water) = $CSNC_3H_5$ (volatile oil of mustard) + $C_6H_{12}O_6$ (dextrose) + $KHSO_4$ (potassium acid sulphate). Beside this reaction others take place resulting in the formation of allyl cyanide and carbon disulphide, which are never entirely wanting in the oil. Contact with the copper of the still, or prolonged contact with water causes the separation of sulphur and the formation of allyl cyanide: $C_3H_5NCS + Cu = C_3H_5CN + CuS$. When the distillation has been conducted in a careless manner, the amount of allyl cyanide can be so large that the oil becomes lighter than water.

Properties.—Oil of mustard is a colorless or yellowish, limpid, and strongly refractive liquid with an exceedingly pungent and acrid odor. Inasmuch as it draws blisters when in contact with the skin, it should not be tasted. The specific gravity varies in accordance with the method of preparation between 1.016 and 1.030. The pharmacopœial requirements are 1.013–1.020 at 25° C. (77° F.), U. S., 1.018–1.025, P. G., and 1.018–1.030, Br. It should be soluble in alcohol in all proportions. Boiling-point 148° to 152° C. (298.4°–305.6° F.). With ammonia it forms thiosinamine. If to 3 Gm. of the oil 6 Gm. of sulphuric acid be gradually added, the liquid being kept cool, the mixture upon subsequent agitation will evolve sulphur dioxide, but will remain of a light yellow color; and although at first clear, it afterward becomes thick and occasionally crystalline, and the pungent odor of the oil disappears.

Composition.—In addition to "mustard oil," $CSNC_3H_5$, or allyl isosulphocyanate, the oil from black mustard contains variable amounts of allyl cyanide, C_3H_5CN, and carbon disulphide, CS_2. Possibly traces of the isomeric allyl thiocyanate and higher boiling (polymeric?) unknown compounds are present.

Adulterations and Tests.—Besides alcohol, carbon disulphide, castor oil, petroleum, etc., which are reported as being used as adulterants, artificial allyl isosulphocyanate may be found. When perfectly pure, it no doubt defies detection. "If a portion of the oil be heated in a flask connected with a well-cooled condenser, it should distil completely from 148° to 152° C. (298.4°–305.6° F.), and both the first and the last portion of the distillate should have the same specific gravity as the original oil (absence of alcohol, chloroform, petroleum, fatty oils, or more than traces of carbon disulphide). If a small portion of the oil be diluted with 5 times its volume of alcohol, and a drop of ferric chloride test-solution be added, no blue or violet color should be produced (absence of phenols)."—U. S.

Since mustard oil is to consist almost exclusively of one substance, its boiling-point is of importance. The fractions, if any, should distil within very limited range, and should have practically the same specific gravity.

Inasmuch as allyl isosulphocyanate combines quantitatively with ammonia to form thiosinamine, this has been used for assay purposes. However, carbon disulphide likewise combines with ammonia, forming ammonium sulphocyanate and ammonium sulphide, which are weighed with the thiosinamine.

Assay of Volatile Oil of Mustard.—Weigh accurately about 2 Gm. of volatile oil of mustard, and dilute this with sufficient alcohol to make 50 Cc. of the solution represent 1 Gm. of the oil; of this solution 5 Cc. are transferred to a 100-Cc. measuring flask, and 30 Cc. of tenth-normal silver nitrate solution and 5 Cc. of ammonia-water are added. The flask is well stoppered and set aside in a dark place for 24 hours. The contents of the flask are diluted with water to the 100 Cc. mark and filtered. To 50 Cc. of the filtrate 4 Cc. of nitric acid and a few drops of ferric ammonium sulphate test-solution are added, and finally sufficient tenth-normal potassium sulphocyanate solution to produce a permanent red color; not more than 5.6 Cc. of the latter reagent should be required (each Cc. of tenth-normal silver nitrate solution consumed corresponding to 0.00492 Gm. of allyl isothiocyanate).—U. S.

Action and Uses.—Volatile oil of mustard is rarely given internally. Locally it may be employed as a counter-irritant. Diluted with olive oil, it may be used as a substitute for mustard papers and as a stimulating liniment.

OLEUM SUCCINI.—Oil of Amber.

Huile volatile de succin, Fr.; *Bernsteinöl*, G.

A volatile oil obtained by the destructive distillation of amber, and purified by rectification.

Origin.—*Succinum, Ambra flava.—Amber*, E.; *Succin, Ambre jaune*, Fr.; *Bernstein, Agtstein*, G.—This fossil resin is the exudation from a number of extinct coniferous trees of the sub-orders *Abietæ* and *Cupressæ*, the principal source of the Baltic amber being *Pinites succinifer* Goeppert (*Pityoxylon succiniferum*), Kraus. It is principally obtained on the southern and southeastern coast of the Baltic, where it is cast ashore or dug out of beds. It has also been found in the interior of Europe and in Siberia, Greenland, and North America. It is hard, somewhat brittle, whitish, yellow, or red brown, transparent, translucent, or opaque, breaks with a conchoidal fracture, and frequently encloses vegetable fragments and insects. It is fragrant when heated, melts at about 287.5° C. (550° F.), dissolves in chloroform, but is insoluble in water, and only partly soluble in alcohol, ether, and volatile oils. Its density varies between 1.05 and 1.10. The annual production of amber in Prussia is estimated at 100,000 kilos (about 220,000 pounds).

Preparation.—The oil is obtained by the dry distillation of amber, succinic acid being formed at the same time. The crude oil thus collected is mixed with 6 times its volume of water, and distilled as long as oil is found in the distillate. The yield is usually stated to be from 60 to 70 per cent. of the crude oil; but Ebert (1865), who prepared the crude oil, obtained from 29 troy ounces of amber 21 fluidounces of oil, specific gravity 0.985, and on rectifying this with water only 2½ fluidounces, or about 12 per cent., of rectified oil, specific gravity 0.903, while the density of the residue had increased to 1.019.

Properties.—Crude oil of amber is a thick brown liquid of a strong empyreumatic and fetid odor, and variable specific gravity approaching the density of water; Power found it to be 0.975.

Rectified oil of amber is thin, colorless or yellowish, becomes darker and thicker on exposure, has a specific gravity of about 0.915, but varies in density and in the boiling-point. It has a pungent, empyreumatic, and somewhat balsamic odor, which is more pleasant than that of the crude oil, and a warm, acrid taste. It has a neutral or faint acid reaction, dissolves, according to Ebert, in 4 parts of alcohol specific gravity 0.817, and in 17 parts of alcohol specific gravity 0.835. It is readily soluble in ether, fixed and volatile oils, dissolves iodine, and, when heated, sulphur and caoutchouc. It absorbs some hydrochloric acid gas without forming a crystalline compound, and in contact with cold fuming nitric acid acquires a red afterward dark red-brown color, and is converted into a brown resinous mass having a peculiar musk-like odor, and formerly known under the name of *artificial musk*.

Composition.—In its purest state oil of amber is a mixture of hydrocarbons with some phenols.

Adulterations.—Oil of amber is not infrequently adulterated with oil of turpentine and with coal oil; the former is recognized by the brisk reaction with iodine, and by the formation of terpin when left in contact with alcohol and nitric acid; the latter by the decreased solubility in alcohol.

Action and Uses.—Oil of amber is an excellent counterirritant when locally applied to the skin. When given internally, it promotes all of the secretions, especially that of the kidneys, and acts as a stimulant and antispasmodic. It has been locally employed in the treatment of rheumatic joints, acute laryngitis, infantile bronchitis, and the convulsive seizures of children. When taken internally, it is said to be a valuable remedy for hysteria, whooping-cough, hiccough, amenorrhœa, and eruptive fevers attended with severe nervous phenomena. The internal dose is from 2 to 6 minims (0.10–0.40 Cc.). As an external application it should be diluted with 3 parts of olive oil.

OLEUM TEREBINTHINÆ, *U. S., Br., P. G.*—Oil of Turpentine.

Essence de térébenthine, Fr.; *Terpentinöl*, G.; *Essencia de treventina*, Sp.

A volatile oil distilled with steam from Turpentine.

(For an account of turpentine-yielding trees, see TEREBINTHINA.)

This great variety would indicate that the authors of pharmacopœias regard the oil from any one species about as good as any other. Like the U. S. P., the Br. P. admits other species than the one mentioned. While the Belgian, Russian, and Swedish pharmacopœias give preference to *Pinus maritima*, they admit oils from other species.

The principal species yielding oil of turpentine in the United States are *Pinus palustris* Mill. (*P. australis* Mich.), long-leaved or Southern pitch pine; *P. Taèda* L., loblolly or rosemary pine; *P. heterophylla* Ell. (*P. cubensis* Griesb.), Cuban, swamp or slash pine; *P. echinata* Mill. (*P. mitis* Mich.), short-leaved, yellow pine. With the extinction of the older turpentine orchards and the movement of this industry to the extreme South, there has also been a shifting of species. No distinction with reference to species appears at all to be made in the market.

By steam distillation the natural oleoresin is resolved into oil of turpentine and resin or rosin (see RESINA).

Composition.—Oil of turpentine consists almost wholly of the hydrocarbon pinene, $C_{10}H_{16}$, the American oil containing both dextrorotatory and lævorotatory varieties, whereas the French oil always shows lævorotation. Derivatives of pinene have also been met with, and camphene and fenchene are said to be present in many oils.

Properties.—Oil of turpentine should be a thin colorless liquid, possessing the peculiar terebinthinate odor and a sharp, acrid taste. It suffers by exposure to air and light, but a moist oil appears to keep better than one that has been carefully dried. While a dried oil readily thickens, a moist oil is apt to remain colorless and thin even when exposed to light, crystals of pinol hydrate separating out in the course of time. While the Br. P. mentions no specific gravity requirements at all, the P. G. restricts the limits to 0.865–0.875. The U. S. P. allows from 0.860–0.870 at 25° C. (77° F.). According to the U. S. P. and P. G., the larger part of the oil should distil between 155° and 162° C. (311° and 323.6° F.); according to the Br. P., between 160° and 180° C. (320° and 356° F.). Soluble in 3 times its volume of alcohol.

Adulterations and Tests.—Inasmuch as turpentine oil is the cheapest volatile oil, it has been used extensively as adulterant of other volatile oils, but is not adulterated by them. It is, however, adulterated with tar oils and with petroleum fractions. Tar oils, even when rectified, are apt to color a 5 per cent. caustic soda solution yellowish brown or dark brown, whereas turpentine oils color the solution but faintly yellowish. As a test for petroleum the P. G. demands solubility in 12 parts of alcohol. A less convenient method consists in destroying the pinene with nitric and sulphuric acids, and isolating the petroleum by steam distillation. "If 5 Cc. of oil of turpentine be shaken with an equal volume of potassium hydroxide test-solution, its color should not become darker than a light straw yellow upon standing 24 hours. If 1 Cc. of the oil be evaporated in a small dish on a water-bath, it should leave not more than a very slight residue (absence of petroleum, paraffin oils, or rosin). 3 drops of oil of turpentine, placed on a sheet of clean white filter-paper and exposed to the air, should evaporate entirely without leaving a permanent stain (absence of kerosene or rosin oil). If

5 Cc. of oil of turpentine be placed in a small beaker and 20 Cc. of sulphuric acid be gradually added, with agitation, while the beaker is cooled by immersion in cold water, and the contents, after cooling and renewed agitation, be transferred to a burette, graduated into tenths, the clear layer above the dark mass should not measure more than 0.35 Cc. (absence of petroleum benzin, kerosene, or similar hydrocarbons)."—U. S

Action and Uses.—When taken internally in small doses oil of turpentine produces a sense of warmth in the epigastrium, soon followed by a feeling of exhilaration. The pulse is quickened and respiration deepened. It is rapidly absorbed and escapes from the body through the lungs and kidneys, imparting the odor of violets to the urine, but not to the breath. On the circulation it acts as a mild and fleeting stimulant to the vasomotor centre, in small amounts produces acceleration of the pulse, and in larger quantity slows the pulse by stimulation of the pneumogastric nerves.

Moderate medicinal doses increase the activity of the kidneys. Somewhat larger quantities are apt to give rise to aching in the loins, frequent micturition, and scalding urine. By toxic doses there are induced intense burning in the epigastric region, great thirst, muscular relaxation, impairment of sensation, at first exhilaration of the mind, followed finally by unconsciousness. The pulse becomes feeble and rapid, the pupils dilated, and the face cyanotic. Nausea and vomiting occur in some cases. Those organs by which the drug is eliminated suffer from extreme irritation, that of the genito-urinary tract manifesting itself in scanty and bloody urine and violent strangury. Death from overdoses of turpentine is rare. The majority of fatal cases reported have been in children. The lethal dose is not definitely known, 4 to 6 ounces (120–180 Cc.) having failed to destroy life in adults.

Inhalation of the vapor produces irritation of the respiratory tract, and occasionally frontal headache and renal inflammation. Its application to the skin results in reddening, and if allowed to remain too long, vesication and severe ulceration are apt to occur.

Absorption from the skin is quite rapid, and may be sufficient in quantity to severely irritate the kidneys. Turpentine is given internally as a diffusible stimulant of especial value in exhausting fevers. It is indicated particularly if ulceration of the intestine exists or if the abdomen is tympanitic. In those cases of typhoid fever which, toward the end of the second week, present a dry, red, fissured tongue and marked tympanites, with profound depression, the administration of from 5 to 10 minims (0.30–0.60 Cc.) of turpentine every 2 to 4 hours is followed by the happiest results. Again, in the convalescence from typhoid fever, if diarrhœa persists and relapses recur, an evidence that the ulceration of Peyer's patches has not completely healed, turpentine is a sovereign remedy, in fact by some is considered a specific.

In addition to its administration by the mouth for the meteorism of typhoid fever, it may be employed in enemata or in stupes applied to the abdomen. In passive hemorrhages from the stomach, intestine, lung, and uterus, turpentine enjoys perhaps too great a reputation as a hemostatic, but may be employed at times with benefit. It has been found of some value in the treatment of purpura hemorrhagica. In chronic inflammations of the genito-urinary tract, as pyelitis, cystitis, and urethritis, turpentine is a useful remedy. Its influence as a stimulating diuretic may be of advantage in well-advanced nephritis, but it is contra-indicated if any acute irritation of the kidney exists. In incontinence of urine from lowered tone of the bladder muscles, and in sexual impotence and spermatorrhœa, the drug may give relief. Although an efficient remedy to be given for the removal of the tapeworm, so large a dose, ½ to 1 ounce (16–30 Cc.), is necessary that enough of the drug may be absorbed to produce severe renal irritation. Externally turpentine is used as a counterirritant to relieve the pain and influence the progress of deep-seated inflammations. For this purpose it is applied over a large area in the form of a stupe, which should remain in position until the skin is distinctly reddened. When a milder action is desired, as in the treatment of lumbago, chronic rheumatism, bronchitis, etc., the oil of turpentine should be diluted with olive oil or the official liniment should be employed. Enemata containing from 2 to 4 drachms of turpentine to the pint of soap solution or emulsion of asafœtida are very valuable in tympanites. The usual dose of turpentine is from 5 to 20 minims (0.30–1.30 Cc.), repeated every 2 to 6 hours. It may be administered in capsules or on a piece of sugar. The official emulsion in the dose of from 1 to 4 drachms (4–16 Cc.) presents an efficient preparation, and may be made more agreeable by the addition of a small quantity of oil of gaultheria or cinnamon.

OLEUM TEREBINTHINÆ RECTIFICATUM, *U. S., P. G.*—Rectified Oil of Turpentine.

Essence de térébinthine purifiée, Fr.; *Gereinigtes Terpentinöl*, G.

Preparation.—Oil of turpentine, a convenient quantity; solution of sodium hydroxide, a sufficient quantity. Shake the oil of turpentine thoroughly with an equal volume of solution of sodium hydroxide, and introduce the mixture into a copper still connected with a well-cooled condenser. Recover about three-fourths of the oil by distillation, separate the clear oil from the water, and filter. Keep the product in well-stoppered amber-colored bottles in a cool place.—U. S.

The directions of the German Pharmacopœia are identical with the above, except that the oil is shaken with 6 times its volume of lime-water instead of an equal volume of the sodium hydroxide solution.

Properties and Tests.—Rectified oil of turpentine is a thin colorless liquid, having the general properties mentioned under OLEUM TEREBINTHINÆ. Its specific gravity is slightly lower than that of the ordinary oil, ranging from 0.860–0.865 at 25° C. (77° F.). If about 10 Cc. of the oil be evaporated in a capsule on a water-bath, no weighable residue should be left.—U. S. An alcoholic solution of the oil should not change the color of moistened litmus-paper.

The object of rectifying the commercial oil of turpentine is to remove any resinified products present.

Only the rectified oil should be used whenever oil of turpentine is intended for internal use.

Action and Uses.—See OLEUM TEREBINTHINÆ.

OLEUM THEOBROMATIS, *U. S., Br.*—Oil of Theobroma.

Oleum theobromæ; Oleum concretum e semine theobromæ cacao, Fr. Cod.; *Oleum cacao*, P. G.—*Butter of cacao*, E.; *Beurre de cacao*, Fr.; *Kakaobutter*, G.; *Manteca* (*Aceite*) *de cacao*, Sp.

A fixed oil expressed from the roasted seeds of *Theobroma Cacao* L. (Fam. *Sterculiaceæ*).

Preparation.—In the manufacture of chocolate a portion of the cacao-seeds are deprived of their fat by removing the shells, heating the kernels to about 70° C. (158° F.), and pressing them between hot iron plates. The expressed fat is usually run into rectangular molds and allowed to congeal. The yield from the different varieties of cacao is from 35 to 45 per cent.

Properties.—Cacao butter is a yellowish-white fat, gradually turning white by age. It is sufficiently hard at ordinary temperatures to be broken into smaller pieces, but softens by the warmth of the hand and melts when taken into the mouth. It has an agreeable odor and a bland chocolate-like taste, dissolves in ether, acetic ether, and 100 parts of cold and in 20 parts of boiling absolute alcohol, separating again from the latter solution on cooling, with the exception of a small portion which remains dissolved. Its specific gravity is 0.970–0.976 at 25° C. (77° F.).—U. S. It is brittle at 15° C. (59° F.), and melts between 30° and 35° C. (86° and 95° F.), U. S., P. G.; 31.1° to 33.9° C. (88°–93° F.), Br.; forming a pale-yellow, transparent liquid which congeals at 20.5° C. (69° F.), the temperature rising to about 26.5° C. (79.7° F.). The specific gravity and fusing-point are variable, according to the length of time the melted fat has congealed.

Composition.—Cacao butter consists of the glycerides of stearic (about 40 per cent.), palmitic, lauric, and small quantities of the glycerides of butyric, formic, acetic, linolic, and arachidic acids.

Tests.—When mixed with other solid fats the fusing-point and specific gravity do not afford reliable tests for determining such admixtures. The presence of tallow may be detected by burning the oil with a wick for a short time, and then extinguishing the flame, when a peculiar tallow-like odor will be observed. For the detection of adulterations Björkland (1864) proposed the test incorporated into the Pharmacopœia, as follows: "If 1 Gm. of oil of theobroma be dissolved in 3 Cc. of ether, in a test-tube at a temperature of 17° C. (62.6° F.), and the tube frequently plunged into water at 0° C. (32° F.), the liquid should not become turbid nor deposit a granular mass in less than 3 minutes; and if the mixture, after congealing, be exposed to a temperature of 15° C. (59° F.), it should gradually form a perfectly clear liquid (absence of wax,

stearin, tallow, etc.)."—U. S. If pure, cacao butter will separate granules in not less than 3 minutes; if adulterated with tallow or suet, a turbidity will appear at once or within 2½ minutes, according to the quantity of the adulterant, of which 5 per cent. may thus be detected. When the congealed mixture is exposed to a temperature of about 15° C. (59° F.) it will gradually become clear again if the cacao butter was pure, but not if it was adulterated. According to Lamhofer, petroleum benzin may be substituted for the ether with nearly identical results, except that the pure oil separates rather more slowly and is always granular, while other fats render the entire liquid cloudy. "The solution of 1 part of oil of theobroma in 2 parts of ether should remain clear if kept for a day at a temperature of 12° to 15° C. (53.6°–59° F.)."—P. G. Oil of theobroma, saponified by alcoholic potassium hydroxide test-solution, should show a saponification value of 188 to 195. If 0.8 Gm. of oil of theobroma be dissolved in 10 Cc. of chloroform in a 250-Cc. bottle or flask, and 25 Cc. of a mixture of equal parts of alcoholic iodine test-solution and alcoholic mercuric chloride test-solution added, and if, after standing for 4 hours, protected from light, 20 Cc. of potassium iodide test-solution be added, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate solution an iodine figure of not less than 33 nor more than 38 should be obtained.—U. S.

During the fiscal year 1901 there were imported into the United States 2,984,996 pounds of cacao butter valued at $790,748, and in 1902, 3,548,041 pounds valued at $782,815.

Action and Uses.—Cacao butter is extensively employed as a base for suppositories. It is one of the few excipients which can be used in pills containing substances that readily decompose, as silver nitrate and potassium permanganate. Locally it is emollient. It has been given internally as a food in wasting diseases.

Allied Fats.—More or less odorous fats are expressed from the seeds of several species of *Bassia*.—Fam. *Sapotaceæ*. *Bassia longifolia* L. yields the greenish *elloopa* or *elloopa oil*. *Bassia butyracea* Roxb. gives the tallow-like *fulwa butter*. The *mahwah butter* melts at about 45° C. (113° F.), is greenish or yellowish, and comes from *Bassia latifolia* Roxb. These fats come from India. The *shea butter*, *galam butter*, or *bambuk butter* is obtained from *Bassia* (*Butyrospermum* Kotschy) *Parkii*, DC., of tropical Africa. It is pale greenish or grayish, has a cacao-like odor and mild taste, and melts at about 28° C. (82.4° F.). The fleshy mahwah-flowers are used as food and for distilling a spirit; when dry they are said to contain 50 per cent. of sugar.

Mafura Tallow has also a cacao-like odor and a mild taste, but it is of a yellowish color and melts at 42° C. (107.6° F.). It is obtained by boiling the seeds of *Trichilia emetica* Vahl *s. Mafureira oleifera* Bertero (Fam. *Meliaceæ*), of tropical East Africa.

OLEUM THYMI, *U. S., P. G.*—Oil of Thyme.

Essence de thym, Fr.; *Thymianöl*, G.

A volatile oil distilled from the leaves and flowering tops of *Thymus vulgaris* L. (Fam. *Labiatæ*), and containing, when assayed by the process given below, not less than 20 per cent., by volume, of phenols.—U. S. Thyme grows abundantly in the wild state in the mountains of southern France. Small amounts of oil have also been obtained from the cultivated herb, but these oils are of little commercial importance. The botanical source of the Spanish oil is not definitely known.

Properties.—The crude oil of thyme is of a dark reddish-brown color. This color has been attributed quite generally to compounds of phenol with iron, with which the oil was supposed to have come in contact during the process of distillation. This color disappears on heating, and reappears in the distillate upon standing. This would indicate that the pigment is of a quinhydrone character, such as has been found in Monarda oils. Commercially "red" and "white" oil are distinguished. The latter, however, is not obtained by simple rectification of the ordinary kind. "White" thyme oil offered at a lower price than "red" oil is apt to contain much turpentine oil.

The U. S. P. describes oil of thyme as a colorless liquid having a strong odor of thyme, and an aromatic, pungent, afterward cooling taste.

The specific gravity of an oil should be above 0.900 (P. G.), varying for good oils between 0.905–0.920; the U. S. P. requirement is 0.900–0.930 at 25° C. (77° F.). The oil is slightly lævogyrate, the U. S. P. allowing not more than —3° in a 100-Mm. tube, but usually too dark to admit of the determination of this constant. It is soluble

in ½ part of 90 per cent., and in 1 to 2 parts of 80 per cent. alcohol; of 70 per cent. alcohol 15–30 parts are mostly requisite to form a clear solution.

Composition.—The phenol content of the oil varies, as a rule, between 20 and 25 per cent., and in rare instances rises to 42 per cent. The phenol of the French and German oil is mostly thymol; sometimes, however, carvacrol or a mixture of both. The phenol of the Spanish oil is carvacrol, and the phenol content as high as 50–70 per cent. Besides these phenols, oil of thyme contains cymene, *l*-pinene in very small amount, borneol, and linalool.

Adulterations and Tests.—As already stated, turpentine oil is frequently added. This lowers the specific gravity and increases the angle of rotation. The addition of the wild thyme oil does not change the specific gravity, but increases the angle of rotation, its α_D being as high as —12° and more. The thymol assay, however, is the most important criterion.

If 1 Cc. of oil of thyme be shaken with 10 Cc. of hot water and, after cooling, the liquid be passed through a wet filter, the filtrate should not assume, with a drop of ferric chloride test-solution, a bluish or violet color (absence of official phenol).

Assay of Oil of Thyme.—Introduce 20 Cc. of solution of sodium hydroxide (1 in 20) into a burette of 50-Cc. capacity (graduated in $\frac{1}{10}$ Cc.). Add 10 Cc. of the oil to be assayed, stopper the burette with a well-fitting cork, shake the mixture thoroughly, and set aside for 12 to 24 hours. Drops of oil adhering to the side of the burette should be loosened by tapping and rotating it. After the alkaline solution has become clear, the volume of non-phenol oil remaining (which should measure not more than 8 Cc.) is noted and subtracted from the 10 Cc. of the oil originally taken. The difference, multiplied by 10, indicates the percentage of phenols in the oil.—U. S.

In order to determine at the same time whether the oil contains thymol or carvacrol, the alkaline solution of phenylate is separated from the oil, transferred to a separating funnel, and acidulated with sulphuric acid. After the phenol has completely separated, the aqueous solution is run off and the oil set aside in a capsule in a cool place. If the oil consists of thymol, it solidifies upon standing, or crystallization may be induced by adding a fragment of a thymol crystal. If it consists of carvacrol the oil remains liquid. If both phenols are present, it crystallizes partially.

This method yields approximate results only. On the one hand the alkaline solution of phenols dissolves some of the hydrocarbons, on the other hand a part of the phenol remains dissolved in the oil. Both errors probably compensate each other. To remove the hydrocarbons dissolved in the alkali by shaking with ether would simply increase the error, inasmuch as thymol and, still more, carvacrol can be partly extracted from their alkaline solutions by ether.

More rational, though more complicated, is the assay method devised by Kremers and Schreiner. It is a modification of the method suggested by Messinger and Vortmann, and is based upon the fact that in alkaline solution thymol combines with iodine to a red insoluble compound, and that the excess of iodine can be titrated back by standard thiosulphate after the solution has been acidified. Each molecule of thymol requires 4 atoms of iodine for precipitation. The process is carried out in the following manner:

5 Cc. of the oil to be examined are weighed and transferred to a burette provided with a glass stopper and calibrated into tenths. The oil is diluted with about an equal volume of petroleum ether. 5 per cent. sodium hydroxide solution is added and the two solutions shaken. After the two solutions have separated upon standing, the aqueous solution is drawn off into a 100-Cc. flask. This operation is repeated as long as the ethereal solution diminishes in volume. The alkaline phenol solution is diluted to 100 Cc., or, if necessary, to 200 Cc.

10 Cc. of this solution are transferred to a measuring flask of 500-Cc. capacity and $\frac{N}{10}$ iodine test-solution added in slight excess, whereby the thymol is precipitated as a dark-brown iodine compound. In order to ascertain whether sufficient iodine has been added, a few drops are transferred to a test-tube and acidulated with hydrochloric acid. An excess of iodine is indicated by a brown color of the solution, an insufficient amount of iodine by milkiness produced by thymol. An excess of iodine having been established, the entire alkaline solution is acidulated and diluted to 500 Cc. In 100 Cc. of the filtrate the excess of iodine is ascertained by titration with $\frac{N}{10}$ sodium thiosulphate solution.

The number of Cc. of sodium thiosulphate solution required are deducted from the

volume of iodine solution used, and the resultant multiplied by 5, this product indicating the total amount of iodine used by the thymol.

Each Cc. of $\frac{N}{10}$ iodine test-solution corresponds to 0.003741 Gm. of thymol. From the amount of thymol found in the alkaline solution the percentage of phenol in the original oil can readily be ascertained.

The reaction involved is expressed by the following equation: $C_{10}H_{14}O + 4I + 2NaOH = C_{10}H_{12}I_2O + 2NaI + 2H_2O$. The carvacrol assay should be slightly modified, because the carvacrol iodide separates in a milky state. In order to obtain a precipitate the mixture is thoroughly shaken after the addition of iodine, and then filtered. Then the solution is acidulated with hydrochloric acid, and the process continued as directed under thymol. The calculation is the same.

Action and Uses.—Garden thyme and wild thyme have long been used as condiments to promote digestion and to flavor insipid dishes. Externally it has been applied in fomentations, baths, fumigations, etc., to relieve muscular rheumatism and chronic gout, to cure scabies, indolent ulcers, etc.

In man, the daily dose of 5 or 6 drops acts as a general stimulant, and when the oil is continued in increasing doses it renders all the functions more active and energetic. The urine increases in quantity and acquires a violet odor. If the daily quantity be gradually augmented from 6 to 12 drops, the effects are apt to be intensified, and the odor of the medicine may be perceived on the breath and the skin. Sometimes the skin presents erythematous or papular eruptions and the fauces become dry.

Externally the oil is applied in baths and lotions (by mixing with water or alcohol a sufficient quantity of powdered sodium carbonate previously impregnated with the oil) to the treatment of scabies, muscular rheumatism, etc. Applied on cotton it mitigates the pain of toothache, earache, etc. The average dose is 2 minims (0.1 Cc.).

The essential oil is most conveniently given in capsules, owing to its acrid taste and the eructations it causes.

OLEUM TIGLII, *U. S.*—Croton Oil.

Oleum crotonis, Br., P. G.; *Huile de Croton Tiglium*, Fr. Cod.; *Krotonöl*, G.; *Aceite de grano tiglio*, Sp.

The fixed oil expressed from the seeds of *Croton Tiglium* L. (*T. officinale* Klotzsch —Fam. *Euphorbiaceæ*).

Origin.—Croton seeds or Molucca grains (*Semen vel Grana Tiglii; S. v. G. Crotonis.—Grains de Tilly, Grains de Moluques, Petits pignons d' Inde*, Fr.; *Granatill, Purgirkörner*, G.; *Grano Tiglio*, Sp.) are the product of a large shrub, native of the East Indies and cultivated in a number of tropical countries. The seeds are borne in a 3-celled capsule somewhat resembling that of the castor-oil plant, but with a single seed in a cell. The seeds have a form almost identical with that of the castor-oil seed, but average somewhat larger, have a less conspicuous caruncle, and a roughish not shining surface, of a brown color, or blackish where the outer layer has become abraded. The structure is identical with that of the castor-oil seed. There is little odor, and the oily taste soon becomes extremely acrid. The yield of oil is from 30 to 40 per cent. of the weight of the seeds, about one-third of the latter pertaining to the seed-coats. Several seeds have been used to substitute or adulterate Croton seeds, more in earlier times. All are larger, and either grayish black or dark grayish brown in color. The principal one is the East Indian *Kuli seed*, the product of *Croton oblongifolius* Roxb., of which the root-bark is an important drug in India. According to Lloyd (*Western Druggist*, 1898, p. 151), croton seeds figured as purgatives in European literature as early as 1578, under the name *pini nuclei moluccani*, and later as *grana teglia* or *grana Molucca*.

FIG. 295.

Croton seed: lateral and ventral view, and longitudinal section, showing embryo.

Preparation.—Croton oil is obtained in large quantities in India and in Great Britain by subjecting the seeds, freed from their integuments, to pressure, and also by extraction with volatile solvents.

Properties.—Croton oil from India is of a pale-yellow color; that made in England is of a more or less deep reddish-brown hue, the darker color being probably due to the greater age of the seed and to the higher temperature at which the oil is expressed. It is somewhat viscid and slightly fluorescent. It has a slight, peculiar, somewhat rancid

odor, and a taste which is at first mild, but afterward acrid and burning. Great caution is necessary in tasting the oil. When applied to the skin it produces rubefaction or a pustular eruption. Its reaction to test-paper is distinctly acid and its consistence rather viscid. It dissolves freely in ether, chloroform, carbon disulphide, petroleum ether, and fixed and volatile oils. When fresh it is soluble in from 55 to 60 parts of alcohol, the solubility increasing by age.—U. S. Alcohol dissolves from fresh croton oil about 20 per cent. of oil which carries the vesicating principle, the purgative principle remaining in the insoluble portion (H. Senier, 1883). The variations in the solubility in alcohol and other properties of croton oil are in part attributable to the age (Warrington, 1865) of the oil, and probably also to the different species of seeds used in its preparation. According to Dr. M. Burrough, much of the oil expressed in India is derived from Barbadoes nuts, *Jatropha Curcas*, or *Curcas purgans* (see below). Croton oil has the specific gravity at 25° C. (77° F.) of 0.935–0.950 (U. S.), congeals at —16° C. (3.2° F.), and is characterized by a high saponification value (212 to 218). Exposed to the air croton oil becomes more or less viscid, but is not a drying oil. It does not form elaidin.

Composition.—Croton oil is composed of the glycerides of stearic, palmitic, myristic, lauric, and oleic acid, and of the volatile acids, acetic, butyric, formic, valeric, and *tiglic* (Geuther and Frölich, 1870) *acid*, $C_5H_8O_2$. Tiglic acid is an isomeride of angelic acid, and identical with Frankland and Duppa's methyl-crotonic acid. It melts at 64.5° C. (148.1° F.) and boils at 198.5° C. (389.3° F.). The vesicant principle of croton oil was determined by Dunstan and Boole (*Proc. Roy. Soc.*, London, lxiii., 1895) to be *croton-resin*, $C_{13}H_{18}O_4$, a bright-yellow, hard, brittle substance, melting at 90° C. (194° F.), and which is insoluble in water and benzene, but readily soluble in alcohol, ether, and chloroform.

Tests.—Croton oil should be completely soluble in absolute alcohol, and the solution not redden litmus-paper (Br.). If to 2 Cc. of the oil 1 Cc. of fuming nitric acid and 1 Cc. of water be added, and the mixture be shaken vigorously, it should not solidify, either completely or partially, but only thicken slightly, after standing for 1 or 2 days (absence of other non-drying oils). If 0.3 Gm. of croton oil be dissolved in 10 Cc. of chloroform in a 250-Cc. bottle or flask, and 25 Cc. of a mixture of equal parts of alcoholic iodine test-solution and alcoholic mercuric chloride test-solution added, and if, after standing 4 hours, protected from the light, 20 Cc. of potassium iodide test-solution be added, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate solution, an iodine figure of not less than 102 nor more than 105 should be obtained.—U. S. Croton oil may be identified in other oils by shaking the oil with a dilute alcoholic solution of potassium hydroxide, and after separation acidulating the alcoholic liquid with dilute hydrochloric acid and extracting with ether. The supernatant ether is removed, evaporated, and the residue applied upon the arm, when in a few hours redness and the peculiar pustular eruption will appear if the oil contained croton oil. When gently heated with twice its volume of absolute alcohol, it forms a clear solution, from which the oil should separate on cooling.—U. S.

In 1901 (fiscal year ending June 20) 461 pounds of croton oil, valued at $219, were imported into the United States, and in 1902, 1135 pounds, valued at $565.

Action and Uses.—In medicinal doses croton oil produces profuse watery evacuations in from 1 to 4 hours, accompanied by some tenesmus and a sense of heat in the anal region. In overdose it is a violent depressant poison, producing vomiting, profuse purging, severe griping, collapse, and death. The quantity necessary to cause a fatal result varies within wide limits. The minimum fatal dose is not known. Death has occurred in an infant of 12 months from 3 drops of the oil; on the other hand, there are reported cases in which recovery has resulted when as much as 1 drachm (4 Cc.) has been ingested. Applied to the skin, it may be absorbed and produce purgation, but, as a rule, its effects are local, and consist in a papular eruption which gradually becomes pustular, even in the absence of pyogenic bacteria. The minuteness of the dose of croton oil renders it useful when a more bulky purgative cannot be given, or when the patient struggles against the administration of a remedy. Such conditions are met with in the unconsciousness of apoplexy, in coma, in the cerebral congestion, and in the obstinate constipation sometimes met with in mania. Children do not bear the drug well. In obstinate constipation, complicating the various forms of paralysis, and in chronic lead-poisoning, croton oil is sometimes given with the happiest results when all other purgatives have failed.

As a counterirritant it is applied externally in sciatica and other nerve inflammations, chronic articular rheumatism, gout, and diseases of the lungs. When used externally it should usually be mixed with 2 or 3 parts of castor oil, olive oil, or soap liniment, and thoroughly rubbed into the skin with a piece of muslin or flannel. At times it is necessary to apply the oil undiluted.

The dose is from ½ to 2 minims (0.025–0.10 Cc.), in an emulsion, or diluted with a few drops of some bland oil. It may also be given in pill. It produces great irritation and inflammation. When poisoning occurs, oils, milk, mucilage, or gelatin solution should be given to allay the inflammation of the mucous membranes, and opium for the relief of the pain. If collapse supervenes, external heat should be applied and alcohol and strychnine administered as stimulants.

Allied Drugs.—CURCAS (*Semina ricini majoris, Semen Curcadis, Semen ficus infernalis, Nuces catharticæ Americanæ.—Purging-, Physic-,* or *Barbadoes nut,* E.; *Purgirnuss, Schwarze Brechnuss, Grosse Ricinuss,* G.; *Pignon des Barbades* or *d' Inde, Semence des médiciniare,* Fr.; *Piñon,* Sp.) is the seed of *Jatropha purgans* (Adans) (*Curcas p.* Adans.; *C. Adansonii* Endl.; *Jatropha Curcas* L.), a shrub or small tree of tropical America. The seeds, and the oil expressed from them, are largely used in their own home as a purgative, substituting Castor, or more particularly Croton Oil. They have also been rather largely introduced to Europe for the same purpose, especially in Spain and Portugal. The seed is 1.5 to 2 Cm. (⅗–⅘ In.) long, oval or a little broader near one end, moderately flattened dorsally, black or blackish gray, striate or somewhat ribbed, rough and not shiny, bearing a broad whitish hilum and caruncle at the smaller end. The kernel consists of an oily whitish albumin with a central embryo having the general structure of that of the Castor oil seed. The seeds are inodorous, of a sweetish and oily taste, later becoming acrid. They contain about 30 to 40 per cent. of a colorless or light-yellow fixed oil, of a specific gravity of 0.92, congealing to a butyraceous mass at —8° C. (17.6° F.); inodorous and nearly insoluble in alcohol. The acid present has been described as curcinoleic acid ($C_{15}H_{28}O_3$). That previously described as isocetic acid is now believed to be a mixture. With the oil exists a small amount of resin. As in Castor and Croton seeds, there also exists, probably chiefly in the embryo, a toxic albuminoid substance called curcin. This becomes inert at a temperature above 50° C. (122° F.) or when treated with precipitants (Siegel).

FIG. 296.

Curcas (Nat.).

The brown and somewhat smoother seeds of *Jatropha multifida* L. (*Curcas m.* Endl.) are similarly used, and their oil is believed to be identical. The seeds of *Joannesia princeps* Vell. (*Anda Brasiliensis* Raddi; *A. Gomesii* Juss.; *Andicus pentaphylla* Vell.), the *Anda Assu, Semen Andsu, Ararafrüchte,* or *Andanüsse,* of tropical America, act almost exactly the same, both as a medicine and as an emetico-cathartic poison. They are sub-reniform, and somewhat resemble chestnuts in color and general appearance, but possess a whitish aril.

The seeds of various species of *Euphorbia* (see EUPHORBIACEÆ) contain fixed oils which act more or less like Croton Oil. Two drops of that from the seeds of *E. calyculata* H. B. K., a Mexican species, are said to act as a drastic, and it has been proposed to use this under the name *Mexican Croton Oil.* It is yielded to the extent of 30 per cent., and is amber yellow, nearly odorless if fresh, bland at first, afterward acrid, soluble in ether and chloroform, partly in alcohol. The seeds of *E. Lathyris* L. (*Tithymalis L.* Scop.), the *Caper-spurge* or *-bush, Wild caper, Garden* or *Myrtle spurge, Gopher-* or *Mole-plant, Wolf's milk, Catapuce,* medicinally known as *Semina cataputiæ minoris, Semina lathyridis majoris, Grana regia majora, Kleine Springkörner, Kleine Purgirkörner,* of Europe, naturalized in the United States, yield about 40 per cent. of an oil much like Croton Oil; when fresh, colorless, odorless, and tasteless, but becoming acrid and correspondingly more violent in its action with age. Upon standing, it deposits a crystalline mass. If perfectly fresh, even so much as 10 drops act only mildly. This change in activity is in all probability due to the separation of the fatty acid. It is said to contain *æsculetin.* The seeds themselves are also purgative, but there is with this action a distinct tendency toward emesis. Five of these small seeds have purged.

OLIBANUM.—Frankincense.

Gummi resina olibanum, Thus.—Weihrauch, G.; *Oliban, Encens,* Fr.; *Incienso,* Sp.

A gum-resin obtained from *Boswellia Carterii* Birdw. and other species of *Boswellia* (Fam. *Burseraceæ*).

Origin.—The geographical source, methods of production and collection, and commerce of this drug are identical with those of Myrrh (see MYRRHA). The Olibanum plants are small trees or large shrubs with pinnate leaves. The Indian olibanum or Male incense is from *B. serrata* Roxb. (*B. thurifera* Colebr.), of India.

Description.—In separate, irregularly oblong or rounded, pebble-like tears, usually less than 1.25 Cm. (½ In.) in diameter, and rarely reaching double this size, varying from nearly white (when fresh) to more or less yellow or even reddish brown, rarely with a greenish-blue tinge, the surface more or less powdery; brittle, the fracture nearly flat, the surface waxy-lustrous; thin fragments somewhat translucent; odor balsamic and terebinthinate, softening between the teeth, and of an aromatic and resinous and somewhat bitter taste; odor, on burning, highly and pleasantly aromatic; forming a white emulsion with water and almost wholly soluble in alcohol.

The poorer grades of Olibanum may exhibit masses of softish, coherent tears, dark colored, opaque on fracture, or containing much impurity. "Seed-Olibanum" is in small, grain-like tears and usually with much sand or other earthy matter intermixed.

Constituents.—Olibanum consists of from 60 to 70 per cent., or occasionally more, of resin, 30 to 35 per cent. of gum, 3 to 8 per cent. of volatile oil, and a small amount of an unstudied bitter principle. The volatile oil is colorless to yellowish, has the odor of the drug with a slight lemon-like fragrance, and a specific gravity of 0.875–0.885. It consists chiefly of l-pinene ("olibene"), dipentene, and phellandrene (*Gildemeister and Hoffmann*). The resin is *Boswellic* or *Boswellinic acid* ($C_{32}H_{52}O_4$) and *Olibano resin*, $(C_{14}H_2O)_n$, in equal proportions, with a little ester of the former acid (*Halbey*). The gum is mostly arabin (see ACACIA), the remainder bassorin (see TRAGACANTHA).

Action and Uses.—This gum resin is rarely employed in internal medicine at the present time. Its principal use is in the preparation of extemporaneous plasters. Because of its stimulating properties it may be substituted for either BALSAM PERU or BALSAM TOLU (which see). It was formerly combined with soap as an excipient, and administered in pill form, in doses of from 15 to 30 grains (0.97–1.94 Cc.).

Allied Products.—The genus *Boswellia* is credited with some 10 species of northeastern Africa and India, but the species are difficult of definition and the number is probably very much greater. *B. Frereana* Birdw., of the same region with the Olibanum plant, is regarded as the source of the *African Elemi* or *Luban Mayeti*.

ONAGRACEÆ.—The Evening Primrose Family.

A family of 36 genera and nearly 500 species of highly ornamental flowering plants, including the Fuchsias, Epilobiums, Lopezias, and Œnotheras. From an economic standpoint the family is of little importance except for decorative purposes. Many of its herbs are rich in tannin, and have a considerable domestic and some professional use as astringents.

FIG. 297.

Evening Primrose (½ Nat.).

ŒNOTHERA (*Evening Primrose, Night willow-herb, Rampion, Scurvish*, E.; *Nachtkerze*, G.; *Onagre*, Fr.) is the root, and especially the leaves and flowering tops, of *Onagra biennis* (L.) Scop. (*Œnothera b.*—L.), a tall, stout herb growing throughout most of North America. The root is conical, 12 to 25 Mm. (½–1 In.) thick at the base, 10 to 15 Cm. (4–6 In.) long, with spreading branches, externally pale brown or sometimes reddish, with a thin bark, internally white, fleshy, inodorous, of a sweetish taste, and in the second year woody and tough. The *stem* is from 0.9 to 1.8 M. (3–6 Ft.) high, rough, hairy, often purplish. The *leaves* are alternate, ovate-oblong or oblong-lanceolate, 7 to 12 Cm. (3–5 In.) long, somewhat petiolate, acute, nearly entire, and short-hairy. The *flowers* are in terminal leafy spikes, have a sessile cylindrical ovary united with the long tubular calyx, 4 obcordate yellow petals, and 8 stamens, and produce a 4-valved capsule containing numerous seeds. The herb is inodorous and has a mucilaginous and mildly astringent taste. The constituents have received no careful investigation. Mucilage and tannin exist in considerable amount. Because of its antispasmodic properties this remedy has been employed internally in the treatment of whooping-cough, hiccough, and spasmodic asthma. In the form of a 25 per cent. ointment it may be locally used as a remedy for porrigo and other infantile cutaneous affections. The internal dose is from ½ to 1 fluidrachm (1.8–3.7 Cc.) of the fluidextract.

Onagra, with the very similar genera *Anogra* and *Œnothera*, together contain about two-score species, most of which apparently agree with the above in constituents and properties.

Jussieua, a genus of about 40 species of plants, of similar appearance to that of the Evening Primroses, mostly tropical American, agree closely in constituents and properties, as do most of the 160 species of *Epilobium*. *E. hirsutum* L. is the *St. Anthony's herb* of antiquity. *E. angustifolium* L., now separated from this genus as *Chamænerion a.*—(L.) Scop. (*E. spicatum* Lam.), is one of the American *Fire-weeds*, largely used in the household as an intestinal astringent. It is also known as the *Great* or *Spiked willow-herb*, *Bay-willow*, *Flowering-willow*, *Purple rocket*, *Wickup*, or *Wicopy*. It is a perennial herb, 4 to 8 feet high, the stem usually simple, densely clothed with alternate leaves which are narrowed into a petiole-like base, 3 to 6 inches long, lanceolate, acuminate, obscurely toothed, thin, and smooth. The flowers are in a long, terminal, often branched, raceme-like spike, handsome, of a light rose-purple, the ovary enclosed in the calyx-tube, calyx and corolla each 4-parted, stamens 8 and declined, like the style. The capsule is quadrangular, linear, and contains numerous cottony-tufted seeds.

Several species of *Ludwigia* are used as expectorants and diuretics. The seeds of *Trapa natans* L. are eaten in Oriental countries under the name *Water chestnut* or *Jesuit-nut*.

ONONIS.—Ononis.

Radix ononidis, P. G.; *Radix restis bovis.—Petty whin, Rest-harrow, Stay-plow*, E.; *Ochsenbrechkraut, Hanhechel*, G.; *Bougraue*, Fr.

The dried root of *Ononis spinosa* L. (Fam. *Leguminosæ*).

Origin and Description.—This is the root of a perennial herb growing in sandy soil throughout a large part of Europe. It is about 60 Cm. (2 Ft.) long, 1 to 2 Cm. ($\frac{2}{5}$—$\frac{4}{5}$ In.) thick, slightly branched, many headed, tough-woody, and mostly curved and of a flattened and twisted appearance. It has a deeply wrinkled, dark gray-brown thin bark and an irregular whitish, tough, fibrous meditullium with numerous medullary rays. It has a faint odor resembling that of liquorice-root, and a mucilaginous, sweetish, afterward bitterish and disagreeable taste.

Constituents.—Besides the peculiar body *ononid*, believed to be altered glycyrrhizin, it contains the glucoside *ononin* ($C_{30}H_{34}O_{13}$), which is finely crystalline, colorless, and tasteless, slightly soluble in boiling water and with difficulty in alcohol, and insoluble in ether. *Onocerin* ($C_{12}H_{20}O$) is very similar.

Action and Uses.—Ononis is occasionally prescribed in conjunction with juniper, squill, and potassium acetate in the treatment of dropsical conditions and chronic rheumatic affections. Formerly it was recommended as an external application to hemorrhoids, variocele, and cutaneous eruptions. The glucoside "ononin" may be given internally in doses of from 3 to 5 grains (0.19–0.32 Gm.).

OPII PULVIS, *U. S.*—Powdered Opium.

Poudre d'opium, Fr.; *Opiumpulver*, G.

Preparation.—The U. S. Pharmacopœia directs that opium shall be dried at a temperature not exceeding 85° C. (185° F.) and reduced to a very fine powder.

Powdered opium, for pharmaceutical and medicinal purposes, when assayed by the process given under Opium, should yield not less than 12 nor more than 12.5 per cent. of crystallized morphine. If of a higher percentage, it may be brought within these limits by admixture with powdered opium of a lower percentage, or powdered sugar of milk in proper proportions.—U. S.

Action and Uses.—For the action and uses of powdered opium, see Opium.

OPIUM, *U. S., Br., P. G.*—Opium.

Meconium, Succus thebaicus, Lachryma Papaveris.—Opium, E., Fr., G.; *Extractum Thebaicum*, Dan.; *Meconium, Laudanum*, Russ.; *Oppio*, It.; *Opio*, Sp.

The concrete milky exudation obtained by incising the unripe capsules of *Papaver somniferum* L. (*P. officinale* Gmel.; *P. album* Mill.—Fam. *Papaveraceæ*), and yielding, in its normal moist condition, not less than 9 per cent. of crystallized morphine, when assayed by the U. S. P. process.

Opium is official in all pharmacopœias, which differ considerably in their definitions. That of the B. P. merely requires that it be obtained by incision from the unripe cap-

sules of the species named and inspissated by spontaneous evaporation. This is followed by a provision that any suitable variety may be used for the tincture and extract (which are of standard alkaloidal strength), yielding when dry not less than 7.5 per cent. of anhydrous morphine; for other official purposes the morphine yield must be not less than 9.5 nor more than 10.5 per cent. That of a higher yield may be diluted with that of a lower, which, however, must contain between 7.5 and 10 per cent., or with milk-sugar. This exclusion of very low-grade opium, even for mixing purposes, is doubtless based upon the idea that such an article differs from the better not only in its smaller content of morphine but also in its greater content of other and undesirable alkaloids, which generally compensate to a certain extent for the absence of the morphine. The P. G., which mixes badly the definition and description, requires (as do most pharmacopœias) that opium be collected in Asia Minor, that it yield from 10 to 12 per cent. of morphine, and that it lose not more than 8 per cent. of moisture when completely dried at a temperature of 100° C.

Very interesting questions have arisen as to whether an article is to be regarded as conforming to the definition when, although it yield the required percentage of morphine, it contains some foreign substance, such as starch or chopped vegetable tissue, intentionally added as a diluent, but itself inert. It would seem as though a negative answer should be returned, so far as relates to those pharmacopœias which specify certain substances which may be used as diluents, as does the B. P. This the U. S. P. does not do under this title, though it does so under Opii Pulvis.

Origin and Production.—The production of Opium of the official grade was in the past confined almost exclusively to Asia Minor, and this article has been distinguished as "Turkish," "Constantinople," or "Smyrna," often as "Medicinal" opium. During recent years the quality of opium elsewhere produced has greatly improved, and it is said that much other than the Turkish now reaches the official standard. Notwithstanding these facts, Turkish opium is still far superior to other commercial varieties, and through custom, and because of superior qualities other than the morphine content, as well as because of technical conformity to the official description, it still supplies the great bulk of the article medicinally employed.

The successful production of opium requires a rich soil, heavily fertilized, thorough tillage, and painstaking care. In the seasons of sowing and time required for maturity, the opium crop is strikingly similar to wheat, as grown in America, there being a "winter" and a "spring" crop. The winter crop is sown in September, and is expected to be protected during the winter season by a covering of snow. Failure in such protection subjects it to a heavy loss by winter killing. It may then be sown again in February or March, but a successful crop is dependent upon exceptionally favorable conditions, especially as to an abundance of rain falling just at the right time. In any case, this crop is usually inferior to the former. During the entire period, including that of harvesting, the crop is subject to great climatic vicissitudes. Although there are varieties of opium dependent upon the color of the flowers, it is said that a field usually displays flowers of all colors from white to deep red, though the "black" variety, with red flowers and black (occasionally white) seeds, predominates. Each plant produces from 5 to 20 capsules. When these are just turned of a pale-yellow color, the time for incision has arrived, and this is performed in the late afternoon. The capsule (see Papaver) contains a dense network of laticiferous vessels underneath the epidermis, which at this time are distended with milk-juice, which escapes when an incision is made. In Asia Minor these incisions, 1 to 3 in number, are spirally transverse, entirely encircling the capsule, and made by a knife possessing the same number of blades. Great skill is required in performing this process, a too-shallow incision failing to secure all the milk, a too-deep one permitting the milk to enter the cavity, resulting in its loss as well as that of the seeds. The following morning the juice has thickened sufficiently for collection and is scraped off by a blunt knife and transferred to a poppy-leaf held in the left hand. Often a second scarification is made a day or two later. To decrease the adhesiveness of the opium the collector is said to apply his saliva from time to time to the edge of the knife. Owing to local differences in the performance of this scraping process the opium may (*Smyrna Opium*) or may not (*Constantinople Opium*) contain a certain amount of the epidermis of the capsule. This admixture naturally amounts to from 5 to 8 per cent., but advantage is taken of its presence to add considerable quantities of chopped vegetable tissues, so much as 33 per cent. having been extracted from

an opium which, however, yielded the standard percentage of morphine. The treatment of the opium at this stage is subject to considerable variation in different districts and by individual producers, chiefly for the purpose of adulteration or dilution (see *Adulterants*). In some places it is beaten up to a homogeneous mass, and the practice of diluting an excessively rich article with one of lower grade is very common. The grade of Turkish opium called "Adeth" (meaning *usual* or *ordinary*) yields almost uniformly 9.5 per cent. of morphine. Besides the differences in morphine content, there are other differences of color, consistency, and especially of aroma and flavor, which are regarded as important, especially for exportation to China for chewing or smoking purposes.

The masses thus collected are subjected to a drying process, conducted chiefly in the shade. Too long continued, this results in an undue loss of weight; too incomplete, it subjects the article to the great danger of mouldiness, a common defect in the commercial article. The poppy leaf is now wrapped about the mass and the latter is packed in the capsules of a species of Rumex.

Almost every country in the world, the climate of which has offered any possibility of success, has attempted the production of Opium. Although most of them have not yet succeeded in producing an article of equal quality with that of the Turkish, many have demonstrated the probability that this could be done by the exercise of sufficient care and after full experience. Several, while producing an article of inferior grade, produce amounts far larger than that of the Turkish. While the best of such Opium is utilized in morphine manufacture, the great bulk of it is employed in the vicious practices of chewing and smoking, in which vices China occupies the first place. Since the variations in Opium depend upon climate and methods of production, the names assigned to the varieties are almost wholly geographical. Although most of the unofficial opiums are rarely or never seen in the United States, brief reference is here made to all the more important sorts. Neither in America nor Europe is the article produced upon a commercial scale, although in both opium of a high quality (containing about 20 per cent. of morphine) has been produced, the cultivation in Europe extending as far north as Sweden. In both places it is the cost of production rather than natural difficulties which bars development of the industry. The same statement may be made regarding Australia.

Bulgarian Opium, though produced to only a trifling extent, is of interest because of its high quality. Four samples exhibited at the Antwerp Exhibition in 1896 were found to contain respectively 7.25, 11.90, 11.07, and 19.15 per cent. of morphine.

Egyptian Opium is prepared in a manner very similar to the Turkish, but it is somewhat harder and of a dark color. Its quality is extremely variable, the morphine percentage ranging from almost nothing up to near the official average.

In other parts of Africa, especially in the countries adjacent to the Mediterranean, trifling amounts are produced.

Persian Opium is produced in large quantity and is of considerable importance, much of it being exported to the United States and London for the manufacture of morphine, of which it frequently yields 12 per cent. or more. It is commonly wrapped in paper, the paper often marked with Chinese characters, in cylindrical sticks, often in cones or balls, and packed in chopped dry Poppy refuse. This opium has an oily appearance, both internally and externally, due to the collectors' custom of employing oil to prevent the adhesion of the opium to their tools. Persian Opium is far more subject than other sorts to change of appearance due to manipulation. For the Chinese market, such manipulation is accompanied by heavy adulteration, while for Europe and America it is done more to alter its appearance and cause it to resemble the Turkish article. Persian opium is notable for exhibiting more crystals than the Turkish, these being often visible to the naked eye.

Indian Opium, though second only to the Chinese in extent of production, is of little interest in Materia Medica proper, since very little of it is exported, except that known as *Provision Opium*, which is sent to China for vicious uses. The greater part of it falls far below the official standard, though the Patna product is said to frequently attain thereto. It yields upward of 70 per cent. of extract, against about 50 per cent. from the official. Its collection is very similar to that of the Turkish, though vertical incisions are made in the capsules. It contains much moisture, said to be owing to the heavy dews that fall upon it; and it is apparently subject also to more or less fermentation, which imparts to it a peculiar odor. It is either wrapped in oiled paper or enclosed in

small cases made by glueing together poppy leaves with an adhesive substance, made partly from a poppy plant extract, partly from a dark juice which exudes from the opium during its preparation. Like the Persian, it is distinguished by the conspicuousness of its crystals.

Chinese Opium, which is produced to the enormous extent of about 40,000,000 pounds annually, probably double the total production of all other kinds, is wholly consumed at home, together with great quantities imported from India, Persia, and elsewhere. Up to a comparatively recent period, Chinese opium was notable for its low morphine percentage and general poor quality, thus giving a high preference to the Indian importations. Of late, earnest attention has been given to the improvement of its quality, with a consequent heavy decline in the importations referred to.

Consumption and Commerce.—The world's average annual consumption of Opium for medicinal purposes is estimated at about 5500 cases. This amount is really trifling as compared with its use for vicious purposes, though such latter use relates chiefly to other varieties. In the United States the illicit use of Opium is less extensive than in other countries and its medicinal relations are of prime importance. The opium trade is influenced by very many and diverse conditions and is complicated and difficult to follow. Importations into the United States have been of the most irregular character, determined chiefly by the frequent changes in the tariff. Upon the one hand, anticipation of such changes has frequently induced heavy speculative buying or its cessation; upon the other, the high duty frequently charged has, while not decreasing the amount of importations, heavily increased smuggling.

Description.—In irregularly globular, usually more or less flattened masses, weighing from 250 to 1000 grams ($\frac{1}{2}$–2 lbs.), the surface marked with the impression of a poppy leaf used for wrapping, and frequently bearing fragments of this and some Rumex fruits, of a chestnut brown or reddish brown, changing to dark or blackish brown with long keeping; plastic and rather soft or gradually hardening from without inward, with age; fractured surface exhibiting more or less tissue-fragments, together with small tear-shaped particles of opium and, under the microscope, some acicular crystals, especially visible after moistening with benzene; of a heavy narcotic odor and taste, the latter disagreeable and bitter. The required morphine percentage has been stated under *Definition*. The ash residue is too irregular to be characteristic. The character of the tissue fragments, as pertaining to the epidermis of the capsules, is regarded as characteristic of Smyrna opium.

Various provisions are found in the different pharmacopœias regarding the percentage of moisture, and the ash, which, according to the Russian, shall not exceed 8 per cent. and shall not effervesce with hydrochloric acid. The Russian states that a drop of ferric chloride added to the filtrate of Opium shaken up with water should color it dark red. The Norwegian requires that 2 grams, shaken up with 25 Cc. of warm water, should not be ropy nor mucilaginous after cooling. The Dutch requires a yield of 50 per cent. of dry extract, the French the same amount of thick extract.

Adulterants.—The introduction to Opium of inert substances intended to reduce its morphine strength, has been discussed under *Production*. Very similar may be considered the addition of an extract of capsules, or a mass consisting of the latter finely beaten up with water, both of which contain some morphine, or of an extract of the herbage, which is practically destitute of that constituent. The latter method of adulteration is of great antiquity, but is now little practised. The practice, formerly very common, of introducing stones, bullets, nails, and other heavy objects, has also been largely eliminated as a result of improved commercial precaution. Some years ago a good deal of interest was excited in the manufacture in the United States of a "pudding" or so-called *Boston* opium, mixed up with the sole object of bringing the morphine percentage down to the official limit. Except for its reduced strength, this article was of good appearance and quality. It seems now to be rarely or never seen. In 1882 Stevenson reported upon a sample of spurious Opium, consisting chiefly of Aloes, which, by suitable mixing and interment in the earth for a month and a half, had largely lost the odor of aloes. Various kinds of resinous, saccharine, and mucilaginous substances, ashes, clay, gypsum, sand, and litharge have been employed, and in some cases merely added to an Opium from which the morphine had been mostly or wholly extracted. For reference to an undue amount of moisture, see *Constituents*.

Examination.—Hager suggested the following course for determining the presence of adulterants: The sample is dried and powdered, and 25 grains of the powder are

triturated with ½ ounce of boiling water; the formation of a stiff paste or mucilaginous liquid would indicate the presence of starch, flour, gum, or salep. 2 ounces of water are added, and the liquid filtered; the filtrate should be of a wine-yellow color, indicating the absence of liquorice or other aqueous extracts, which would impart to the filtrate a brown color; the liquid should likewise have an acid reaction, otherwise the admixture of chalk, litharge, or ashes may be inferred. On evaporating the filtrate to 1 ounce, potassium ferrocyanide or the addition of twice its bulk of alcohol should not cause any precipitate; the former test would indicate the presence of salts of heavy metals; the latter an adulteration with gum or certain salts. The insoluble residue of opium left on the filter after washing and drying should weigh between 10 and 11½ grains; should it weigh more, sand, clay, or other insoluble substances may be present, and in case it weighs less, sugar, gum, or other soluble impurities are indicated. On agitating powdered opium with chloroform the mineral impurities and starch settle to the bottom, and the latter acquires a blue color on the addition of a little iodine. Mineral impurities are likewise indicated by the amount of ash left, which for genuine powdered opium is about 6 per cent., varying, however, between 4 and 8 per cent.

Constituents.—Opium is entirely free from starch and tannin. Among the principles ordinarily found in plants, the following have been observed in opium: an odorous principle, soluble in ether, benzene, and petroleum-benzin; glucose, gum, pectin, a compound resembling caoutchouc, wax, fat, a small amount of resin, coloring-matter, and that indefinite substance usually designated as "extractive." The mineral constituents average about 6 per cent. The important constituents are the alkaloids. Their total number is uncertain, since some of those reported have been imperfectly described, and it is not certain that they are not mixtures. It is not likely, however, that the known alkaloids of opium are less than 20 in number, though apparently they do not all occur in all varieties of the drug. Of these, morphine is by far the most important, not only because its amount renders it the overwhelming physiological agent, but because its action and uses are far more numerous and important than those of all the other constituents combined. Codeine probably stands next in importance to morphine. Since both these alkaloids, together with their derivatives, Apomorphine and Apocodeine, are described under separate titles, they will not be here considered, except as to their occurrence. It is now pretty well established that they exist in opium partly as sulphates and partly as acid meconates. The percentage of morphine varies, in natural opium, from less than 1 to nearly 25 per cent. The official and legal requirements as to its percentage have been stated. The ordinary Turkish opium of the New York market almost always contains in the neighborhood of 10.5 or 11 per cent. The amount of codeine ordinarily is somewhat more than 1 per cent. Of the remaining alkaloids, the percentage is extremely variable. Of Thebaine, Narceine, Papaverine, and Pseudomorphine, the respective amounts vary from about 0.2 to about 1 per cent. That of narcotine is several times greater, more than 10 per cent. having been frequently reported. All the others exist only in minute amounts. The proportion in which the alkaloids are present is, without doubt, largely influenced by the climate, the nature of the soil, and the treatment to which the milk-juice is exposed in obtaining the opium.

Narcotine ($C_{22}H_{23}NO_7$ or $C_{19}H_{14}NO_4(OCH_3)_3$), discovered by Derosne in 1803, may be extracted with ether from the precipitate produced by ammonia in the aqueous infusion of opium, and from the insoluble residue of the latter by exhausting it with hot acetic or dilute hydrochloric acid. It crystallizes in tasteless, colorless, shining, rhombic prisms or white needles, melting at 176° C. (349° F.) and dissolving at about 15° C. (59° F.) in 100 parts of 85 per cent. alcohol, 33 parts of absolute ether, 2.7 parts of chloroform, 310 parts of amylic alcohol, or in 22 parts of benzene. It requires 7000 parts of boiling water for solution and is insoluble in cold dilute acetic acid. It is a weak base, probably existing free in the drug, and yields mostly uncrystallizable salts, which have a bitter taste and an acid reaction. Chloroform dissolves the alkaloid from the aqueous solutions of its salts. Solution in cold sulphuric acid is colorless, but turns slowly to yellow, orange, and red; it gives a blood-red color with a mixture of sulphuric and nitric acids. When boiled for a long time with water or heated with nitric acid, it is decomposed into *meconin*, $C_{10}H_{10}O_4$, and *cotarnine*, $C_{12}H_{13}NO_3$, which is a stronger base, soluble in ammonia, fusible in boiling water, and, on being boiled with very dilute nitric acid, is converted into *cotarnic* and *apophyllic acids*, the latter containing nitrogen. On heating narcotine with manganese dioxide and dilute sulphuric acid, cotarnine is obtained, and in

addition thereto *opianic acid*, $C_{10}H_{10}O_5$, which crystallizes in needles and fuses at 140° C. (284° F.). When heated with hydrochloric or hydriodic acid, it parts with 1, 2, or 3 methyl groups (CH_3) and yields new bases. Wright and Beckett have shown that it may be converted into *vanillin*. According to Wegscheider, opianic acid, heated above its melting-point, yields an anhydride, $C_{30}H_{28}O_{14}$, which by moderate fusion with potassium hydroxide is converted into meconin and *hemipinic acid* ($C_{10}H_{10}O_6$), and on treating the latter under pressure with HCl, isovanillic and protocatechuic acids are obtained.

Narceine ($C_{23}H_{29}NO_9 + 2H_2O$), discovered by Pelletier in 1832, occurs in long quadrangular prisms or white silky needles, which have a slightly bitter taste, melt, when anhydrous, at 145.2° C. (291.6° F.), are insoluble in ether, and are sparingly soluble in cold alcohol and water. Fröhde's reagent renders it brown green, afterward yellow and reddish. Erdmann's test produces a deep-yellow, brown-yellow, and, finally, a deep-orange color. Iodine, not used in excess, produces a blue, nitric acid a rapidly fading yellow color. Narceine is a weak base, and yields crystallizable salts which are mostly not freely soluble in water or are decomposed by water, the hydrochloride yielding a highly basic salt.

Thebaine, or paramorphine ($C_{19}H_{21}NO_3$), was discovered by Thiboumery in 1835. It forms silvery scales or hard prisms; is soluble in ether, more freely in alcohol, amylic alcohol, benzene, and chloroform, but nearly insoluble in water and alkalies. It is colored blood red, afterward yellow, by sulphuric acid, yellow by nitric, orange red by Erdmann's test, orange yellow, and finally colorless by Fröhde's reagent, and red brown by chlorine-water and ammonia. The salts of thebaine crystallize readily. Diluted acids readily alter the alkaloid, yielding two amorphous isomeric bases, *thebenine* and *thebaicine*, which are sparingly soluble in hot alcohol and insoluble in other simple solvents.

Papaverine ($C_{20}H_{21}NO_4$), discovered by Merck in 1848, forms colorless needles or prisms, which are slightly soluble in cold ether and alcohol, but readily soluble in hot alcohol, amylic alcohol, chloroform, and benzene. It melts at 147° C. (296.6° F.). Nearly all its salts are sparingly soluble in cold water and dilute acids, and its solutions part with the alkaloid on being agitated with chloroform. Warm sulphuric acid colors it deep purple or violet blue. Fröhde's reagent renders it bright violet blue, then blue, yellowish, and finally colorless.

Pseudomorphine, also known as *phormine*, *oxydimorphine*, and *dehydromorphine*, was discovered by Pelletiêr and Thiboumery (1835). It is a derivative of morphine, and probably does not pre-exist in opium, being readily formed by the action of oxidizing agents on alkaline solutions of that base. Its production is said to be due to the removal of an atom of hydrogen from each of two molecules of morphine and the subsequent union of the two residues, thus: $2C_{17}H_{19}NO_3 - H_2 = C_{34}H_{38}N_2O_6$. Pseudomorphine occurs as a fine crystalline powder, insoluble in water, alcohol, ether, and chloroform, but dissolves in acetic acid and in solutions of the alkali hydroxides, and is said to be also soluble in benzene. With mineral acids it forms salts sparingly soluble in water. Pseudomorphine is of special interest and forensic importance, as it is a non-poisonous base, and while its reactions with nitric acid and with ferric chloride are very similar to those of morphine, it may be distinguished from the latter by the green coloration developed upon mixing pseudomorphine with concentrated sulphuric acid and adding a drop of formaldehyde solution or a few grains of sugar.

Rhœadine, $C_{21}H_{21}NO_6$, discovered by O. Hesse in 1865, is in white tasteless prisms which are nearly insoluble in ether, alcohol, benzene, chloroform, water, and ammonia, and which yield with dilute acids tasteless and colorless solutions, acquiring an intense purple color on the addition of strong hydrochloric or sulphuric acid. Besides the coloring-matter, an isomeric, bitter, colorless base, *rhœagenine*, is formed in this reaction. The color produced by acids with Merck's *porphyroxin* (1837) depends on the presence of some rhœadine.

Cryptopine, $C_{21}H_{23}NO_5$, was discovered by T. and H. Smith in 1867. It crystallizes in minute prisms, is sparingly soluble in water, ether, benzene, and cold alcohol, dissolves in potassa and chloroform, and forms bitter salts, which have a pungently cooling taste, and when dissolved in hot water usually produce a jelly-like mass, which is gradually changed to crystals. Sulphuric acid colors it yellow, soon turning violet color, but in the presence of minute traces of ferric salt or of chlorine a dark violet-blue color is at once produced, which on warming turns dingy green.

Oxynarcotine, $C_{22}H_{23}NO_8$, was isolated from the mother-liquors of narceine by Wright and Beckett (1876). It dissolves in alkaline liquids, but is nearly insoluble in benzene, chloroform, and hot alcohol and water. Like narceine and narcotine, it yields *hemipinic acid.*

Gnoscopine, $C_{22}H_{23}NO_7$, was found by T. and H. Smith (1878) in the mother-liquors of narceine. It forms thin needles of a woolly appearance, melts with decomposition at 233° C., is soluble in chloroform and carbon disulphide, slightly soluble in benzene, and is insoluble in petroleum and in fusel oil. Sulphuric acid dissolves it with a yellowish color, becoming carmine red with a trace of nitric acid.

The following alkaloids were discovered by O. Hesse (1870 and 1871), and may be prepared from the mother-liquors left in the preparation of morphine by Gregory's method.

Lanthiopine, $C_{23}H_{25}NO_4$, is crystalline, tasteless, sparingly soluble in acetic acid, alcohol, ether, and benzene; is readily soluble in chloroform; is colored orange red by nitric and pale violet by sulphuric acid, the latter color changing to dark brown on heating.

Meconidine, $C_{21}H_{23}NO_4$, is amorphous, colorless or yellowish, tasteless, easily soluble in alcohol, ether, benzene, chloroform, and acetone. It yields very bitter unstable salts, and is dissolved by sulphuric acid with an olive-green, and by nitric acid with an orange-red color.

Laudanine, $C_{20}H_{25}NO_4$, crystallizes in hexagonal prisms, melts at 166° (331° F.), is sparingly soluble in ether and cold alcohol, soluble in benzene, chloroform, and alkalies; in ferric chloride with an emerald-green, in nitric acid with an orange-red, and in sulphuric acid containing iron with a rose-red color, the latter changing to violet on heating. The hydriodate is sparingly soluble in cold water; the hydrochlorate is nearly insoluble in solution of sodium chloride.

Codamine, $C_{20}H_{25}NO_4$, crystallizes from ether in large 6-sided colorless prisms; is easily soluble in chloroform, benzene, ether, alcohol, and boiling water; forms amorphous bitter salts, and dissolves in nitric acid with a dark-green, and in sulphuric acid containing iron with a blue color, changing to green and dark violet on warming.

Laudanosine, $C_{21}H_{27}NO_4$, is soluble in alcohol, chloroform, ether, and warm benzol; the crystals fuse at 89° C. (192.2° F.). It neutralizes acids, and yields with hydriodic acid a sparingly soluble salt. Pure sulphuric acid colors rose red, in presence of ferric salt brown red, on warming, green and deep violet.

Protopine, $C_{20}H_{19}NO_5$, resembles cryptopine, and is with difficulty soluble in ether, alcohol, and benzene, more readily soluble in chloroform. The solutions of its salts do not gelatinize and have a bitter taste. The solutions in sulphuric acid turn yellow, red, and purple; in presence of ferric salt they are deep violet.

Hydrocotarnine, $C_{12}H_{15}NO_3$, crystallizes in large colorless prisms, fuses at 55° C. (131° F.); volatilizes, partly unchanged, at 100° C. (212° F.); is easily soluble in benzene, ether, and alcohol, and forms readily soluble salts. It is formed from narcotine, besides meconin, by the action of nascent hydrogen.

Tritopine ($C_{42}H_{54}N_2O_7$), discovered by Kander in 1890, occurs in prismatic crystals, soluble in chloroform, slightly in ether.

Xanthaline ($C_{37}H_{36}N_2O_6$) was described by T. and H. Smith in 1881.

From many of the above alkaloids derivatives have been obtained which are highly interesting from a scientific point of view, and which prove that at least between some of them there exists a close relation. It is not unlikely that some of those enumerated above are the decomposition-products of others. This may most likely be affirmed to be true of Wittstein's *metamorphine* (1860), which was obtained in preparing morphine by Mohr's process, but has not been observed since. It liberated iodine from iodic acid, was colored red by nitric acid, but was not affected by ferric chloride. Hinterberger's opiane was proved by Hesse to be impure narcotine.

Meconic acid ($C_7H_4O_7$), long official in the B. P., discovered by Sertürner, is obtained by precipitating the concentrated infusion of opium with calcium chloride, and treating the calcium meconate repeatedly with warm diluted hydrochloric acid. It crystallizes in micaceous scales or rhombic prisms containing $3H_2O$, dissolves in 4 parts of boiling water, and is also soluble in alcohol. Opium yields 3 to 4 per cent. of it. It is a tribasic acid, and imparts to ferric salts a deep-red color, which does not disappear on the addition of dilute hydrochloric acid (difference from formic and acetic acids) or by

the chlorides of gold or of mercury (difference from sulphocyanates). When boiled with water, or more rapidly when boiled with dilute hydrochloric acid, meconic acid is decomposed into carbon dioxide and crystallizable *comenic acid*, $C_6H_4O_5$, which on being heated yields a sublimate of *pyrocomenic acid*, $C_5H_4O_3$. The two derivative acids likewise reddeu ferric salts, the last less deeply than the former. Lactic acid also occurs.

Meconin is obtained from narcotine (see above), exists also in opium, and forms colorless shining prisms, which are inodorous, bitter, soluble in alcohol, ether, and slightly soluble in water. It was discovered by Dublanc (1832), and is also known as *opianyl*. It melts in water at 77° C. (170.6° F.) and in the air at 110° C. (230° F.), and when evaporated with slightly diluted sulphuric acid gives a green color.

Meconoisin ($C_8H_{10}O_2$) was obtained by T. and H. Smith (1878) from the mother-liquors left on the isolation of meconin, from which it separates in an impure state as brown leaf-like crystalline masses. When pure it is colorless, is freely soluble in alcohol, ether, and hot water, fuses at 88° C. (190.4° F.), and on evaporation with dilute sulphuric acid yields a red color, changing to purple.

Assay of Opium.—The U. S. P. gives the following process for determining the morphine-content of opium: opium, in any condition to be valued, 10 Gm.; ammonia-water, 3.5 Cc.; alcohol, ether, distilled water,, lime-water of each, a sufficient quantity. Introduce the opium, which, if fresh, should be in very small pieces, and if dry, in very fine powder, into an Erlenmeyer flask having a capacity of about 300 Cc., add 100 Cc. of distilled water, cork it well, and agitate every 10 minutes, or in a mechanical shaker, during 3 hours. Then pour the whole as evenly as possible upon a wetted filter having a diameter of 12 Cm., and, when the liquid has drained off, wash the residue with distilled water, carefully dropped upon the edges of the filter and its contents, until 150 Cc. of filtrate are obtained. Then carefully transfer the moist opium back to the flask by means of a spatula, add 50 Cc. of distilled water, agitate thoroughly and repeatedly during 15 minutes, and return the whole to the filter. When the liquid has drained off wash the residue, as before, until the second filtrate measures 150 Cc., and finally collect about 20 Cc. more of a third filtrate. Evaporate in a tared capsule, first the second filtrate to a small volume, and then add the first filtrate, rinsing the vessel with the third filtrate, and continue the evaporation until the residue weighs 14 Gm.

Rotate the concentrated solution about in the capsule until the rings of extract are dissolved, pour the liquid into a tared Erlenmeyer flask having a capacity of about 100 Cc., and rinse the capsule with a few drops of water at a time until the entire solution weighs 20 Gm. Then add 10 Gm. of alcohol, shake well, add 25 Cc. of ether, and shake again. Now add the ammonia-water from a graduated pipette or burette, stopper the flask with a sound cork, shake it thoroughly during 10 minutes, and then set it aside, in a moderately cool place, for at least 6 hours or over night.

Remove the stopper carefully, and should any crystals adhere to it, brush them into the flask. Place in a small funnel 2 rapidly acting filters, of a diameter of 7 Cc., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), wet them well with ether, and decant the ethereal solution as completely as possible upon the inner filter. Add 10 Cc. of ether to the contents of the flask, rotate it, and again decant the ethereal layer upon the inner filter. Repeat this operation with another portion of 10 Cc. of ether. Then pour the liquid in the flask into the filter, in portions, in such a way as to transfer the greater portion of the crystals to the filter, and, when the liquid has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water, using not more than about 15 Cc. in all. Use a feather or rubber-tipped glass rod to remove the crystals that adhere to the flask. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother-liquor, and afterward wash them, drop by drop, from a pipette, with alcohol previously saturated with powdered morphine. When this has passed through, displace the remaining alcohol by ether, using about 10 Cc. or more if necessary. Allow the filter to dry in a moderately warm place, at a temperature not exceeding 60° C. (140° F.) until its weight remains constant, then carefully transfer the crystals to a tared watch-glass and weigh them.

Place the crystals (which are not quite pure) in an Erlenmeyer flask, add lime-water (10 Cc. for each 0.1 Gm. of morphine), and shake the flask at intervals during half an hour. Filter through two counterpoised rapidly acting filters, one within the other as directed above. Rinse the flask with more lime-water and wash the filters with the same fluid until the filtrate, after acidulating, yields no more precipitate with mercuric potassium iodide test-solution. Press the filters until nearly dry between bibulous paper and dry them to constant weight, and weigh. Deduct the weight of the insoluble matter remaining on the filter from the weight of the impure morphine previously found. The difference multiplied by 10 represents the percentage of crystallized morphine contained in the opium.—U. S.

As it is not always convenient to maintain a temperature at or not exceeding 60° C. (140° F.) during the drying of the crystals, this operation may be carried on on a boiling water-bath for 4 hours or in an air-bath at 110° C. (230° F.) for 2 hours, to constant weight. In this way the crystals of morphine will be rendered anhydrous, which will necessitate multiplication of the weight by 1.063, in order to get the result in terms of hydrated crystals, as demanded by the Pharmacopœia.

The assay process of the British Pharmacopœia differs materially from the above. It consists in treating powdered opium with milk of lime for half an hour, then filtering the mixture, adding alcohol and ether to an aliquot part of the filtrate, and finally liberating the morphine by addition of ammonium chloride. After washing the crystals of morphine with morphinated water they are dried to an anhydrous condition, weighed, and titrated with decinormal sulphuric acid. A correction factor is added to the final result to compensate for average loss of morphine during the process, 10 per cent. of anhydrous morphine being demanded as the official standard. This method of assaying opium, better known as the "lime method," is in favor with many operators, and has the advantage of greater purity of the morphine obtained, the latter being wholly soluble in 10 times its weight of lime-water; it also requires less time than the U. S. P. method. The weak point of the lime method lies in the fact that the increase of volume of the liquid may not always be uniform, and the solubility of morphine in the mother-liquor and wash-water may vary with different samples of opium, for which reasons an average has been decided upon in both cases. For details of this process see *Proc. Amer. Pharm. Assoc.*, 1902, p. 425.

Pharmaceutical Preparations.—Camphorated Tincture of Opium, Deodorized Opium, Extract of Opium, Pills of Opium, Powder of Ipecac and Opium, Tincture of Deodorized Opium, Tincture of Opium, Troches of Licorice and Opium, Vinegar of Opium, Wine of Opium, U. S. P.

Action and Uses.—When opium is taken internally in moderate medicinal dose, it produces a sense of mental and physical rest which differs in its degree. In some instances the patient describes the sensation as exceedingly agreeable; in other instances this period of well-being is very slight, and the second effect, that of drowsiness or sleep, is developed. The danger of this sleep depends largely upon the susceptibility of the patient and the size of the dose. Some persons are made wakeful by doses which would put ordinary persons to sleep, and rarely extreme susceptibility is present, so that deep sleep is caused by very small doses. The sleep is usually dreamless, or if dreams are present they are commonly of an agreeable type. On waking, the patient may feel greatly refreshed, or if susceptible to the after-effects of the drug he may be immediately or after several hours depressed, nauseated, and may even vomit. This effect is produced not by the opium itself, but by the oxydimorphine which is produced in the process of oxidizing the drug in the body. It is also in part due to narcotine, one of the alkaloids of opium. In some instances this secondary effect of opium is so severe as to prevent the use of the drug if it can be possibly avoided. When small doses are used, opium is entirely destroyed in the body by oxidation; but if the dose be very large, some of its alkaloidal contents escapes in the urine. If doses in excess of those which are medicinal in size are given, the sleep comes on more speedily and is more profound, but even in severe poisoning active measures will arouse the patient to some degree of consciousness as a rule. The effect of the drug in doses of this and of the smaller size is to make the pulse fuller and slower, the skin warm and dry, and the face slightly flushed. As the poisoning deepens the face becomes blue or cyanosed, from failure of respiration, and the breathing drops from the normal rate to 12 or 10 per minute. At first the respirations, though slowed, are deeper; then they become more and more shallow and more and more slow, till they cease in death. The pulse, at first somewhat slow, becomes more rapid as the poisoning advances, and the skin becomes cold and clammy when the patient is near dissolution. The pupils are tightly contracted till the moment of death, when they become widely dilated. When the patient is aroused the cyanosis disappears with the temporary increase in the respiratory activity, but as he sinks back into unconsciousness the blueness returns. The body temperature is not materially reduced till death is at hand. The treatment of opium-poisoning consists in the use of an emetic or stomach-pump, the giving of strychnine hypodermically, of strong black coffee by the mouth or rectum, to stimulate the heart, respiration, and the vital forces generally, and the giving of potassium permanganate to act as a chemical antidote on the drug while it is still in the stomach. The electric wire brush with a fairly strong current may also be used to keep the patient awake, so that he will breathe voluntarily instead of depending upon the depressed respi-

ratory centre in the medulla. If the electric brush is not obtainable, slapping with wet towels or small twigs may be used, care being taken not to bruise the patient or exhaust him by too constant walking to keep him awake. It is also important to wash out the stomach frequently, in order to remove the drug which is excreted into the viscus after it has been absorbed.

Medicinal doses of opium check secretion of all glands in the body except those of the skin and kidneys, the activity of which is sometimes increased, particularly that of the skin. Such amounts also diminish intestinal peristalsis and cause constipation by stimulating the inhibitory fibres of the splanchnic nerves and by checking the secretion of the intestinal juices. For these reasons it is a valuable remedy in watery or serous diarrhœa, but it is contraindicated in mucous diarrhœa, since it locks in the bowel discharges which should be expelled.

Opium relieves all forms of pain by directly benumbing the perceptive centres in the brain and by allaying irritation and spasm. Aside from the anæsthetic drugs it is the most powerful pain-relieving drug that we have.

Because of its pain-relieving and diaphoretic power it is used largely in the form of Dover's Powder to produce sweating in the early stages of acute diseases.

As opium checks excessive secretion, it also proves useful in diabetes mellitus and insipidus, in the former disease often in an unexplained manner diminishing the excretion of sugar.

Opium will always produce sleep if given in large enough dose, and is particularly useful in insomnia due to pain. It is not to be used in nervous insomnia, as it is apt to produce the opium-habit.

Because of its sedative effects it is often given to produce rest and to conserve energy in cases in which, because of active delirium and restlessness, the vital forces are impaired. So, too, in cases of advanced valvular disease of the heart it may be beneficial.

The opium-habit is an exceedingly common condition, arising from abuse of the drug. Its chief characteristics are the development of lack of moral sense in the patient, clever lying by him, and an insatiable desire for additional doses of the drug. It is best treated, as a rule, by isolation, and the proper use of hyoscine. The dose of gum opium is from ½ to 1 grain (0.03–0.06 Gm.), of powdered opium ¼ to 1 grain (0.015–0.06 Gm.).

OPIUM DEODORATUM, *U. S.*—Deodorized Opium.

Opium sans odeur, Fr.; *Desodorirtes Opium*, G.

Preparation.—Powdered opium, 500 Gm.; purified petroleum benzin, a sufficient quantity. Macerate the powdered opium for 24 hours in a wide-mouthed, well-closed bottle, with sufficient purified petroleum benzin to completely cover it, shaking occasionally. Decant the liquid as closely as possible, and repeat the treatment with purified petroleum benzin. Again decant the liquid and pour the contents of the bottle into a plain filter contained in a glass funnel, which should be well covered, drain, and then slowly percolate the residue with purified petroleum benzin until the latter passes without odor. Remove the filter containing the opium from the funnel and expose the powder to the open air, so that it may dry thoroughly.

Deodorized opium should be kept in well-stoppered bottles, and, when assayed by the process given under OPIUM, should be found to yield not less than 12 nor more than 12.5 per cent. of crystallized morphine.

Opium of any coarser degree of powder may be deodorized in the same manner as directed above.—U. S.

The above process, first suggested by A. E. Ebert, is decidedly preferable to the ether-process of former pharmacopœias, inasmuch as it fully deodorizes the opium without removing from it the narcotine. The odorous matter in opium, which is said to cause the nausea and discomfort in many patients, together with caoutchouc, wax, and oily substance, is effectually removed by the benzin, which latter should be of high grade, about 88° C. (190.2° F.), and thoroughly purified by the official process.

Action and Uses.—The action and uses of deodorized opium are the same as those of opium. It possesses the advantage over gum or powdered opium in that it does not so commonly produce the nausea and other unpleasant after-effects of these forms of the drug. The dose is from ¼ to 1 grain (0.015–0.06 Gm.).

OPIUM GRANULATUM, *U. S.*—Granulated Opium.

Opium grenelé, Fr.; *Granulirtes Opium*, G.

Preparation.—The U. S. Pharmacopœia directs that opium shall be dried at a temperature not exceeding 85° C. (185° F.) and reduced to a coarse (No. 20) powder.

Granulated opium, when assayed by the process given under OPIUM, should yield not less than 12 nor more than 12.5 per cent. of crystallized morphine. Granulated opium of a higher percentage may be brought within these limits by admixture with granulated opium of a lower percentage in proper proportions.—U. S.

Action and Uses.—For the action and uses of granulated opium, see OPIUM.

ORCHIDACEÆ.—The Orchid Family.

Few, if any, plants exceed the orchids in botanical and curious interest; yet the family is almost devoid of economic value, apart from VANILLA, except for its ornamental properties. More than 400 genera are recognized, and the species probably number not far from 10,000. Interest centres chiefly in the curious forms of the flowers, often simulating those of particular insects, as do the colors. In these ways, as well as by their peculiar odors, the flowers are highly adapted to insect pollination.

CYPRIPEDIUM and SALEP are the only important medicinal products, and these are elsewhere considered.

CORALLORHIZA (*Coral-root, Crawley, Turkey-claw, Chickens'-toes, Dragon's claw*) is the root and other underground portion of *Corallorhiza odontorhiza* (Willd.) Nutt. (*Cymbidium o.*—Nutt.), a peculiar, leafless, purplish-brown saprophyte, growing in deep forests, in leaf-mould, through the eastern and central United States. The stem is about 2.5 Cm. (10 In.) high, rather stout and succulent, and bears from 8 to 20 flowers of a somewhat paler color than the stem, their lips nearly entire. The drug consists of numerous small fleshy tubers, which are united by their broader sides and form many branches of different length, but of the same articulated appearance, resembling coral in arrangement. It is of a brown color externally, whitish within, and has, particularly in the fresh state, a peculiar odor and a bitterish and astringent taste. Its proximate constituents have not been ascertained, but it apparently contains a little volatile oil, tannin, and a bitter body.

C. multiflora Nutt. is similar but somewhat stouter. Its flowers are open, and the lip is deeply 3-lobed.

Angræcum fragrans Thou., of Madagascar, yields very fragrant herbage which, under the names *Faham* or *Faham tea* and *Isle of Bourbon tea*, is used as a substitute for ordinary tea. It is said to have a somewhat similar nervous effect and is employed as a stomachic and antispasmodic, much like *Cypripedium*.

Goodyera is the herbage of *Peramium ripens* (L.) Salisb. (*Satyrium r.*—L.; *Goodyera r.*—R. Br.), and to some extent of *P. pubescens* (Willd.) Mac M. These are known as *Rattlesnake* or *Net-leaved plantain*. The first named is also called *White plantain* or *Squirrel-ear*. They are peculiar little woodland herbs, their ovate leaves beautifully reticulated with white lines. They enjoy some domestic repute as alteratives.

Many plants of the family possess slight aromatic properties. The root of *Cremastra Wallichiana* Lindl., the *Nimak-kotuk* of the East Indies, is chewed for the relief of toothache.

OROBANCHACEÆ.—The Broom-rape Family.

This is a small and very curious family of saprophytes, of almost no economic value. A large part of its species have been more or less used in medicine. Some of them appear to possess some medicinal activity, but most of their use appears to depend upon fanciful ideas derived from their peculiar forms and habits. The family includes a dozen genera and 125 recognized species, according to Beck. The following are the best known in medicine:

CANCER-ROOT is a name which has been applied, evidently because of their tumid and misshapen saprophytic roots, to the 4 species next named, as well as to others, not of this family.

Leptamnium Virginianum (L.) Raf. (*Orobanche V.* L.; *Epiphagus V.* Bart.; *Epifagus Americana* Nutt.) is the *Beech-drops* or *Cancer-drops*, *Broom-rape* or *Fir-rape* (*Krebswurz*, G.; *Orobanche de Virginie*, Fr.), native of eastern North America, where it is parasitic upon the roots of beech trees. The subterranean portion consists of a subglobular scaly tuber, 12 Mm. (½ In.) or more in diameter. The stem is about 30 Cm. (12 In.) high, much branched, angular, with ovate scales at the base of the branches and flowers. The flowers are in long spicate racemes, the lower ones fertile and with a short corolla, the upper ones sterile, with a long tubular and 2-lipped corolla, about 8 Mm. (⅓ In.) long. The stamens are didynamous, and the superior capsule is 1-celled, 2-valved, and contains numerous minute seeds. All parts

of the plant have a pale purplish- or yellowish-brown color, and a disagreeable, bitter, and somewhat astringent taste. The constituents of the plant have not been investigated.

Thalesia uniflora (L.) Raf. (*Orobanche u.* L.; *Anoplanthus u.* Endl.; *Aphyllon u.* T. et G.) is the *Naked, One-flowered,* or *Pale broom-rape* or *Cancer-root,* and grows throughout most of North America, in woodlands and copses. The peduncles grow in fascicles from a very short, thick, fleshy and scaly, nearly subterranean stem, and are about 10 Cm. (4 In.) long, each terminating in a nodding flower, having a curved, tubular, somewhat 2-lipped corolla, the stamens included. The whole is pubescent and of a pale tawny-violet color.

T. fasciculatum (Nutt.) Britton, the clustered *Cancer-root,* etc., bears several erect flowers upon a peduncle.

Conofolis Americana (L. f.) Wallr. (*Orobanche A.* L. f.) is the *American broom-rape, Earth-club,* or *Squaw-drops,* and grows in oak-woods throughout the eastern and central United States. The stems are about 10 to 15 Cm. (4–6 In.) high, as thick as the finger, of a rust-brown color, scaly and fleshy, and bear singly in the axils of the scales slender, curved, 2-lipped, yellowish flowers which have 4 exserted stamens.

Various species of the Old World genus *Orobanche,* the true Broom-rapes, are used either as antispasmodics or mild astringents, as well as for fanciful reasons.

OXYGENIUM.—Oxygen.

Oxygène, Fr.; *Oxygen, Sauerstoff,* G.

Symbol, O. Atomicity bivalent. Atomic weight, 15.88.

Oxygen was discovered by Scheele (1773) and Priestley (1774). It constitutes about one-fifth of the volume of atmospheric air, the remainder being nitrogen with a small proportion of carbon dioxide. Eight-ninths of the weight of water and one-half the weight of many minerals consist of oxygen, and it is estimated that at least one-third the weight of the solid crust of the earth is made up of this element, which is the most abundant of all.

Preparation.—Oxygen may be obtained by exposing manganese dioxide, mercuric oxide, or some other metallic oxide, to a strong heat, but it is most conveniently prepared by heating a mixture of 4 or 5 parts of potassium chlorate with 1 part of manganese dioxide. At a low red heat the chlorate is completely decomposed into oxygen and potassium chloride, which remains mixed with the manganese dioxide; the latter, not being altered, may be recovered by dissolving the potassium chloride in water: $KClO_3$ yields $KCl + O_3$. Care should be taken that black antimony sulphide be not used in place of manganese dioxide, and that the mixture be free from organic compounds or charcoal, since a violent explosion would take place on the application of heat.

When manganese dioxide is mixed with potassium chlorate, oxygen is given off from the latter at a much lower temperature and more regularly than when the chlorate is heated alone. It is not definitely known what part the manganese dioxide plays in the change, as it apparently remains unaffected after the action is over. This and all similar cases are designated as action due to *catalysis.*

The oxygen should be purified before storing in receivers, by allowing it to pass through wash-bottles containing alkali. To render oxygen dry, it is passed through concentrated sulphuric acid.

Compressed oxygen is now in the market in strong steel cylinders. This is a convenient form for obtaining oxygen when large quantities are needed.

Properties.—Oxygen is a colorless inodorous gas having the density 1.1056 (air = 1). 1 liter at 0° C. (32° F.) and 760 Mm. barometric pressure weighs 1.4292 Gm. It can be liquefied (see under AER), and then it has a bluish color, boils at −181° C. under atmospheric pressure, and has the density 1.135 (water = 1). 100 volumes of water at 0° C. (32° F.) dissolve 4.1 volumes, at 15° C. (59° F.) 2.9 volumes of oxygen. 100 volumes of absolute alcohol dissolve 28 volumes of oxygen. It combines with almost all elements (argon, helium, fluorine, krypton are exceptions) either at ordinary temperature or when heat is applied. The products are called *oxides,* the act of combination is called *oxidation,* and when attended with great heat and light it is termed *combustion.*

Oxygen is essential to animal life, respiration being a process of slow combustion whereby some of the waste products of the body are oxidized to carbon dioxide, which is given off from the lungs. Carbon dioxide is food for plants, which appropriate the carbon and give off the excess of oxygen, and thus a constant proportion of oxygen and carbon dioxide is kept up in the atmosphere by the reciprocal action of plants and animals (see AER).

Ozone.—This is an allotropic modification of oxygen, formed when electric discharges take place through oxygen or air, by the slow oxidation of phosphorus in moist air, and under various other circumstances. Various electrical ozonizing machines exist, but those of Siemens and v. Babo are the best, by which air or oxygen containing 8 to 9 per cent. of ozone can be obtained. When such a mixture is cooled by liquid air or oxygen, the ozone condenses to a blue liquid containing as much as 80 per cent. of pure ozone, which is very dangerous, as it explodes very easily, forming oxygen. Ozone has the molecular formula O_3, and is a condensed form of oxygen, 3 volumes of the latter forming 2 volumes of the former. In the gaseous state it has a characteristic and penetrating odor, resembling sulphur dioxide. It gradually breaks down into oxygen, the more so as its temperature is raised, is less soluble in water than oxygen, and gradually forms hydrogen dioxide with it: $H_2O + O_3 = H_2O_2 + O_2$. As such water possesses oxidizing powers, it led to the very general but erroneous view that ozone was soluble in water, and that "ozone-water" was a very good medicinal and antiseptic agent. Ozone is soluble in some organic liquids, such as turpentine and cinnamon oils, which thus become strong oxidizers. It bleaches indigo solution, liberates iodine from potassium iodide, turns silver dark, gives a blue color with tincture of guaiac, and turns an acid (HCl) solution of meta-phenylene-diamine red much sooner than does hydrogen peroxide or nitrous acid.

The quantity of ozone in air or oxygen is determined by passing the mixture through potassium iodide solution, acidifying, and titrating the iodine set free by centinormal thiosulphate solution. 1 Cc. of the latter represents 0.00024 Gm. of ozone.

Minute quantities of ozone exist in the atmosphere, which are variable and dependent on the time of year, temperature, condition of the earth's surface, etc.

Action and Uses.—Oxygen gas is used by inhalation in medicine for the purpose of improving the condition of the blood in those diseases of the respiratory and circulatory systems which result in an imperfect supply of this gas to the tissues. It is also employed by inhalation in cases in which the use of drugs, such as the anæsthetics, for example, have impaired the respiratory function and produced cyanosis, and not infrequently it is employed by surgeons for the purpose of preventing disagreeable effects and after-effects produced by ether and chloroform; the gas being given by inhalation with the vapor of these anæsthetics.

The real value of oxygen in relieving respiratory distress in the course of pneumonia and other diseases of the respiratory system which are associated with a certain degree of cyanosis is problematical. An investigation as to the custom of physicians of large experience in the treatment of these disorders reveals the fact that they constantly resort to this gas for the relief of cyanosis and respiratory difficulty, and yet are unable to assert that it does the patient any considerable amount of good. Its use in the dyspnœa and coma due to Bright's disease and in that due to diabetes is popular, but its employment is not based upon any sound scientific reasoning; for in many of these cases the dyspnœa does not result in very great cyanosis, and is due more to toxæmia and depression than it is to any distinct interference with the absorption of oxygen by the blood.

While a number of forms of apparatus have been invented for the purpose of the inhalation of this gas, none of them are of practical value at the bedside, for the patient is so short of breath that though he needs oxygen he is usually too short of breath to be willing to submit to the use of a face mask through which he may inhale the gas. In the experience of the writer the gas is best given by permitting it to escape beneath the nostrils of the patient, so that he takes a considerable quantity of it into his lungs, with each inspiration of ordinary air.

In the use of oxygen it is important to remember that it can only be taken up by the blood in certain definite quantities, for oxygen forms a chemical compound with the hæmoglobin, and therefore it is not possible for each red blood-corpuscle to contain a greater quantity of oxygen than that which is necessarily present in oxyhæmoglobin.

Oxygen was originally introduced into medicine with the idea that it could be taken up by the blood in unlimited quantities if the opportunity was offered, and it has been employed in a host of diseases with asserted advantage with this idea in view. Thus pulmonary consumption, diabetes, albuminuria, dyspepsia, and even epilepsy have been treated by its inhalation. Needless to say, the results obtained have been *nil*, and if the patient has improved, the improvement has been due to coincidence or to the imagi-

nation of the patient. In cases of respiratory distress due to profound anæmia or hemorrhage it is evident that oxygen cannot be expected to relieve the patient materially, for the difficulty lies, not in lack of oxygen, but in the fact that the blood does not contain a sufficient number of red corpuscles to absorb the quantity of oxygen which is needful for a normal existence.

OXYMEL, *Br.*—Oxymel.

Oxymel simplex, Mel acetatum.—Oxymel simple, Mellite de vinaigre, Acètomel, Fr.; *Sauerhonig,* G.

Preparation.—The Br. P. directs 40 ounces (by weight) of liquefied clarified honey to be mixed with 5 fluidounces of acetic acid and sufficient distilled water to produce a mixture having the specific gravity 1.320. The French Codex orders 1 part of white wine vinegar to be mixed with 4 parts of virgin honey, and the mixture to be concentrated and clarified with paper pulp, and to have while boiling a specific gravity of 1.260.

Action and Uses.—This is an official form of the popular mixture of honey and vinegar, which is generally used as a gargle in sore throat. It may be prescribed as an excipient for various expectorant medicines, and particularly for squill and ipecacuanha in the form of syrup.

OXYMEL SCILLÆ, *Br., P. G., Fr. Cod.*—Oxymel of Squill.

Oxymel scilliticum.—Oxymel scillitique, Mellite de vinaigre scillitique, Fr.; *Meerzwiebelhonig,* G.

Preparation.—Squill, bruised, 2½ ounces; acetic acid, 2½ fluidounces; distilled water, 8 fluidounces; clarified honey, a sufficient quantity. Digest the squill for 7 days in a mixture of the acetic acid and distilled water. Press strongly; filter. Mix the product, which should measure about 10 fluidounces, with about 27 fluidounces of the clarified honey, or sufficient to produce oxymel of squill having the specific gravity 1.320.—Br.

The P. G. directs that 1 part of vinegar of squill and 2 parts of honey shall be mixed and evaporated to 2 parts.

The Fr. Cod. orders 1 part of vinegar of squill to be mixed with 4 parts of honey, the mixture to be clarified with paper pulp and evaporated until it has a specific gravity of 1.260.

Action and Uses.—Oxymel of squill may be substituted for syrup of squill, the properties of which it adequately represents. The dose is from 30 to 60 minims (2–4 Cc.) as an expectorant for adults, and 5 to 20 minims (0.30–1.30 Cc.) for infants and children.

P.

PALMÆ or PRINCIPES.—The Palm Family.

The Palms, comprising about 128 genera and more than 1000 species of shrubs and trees of tropical and subtropical regions, together with the Pine and Grass families, take first rank in economic importance. All three families, strangely enough, are among the very lowest of flowering plants. There are a number of Palms, any one of which, like the Coco-nut, is capable of supplying almost all human necessities. Some of the most important starch-yielders pertain to this family and are discussed under AMYLUM. Several important yielders of sugar are mentioned under SACCHARUM. The annual product of Palm oils is of great value (see OLEA PINGUIA). The young tissues of many species constitute an excellent substitute for cabbage. Many excellent and important edible seeds and fleshy fruits are produced, and great quantities of alcohol and alcoholic beverages are manufactured from Palm products. Palm wax has been considered under CERA, a balsam under RESINA DRACONIS. Least among the useful properties of the family are those pertaining to medicine. The only strongly pronounced medicinal property pertaining to the family is an anthelmintic one, illustrated by ARECA, and Coco-nut oil. The only other drug of this family worthy of special mention is SABAL, elsewhere considered.

PANAX.—Ginseng.

Kraftwurzel, G.; *Schin Seng, Jin-tian, Jin-shen*, Chin.

The roots of several species of *Panax* L.—Fam. *Araliaceæ*.

Although Ginseng is not official in any pharmacopœia and its medicinal value is almost *nil*, yet its great and growing commercial importance calls for a somewhat extended account.

Origin.—The original Ginseng is derived from *P. Ginseng* Nees (*Aralia G.* Dec. et Planch.), and is distinguished as Asiatic or Chinese Ginseng. It is a native of Manchuria and other parts of eastern Asia, and is largely cultivated there, as well as in Korea and Japan. The use of the root was so popular in China that the above-named sources of supply were found incapable of supplying the demand, and recourse was had to the American species *P. quinquefolius* L. (*Ginseng q.*, Wood; *Aralia q.*, Dec. et Planch.; *P. Ginseng* C. A. Meyer; *P. Ninsi* Thunb.), which yields the *American ginseng, Jinshang, Ninsin, Five-fingers, Garentoquen* (or *Grantogen*), or *Schinseng*. This is eagerly purchased by Chinese traders for export to China. The above-named are the two principal varieties; others are mentioned below.

The American species, in which we are chiefly interested, is a smooth perennial herb, from a very slow-growing root, described below. The stem is from 30 to 50 Cm. (1 to 2 Ft.) high, erect, and bearing at the summit a whorl of (usually 3) long-petioled, large, 5- to 7-digitately compound leaves, and an umbel of 5 to 20 small greenish-yellow flowers. The leaflets are from 5 to 15 Cm. (2 to 6 In.) long, ovate to obovate, abruptly short-acuminate, irregularly toothed and thin. The umbel is borne on a slender peduncle 1 to 2 inches in length, and the flowers on slender pedicels about half as long. The fruit is bright-red, about 1 Cm. ($\frac{2}{5}$ In.) broad, flattened and 2-carpelled. The plant grows in rich woods throughout eastern and central North America. It was used to a considerable extent by the North American Indians. Since its collection for exportation, it has been so eagerly sought as to have become exterminated in many districts where it was formerly abundant, and quite scarce elsewhere. A great deal is collected in eastern and central New York, the most of it, perhaps, in and about Minnesota. The tendency toward its extermination, and its high market value, have led to its cultivation, discussed below, and to various devices for preserving the natural supply. In Canada, a fine is imposed for collecting it between January and the first of September. Among the Indians, it is customary to collect the root only after the maturity of the fruit, and to bend down the stem so as to permit of covering the former with earth, before digging the root, thus providing for its propagation. We have been assured by Indian collectors that a large number of such seeds will germinate, and that they have been able to increase their area of collection by this method.

The root should be collected only in the fall, in which case it will retain its plump and handsome appearance after drying. Such roots are also characterized by a much more prominent dark cambium-zone on transverse section. The root is much more highly prized when of a fine light color, which it is far more apt to assume when grown in deep black forest mould. The best root is said to be that collected by the Sioux Indian women, who impart this white appearance by rotating it with water in a partly filled barrel, through which rods are run in a longitudinal direction. In no other way, it is said, can the surface be so thoroughly and safely cleansed.

Fig. 297.

Panax quinquefolius L.

Description.—Ginseng root ranges from 5 to 7 Cm.(2 to 3 In.—occasionally nearly twice this size) in length, and from 1 to 2 Cm. ($\frac{1}{2}$ to 1 In.—occasionally more) in thickness. Its main portion is fusiform and heavily annulated, with a roundish summit, often with a slight terminal projecting point. At the lower end of this straight portion there is a narrower continuation, turned obliquely outward. Very often a rather smaller branch turns outward in the opposite direction, and a very small branch is occasionally borne in the fork between these two. Some small rootlets exist upon the lower portion. The color ranges from a pale yellowish-white to brownish-yellow or, if badly cured, to a brownish color. The structure is fleshy and somewhat elastic or flexible, and it is of a firm, solid consistence, if collected at the proper time and properly cured. The bark is very thick, yellowish-white, radially striate in old roots, and contains brown-red resin-cells. A brown cambium-band separates the bark from the wood, which is strongly and coarsely radiate, with yellowish wood-wedges and whitish medullary rays. The root is of a somewhat aromatic odor and a slightly sweetish and aromatic and strongly mucilaginous taste.

Since the chief value of Ginseng depends upon its favor with the Chinese, and this in turn depends almost wholly upon fanciful considerations, its commercial value is determined in a high degree by its appearance. The roots are valued in accordance with their large size and light color, their plumpness and firm consistence, their unbroken and natural form, and, above all, by the presence in a perfectly developed condition of the three branches above described. A Chinese trader, examining a lot of Ginseng, will eagerly, and by the most cunning devices, seek an opportunity for abstracting from a bale one or more select roots which may represent, in the Chinese market, a money value several times greater than that of the entire remainder of the lot.

Adulteration.—So far as the American market is concerned, there is hardly any other article which can be successfully substituted for entire Ginseng, the only condition in which it is handled to any extent. Adulteration, however, is largely practised, chiefly by the Chinese, by introducing heavy bodies to increase its weight. They are frequently known to bore out the interior through a minute opening and to plug it with lead, afterward closing and concealing the orifice.

Constituents.—The constituents of Ginseng are quite unimportant. There is a large amount of starch and gum, some resin, a very small amount of volatile oil, and the peculiar sweetish body panaquilon ($C_{12}H_{25}O_9$). This occurs as a yellow powder, soluble in ether and alcohol, not in water, colored purple-red with sulphuric acid, and precipitating with water a white amorphous substance which has been called panacon ($C_{11}H_{19}O_4$).

Cultivation.—The cultivation of Ginseng offers a rich field to American agriculture. The most contradictory statements have been made, many of them, on both

sides, from self-interest. Confidence-men, engaged in vending the seeds or roots, have made fabulous statements as inducements for taking up its cultivation, while upon the other hand, those who were already profiting largely from its cultivation have presented discouraging reports, fearing a reduction of their profits through undue competition. The facts are, that the cultivation of Ginseng presents considerable difficulty, owing to the great care and special methods required; and that it is a very slow-growing crop, so that rapid returns can hardly be anticipated. Nevertheless, the percentage returns for the industrious, patient, and painstaking farmer are large, and the demands for a fine article for export are not at all likely to be exceeded by the supply. It is not likely that any cultivation within the present generation will reduce the wholesale price below 2 or 3 dollars per pound. Bulletins of instruction for its cultivation are issued by the U. S. Department of Agriculture. See also *Proc. Amer. Pharm. Assoc.*, 1901, p. 90.

Chinese Ginseng is a larger plant but presents practically the same appearance and habits of growth. Its culture in the United States has never been attempted, but it would appear to be a very promising field for experiment. The drug is also considerably larger than the American, but otherwise its characters are practically the same. The article known as *Red Chinese Ginseng* is made by subjecting the root to a prolonged steaming process by which its weight is reduced about one-half, and it is made to assume a somewhat translucent appearance. Either this, or an unknown species, or possibly both, yield an article known as *Mandarin Ginseng*, select roots of which frequently bring several hundred dollars an ounce.

Six species of Panax are recognized, and the roots of all appear to show a similar composition and properties.

Action and Uses.—This plant possesses little more than the properties of a stomachic. In the United States it is occasionally employed as a masticatory, but in China both varieties are used as a panacea, and particularly for dyspepsia, vomiting, nervous disorders, and sexual impotence.

PANCREATINUM, *U. S.*—Pancreatin.

Pancreatina, Fr. Cod.; *Pancréatine médicinale*, Fr.; *Pankreatin*, G.

A mixture of the enzymes naturally existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of the hog or the ox, and consisting principally of amylopsin, the starch-converting enzyme, myopsin and trypsin, the enzymes that digest albuminoids, and steapsin, the enzyme that digests fat, and capable of converting not less than 25 times its own weight of starch into water-soluble substances, principally sugar, when tested by the process given below.—U. S.

Origin.—The pancreas, or sweetbread, is a large compound racemose gland situated in the epigastric and right and left hypochondrial regions, beneath the stomach. Its right rounded extremity lies next to the duodenum; its left pointed extremity adjoins the spleen. The cells of the gland contain principally zymogens, from which the enzymes are derived. The juice secreted by the pancreas is a clear, colorless, odorless, viscid liquid, when fresh usually not containing more than 1–2 per cent. of matter in solution. While the pancreatic juice obtained from living animals is alkaline, the gland itself, examined soon after removal from recently killed animals, will be found to give an acid reaction. Hydroalcoholic, aqueous, or glycerin solutions prepared from such glands also show an acid reaction toward litmus. The ash from the gland is acid, and contains phosphoric acid.

Preparation.—The U. S. P. gives no process for preparation of pancreatin. The French Codex directs that the pancreas gland, freed as far as possible from foreign matter, is to be minced and placed in water containing a small quantity of chloroform to prevent decomposition. After some time of contact the insoluble residue is expressed, and the resulting liquid filtered and rapidly evaporated in a current of air at a temperature not exceeding 45° C. (113° F.).

Other methods are followed by different manufacturers, such as precipitation with alcohol of an infusion prepared from the pancreas gland with cold water, after removal of fat and connective tissue; or the pancreas, having been freed by mechanical means, as far as possible, from fatty and connective tissue, is minced and passed through a sieve, carefully dried and powdered, and then purified by treatment with solvents for the removal of fat, coloring-matters, etc.

Constituents.—Pancreatin consists of a mixture of at least 4 soluble unorganized ferments, more specifically termed enzymes, and differing from one another in their digestive functions. They are designated respectively as the proteolytic, the amylolytic, or diastasic, the fat-splitting, and the milk-curdling ferment. As yet none of the ferments has been isolated. These enzymes do not exist as such in the cells of the pancreas, but are derived from the zymogens during the digestive process.

Trypsin, the proteolytic ferment, resembles pepsin in its behavior toward albuminoids, and continues in the intestine the work of that ferment begun in the stomach. It differs, however, from pepsin in acting best in a slightly alkaline medium and in splitting the products of peptic digestion, the albumoses and peptones, into simpler bodies, better adapted for absorption as nutritive agents. It is particularly active toward fibrin and muscular tissue, but does not digest coagulated egg-albumin as rapidly as pepsin. It also rapidly digests the casein of milk, with the intermediate formation of metacasein, coagulable by boiling. The presence of a small amount of sodium or potassium bicarbonate in the milk prevents the coagulation of the metacasein. As in the case of pepsin, the action of trypsin is confined to the surface of the substance exposed, the more soluble bodies passing into solution as fast as formed.

While the presence of about 1 per cent. of sodium carbonate or bicarbonate, of the digesting mass, is favorable to increased tryptic activity, the latter also occurs in neutral or even very slightly acid media, showing that the presence of alkali is not absolutely essential. The presence of very small proportions of acid (about 0.03 per cent. of hydrochloric or 0.25 per cent. of acetic acid) is by no means hurtful to the action of trypsin, but an increase to even as little as 0.1 per cent. of hydrochloric acid completely destroys the ferment, and hence its activity ceases at once in a medium having the degree of acidity favorable to peptic action. Trypsin is most active at a temperature between 37° and 40° C. (98.6° and 104° F.). and continues up to 50° C. (122° F.), above which it rapidly diminishes, and ceases altogether at 75° C. (167° F.).

Amylopsin, or pancreatic diastase, closely resembles ptyalin and grain diastase, both in properties and products of conversion, but its action is much more energetic, rapidly liquefying starch-paste and converting starch into dextrin and maltose. Its greatest activity is manifested at a temperature between 30° and 45° C. (86° and 113° F.), and is destroyed at 65° C. (149° F.). The action of amylopsin is not increased by alkalies and is weakened by the presence of acids.

Steapsin, or lipase, has the special function of emulsifying fats and splitting them up into glycerin and free fatty acids. It is rapidly destroyed by strong alcohol and by all acids, except the fatty, being the most delicate of the pancreatin enzymes. Its action on fats can be readily demonstrated by adding a few drops of a neutral solution of pancreatin to a neutral ethereal solution of butter, when upon addition of a little litmus solution the characteristic color-change will take place.

Rennin, or the milk-curdling ferment, is probably identical with that found in the stomach, although according to F. Baden Benger (*J. S. C. I.*, 1887) an alkalinity of 3 to 4 grains of sodium bicarbonate per ounce of milk is favorable to the action of the rennin of the pancreatic juice, whereas the activity of the rennin of the stomach is destroyed by the alkalinity of 1 grain per ounce under similar conditions. The presence of the milk-curdling ferment often fails of detection, on account of the rapid digestion of the casein by the trypsin.

Properties.—The U. S. P. describes pancreatin as a cream-colored, amorphous powder, possessing at most only a faint peculiar odor and a somewhat meat-like taste; slowly soluble in water, and containing not more than 10 per cent. of matter insoluble in that solvent; insoluble in alcohol. It is hygroscopic, and when exposed to the air for some time loses its value; hence it should be preserved in well-stoppered bottles. Dilution with sugar of milk seems to retard deterioration, and saccharated pancreatin has been found to retain its peptonizing value far better than the pure article. Dissolved in water, pancreatin yields a clear, pale-yellowish liquid, which is precipitated by heat, mineral acids, metallic salts, absolute glycerin, strong alcohol, and tannic acid, but not by a saturated solution of sodium chloride; in this latter respect it differs markedly from pepsin. It is not possible to prepare a solution of pancreatin which will retain the activity of all the enzymes present: this is perhaps due to the destructive effect of the trypsin upon the other ferments. Pancreatin is incompatible with acid pepsin solutions, and hence they should not be combined. In dry form the ferments of pancreatin are

very stable, but in solution, neutral or alkaline, they undergo change even at ordinary temperature.

Valuation.—The chief value of pancreatin lies undoubtedly in its peptonizing and starch-converting power, and hence both should be determined. The French Codex demands that pancreatin shall dissolve and change into peptone 50 times its weight of fibrin and convert 40 times its weight of potato-starch into sugar, methods of assay being given for both determinations. The U. S. P. gives the following methods for valuation of the amylolytic and proteolytic powers of pancreatin.

Assay of Pancreatin.—Dry powdered starch, 7.5 Gm., distilled water 120 Cc., pancreatin, 0.3 Gm., iodine test-solution, consisting of 2 drops of one-tenth normal iodine solution dissolved in 60 Cc. of distilled water. Place the starch in a flask, add the 120 Cc. of distilled water, and boil until a transparent mixture results. Cool the resulting paste to 40.5° C. (105° F.), and add to it the pancreatin previously dissolved in about 10 Cc. of water at 40.5° C. (105° F.). Shake well and maintain the temperature at 40.5° C. (105° F.) for 5 minutes, when all the starch should be converted into water-soluble substances, resulting in a thin liquid. To 2 drops of this thin liquid, kept at 40.5° C. (105° F.), add the 60 Cc. of iodine test-solution, when no blue color should result, indicating conversion into sugar, or at most a wine-red color, indicating dextrin and maltose. The appearance of a blue, purple, or any shade of color containing a blue tint condemns the pancreatin as being below standard.—U. S.

If there be added to 100 Cc. of tepid water contained in a flask, 0.28 Gm. of pancreatin and 1.5 Gm of sodium bicarbonate and afterward 400 Cc. of fresh cows' milk previously heated to 38° C. (100.4° F.), and if this mixture be maintained at the same temperature for 30 minutes, the milk should be so completely peptonized that if a small portion of it be transferred to a test-tube and mixed with some nitric acid, no coagulation should occur.—U. S.

Peptonized milk, prepared in the manner just described, or even when the process is allowed to go on to the development of a very distinct bitter taste, should not have an odor of rancidity.

Action and Uses.—Pancreatin contains three digestive ferments, namely, trypsin, which converts proteids into peptones, amylopsin, which converts starches into sugar, and steapsin, a fat-splitting ferment, which aids in the emulsification of fats and decomposes them into glycerin and fatty acids. It is evident, therefore, that pancreatin is a powerful and useful digestive substance, more valuable than is pepsin, since it deals with practically all articles of food. For its activities to be exercised it is essential that the reaction present shall be alkaline. Because of the activities just described pancreatin is used in medicine for the purpose of aiding the digestive functions whenever they are unable, by reason of insufficient or abnormal secretion, to deal with the food which is ingested. In some cases it is given with the food, adding it in liquid or powdered form to the milk or other liquid nutriment if for a child or invalid, or prescribing it in capsule or tablet if the patient is an adult whose digestion is impaired. In whatever manner it is given it is customary to prescribe sodium bicarbonate at the same time.

A large part of the pancreatin at present employed is prepared by Parke, Davis & Co. or Fairchild Brothers and Foster, and is put up either as pure pancreatin in powder with or without sodium bicarbonate, or in the form of tablets, or as peptonizing powders, so prepared that each tablet or powder is of such a size that it will peptonize or digest a given quantity of milk.

The following specific instances in which pancreatin can be employed with advantage may be cited: In cases of gastro-intestinal indigestion in adults and children; in those instances in which bottle-fed babies are unable to digest and assimilate food, and as a consequence pass undigested curds and fat in the stools, for the preparation of nutritive enemata, in the hope that the patient may be nourished by the rectum, when, because of gastro-duodenal disorder, food cannot be taken by the mouth.

For the preparation of food for a bottle-fed child the pancreatin may be added just as the milk is given and the digestive process carried out solely in the stomach, or the milk may be exposed to warmth and the action of the pancreatin for some minutes before it is swallowed.

In cases of indigestion and diarrhœa milk may be prepared as follows: Pour into a clean porcelain-lined saucepan the powder contained in one of the peptonizing tubes, and a teacupful (gill) of cold water; stir well; then add a pint of cold, fresh milk. Heat, with constant stirring, to boiling point. The heat should be so applied that the mixture will boil in 10 minutes. When cool, pour into a clean bottle, cork well, and keep in a cold place. When needed, shake the bottle, and pour out the required portion.

Peptonized beef may be prepared by mincing a quarter of a pound of raw lean beef, and adding to it half a pint of cold water. The meat and water are mixed in a saucepan and cooked over a slow fire, stirring constantly until the mixture has been boiled a few minutes. Pour off the liquid and rub the meat into a paste. Then put it in a clean fruit jar with half a pint of cold water, and add the liquid which was poured off after cooking. Add to the contents of the jar 20 grains of pancreatin and 15 grains of bicarbonate of sodium. Shake thoroughly and put in a warm place, allowing it to stand for three hours with occasional stirring. At the end of this time the contents of the bottle should be brought to the boiling-point quickly, to destroy the pancreatin, and then placed upon ice for preservation. Or, if used immediately, it may be strained and seasoned to taste with salt and pepper, although if not strained it is more nourishing.

Oysters may be peptonized by mincing 6 to 12 large oysters, mixing the minced oysters in a moderate quantity of their own liquid, adding 5 grains of pancreatin and 20 grains of bicarbonate of sodium, and placing this mixture in a water-bath at 100° F. for a period of 20 minutes. After this time, bring the liquid to a boil quickly for the double purpose of cooking the oysters and stopping further digestion.

The digestibility of arrowroot, oatmeal, barley, wheat, or other farinaceous foods can also be increased by mixing with a portion of gruel suitable for one meal a peptonizing tablet or the contents of a peptonizing tube.

When pancreatin is used for the preparation of a nutritive enema the following plan may be employed: Beat up an egg, both the yolk and the white, in a pint of milk. Warm the mixture to the temperature of the body by immersing the bottle which contains it in warm water. Add to the contents of the bottle a peptonizing tablet or the contents of one peptonizing tube. Stir or shake thoroughly, and reimmerse the bottle in the warm water. The enema may be used at once, or if kept on ice it may be given at any time within 24 hours, but it must be warmed before it is used.

PAPAVERACEÆ.—The Poppy Family.

(Including the *Fumariaceæ* or *Fumitory Family.*)

This is a small family, of 28 genera and about 260 species, distributed through temperate and subtropical regions. Except for its ornamental properties, and the use of the fixed oil of poppy seeds as an edible substitute for olive oil, economic interest in the family relates wholly to medicine. So far as known, every member of the family produces alkaloids, and these are in general highly active. Most of these alkaloids will be found discussed under CHELIDONIUM, OPIUM, and SANGUINARIA. A number of minor drugs, considerably used, are described below.

PAPAVER.—This genus contains about 40 species, mostly natives of Europe and adjacent Asia. Besides OPIUM, it yields the 3 following important products:

PAPAVERIS CAPSULÆ, or *Poppy capsules* (Br.), *Fructus Papaveris immaturi* or *Unreife Mohnköpfe* (P. G.), *Papaver* (U. S. 1870), *Mohnkapseln* (G.), *Pavot blanc, Tetes de pavot* (Fr.), *Adormidera* (Sp.), are the nearly ripe capsules of *P. somniferum* L. This, the *Opium poppy*, is elsewhere fully described. The white-flowered and white-seeded form (*P. officinale* Gmel.) alone yields the official capsules (Figs. 294 and 295), but the broad capsules (Fig. 293) are also more or less employed. The former are usually about 6.2 to 7.5 Cm. (2½ to 3 In.) long, exclusive of the stout peduncle, and a little more than half as broad, oval, more or less elongated and narrowed at the base, capped with the 8- to 20-rayed, broad, peltate stigma, from each of the rays of which a line descends upon the smooth, light-brown surface of the capsule, and marks the location of the placentæ, which project inward, forming incomplete partitions. Underneath the margin of the stigma, and between its rays, pores open for the discharge of the very numerous seeds. Occasionally they have a much more elongated form, and occasionally the depressed form shown in Fig. 295. The crushed dried capsules have a very slight narcotic odor, strong in the fresh state, and a bitter taste. Examined microscopically, they exhibit the laticiferous ducts which, when incised, exude opium. Testimony regarding the constituents of Poppy capsules is highly contradictory, and it is probable that these differ with the degree of maturity and other conditions of the capsule. The only constituent of practical importance is about 0.2 per cent. of morphine. Narcotine, narceine, papaverine, rhœadine, probably codeine, and meconic acid have also been reported, and in the waxy coating cerylcerotate ($C_{27}H_{55}.C_{27}H_{53}O_2$), melting at 82.5° C. (180.5° F.), crystallizing in silky scales, and cerylpalmitate ($C_{27}H_{55}.C_{16}H_{31}O_2$), melting at 76° C. (168.8° F.).

Because of the small amount of morphine present in these capsules they may be employed either in syrup or infusion for the purpose of arresting pain and promoting sleep. Their nar-

Fig. 299.

Fig. 298.

Fig. 300.

Poppy capsules and seeds: *a*, natural size; *b*, magnified.

White. Black. Depressed.

cotic effect is analogous to that of Opium. A decoction of the capsules may be employed as an anodyne embrocation.

Semen Papaveris, or *Mohnsamen* (P. G.), *Poppy-seed* or *Maw-seed* (E.), *Magsamen* (G.), *Semences* or *Grains de pavot* (Fr.), are the seeds of *P. somniferum* L. Both the White and the Black or Blue poppy-seeds are used, but the White are preferred. The seeds are figured above. They contain an oily albumen, which encloses a curved embryo. They are odorless and possess a bland, oily, sweetish, and very slightly bitterish taste. They contain 55 per cent. of fixed oil (Oleum Papaveris), 23 per cent. of pectin, and about 12 per cent. of protein. Poppy seeds are employed for their oil, which is largely used by artists because of its drying properties. Neither the oil nor the seeds are employed in medicine.

Rhœados Petala, *Red poppy petals* (Br.), or *Flores rhœados*, *Corn poppy* or *Corn rose* (E.), *Klatschrose* or *Klappenrose* (G.), *Coquellicot* or *Pavot rouge* (Fr.), *Amapola* (Sp.), is the petals of *P. Rhœas* L., native of Europe and largely cultivated for ornament. The petals are roundish, obovate, 5 Cm. (2 In.) or more broad, clawed, deep scarlet-red when fresh, dull-purple when dried, bearing a large black spot near the base, very thin, narcotic when fresh, without characteristic odor when dried, mucilaginous and slightly bitter. Although said to contain rhœadine, the constituents are of no medicinal importance, the drug being valued only for its coloring properties, due to 2 deliquescent coloring principles—*rhœadic acid*, which is dark-red, soluble in alcohol and water, but insoluble in ether, and yields brown compounds with alkalies; and *papaveric acid*, which is bright-red, soluble in water and dilute alcohol, and forms violet compounds with alkalies. Red poppy leaves possess little medicinal activity, but are occasionally employed in the form of a syrup for their mild anodyne properties.

Stylophorum (*Yellow* or *Celandine Poppy*) is the plant *Stylophorum diphyllum* (Mx.) Nutt. (*Chelidonium d.*—Mx.), used either fresh or in the dried state. It is a glaucous, yellow-juiced and yellow-flowered perennial of the central United States, very similar to Chelidonium. The stem bears only from 2 to 4 leaves, the 2 upper ones opposite. They are 10 to 25 Cm. (4 to 8 In.) long, petioled, pubescent underneath, at least when young, once or twice pinnatifid, the segments obovate and somewhat crenate or crenately lobed. The yellow flowers are about an inch broad and 2 to 4 together at the summit of the stem. In constituents, properties, and uses, Stylophorum is almost identical with Chelidonium. Schlotterbeck and Watkins have isolated no less than 6 alkaloids from the root (see *Proc. Amer. Pharm. Assoc.*, 1901, 251, and 1902, 404).

Glaucium Glaucium (L.) Karsten (*Chelidonium G.*—L.; *G. flavum* Crantz.; *G. luteum* Scop.), the *Yellow sea* or *Horned poppy*, *Horn poppy*, *Sea celandine*, *Bruise-root*, *Squamatore* (E.), *Hornmohn* (G.), *Pavot cornu* (Fr.), is a peculiar smooth, pale, glaucous-green, succulent biennial of Europe and naturalized in the United States. It grows mostly on sea-beaches and has large, clasping, pinnatifid or sinuate-toothed leaves, yellow, poppy-like flowers, and linear, muricate capsules. It exudes a yellow milk-juice, less acrid than that of celandine. Richard Fischer has carefully examined the root and herbaceous portion of the plant and found them to contain the alkaloids glaucine, fumarine, and chelerythrine (*Arch. d. Pharm.*, 1901, 426–437). *Glaucine* ($C_{21}H_{25}NO_4$) occurs in pale-yellow, well-developed, strongly refractive prisms and tabular crystals, of sharp and bitter taste, soluble in hot water and in alcohol,

ether, and petroleum ether. *Glaucopicrin*, soluble in water and alcohol, but with difficulty in ether, is also said to be present. The drug is used to some extent like *Chelidonium*.

ARGEMONE, the *Mexican*, *Prickly*, *Thorn*, or *Thistle poppy*, *Poppy* or *Flowering thistle*, is a small genus of plants much resembling the last, though the principal veins of the leaves usually terminate in slender prickles. They are plants of the southwestern United States and southward, and have become extensively naturalized in many tropical and subtropical countries. There is much confusion as to the species referred to in the published accounts of the constituents and properties, but it is probable that all are very similar. The plants exude a milky juice, and are bitter and acrid, like Glaucium. The chemical constituents of the plant have been carefully studied by J. O. Schlotterbeck (*Proc. Amer. Pharm. Assoc.*, 1901, p. 247), and it has been shown that Charbonnier's claim, that a trace of morphine is present, is false. The alkaloids found in *Argemone Mexicana* are berberine and fumarine. The important constituent is the fixed oil of the seeds, which exists to the extent of about one-third of their weight. It is light-yellow, of a specific gravity of about 0.919, almost odorless and of bland taste, remaining clear at 6° C. (21.2° F.), and drying slowly and incompletely. It is used as a mild cathartic, very similar to castor oil. Statements regarding the character of the purgative action, and also as to the dose, show great discrepancies. Argemone, in addition to its purgative action, is thought to possess soporific and anodyne properties. It has been recommended in the treatment of flatulent colic. The milky juice obtained from the fresh plant has been employed internally in the treatment of chronic cutaneous eruptions, and locally for the removal of warts and chancroids. The dose of the seeds as a purgative is from 1 to 2 drachms (4–8 Gm.) infused in water.

FIG. 301.

Argemone Mexicana: branchlet (¾ Nat.) and seed (× 5).

ESCHSCHOLTZIA is a small genus of Californian herbs, several of which are known as *California poppy*. Just which species have constituted the basis of experiment and report is uncertain, since the entire group long went under the name *E. Californica* Esch., which species is, in fact, considerably less common and abundant than some of the others. The plants are low, slender, glaucous herbs, with dissected foliage and large yellow flowers, and exuding colored juices, natives of the Pacific coast and far western regions. Fischer (*Proc. Amer. Pharm. Assoc.*, 1901, p. 438), has examined a species supposed to be *E. Californica*, reviewing the work of previous analysts, and reports that it contains fumarine, β and γ homochelidonine, sanguinarine, chelerythrine, and 2 other alkaloids. Morphine, previously said to be present, was not found. Its constituents are thus much like those of Chelidonium.

BOCCONIA is a name which has been employed for two distinct, though closely related, drugs, and these should be distinguished as *Bocconia root* and *Bocconia bark*.

Bocconia root is the root of *Macleya cordata* (Willd.) R. Br. (*Bocconia cordata* Willd.), more generally known by the latter but incorrect name. It is a stout perennial herb, native of Japan, but extensively cultivated for ornament under the name *Tree celandine*. It grows in clumps, to the height of 4 to 6 feet, bears large, petioled, cordate, lobed, glaucous leaves, and the branches terminate in panicles of small white flowers. The juice is yellow or orange. The root is large, irregularly branched, the branches long, of a deep orange-brown, soft and light, of a sternutatory odor, and acrid and bitter taste. Murrill and Schlotterbeck (*Proc. Amer. Pharm. Assoc.*, 1900, p. 128) have determined the presence in it of fumarine, chelerythrine, and β-homochelidonine. Sanguinarine, previously reported, was not found. In smaller amount, alkaloids were found in other parts of the plant.

Bocconia bark, *Llagua-llagua*, or *Hamakari* of the Bolivian natives, is the bark of several species of *Bocconia*, shrubs or small trees of tropical America. Although none are commercially important, all are powerfully active and poisonous. The living plants exude milk-juices, varying from orange to blood-red in color, and excessively acrid. The dried bark varies from 2 to 6 Mm. ($\frac{1}{12}$ to ¼ In.), rarely more, in thickness, when young is smooth and silvery, with black specks, on the outer surface, becoming with age grayish-red-brown and roughly fissured. The inner surface is of a deep brownish-red. It cuts like cheese, and the cut surface is waxy-lustrous and of a deep-red color. The texture is laminated and somewhat shreddy, and the bark is light and soft, and it contains numerous laticiferous ducts, resin-cells, and oil-globules. It has a narcotic, pungent, and very sternutatory odor, and a

bitter and very acrid taste. Several alkaloids have been found. They have not been carefully identified and are probably mostly those of Bocconia root. The action of the drug is much like that of Sanguinaria.

Fumariaceæ.

The drugs which remain to be considered belong to the Fumariaceæ division of the Papaveraceæ.

Fumaria (*Fumitory, Beggary, Wax-dolls*, E.; *Feldraute, Erdrauch*, G.; *Fumeterre*, Fr.; *Hiel de tierra, Pajarilla*, Sp.) is the herbage of *Fumaria officinalis* L., a low, pale-green, smooth, and glaucous annual, native of Europe and somewhat naturalized in North America. The leaves are finely dissected, the ultimate segments obovate-oblong to spatulate and acutish. The pale-red flowers, varying to purple or crimson, are in racemes, and bear a basal spur on one side. The odor is narcotic, the taste bitter and somewhat acrid. Besides ordinary herbal constituents, fumitory yields the alkaloid *fumarine* ($C_{21}H_{19}NO_4$, subsequently called "protopine," when discovered in opium) and *fumaric acid* [$C_2H_2(COOH)_2$]. Fumarine occurs in colorless monoclinic bitter crystals, soluble in alcohol and chloroform, slightly so in water, and insoluble in ether. It is closely allied to corydaline. Fumaric acid forms colorless prisms or stellate scales, and is soluble in alcohol and ether, somewhat soluble in cold water, and more so in hot water. Its salts are mostly soluble in water, and insoluble in absolute ether.

There are about 40 species of *Fumaria*, 8 or 10 of which are medicinally employed. The name Fumaria, as a drug, might almost be extended to include the very similar and closely related plant *Adlumia fungosa* (Ait.) Greene, *Fumaria f.*—Ait., *Adlumia cirrhosa* Raf., the *Climbing Fumitory, Mountain-, Allegheny-*, or *Wood-fringe, Canary-vine* or *Fairy-creeper*, native of eastern and central North America. It is a very slender and weak herb, climbing by its slender petioles. The foliage is very similar to that of Fumaria, but the segments are mostly ovate. The flowers are in axillary, drooping cymes, and are purplish and 2-spurred at the base. The constituents are apparently very much like those of *Fumaria*. Fumitory was formerly recommended in the treatment of chronic cutaneous affections, in hepatic obstructions, and scorbutic diseases. The expressed juice may be given in doses of from 1 to 2 fluidounces (30–59 Cc.) during the day.

Corydalis is a genus of nearly 100 species, distributed through the north-temperate zone, several of which have been employed in medicine. As commonly understood in medicine, the name Corydalis applies to the tubers of *Bicuculla Canadensis* (Goldie) Millsp. (*Corydalis C.*—Goldie; *Diclytra C.*—DC.; *Dicentra C.*—Walp., also one of the plants often called "*Corydalis formosa*"), the *Turkey* or *Squirrel corn* or *Turkey pea, Wild hyacinth* or *Stagger weed*, a plant of eastern and central North America. It is a low, delicate, pale, smooth, and glaucous perennial herb, with dissected leaves, the segments linear-oblong, and produces several scapes, each bearing about 4 greenish-white, purple-tinged flowers, its 2 short and rounded spurs giving it a heart-shaped appearance. The thin subterranean shoots bear small tubers, which are collected. They are depressed-globose, 6 to 10 Mm. ($\frac{1}{4}$ to $\frac{3}{8}$ In.) thick, of a tawny-yellow color, nearly smooth, with a scar on each of the depressed sides, internally yellow or yellowish-white. The tuber breaks with a somewhat horny or slightly mealy fracture, is nearly inodorous, and has a bitterish and rather persistent taste.

Corydalis contains corydaline, fumaric acid, yellow bitter extractive, acrid resin, and starch. *Corydaline* ($C_{18}H_{19}NO_4$) crystallizes in bitter prisms or needles, which become yellow on exposure. It is soluble in alcohol, ether, chloroform, and fixed and volatile oils, and insoluble in water. Besides this, *Capnoides tuberosum* (DC.) Lyons (*Corydalis t.*—DC.; *C. cava* Schweig.; *C. bulbosa* Pers.), yields *corycavine* ($C_{23}H_{23}NO_5$) in small matted needles, and insoluble in ordinary solvents, crystalline *bulbocapnine* ($C_{34}H_{36}N_2O_7$), the most abundant alkaloid in the plant, and *corydine*, an alkaloid insoluble in water and readily soluble in alcohol and ether. *C. nobilis* Pers. yields *corydalnobiline* ($C_{22}H_{25}NO_5$).

Fischer has examined *B. cucullaria* (L.) Miller (*Dicentra C.* Torrey, etc.), the *Dutchman's, Little boy's*, or *Kitten's breeches, Breeches flower, Soldier's cap, White ear-drops*, a very similar plant, and finds it to contain fumarine and 2 other alkaloids. The same author was in 1902 engaged in reviewing the literature of the constituents of the preceding species.

The genus contains about 15 species, and several others, besides those named above, are employed, and have been found to contain similar alkaloids. This plant is said to be tonic and antisyphilitic. It is occasionally employed in the treatment of chronic cutaneous affections, syphilis, and scrofula. The dose is from 15 to 30 grains (0.97–1.94 Gm.).

PAPAYA. PAPAW. CARICA.

The juice of the fruit of *Carica Papaya* L. (*Papaya Carica* Gærtn.; *P. vulgaris* DC.—Fam. *Papayaceæ*).

Origin.—The *Papaw, Melon-tree, Mamœiro, Melonenbaum* or *Papaybaum*, is a dicœcious or polygamous tree, of very peculiar appearance and habit, native of tropical

America, where it is everywhere cultivated for its edible fruit. It is also cultivated, and has escaped, in other tropical countries. Its large, fusiform root, as well as its trunk, is rather soft and fleshy. It sometimes attains a height of 30 or 40 feet, although under cultivation usually less than half as tall. In the wild state it is occasionally much taller. It is surmounted by an umbrella-shaped crown of alternate, very large and very long-stemmed, palmately-lobed leaves, among the bases of which appear the flowers. As the lower leaves fall away, the fruits form, mostly hanging close against the trunk, which continues to elongate, leaf and flower above. All stages of inflorescence and fructification are thus represented at the same time, the lowermost and ripe fruit being often some distance below the leaves, with which it is connected by successively younger fruits. The tree continues to bear fruit for a very few years and then dies. Its cultivation is usually restricted to a few scattered trees in the vicinity of dwellings. Most attempts to cultivate it in large plantations have been unsuccessful, destructive diseases having made their appearance. There is little doubt that these difficulties will eventually be overcome.

The fruit is used in the green state for pickling, and when ripe as a dessert or hand-fruit and for preserving. The ripe fruits vary greatly in size and form, but may be generally described as melon-like in appearance and structure. The entire surface of the cavity is lined with brown-black globular seeds, resembling large bird-shot. All parts of the plant contain a milky juice, this being particularly abundant in the fruit near the time of ripening. In the herbage and green fruit this juice is bitter and more watery. This watery juice is considerably used as a detergent. The juice is always more or less acrid, or even vesicant, and this property is greatest in that of the young fruit. Processes for destroying its acridity weaken the digestive properties of the juice. Although the acrid and digestant principles are probably distinct, it appears not unlikely that the former prepares the substance to be acted upon, as acid prepares albumen for the action of pepsin.

The juice is collected from incisions made in the fruit when nearly full-grown. It flows rather freely for an instant, but the exuding vessels are promptly clogged by coagulation. Fermentation begins almost as soon as the milk is extravasated. For medicinal use, the milk is prepared in various ways. The activity of its enzyme, though checked in the presence of alcohol, is less susceptible to destruction by such antizymotics as glycerin, salicylic acid, etc., than is pepsin, and these have been used as preservatives. The simplest method of preparation is the mere drying of the juice, which should be performed quickly, avoiding a high temperature. This product is apt to possess a disagreeable odor, evidently due to some degree of decomposition. The dried juice of *Carica Papaya* has been marketed under the name of *papoid*. A large amount of the inert substance of Papaya can be removed by extraction with water and precipitation of the filtered extract by alcohol, the precipitate containing most of the digestive ferment. Such a preparation is called *caricin*, *papain*, or *papayotin*. Watt recommends preparing it by adding to the freshly drawn milk twice its bulk of alcohol and draining and drying the insoluble portion, which forms crude papain. By a repetition of the solution and precipitation, its bulk can be somewhat decreased and its color lightened, with a corresponding increase in its proportional activity. The proteolytic activity of papain or papayotin is similar to that of pepsin in producing albumoses and peptones from coagulated albumin or fibrin. Its activity in solution is destroyed at about 82° C. (179.6° F.), but when dried it may be heated to 100° C. (212° F.) for several hours without impairment. Statements differ as to the relative activity of a given quantity of papain and of the amount of Papaya which yielded it, but it appears that the latter possesses rather more activity. It also possesses a higher degree of acridity than papain.

Constituents.—The digestive constituent or constituents of Papaya being enzymic, are, of course, not extractible in the pure state by any method known at present, though they are mostly contained in the papain, papayotin, or caricin referred to above. Of this, the yield from the fresh leaves is about 4 per cent., from the milk-juice upward of 5 per cent. It is amorphous, white or yellowish-white, odorless when pure, and has a faint pepsin-like taste. A great deal of the papain of the market is said to be nearly or quite inert. Other lots are said to be fictitious, consisting of mixtures of one or more other digestants. Single fruits yielded an average of 33 Gm. of milk-juice, which contains, besides papain, 4.5 per cent. of a caoutchouc-like substance, 2 resins, fat, leucin, tyrosin, and malic acid. The very bitter crystalline alkaloid, *carpaine*,

($C_{14}H_{25}NO_2$), has been found to the extent of 0.25 per cent. in dried young leaves, but only 0.07 per cent. in old leaves. The seeds yield a yellow acid resin, which is generally stated as being a substance which gives to the seeds their pungency. There is, however, evidence going to show that this pungency is due to the freeing of a volatile principle from a glucoside similar to sinigrin, through the action of myrosin, similar to what takes place in black mustard. The seeds are used as an anthelmintic, especially against lumbrices.

Action and Uses.—Under the name of "Papayotin," "Papoid," "Caroid," and other trade names, this drug is quite largely employed by some physicians in the treatment of indigestion, since it is capable of transforming proteids into peptones and albumoses by the proteolytic activity already mentioned. This power is slightly active in an acid mixture, as is pepsin, but is greatest in an alkaline mixture, and therefore it is claimed that it is of value both in gastric and intestinal indigestion. It may be said that papaya is slightly inferior to pepsin and greatly inferior to pancreatin in digestive value. Different preparations vary greatly in digestive powers.

The dose is from 1 to 10 grains (0.06–0.60 Gm.), given in solution, tablet, pill, or capsule.

PARAFFINUM, *U. S.*—Paraffin.

Paraffinum durum, Br.; *Paraffinum solidum*, P. G.; *Hard Paraffin*, E.; *Paraffine*, Fr.; *Festes Paraffin, Ceresin, Gereinigtes Erdwachs*, G.

A mixture of solid hydrocarbons, chiefly of the methane series; usually obtained by chilling and pressing the distillates from petroleum having high boiling-points, and purifying the solid press cake so obtained.—U. S.

The Br. P. defines the official article to be a mixture of several of the harder members of the paraffin series of hydrocarbons. Hard paraffin of the P. G. is obtained by purification of the natural deposit known as crude earth-wax.

Origin.—The paraffins are formed under various circumstances from fats and other organic compounds, but are chiefly obtained among the products resulting from the destructive distillation of bituminous shale and other substances. They are a natural constituent in varying proportions of the different kinds of petroleum, and solid paraffins are found native in Austria, Great Britain, the United States (Utah), and some other countries, constituting the minerals known as mineral wax, earth-wax, and ozokerite.

Composition and Characters.—The general formula of the paraffins is the same as that of the lighter coal oils, C_nH_{2n+2}, but in their physical properties they differ from the latter in being at the ordinary temperature either solid, and frequently crystalline, or of a butyraceous consistence or liquid. Those which are liquid at the ordinary temperature are known in commerce as *paraffin oils*, while the name *paraffin* is retained for the solid products. They can be separated from one another only with great difficulty, but it is known that the different members of this homologous series increase in density, viscidity, and in boiling-point, and the solid paraffins also in melting-point and hardness, as the molecular weight increases.

Preparation.—The first step in obtaining hard paraffin is to distil the tarry oil from shale, whereby a residue of coke and asphalt is left. The distillate is treated with sulphuric acid and subsequently with sodium hydroxide for the purpose of removing olefins and phenolic bodies. After washing the product, it is redistilled, and after recovery of lighter hydrocarbons and lubricating oils, yields a thick oil from which paraffin separates on cooling. The crude paraffin is removed, dissolved in petroleum or naphtha, and again allowed to separate by refrigeration and pressure. Finally the resulting wax-like paraffin is melted and decolorized by filtration through animal charcoal.

Properties.—Paraffin occurs as a colorless, more or less translucent mass, crystalline when separating from solution; without odor or taste, and slightly greasy to the touch. Its specific gravity ranges from 0.890 to 0.905 at 25° C. (77° F.), (from 0.820 to 0.940 at 15.5° C. (60° F.), Br.). It is insoluble in water and alcohol; slightly soluble in absolute alcohol; readily soluble in ether, petroleum benzin, benzene, carbon disulphide, volatile oils, and in warm fixed oils. When heated, it melts at from 51.6° to 57.2° C. (125°–135° F.) (54.4° to 57.2° C. (130°–135° F.), Br., 74° to 80° C. (239.2°–250° F.), P. G.), and on stronger heating ignites, burning with a luminous flame and depositing carbon, but leaving no permanent residue. If 0.5 Gm. of paraffin be heated in a dry test-tube with an equal weight of sulphur, the mixture will become black from

the separated carbon, with the evolution of hydrogen sulphide gas. Paraffin is not acted upon or colored by concentrated sulphuric acid or nitric acid in the cold.—U. S. By continued boiling with nitric acid, the higher paraffins yield nitro-compounds and various acids. Chlorine and bromines do not act on paraffins in the dark, but on exposure to sunlight or on application of heat from substitution-products. In distilling paraffin, the heat to which the vapors are exposed influences the melting-point, and consequently the composition; at a red heat naphthalene is produced, and when paraffin is heated for some time in a sealed tube it is split into an olefin and a paraffin of a lower boiling-point. Obtained from the residuum of petroleum distillation, it is about 43° C. (109.4° F.) or somewhat higher; from peat, about 47° C. (116.6° F.); from ozokerite, about 60° C. (140° F.); from Rangoon tar of Burmah, about 62° C. (143.6° F.). The mineral wax of Moldavia, known as *zietrisikite*, melts between 85° and 90° C. (185°–194° F.), and is insoluble in ether.

Tests.—An alcoholic solution of paraffin should not redden blue litmus-paper (U. S., Br., P. G.). If 0.5 Gm. of paraffin be heated and 0.1 Gm. of powdered fuchsin added to the fused mass, the latter should not assume a pink or red color (absence of stearic acid) (U. S.). If 3 Gm. of solid paraffin be added to 3 Cc. of sulphuric acid in a test-tube previously rinsed with warm sulphuric acid, and then heated for 10 minutes in a boiling water-bath, the paraffin should not suffer any change and the acid be at most but slightly colored (P. G.).

Action and Uses.—Hard paraffin is very little used in medicine. Its most common employment is for the sealing of bottles, jars, or boxes containing drugs which it is desirable to protect from the effect of the air. In 1891, Corning, of New York, suggested its employment for the purpose of overcoming minor deformities by injecting it into the subcutaneous tissues. It has been largely used by many surgeons to correct the deformity of saddle-nose and by gynecologists in the treatment of incontinence of urine when the urethra or neck of the bladder needs support. Surgeons have used it to prevent the reunion of nerves after they have been divided, to take the place of a testicle which has been removed, and to diminish the size of a hernial ring. It has even been employed for the purpose of increasing the shapeliness of the female breast. When injected into the subcutaneous tissues it produces no marked effects beyond some swelling and redness, which rapidly disappear under the application of cold. Within a very few minutes after its injection, by means of a syringe attached to a hollow needle, the paraffin becomes hard. It is therefore necessary to rapidly mold it to the desired shape after the injection is made. Its full degree of firmness, however, is not attained until after two or three months have passed, when it often becomes as hard as cartilage and encapsulated. According to some, it remains unchanged in the tissues indefinitely, but others believe that it is gradually absorbed and its place taken by granulation tissue. If the nutrition of the part is not good, or if the paraffin is impure, or, again, if strict antiseptic precautions are not taken, sloughing may take place. J. Chalmers DaCosta quotes Gersuny as employing a solid paraffin mixed with liquid paraffin. The melting-point of the mixture should be about 104° F.—that is to say, the proportions of these two ingredients should be such that the mixture melts at this temperature. It is to be sterilized by boiling, and the syringe is to be warmed in order to prevent the paraffin from solidifying in its barrel. It is also wise to warm the parts to be injected by means of hot compresses. Mixtures which melt at somewhat higher temperatures than 104° F. are dangerous, in that they may produce thrombosis in surrounding blood-vessels, and mixtures which melt below this point may fail to accomplish their purpose by reason of the fact that should the patient be attacked by fever or exposed to heat, the paraffin would melt and lose its shape.

PARAFFINUM MOLLE, *Br.*—Soft Paraffin.

Petrolatum molle, U. S. 1890; *Pétroléine*, Fr. Cod.; *Paraffinum unguinosum; Adeps petrolei.*—*Soft petrolatum, Cosmoline, Vaseline, Paraffin jelly, Soft petroleum ointment*, E.; *Graisse minérale, Pétréoline, Piméléine, Vaseline*, Fr.; *Weiches Paraffin, Paraffinsalbe*, G.

A semisolid mixture containing soft members of the paraffin series of hydrocarbons, usually obtained by purifying the less volatile portions of petroleum.—Br.

Preparation.—Soft paraffin is usually obtained as an intermediate product in the distillation of crude American or Russian petroleum. After removal of the lighter

fractions, benzin, ligroin, and kerosene, all distilling below 330° C. (626° F.), liquid paraffin is collected below 390° C. (734° F.), and the residue then repeatedly treated with sulphuric acid, sodium hydroxide, and animal charcoal, as stated under PARAFFINUM (see above).

Properties and Tests.—Soft paraffin occurs in translucent masses, both white and of yellow color, greasy to the touch, and without unpleasant odor or flavor, even when warmed to 50° C. (122° F.). Its specific gravity at the melting-point, 35.5° to 38.9° C. (96° to 102° F.), or even a little higher, ranges between 0.840 and 0.870. It is insoluble in water, slightly soluble in absolute alcohol, and freely soluble in ether, benzene, and chloroform. Soft paraffin should volatilize without giving off acrid vapors and burn without leaving a residue. The absence of fixed oils, fats, and resins is indicated by the absence of a precipitate upon addition of an excess of acid to the filtrate obtained after boiling soft paraffin with sodium hydroxide solution.

Action and Uses.—Soft paraffin is used as an ointment for the dressing of burns and excoriations, and as an ointment base in the application of drugs to the skin in the treatment of eczema, psoriasis, and scabies. Indeed, it may be employed as an ointment base for almost any purpose, provided that it be borne in mind that in rare cases it will irritate the skin, and more rarely still produce boils or eczematous eruptions. In some instances, these results are probably due to the employment of an impure paraffin. The well-known French ophthalmologist, Galezowski, considers that it is the best excipient for the yellow oxide of mercury and the nitrate of silver, and other mineral substances which are used in the treatment of such eye disorders as keratitis and conjunctivitis. Soft paraffin may also be used as a lubricant in vaginal and rectal examinations.

In its liquid form, which is now placed upon the market under a variety of names, it is employed for the purpose of acting as a vehicle for various drugs, volatile oils, and camphoraceous bodies. Thus, it can be employed as a vehicle for ether, chloroform, benzene, sulphide of carbon, iodine, bromine, phosphorus, eucalyptol, thymol, menthol, myrtol, terpinol, iodoform, and paraldehyde. When holding these substances in solution, it may be used for local applications, or given internally, as it is without any physiological effect in the alimentary canal. When vegetable alkaloids are dissolved in it, such as morphine and cocaine, their rapidity of action is very materially diminished, particularly the latter drug. The hydrochloride of cocaine cannot be used in this way. Rhinologists and laryngologists employ liquid paraffin in its purest forms as a protective after making applications to the mucous membrane of the upper respiratory passages. Under these circumstances its influence is usually negative or at most sedative. But occasionally cases are met with in which when it is applied to the pharynx it produces a sense of dryness or irritation.

PARALDEHYDUM, *U. S., Br., P. G.*—Paraldehyde.

Paraldéhyde, Elaldéhyde, Fr.; *Paraldehyd,* G.

Formula, $C_6H_{12}O_3$. Molecular weight, 131.10.

A polymer of acetaldehyde, CH_3COH. It should be kept in well-stoppered, dark amber-colored bottles, in a cool place.—U. S.

Preparation.—If ordinary (ethyl) aldehyde be treated at normal temperature with small quantities of hydrochloric acid, sulphur dioxide, sodium acetate, or zinc chloride, the temperature of the liquid rises and almost complete conversion into paraldehyde takes place. For the trade it is usually manufactured by conducting gaseous hydrochloric acid into aldehyde at ordinary temperature; the conversion into paraldehyde is known to be complete when the liquor is no longer soluble in an equal volume of water. The crude product is cooled to below 0° C. (32° F.), and the crystalline mass thus obtained is carefully distilled, the process of freezing and distilling being repeated until the whole product finally volatilizes at 124° C. (255.2° F.).

Properties and Tests.—A colorless, transparent liquid, having a strong, characteristic, but not unpleasant or pungent odor, and a burning and cooling taste. It has a specific gravity of 0.990 at 25° C. (77° F.): soluble in 8 volumes of water at 25° C. (77° F.), the solution becoming turbid on being boiled, and in 16.5 parts of boiling water; miscible in all proportions with alcohol, ether, and fixed or volatile oils. When cooled to near 0° C. (32° F.), paraldehyde solidifies to a crystalline mass, which becomes liquid again at 10.5° C. (51° F.). It boils at 123° to 125° C. (253.4°–257° F.), giving off

inflammable vapors. Paraldehyde is neutral, or has a slightly acid reaction. When distilled with a small portion of sulphuric acid, paraldehyde is converted into ordinary aldehyde, boiling at about 21° C. (70° F.). On warming some silver ammonium nitrate test-solution saturated with paraldehyde in a test-tube, a silver mirror will form on standing. On heating some paraldehyde on a water-bath, it should completely volatilize, without leaving any disagreeable odor (absence of impurities derived from fusel oil). 1 Cc. of paraldehyde should form with 10 Cc. of water a clear solution, free from oily drops (absence of amyl alcohol, etc.), and this solution, when acidulated with nitric acid, should not be affected by silver nitrate test-solution (absence of hydrochloric acid) or barium chloride test-solution (absence of sulphuric acid). A mixture of 8 Cc. of paraldehyde and 8 Cc. of alcohol with 1 drop of phenolphthalein test-solution should acquire a pink color upon the addition of 0.5 Cc. of normal potassium hydroxide test-solution (limit of free acid).—U. S.

The P. G. and Br. give the specific gravity at 0.998; the latter requires that no coloration shall take place within 2 hours if paraldehyde be mixed with a solution of potassium or sodium hydroxide (intended to detect the presence of aldehyde). "A mixture of 1 Cc. each of paraldehyde and alcohol should not, after addition of 1 drop of normal alkali solution, show any acid reaction (limit of acid)."—P. G.

Action and Uses.—Paraldehyde is a safe and pure hypnotic, resembling chloral in its effect upon the brain. The sleep produced by moderate doses is natural, comes on speedily, and lasts usually from 5 to 7 hours. The awakening is not attended by headache or weariness. Toxic doses cause coma, muscular relaxation, lowered arterial pressure, and death from paralysis of respiration. The circulatory depression is not so marked as that produced by chloral. In poisonous doses it reduces the hæmoglobin of the blood to methæmoglobin. Eliminated in the urine and breath it imparts its odor to both. It has no influence over pain, and is valueless as a hypnotic when this symptom is the cause of insomnia. In the insomnia accompanying mental or physical strain, delirium tremens, mania, and other forms of insanity of the acute type it has proved useful, and doubtless would be more generally employed were it not for its nauseous taste, the disagreeable odor it imparts to the breath, and its tendency to irritate the stomach. Used for a long time, it may impair digestion and produce irritation of the skin and mucous membranes, particularly those of the thorax and rectum. The dose is from ½ to 2 fluidrachms (2–8 Cc.) well diluted. Brandy, whiskey, or some aromatic may be added to it to mask its taste.

Allied Compounds.—METALDEHYDE, $C_{12}H_{24}O_6$, is obtained by the action of polymerizing agents on common aldehyde at a temperature of 0° C. (32° F.). It is a white crystalline body, insoluble in water, but freely soluble in alcohol and ether. When heated to 112°–115° C. (233.6°–239° F.) it sublimes without melting, but is partially decomposed. It is claimed to possess hypnotic properties (Helbing). *Sulphaldehyde* is formed by the action of hydrogen sulphide on aldehyde. It is said to be an oily liquid of a repulsive odor, solidifying at —8° C. (17.6° F.), and melting again at —2° C. (28.4° F.). Little attention has been bestowed upon it.

ALDEHYDE, *Acetic or ethyl aldehyde, Acetaldehyde* ($CH_3CHO = C_2H_4O$).—This body was noticed, but not isolated, by Scheele (1774), who supposed it to be ether. Liebig (1835) isolated it and determined its relation to alcohol. Aldehyde is formed by the oxidation of alcohol and many of its derivatives; it is found among the products of the dry distillation of wood and sugar and on distilling various protein compounds with manganese dioxide and sulphuric acid. The formation of polymeric modifications of aldehyde was first observed by Liebig. Pure aldehyde is prepared by distilling either of the two following mixtures: 4 parts each of 80 per cent. alcohol and water and 6 parts each of manganese dioxide and sulphuric acid (Liebig), or 3 parts of alcohol, 4 parts of sulphuric acid, mixed and slowly added to 3 parts of potassium dichromate and 12 parts of water contained in a glass retort (Rogers). In both cases the impure distillate is rectified at a temperature of 50° C. (122° F.), and the vapors conducted into anhydrous ether, which is afterward charged with gaseous ammonia, when *aldehydeammonia*, $C_2H_4ONH_3$, crystallizes. The crystals are washed with ether, decomposed by dilute sulphuric acid, and the distillate rectified over calcium chloride. As thus obtained it is a colorless, very mobile liquid, of neutral reaction, and very inflammable; it has a peculiar, rather suffocating odor, and boils at 21° C. (69.8° F.). It is miscible in all proportions with water, alcohol, and ether, and yields with alcoholic potassium hydroxide solution a yellow resin (aldehyde resin), and exposed to the air is converted into acetic acid. Aldehyde separates from ammoniacal silver nitrate solution a metallic mirror, the reaction becoming more delicate in the presence of caustic soda.

PAREIRA, *U. S.*—Pareira.

Pareiræ Radix, Br.; *Pareira brava*, E., G., Fr., Sp.; *Grieswurzul*, G.; *Butua*, Fr., Sp., Port.; *Abutua*, Port.

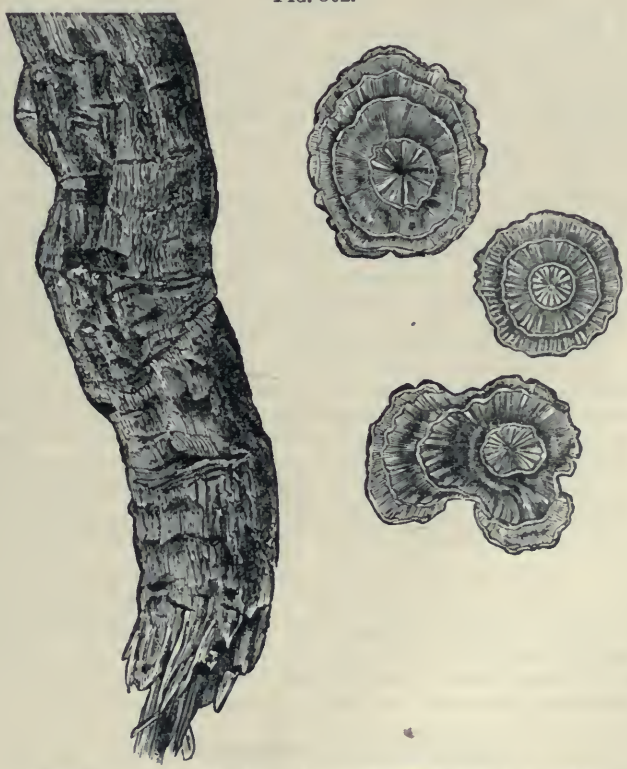
The dried root of *Chondrodendron tomentosum* Ruiz et Pavon (*Cocculus Chondrodendron* DC.—Fam. *Menispermaceæ*).

Pareira is official in but few pharmacopœias. The Portuguese names the roots of *C. platyphyllum* Miers and *Cissampelos Pareira* L.

Origin.—From a tall woody twiner of tropical South America, especially of the upper valley of the Amazon. In its own home it is much confused with the related and similarly growing *Cissampelos Pareira* (see *Substitutes*) and with several species of the related genus *Abuta*, Aubl., which grow as vines, shrubs, or small trees. Pareira is collected by natives, without system, and the market supply is highly irregular and uncertain.

Description.—In subcylindrical, knotty and somewhat tortuous, hard, heavy, and tough pieces of irregular length and 1 to 6 Cm. (about ½ to 2½ In.) thick; externally dark-brown

Fig. 302.



Pareira brava: portion of a root, and transverse sections of the same.

or blackish, longitudinally wrinkled, and bearing transversely elongated protuberances or incompletely annular ridges, as well as constrictions, or occasionally fine fissures; the transverse surfaces drying with several equilaterally concentric circles of interrupted, porous wood-wedges, projecting beyond the markedly retracted intervening tissue of the rather large medullary rays; internally pale brown or yellowish brown, cutting with a waxy luster; inodorous and bitter.

Substitutes and Adulterants.—The pharmacist is quite as likely to receive spurious as genuine Pareira. Although there is much similarity, the differences are ample for distinction. Externally, the rough and nearly black surface of the genuine is closely resembled by only one of the spurious varieties. The originally cut ends show the wood-bundles distinctly, though slightly projecting, while the drug appears soft when cut with a knife and the cut surface has a waxy luster. The commonest substitute is an

unknown related root (or probably a stem) which is gray-brown and smoothish, much lighter in weight, tougher, more fibrous, the rings showing a disposition to separate from one another, the wood-bundles not projecting at the ends, and the drug not cutting with a waxy luster. It contains a very little alkaloid, and yields only about 0.25 per cent. to petroleum ether. The stem of the Pareira vine is somewhat similar to the drug just described. Its pith is distinct. Other substitutes lack the concentric structure. A black substitute, closely resembling the genuine, does not leave a waxy lustrous surface when cut transversely.

Constituents.—Owing to the uncertain identity of the drugs which have been examined under the name of Pareira, most of what has been written regarding its constituents is unreliable. Ringer and Brooke (1892) appear to have had the genuine root when they found 0.819 per cent. of an alkaloid soluble in alcohol and ether, which may or may not have been pelosine (see *Cissampelos*, under *Allied Drugs*). These authors distinguish the genuine by its yield of 8.67 per cent. of fatty products to petroleum ether. Starch, gum, tannin, and phlobaphene were also found. Statements regarding the ash percentage vary from about 11 to 6 per cent., due doubtless to the incineration of different articles.

Pharmaceutical Preparation.—Fluidextract of Pareira, U. S. P.

Action and Uses.—Pareira is useful as a diuretic. In subacute or chronic pyelitis, cystitis, urethritis it does good by exerting a stimulant influence upon the mucous membrane of the entire genito-urinary tract; its action being similar to that of buchu. It is administered in the form of the official fluid extract or of the unofficial infusion [1 ounce to the pint (30–500 Cc.)]; of the former the dose is 1 drachm (4 Cc.), of the latter, 1 ounce (30 Cc.) three times a day.

Allied Drugs.—*Cissampelos* root, because originally, and in many places still, known as Pareira, is often substituted. It is the root of *C. Pareira* L., a woody climber which is credited to tropical regions of both hemispheres, though it is by no means certain that the East Indian root so-called, which is much smaller than the American, is of the same species. This root is 6 to 12 Mm. ($\frac{1}{4}$ to $\frac{1}{2}$ In.) thick, if from India, frequently more than twice as large when from South America or the West Indies, somewhat flattened-cylindraceous, bears a number of broad, shallow grooves and many short transverse fissures, and is of a dark-brown color. The thin bark separates readily. The cross-section shows no concentric structure and is of a yellow-brown color. The fracture is fibrous and tough, the taste bitter, much as in Pareira. It contains 0.5 per cent. of the alkaloid *pelosine*, nearly if not quite identical with beberine and buxine. Pelosine is amorphous, nearly insoluble in water, somewhat soluble in ether and carbon disulphide, but freely soluble in chloroform and acetone, also in alcohol and benzene; its nitrate is sparingly soluble, and its acetate is precipitated by sodium phosphate, by the group reagents for alkaloids, and by potassium iodide, ferrocyanide, ferricyanide, and chromate; the precipitate with phosphomolybdic acid dissolves in ammonia with a blue color.

Yellow Pareira is believed to be the root of *Abuta amara* Aubl., of Brazil, where it is esteemed quite as highly as the official. It is flattened-cylindraceous, very excentric in structure, bright yellow internally and very bitter. It contains beberine or a similar alkaloid, and probably berberine also.

White Pareira (*Butua*, Brazil) is from a related species, *A. rufescens* Aubl. It is whitish or pale yellow internally, with dark medullary rays, and is very starchy.

PASSIFLORA.—Passion-flower.

Passionsblume, G.; *Grandille*, Fr.; *Granadita*, Sp.

The rhizome of *Passiflora incarnata* L. or of *P. lutea* L.

Origin.—These plants are slender, tendril-bearing, climbing, perennial herbs of the southern United States, bearing broad, 3-lobed leaves and usually 5-merous flowers, and having in the throat of the calyx a peculiar fringed crown. The first-named has whitish to flesh-colored or purplish flowers, 3 to 5 Cm. (1 to 2 In.) broad; the second has pale-yellow flowers, only about half as large.

The herbage is sometimes employed as a substitute.

Description.—The rhizome ("root" of commerce) is of irregular length, 3 to 6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ In.) thick, cylindrical, finely striate, light-yellowish-brown or slightly greenish, the internodes from 2.5 to 7.5 Cm. (1 to 3 In.) long, the nodes indistinct; hollow, the wood-zone yellowish-green and finely radiate on transverse section, the bark-section purplish; odor slight; taste slight but rather unpleasant and fatty.

Constituents.—Beyond the fact that an alkaloid has been reported, nothing is known of the constituents.

Action and Uses.—Passiflora is little used in medicine. An extract of the rhizome was at one time considered of value as an application to hæmorrhoids, erysipelas, and burns. Internally, the inspissated juice of the leaves has been employed in neuralgic affections in the dose of 1 to 4 drachms (4–16 Gm.).

Allied Products.—The genus contains more than 250 species, mostly of tropical America. Several species are endowed with active properties. *P. quadrangularis* L. yields a delicious fruit, but its root is narcotic, producing spasms, convulsions, a cataleptic condition, and sometimes vomiting. *P. hispida* DC. (*P. marigouja* Per.) and *P. rubra* L., of the West Indies, are also narcotic. *P. fœtida* L. is antispasmodic. *P. laurifolia* L. (*P. tinifolia* Juss.) is anthelmintic. *P. lyrifolia* Tussac is used as a diuretic. Quite a number of species, besides *P. quadrangularis*, as well as those of related genera, yield edible fruits. More than 25 species, besides those named above, are used medicinally or are known to be poisonous.

PELLETIERINÆ TANNAS, *U. S.*—Pelletierine Tannate.

Pelletierinum tannicum; Punicinum tannicum. Punicine tannate, E.; *Tannate de pelletierine*, Fr. Cod.; *Gerbsaures Pelletierin, Gerbsaures Punicin*, G.

Under the official title above given, the Pharmacopœia recognizes a mixture in varying proportions of the tannates of 4 alkaloids obtained from the bark of *Punica Granatum* L.—Fam. *Punicaceæ*. The 4 alkaloids found in pomegranate bark are known both as *pelletierine, isopelletierine, methylpelletierine, pseudopelletierine*, and *punicine, isopunicine, methylpunicine, pseudopunicine*, the former names being preferred, and given in honor of the French chemist, Pelletier.

Preparation.—To obtain the mixture of alkaloids designated as pelletierine tannate, the ground bark is mixed with milk of lime, transferred to a percolator, and exhausted with water, The resulting infusion is shaken out with chloroform, and the chloroformic solution of free alkaloids then shaken out with very dilute sulphuric acid. If to a neutral solution of the mixed sulphates a solution of tannic acid be added, the sparingly soluble tannates will be precipitated and are subsequently dried.

Properties.—Pelletierine tannate (commercial) occurs as a light-yellow, odorless, amorphous powder, possessing an astringent taste and a weak acid reaction. It contains about 7 per cent. of moisture, which may or may not be water of crystallization, and corresponds to 2 molecules of water. Soluble, at 25° C. (77° F.), in 235 parts of water, and in 12.6 parts of alcohol; very soluble in water at 80° C. (176° F.), and in alcohol at 60° C. (140° F.); soluble also at 25° C. (77° F.) in 300 parts of ether, but insoluble in chloroform. Soluble in warm diluted acids. The salt, when dried over sulphuric acid and heated, turns brown at 150° C. (302° F.), softens at about 165° C. (329° F.), and when heated higher decomposes and chars without melting. It leaves no residue on ignition. An aqueous solution of the salt is colored blue-black by ferric chloride test-solution; addition of lead, mercury, or zinc salts causes a white precipitate, as does also ammonia water or caustic alkalies, the precipitate in the latter cases being soluble in excess of the precipitant and forming a yellowish-red solution. Platinic chloride test-solution does not cause precipitation. Aqueous solutions of the salt immediately reduce silver nitrate or gold chloride test-solutions to metallic silver or gold respectively, the former as a black precipitate, and the latter as a thin, purplish mirror on the test-tube. Sulphuric acid when added to pelletierine tannate gives a yellow color, which upon heating turns slowly green and finally purple. Nitric acid produces no color. Sulphuric acid containing a trace of selenous acid produces a light bluish-green color, gradually becoming dark green and developing a pink border.—U. S.

Pelletierine tannate should be kept in well-stoppered, small, dark, amber-colored vials.

The four alkaloids above named may be separated after extraction from the bark and conversion into sulphates, by the following method: Addition of sodium bicarbonate in excess to a solution of the sulphates precipitates methylpelletierine and pseudopelletierine, which are removed by filtration and washing the filtrate with chloroform; after this pelletierine and isopelletierine are precipitated by addition of potassium hydroxide solution and extracted with chloroform. From the latter chloroformic solution the two alkaloids are removed by shaking out with dilute sulphuric acid, and the sulphate solution evaporated to dryness, placed on tissue paper, and exposed to the atmosphere. The isopelletierine sulphate liquefies through absorption of moisture, and is absorbed by the paper, leaving the pelletierine

sulphate as a dry crystalline mass, which is removed, dissolved in water, and made alkaline with potassium hydroxide solution. After extraction of the mixture with chloroform or ether and evaporation of the volatile solvent, the residue from the latter is dried and distilled in a current of hydrogen. Pure pelletierine is a colorless, volatile, oily liquid having a peculiar odor, a specific gravity of 0.988 at 0° C. (32° F.), and boiling at 195° C. (383° F.). It is soluble in 23 parts of cold water, and miscible in all proportions with alcohol, ether, and chloroform. When exposed to the air it undergoes oxidation and gradually assumes a dark color. Pelletierine is a strong base, forming crystallizable salts with acids. The solutions of its salts are precipitated by most alkaloidal reagents, but not by platinic chloride. Pelletierine sulphate, $(C_8H_{15}NO)_2H_2SO_4$, occurs in the form of minute white acicular crystals, which are non-hygroscopic, but readily soluble in water.

The mixture of methylpelletierine and pseudopelletierine mentioned above is dissolved in chloroform and shaken out with dilute sulphuric acid. The resulting solution of sulphates is partially neutralized with alkali and shaken out with chloroform, whereby the methylpelletierine is removed, the pseudopelletierine remaining in solution. Upon evaporation of the chloroformic solution methylpelletierine is obtained, and can be purified by repeated conversions into sulphate and precipitation, until its optical rotation becomes constant. The pseudopelletierine may be recovered from the original still somewhat acid solution by adding alkali in excess and shaking the liberated base out with ether. Upon evaporation of the ethereal solution, the alkaloid is obtained in crystalline form.

Action and Uses.—The employment of this alkaloidal salt in medicine is almost solely as a tæniacide, for which purpose it is probably the most efficient drug known. In large doses it produces symptoms of muscular paralysis, being similar in its action to curare; in other words, it paralyzes peripheral motor nerve plates. Even in full medicinal doses it may bring about a sensation of general muscular relaxation, to which are frequently added giddiness, confusion, and uncertain vision, and occasionally nausea and vomiting. These unpleasant effects may to a certain extent be obviated if the patient remains quiet after taking the drug. While pelletierine is useful as a tæniacide in adults, it is not the remedy of choice in very young children. As usual, before the administration of an anthelmintic, the patient should be starved for at least 12 hours, and in from ½ to 2 hours after the drug is administered an active purge should be given. The dose is from 3 to 8 grains (0.20–0.50 Gm.), commonly given in syrup or capsule.

PEPO, *U. S.*—Pumpkin Seed.

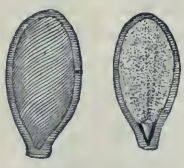
Semen peponis.—*Kuerbissamen* or *Kuerbisskoerner*, *Graumontsamen*, G.; *Semences de potirons* or *de Courge*, Fr.; *Semillas de calabaza*, Sp.; *Pevides de cucurbita*, Port.

The dried ripe seed of *Cucurbita Pepo* L. (Fam. *Cucurbitaceæ*).

Pumpkin seeds are official in a number of pharmacopœias, though the latter do not agree in the botanical names employed.

Origin.—The well-known pumpkin of cultivation, the sole source of the seeds, is of unknown nativity, though it is believed to have originated in North America. The specific identity, or other relations, of several varieties of Pumpkin and Squash are unsettled, although, so far as our definition is concerned, the Squash is supposed to be distinct.

Fig. 303.



Pumpkin seed: entire and longitudinally divided.

Description.—About 2 Cm. (⅘ In.) long, strongly flattened, oval-ovate, somewhat oblique at the bluntly pointed end, rounded at the base, slightly convex on the broad surfaces, with a very slight groove near the little, or not at all, thickened margin, the white or pale-yellow surface nearly smooth or finely granular, frequently covered with fragments of a white membranous tissue; kernel consisting of 2 flat cotyledons and a short conical radicle, devoid of endosperm; nearly inodorous and of a bland, sweet and pleasant, oily taste.

Constituents.—Pumpkin seeds contain 30 per cent. or more of a reddish-yellow fixed oil and a greenish-brown, soft, acrid, and somewhat bitter resin, together with starch, sugar, and other ordinary plant-principles, and an albumin which is easily obtained in well-developed octahedral crystals. The oil has scarcely any odor and is of a mild, sweetish pleasant taste, commencing to congeal at —17° C. (—1.4° F.). Its specific gravity is between 0.91 and 0.915. It consists of glycerides of palmitic, myristic, and oleic acids, which also exist free in the seeds (Kopylow). The resin is generally regarded as the active constituent. Although it has been said that the oil, in doses of

about ½ ounce, possesses the medicinal effect of the seeds, the statement has been denied. If correct, the action is probably due to the presence of some resin in the oil.

Action and Uses.—A very efficient and harmless tæniacide. 1 to 2 ounces (30–60 Gm.) of the seed, thoroughly ground, and made into an electuary with sugar or into an emulsion with water, should be taken on a fasting stomach and followed in from 1 to 2 hours by an active purge. The resin has been given in doses of 15 grains (1 Gm.).

Pumpkin seeds are also distinctly diuretic.

Allied Drugs.—It appears that most of the *Cucurbitaceous* seeds possess the properties of pumpkin seeds. Squash seeds are ordinarily somewhat lighter colored and more spongy, relatively broader and more blunt, and with a more thickened margin. Muskmelon and cucumber seeds are much smaller, relatively narrower and thicker, and with almost no marginal groove. Watermelon seeds, which are sometimes white or whitish, are smaller, flatter, harder, and have a more abrupt and angular edge, usually with minute undulations upon their surfaces.

PEPSINUM, *U. S., Br., P. G.*—Pepsin.

Pepsine, Fr. Cod.; *Pepsine*, Fr.; *Pepsin*, G.

A proteolytic ferment or enzyme obtained from the glandular layer of fresh stomachs of healthy pigs, and capable of digesting not less than 3000 times its own weight of freshly coagulated and disintegrated egg-albumin, when tested by the process given below. If it be desired to use a diluent for reducing pepsin of a higher digestive power to that required by the Pharmacopœia, sugar of milk should be employed for that purpose.—U. S.

An enzyme obtained from the mucous lining of the fresh and healthy stomach of the pig, sheep, or calf. Tested as prescribed it should dissolve 2500 times its weight of hard-boiled white of eggs.—Br.

The French Codex recognizes two varieties of pepsin, designated respectively as Pepsine extractive and Pepsine médicinale. The former is obtained from the stomach of the hog and the rennets of sheep and calves, while the latter is a mixture of the former with starch. No process of preparation is given.

History.—Pepsin was discovered in 1836 by Schwann, and he named it pepsin, from πέψις (digestion). Pepsin is a secretory product of certain glands imbedded in the tissue of the inner coating of the stomach, but has also been found in muscular tissue, urine, brain, and the mucous membrane of the intestine. True or active pepsin probably does not exist at all times in the gastric juice, but is formed by the action of hydrochloric acid and chlorides from a mother substance known as "pepsinogen" as the digestive functions of the stomach may require; in support of this theory we find that glycerin will abstract increased quantities of pepsin from the mucous membrane of the stomach after this has been treated with 0.2 per cent. hydrochloric acid or 1 per cent. sodium chloride solution. The use of pepsin in medicine is mainly due to the efforts of Dr. Corvisart, court physician to the Emperor Napoleon III., but the quality of the commercial article has been vastly improved since that time: to the perseverance and energy of American pharmacists are due the improvements in the mode of manufacturing pepsin and the wonderful increase in digestive power of the commercial article.

Preparation.—A crude pepsin, consisting of the carefully dried mucous membrane of the stomach, is obtained by the following process of Dr. Lionel Beal: The stomach of one of these animals recently killed having been cut open and laid on a board with the inner surface upward, any adhering portions of food, dirt, or other impurity are to be removed and the exposed surface slightly washed with cold water; the cleansed mucous membrane is then to be scraped with a blunt knife or other suitable instrument, and the viscid pulp thus obtained is to be immediately spread over the surface of glass or glazed earthenware and quickly dried at a temperature not exceeding 100° F. The dried residue is to be reduced to powder and preserved in a stoppered bottle. Lamatch's German pepsin is obtained by triturating the mucous membrane of the stomach with clean dry sand, filtering the liquid obtained, and drying this in thin layers at a temperature of 50° C. (104° F.). In the United States two kinds of pepsin are manufactured, known respectively as precipitated pepsin and soluble or scale pepsin; the former is made by the method recommended by E. Scheffer in 1872, and consists in precipitating an acid infusion of clean mucous membrane of hog stomach (prepared cold) by a saturated solution of sodium chloride, redissolving the precipitate in acid water, reprecipitating with salt in order to purify the pepsin, and finally drying at or below 40° C.

(104° F.). (See *Amer. Jour. Pharm.*, 1872.) The process for the manufacture of the so-called scale or peptone pepsins insures an increased yield of product and higher digestive power, but not always the same degree of purity: it consists in subjecting the well-cleaned mucous membranes of animal stomachs, after being thoroughly minced by machinery, to a process of self-digestion in water acidified by hydrochloric acid at a temperature of 38° to 45° C. (100.4°–113° F.), until the whole mass is converted into a uniform transparent glairy fluid. This is allowed to cool and deposit over night after an addition of chloroform or sulphurous acid solution, which prevents putrefaction and in nowise interferes with the activity of the pepsin; the liquid is carefully strained, concentrated in a vacuum apparatus to a syrupy consistence of 8° to 10° B., and spread upon plates of glass, where it is allowed to scale in suitable dust-free rooms. Pepsin thus prepared always contains mucus, peptones, and syntonin, while that prepared by the Scheffer method is contaminated with salt and some inert albuminous matter. In 1891 a process was patented in the United States and in England combining the advantages of the two preceding processes. The essential features are as follows: the well-cleansed and minced mucous membranes are brought to solution by digesting with acidulated water, the solution being clarified after addition of sulphurous acid; the clear liquid is separated from the deposit, and then precipitated by saturating at a higher temperature with sodium sulphate, whereby the pepsin is deposited, while the peptone remains in solution. The precipitated pepsin is dissolved in weak hydrochloric acid and subjected to dialysis, which removes the sodium sulphate and remaining peptones, after which the residual solution is concentrated at a low temperature and dried on plates of glass. The sodium sulphate is not lost in the process, but obtained from the peptone solution by recrystillization. The commercial processes are evolved by slight modifications of the above (see *Pharm. Jour. and Trans.*, 1893, pp. 588–592). A relatively pure pepsin may be obtained by digesting the mucous membranes of the stomach with water acidulated with 5 per cent. of phosphoric acid, filtering, and precipitating the clear filtrate with lime-water, whereby the pepsin is removed mechanically by the phosphate. The precipitate is collected, dissolved in diluted hydrochloric acid, and the pepsin precipitated by means of an ether-alcohol solution of cholesterin. From the latter precipitate the cholesterin is removed by washing it with ether. The residuum, consisting of pepsin, is dried and bottled. Selldén (1873) observed that the mucous membrane is not deprived of pepsin by maceration in acidulated water, but that by digestion at 37° C. (98.6° F.) about double the amount of pepsin is obtained; the mother-liquor from the precipitated pepsin, after having been deprived of salt by dialysis, possesses only very slight digestive properties. That pepsin exists partly in the stomach in an insoluble form has also been demonstrated by Béchamp and by Gautier (1882); the insoluble granules, termed *microzymes*, gradually dissolve in water on digestion.

Properties.—The U. S., British, and German pharmacopœias respectively ascribe the following properties to pepsin: "Lustrous white, pale-yellow or yellowish transparent or translucent scales, or a fine white or cream-colored amorphous powder, free from offensive odor, and having a slightly acid or saline taste. It should not be appreciably hygroscopic. Soluble, or for the most part soluble, in about 50 parts of water with more or less opalescence; more soluble in water acidulated with hydrochloric acid; insoluble in alcohol, ether, and chloroform. Pepsin when in solution is incompatible with alkalies, alkaline earths, or alkaline carbonates, as well as with more than traces of mineral acids. Hydrochloric acid of greater strength than 0.5 per cent. inhibits and rapidly destroys its physiological action. Its solution is precipitated by the salts of many heavy metals, and by tannic or gallic acid. Pepsin and pancreatin in solution are incompatible with one another; if neutral or alkaline, the pancreatin gradually destroys the pepsin, and if acid, the pepsin destroys the pancreatin. On heating a solution of pepsin in acidulated water to 100° C. (212° F.) it becomes milky or yields a light flocculent precipitate, and loses all proteolytic power. In a dry state it can bear this temperature without injury. Pepsin usually has a slightly acid reaction. It may be neutral, but should never be alkaline. The activity of pepsin in solution is destroyed by temperatures exceeding 70° C. (158° F.)."—U. S.

"A light yellowish-brown or white powder, or pale-yellow translucent grains or scales, having a faint odor and a slightly saline taste free from any trace of putrescence, and liable to absorb moisture from the air. Moderately soluble in water, and soluble in about 100 parts of 90 per cent. alcohol."—Br.

"A fine, almost white, slightly hygroscopic powder, having a peculiar bread-like odor

and a sweetish, afterward bitter taste. 1 part forms with 100 parts of water a faintly opalescent solution of very slightly acid reaction."—P. G.

The greater the proportion of peptone present in pepsin the more rapidly does it absorb moisture from the air, and the greater the absence of mucus the less unpleasant will be the odor and the more perfectly clear will be the solution of pepsin in water, especially if the water be acidulated with acetic acid. Except in minute quantities sodium chloride impairs the activity of pepsin; the same is true of alcohol. An aqueous solution of pepsin will decompose in a short time; after addition of hydrochloric acid it remains clear, but gradually loses its effects on albumin. Glycerin, on the other hand, preserves its virtues.

In its proteolytic action pepsin not only dissolves coagulated albumin, but converts it into peptone, which latter should be the true measure of the valuation of pepsin. Its activity was determined (by E. Schütz, *J. C. S.*, 1885; A. Samojloff, *Pflüger's Archiv*, 1901, 85, pp. 86–89) to be proportional to the square root of the amount of the pepsin present (see, also, Bardick and Sayre, *Proc. Am. Pharm. Assoc.*, 1899, p. 310). Pepsin is without action on papain, but the latter destroys pepsin in a neutral or slightly acid medium (V. Harlay, *Jour. Pharm.*, 1900, vi., 11, 466–469).

Tests.—Pepsin exposed on a watch-glass to the air, even in damp weather, should not become sticky in the course of a few hours, showing the absence of an undue amount of peptone. It should form with distilled water an almost clear solution, which is not rendered turbid by the addition of acetic acid, showing the absence of mucus. (Pepsin made by Scheffer's process never yields a clear solution with water, owing to the presence of syntonin or acid albumin.) It should be free from any disagreeable or ammoniacal odor, due to the presence of putrescible matter. A drop of tincture of iodine added to a solution of pepsin should not develop a blue or purplish-red color, showing the absence of starch and dextrin.

Valuation of Pepsin.—The valuation of pepsin by the different pharmacopœias is based upon the proteolytic power or the amount of hard-boiled egg-albumin which the pepsin will dissolve under fixed conditions. The conditions and directions of the various processes must be strictly adhered to to get comparable results for the respective methods.

The following are the official methods of assay of the U. S., British, and German pharmacopœias:

"Mix 9 Cc. of diluted hydrochloric acid with 291 Cc. of distilled water. Dissolve 0.1 Gm. of pepsin in 150 Cc. of the acidulated water. Immerse and keep a fresh egg during 15 minutes in boiling water; remove the pellicle and all of the yolk; rub the white albumin through a clean sieve having 40 meshes to the linear inch. Reject the first portion that passes through the sieve, and place 10 Gm. of the succeeding portion in a wide-mouthed bottle of 100 Cc. capacity. Add 20 Cc. of the acidulated water, and tap the albumin with a glass rod tipped with cork or black rubber tubing until the albumin is completely disintegrated; then rinse the rod with 15 Cc. more of the acidulated water and add 5 Cc. of the pepsin solution. Cork well, invert the vial 3 times, and place in a bath that has previously been regulated to 52° C. (125° F.). Keep it at this temperature for 2½ hours, agitating every 10 minutes by inverting the vial once. After removing from the bath, add 50 Cc. of cold distilled water and pour into a 100 Cc. graduated measuring cylinder. After standing in this for ½ hour, not more than 1 Cc. of undissolved albumin flakes should remain.

"The relative proteolytic power of pepsin stronger or weaker than that just described may be determined by ascertaining by repeated trials the quantity of the above pepsin solution required to digest, under the prescribed conditions, 10 Gm. of boiled and disintegrated egg-albumin. Divide 15,000 by this quantity expressed in Cc. to ascertain how many parts of egg-albumin 1 part of the pepsin will digest."—U. S.

"If 12.5 Gm. of coagulated and firm white of fresh eggs, 125 Cc. of acidulated water, containing about 0.2 per cent. of hydrogen chloride (HCl), and 0.005 Gm. of pepsin be digested together at 40.5° C. (105° F.) for 6 hours, and shaken frequently, the coagulated white of eggs dissolves, leaving only a few small flakes, in an almost clear solution. The white of eggs should be prepared by boiling quite fresh eggs in water for 15 minutes, then immersing them in cold water, and, as soon as sufficiently cool for handling, separating the whites, washing off any fragments of yolk or membrane with water, removing the water with a clean towel, then at once rubbing the whites through a sieve having 12 meshes to a centimeter, and using the product before it has lost moisture. For the acidulated water mix the official hydrochloric acid with water in the proportion of 1 Gm. to 156 Cc.; this will give a solution containing about 0.2 per cent. of hydrogen chloride."—Br.

10 Gm. of fresh hard-boiled (10 min.) egg-albumin, passed through a No. 4 sieve (10 meshes per centimeter), are added to 100 Cc. of water at 50° C. (122° F.), and 0.5 Cc. of hydrochloric acid and 0.1 Gm. of pepsin added thereto. The mixture is kept at 45° C. (113° F.) and agitated frequently during 1 hour, at the end of which time not more than a few whitish-yellow flakes should remain undissolved.—P. G.

The French Codex determines the value of pepsin by allowing it to act on fibrin in acidulated water during 6 hours at a temperature of 50° C. (122° F.), after which the mixture is filtered, and if 20 or 30 drops of nitric acid be then added to the cooled filtrate, no disturbance should occur; the addition of alcohol, on the contrary, causes abundant precipitation. 0.50 Gm. of the medicinal pepsin, or 0.20 Gm. of the extractive pepsin, should digest 10 Gm. of fibrin under the prescribed conditions.

A. H. Allen, in his well-known *Commercial Organic Analysis*, suggests the following method for the valuation of pepsin, which permits of the determination of the peptone and other products of proteolytic action: About 1 Gm. of egg-albumin in scales is powdered and treated in a 100 Cc. flask with 20 Cc. of warm water. When the substance has dissolved, the liquid should be heated in a bath of boiling water to coagulate the albumin, and cooled to a temperature not exceeding 40° C. (104° F.), 0.100 Gm. of the sample of pepsin to be tested should next be added, followed by 25 Cc. of decinormal hydrochloric acid. The liquid is then warmed to 40° C. (104° F.), and kept at that temperature for 3 hours. A volume of $\frac{n}{10}$ sodium carbonate exactly equivalent to the acid previously used is then added, and the liquid heated on the water-bath to 90° C. (194° F.) for 10 minutes. It is then cooled, diluted with water to 100 Cc., and passed through a dry filter. The precipitate will consist of syntonin and any unaltered albumin, while the filtrate contains any albumoses and peptones formed. 50 Cc. measure of the filtered liquid is now saturated in the cold with powdered zinc sulphate (of which about 60 Gm. will be required), allowed to stand with occasional agitation for half an hour, and then filtered. The precipitate is washed with a cold saturated solution of zinc sulphate, the filtrate diluted with water to 250 Cc., acidulated with hydrochloric acid, and treated with excess of bromine water. The nitrogen in the precipitate is determined by the Kjeldahl method and calculated to peptone by multiplying by 6.3. The albumoses may be deduced from the nitrogen found in the precipitate caused by zinc sulphate, after having washed the precipitate with a saturated solution of zinc sulphate.

For application of the method to commercial pepsins, see article of Bardick and Sayre, *Proc. Amer. Pharm. Assoc.*, vol. xlvii., p. 307.

Although the U. S. Pharmacopœia requires of pepsin a digestive power of only 1 to 3000, higher grades are in daily use by physicians, such as 1 to 4000, 1 to 5000, and 1 to 6000. In addition, manufacturers of pepsin are prepared to furnish still purer products, capable of dissolving eight, ten, fifteen, and even twenty thousand times their weight of hard-boiled egg-albumin.

Composition.—Absolutely pure pepsin is unknown; it probably contains the same elements present in other protein compounds. Syntonin has a similar composition, but is insoluble in water and neutral saline solutions; its presence in pepsin made by Scheffer's process was shown by Selldén (1873).

Saccharated Pepsin (*Pepsinum Saccharatum*, U. S., 1890), at one time in favor with physicians, is no longer officially recognized and but rarely used. It was prepared by mixing 1 part of official pepsin with 9 parts of recently dried sugar of milk, the mixture being triturated to a uniform fine powder and preserved in well-stoppered bottles. Containing only 10 per cent. of official pepsin, its digestive power is rather low, although still much higher than the undiluted pepsin of the French and German pharmacopœias.

Pharmaceutical Preparations.—Aromatic Pepsin; Aromatic Solution of Pepsin; Compound Powder of Pepsin; Elixir of Pepsin; Elixir of Pepsin and Bismuth; Elixir of Pepsin, Bismuth, and Strychnine; Glycerite of Pepsin; Solution of Pepsin; Wine of Pepsin.—N. F.

Action and Uses.—Pepsin was introduced into medicine with the idea that it would be of value in those conditions in which the quantity of this ferment of the gastric juice was markedly diminished or absent, but as this rarely occurs, it is doubtful if the administration of pepsin is often needed. The hydrochloric acid that is usually prescribed with it is likely the ingredient of the combination that produces results, for the gastric juice is almost always capable of digesting proteids if it has an acid reaction. This has been proven by acidulating the gastric juice removed from individuals suffering from dyspepsia. The drug has been found of some value in the acute and chronic gastric disorders of infants and young children, and it affords some measure of relief in infantile chronic indigestion with diarrhœa. In the adult it may be used with success in combination with hydrochloric acid, where there is a loss of digestive power either primary or secondary to some other disease. It should never be prescribed in alcoholic menstrua or in combination with alkalies or alkaline salts, as both impair its activity. The acidulated glycerin and water solution is the most stable. It should be administered in moderately large doses, 5 to 30 grains (0.30–2 Gm.).

Saccharated pepsin possesses the same properties and is used for the same purposes as pepsin. Being a weaker preparation, its dose is proportionately larger, and is from 10 to 30 grains (0.6–2 Gm.).

Allied Substances and Products.—Gastric Juice.—As taken from the stomach and filtered from the undigested food, this forms a clear, transparent, limpid liquid of a pale-yellow or brownish color, of a slight peculiar odor, and of a somewhat saline and acidulous taste. It is but slightly heavier than water, and has a strongly acid reaction, which has been attributed to free lactic and hydrochloric acids, to acid phosphates, and to acid hippurates. The gastric juice retains its digestive power for a long time, even after it has become mouldy. Lehmann obtained from it between 0.1 and 0.132 per cent. of free hydrochloric, and between 0.32 and 0.585 per cent. of lactic acid. The latter was observed by Richet (1878) to be identical with *sarcolactic acid* of horseflesh. The total percentage of all solids contained in gastric juice is between 1 and 1.5 per cent., but varies in different animals, and is invariably increased by admixture with saliva. The chlorides amount to nearly 0.5 per cent., among them small quantities of ammonium and calcium chlorides. Phosphates of calcium, magnesium, and iron amount to $\frac{1}{2}$ or $\frac{1}{4}$ per cent., but alkali sulphates and phosphates cannot ordinarily be detected. The gastric juice of the dog and hog have been used in dyspepsia.

Peptones.—Peptones are a product of the digestion of albuminoid substances. In a dry condition they are white amorphous substances and extremely hygroscopic. They are soluble in water. The solution is not coagulated by boiling, nor is a precipitate caused by the addition of acids or potassium ferrocyanide in presence of acetic acid (distinction from albumin), neither is a precipitate caused by solutions of ferric chloride or cupric sulphate, nor by saturating the solution with ammonium sulphate or zinc sulphate (distinction from albumoses). The aqueous solutions of peptone are lævorotatory. Peptones are diffusible through animal membranes and parchment, but much less readily than salts. Neutral solutions of peptone are precipitated by alcohol, tannin, and by various salts of mercury. Acid solutions yield precipitates with potassio-iodide of bismuth, potassio-mercuric iodide, bromine-water, and other group reagents for alkaloids, but these precipitates are soluble in excess of peptone (Tanret, 1881). Brieger (1883) extracted from some peptones by boiling alcohol an amorphous poisonous alkaloid resembling the ptomaïnes in behavior. Peptone is colored yellow by nitric acid, and gives with Millon's reagent, on warming, a red precipitate, and with Fehling's solution a violet-red color.

Peptone is readily assimilated by the intestinal mucous membrane. Poehl (1882) states that peptones may be again converted into albuminoids by the influence of alcohol, various alkali salts, and other agents having much affinity for water. *Peptonized meat* has been recommended as a nutritive medicine. The liquid resulting from the artificial digestion of lean meat is strained, neutralized with sodium bicarbonate, and the filtrate evaporated until it has the density 1.208, when it is stated to contain 50 per cent. of peptone (Petit, 1881), and may be preserved by the addition of glycerin and combined with ferric chloride, mercuric chloride, and other salts. By desiccating its concentrated solution upon oiled plates peptone may be obtained in scales resembling gelatin, which are hygroscopic, but not deliquescent on exposure.

PETROLATUM, *U. S.*—Petrolatum.

Petrolatum spissum, U. S., 1890.

Manufacture.—As already stated under Soft Paraffin, which differs from petrolatum only in its somewhat softer consistence and lower melting-point, petrolatum is obtained as a residue in the fractional distillation of petroleum, which is purified and decolorized as explained under Hard Paraffin. It is a mixture of neutral hydrocarbons, chiefly of the marsh-gas or paraffin series.

Properties and Tests.—Petrolatum, as recognized in the U. S. P., is an unctuous mass, of about the consistence of an ointment, varying in color from yellowish to light amber, slightly fluorescent when yellowish, especially after being melted, transparent in thin layers, completely amorphous, and without odor or taste, or giving off, when heated, a faint petroleum-like odor. When melted and brought to a temperature of 60° C. (142° F.) it has a specific gravity of from 0.820 to 0.850. It melts between 45° and 48° (113° and 118.4° F.). Petrolatum is insoluble in water; scarcely soluble in cold or hot alcohol or cold absolute alcohol; but soluble in boiling absolute alcohol, and readily soluble in ether, carbon disulphide, chloroform, benzin, benzene, oil of turpentine, and fixed oils. When heated on platinum foil to a temperature above its melting-point, it should be completely volatilized without emitting any acrid vapor. Moistened blue litmus-paper should not be reddened in contact with water previously shaken with melted petrolatum. If 2 volumes of concentrated sulphuric acid be added to 1 volume of melted petrolatum in a test-tube placed in hot water, and the contents occasionally agitated during 15 minutes, the acid should not acquire a deeper tint than brown nor lose its transparency (limit of readily carbonizable organic impurities). If 10 Gm. of petrolatum be digested for half an hour with 10 Gm. of sodium hydroxide and 50 Cc. of water, the aqueous layer separated and supersaturated with sulphuric acid, no oily substance should separate (absence of fixed oils or fats of animal or vegetable origin or of resin).—U. S.

A white variety of petrolatum, free from yellow tint, is recognized in the U. S. Pharmacopœia, under the name of PETROLATUM ALBUM. It has the characteristics of petrolatum, with the exception of color, and should respond to all the tests given above.

Action and Uses.—This substance is used as an ointment base instead of lard, etc. It has the advantage over the animal and vegetable fats in remaining free from rancidity, but because it is less readily absorbed than they are it is not a good vehicle for drugs intended to act by absorption through the skin. As a bland, protective application to inflammation of the skin it is of value. Taken into the stomach and intestines it is not absorbed and can, therefore, not be used as a foodstuff; it does, however, produce softening of the stools.

PETROLATUM LIQUIDUM, *U. S.*—Liquid Petrolatum.

Paraffinum liquidum, Br.; P. G.; *Liquid paraffin*, E.; *Paraffine liquide, Huile de paraffine*, Fr.; *Flüssiges Paraffin, Paraffinöl*, G.

A mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off most of the lighter and more volatile portions from petroleum, and purifying the liquid residue.—U. S.

Manufacture.—Liquid petrolatum may be obtained from petroleum after removal of the lighter hydrocarbons, by subjecting the residuary liquid to distillation between 330° and 390° C. (626° and 734° F.), treating the distillate with sulphuric acid and afterward with caustic alkali, and then filtering while hot through animal charcoal. The liquid is cooled to remove solid paraffins, which will crystallize out, and is then again distilled, the fraction distilling above 360° C. (626° F.) being collected.

Properties and Tests.—Liquid petrolatum is a colorless (or very slightly yellowish, U. S.), oily, transparent liquid, without odor or taste. Its specific gravity varies between 0.870 and 0.940 at 25° C. (77° F.), U. S.; from 0.885 to 0.890, Br.; not less than 0.880, P. G. The Br. and P. G. demand that its boiling-point shall not be below 360° C. (680° F.). A mixture of 4 Cc. of liquid petrolatum with 2 Cc. of absolute alcohol, and 2 drops of a clear saturated solution of lead oxide in solution of sodium hydroxide, should remain colorless when kept at 70° C. (158° F.) for 10 minutes (Br.). This latter test depends upon the possible presence of sulphur, which would form sodium sulphide, and as such react with the lead, causing a black coloration due to lead sulphide. In all other respects as regards properties and tests, liquid petrolatum corresponds to those given above under PETROLATUM.

Action and Uses.—This liquid is used as a protective coating, applied by an atomizer, to the respiratory mucous membranes, and as a vehicle for drugs which are to be so applied.

PETROLEUM.—Petroleum.

Oleum petræ.—Rock oil, Coal oil, E.; *Pétrole, Huile minéral*, Fr.; *Steinöl, Bergöl*, G.; *Petroleo*, Sp.

Origin.—Crude petroleum is a liquid mixture of hydrocarbons occurring naturally in the earth and found in immense deposits in certain parts of North America, notably Pennsylvania, Ohio, West Virginia, Texas, California, and Canada, in the Baku district on the west coast of the Caspian Sea, and to a limited extent in most European countries. Occasionally it is found oozing from the ground, frequently mixed with water, but is obtained in largest quantities from wells sunk in the ground to varying depths according to the geological formations from 300 to 2000 feet, whence it is forced up by the natural-gas pressure, or by pumping. Various theories have been advanced to account for its formation both from an inorganic and an organic origin. Thus under the former Byasson (1876) refers it to salt water charged with lime salts coming in contact with metals or their sulphurets; Mendelejeff (1887), to water and metallic carbides; and Ross (1891), to limestone ($CaCO_3$), hydrogen sulphide, and hydrogen peroxide, the gases being of volcanic origin. Its organic origin, however, is more likely as the result of the decomposition and distillation under high pressure of fossil carbonized animal matter. The researches of Höfer, Engler, and Sadtler (*Proc. Amer. Philos. Soc.* 36, 154, pp. 93–102; see also *Zeitschr. angew. Chem.*, 1894, pp. 122–126) give added force to the animal origin of the oil. While primarily produced from animal remains *in situ* in some places, it is likely that in other localities it is the result of distillation from older geological strata.

Properties.—As naturally obtained, petroleum varies in consistence from thin limpidity to the thickness of molassas or tar, and in color from pale yellow to blackish brown, usually of a reddish color by transmitted light, and generally showing a strong greenish fluorescence. Its specific gravity is generally between 0.8 and 0.95, but some varieties slightly exceed water in density. The heavier and dark-colored kinds yield, on rectification, light and limpid oils, and leave a residue consisting of *paraffin* and solid *bitumen*, a variety of which is found native as *asphaltum*. The latter is black, glossy, and brittle, while the bituminous residues from coal-oil distillation are less glossy and scarcely brittle at the ordinary temperature. The solid as well as the liquid fractions of petroleum are inflammable and burn with a bright sooty flame; the vapors of the more volatile kinds, mixed with atmospheric air, are highly explosive.

Barbadoes petroleum and *Seneca oil* were formerly employed for medical purposes. The former is characterized as a dark-colored, almost black, viscid liquid, specific gravity 0.73–0.878, and having a bituminous taste and odor. *Seneca oil*, obtained from the shores of Seneca Lake, was a lighter colored, thinner, and less disagreeable smelling oil.

Constituents.—Petroleum consists of a large number of hydrocarbons, belonging to two homologous series—namely, that of *marsh-gas*, of the general formula C_nH_{2n-2}, and of *olefiant gas* (olefin or ethylene series), having the formula, C_nH_{2n}. On treating petroleum with strong sulphuric acid the olefins, coloring-matter, and some other constituents are removed, and the hydrocarbons of the paraffin series left. The hydrocarbons of both series exist also in isomeric modifications which differ from the normal compounds in volatility and some other properties. Those containing C_4 and less are gases at the ordinary temperatures; the relation of the others is shown by the following table:

	Normal.	Iso.		Normal.	Iso.
Pentane, C_5H_{12}, boils at	38° C.	30° C.	Pentene, C_5H_{10}, boils at	37° C.	35° C.
Hexane, C_6H_{14}, "	70° C.	62° C.	Hexene, C_6H_{12}, "	70° C.	65° C.
Heptane, C_7H_{16}, "	98° C.	90° C.	Heptene, C_7H_{14} "	100° C.	——
Octane, C_8H_{18}, "	124° C.	118° C.	Octene, C_8H_{16}, "	125° C.	——

These compounds are to some extent separated by fractional distillation. The portion boiling below 50° C. (122° F.), being collected by itself, constitutes *naphtha* or *gasolene*, and consists almost exclusively of pentane and pentene; but if the vapors are well refrigerated the product contains also *butane*, C_4H_{10}, boiling at 1° C. (33.8° F.), and constitutes *rhigolene*, which requires to be kept in strong and well-corked bottles and in a cool place, since it evaporates rapidly at the common temperature. The naphtha freed from the low-boiling hydrocarbons is commonly known as *benzin* or *petroleum benzin* (see page 290); its specific gravity is about 0.67. The portion boiling at a higher temperature is separately collected and furnishes *kerosene*, *photogene*, or *coal oil*, which is largely employed for illuminating purposes; its safety for that use depends upon the absence of the low-boiling hydrocarbons. At a still higher temperature paraffin oils, paraffin jelly, and paraffin wax pass over, and the residue left in the still at a temperature of about 400° C. (752° F.) constitutes the ordinary *asphaltum* or *bitumen*. Heptane was ascertained by Thorpe (1879) to be a constituent of the volatile oil of *Pinus Sabiana*. Sulphur to the amount of 1 or 2 per cent. is a constituent of the Beaumont, Texas, petroleum, and is also found to the extent of 0.5 to 0.6 per cent. in the Lima, Ohio, crude oil.

OLEUM PETRÆ ITALICUM, S. PETROLEUM CRUDUM.—Yellowish or reddish, limpid, iridescent, of a peculiar bituminous odor, soluble in fixed and volatile oils, in ether and absolute alcohol, with difficulty soluble in alcohol; specific gravity 0.75 to 0.85.

Crude petroleum varies considerably in composition according to the locality from which it is derived. The Canadian, Ohio (Lima district), and Texas (Beaumont) oils are characterized by variable percentages of sulphur, about 0.4 to 0.5 per cent. in the two former and 1 to 2.5 per cent. in the Beaumont oils. In the Lima oils Mabery (*Amer. Chem. Jour.*, 1891) has identified methyl, ethyl, normal propyl, iso- and normal butyl, pentyl, and hexyl sulphides. For the composition of California, Ohio, and Texas petroleum see articles by C. F. Mabery (*Amer. Chem. Jour.*, *25* [4], pp. 253–284; *ibid.*, *13*, pp. 232–243; *Jour. Amer. Chem. Soc.*, *23*, pp. 264–367).

The total yield of crude petroleum in the U. S. for the year 1901 amounted to 69,389,194 barrels, and for 1902 was estimated at not less than 83,000,000 barrels.

Uses.—In the dose of 15 to 30 minims (1–2 Cc.) it has been used internally as an intestinal antiseptic.

PHENACETINUM, *Br., P. G.*—Phenacetin.

Acetphenetidinum, U. S.; *Acet-Phénétidine*, Fr. Cod.
For full description, see ACETPHENETIDINUM, page 11.

PHENOL, *U. S.*—Phenol.

Acidum carbolicum, Br., P. G. (U. S. 1890); *Phénol, Acide carbolique, Acide phénique*, Fr. Cod.; *Acidum phenicum s. phenylicum.—Carbolic acid, Phenic acid, Phenic alcohol, Benzophenol*, E.; *Karbolsäure, Phenylsäure*, G.; *Fenolo cristallizzato*, F. It.; *Acido fenico (carbolico)*, It., Sp.

Formula, C_6H_5OH. Molecular weight, 93.34.

Hydroxybenzene, obtained either from coal-tar by fractional distillation and subsequent purification, or made synthetically, containing, when assayed by the process given below, not less than 96 per cent. of absolute phenol. It should be kept in dark amber-colored, well-stoppered bottles.—U. S.

Although the name *carbolic acid*, by which this compound was officially recognized for many years, has been dropped from the Pharmacopœia, it will no doubt continue to be used commercially for some time to come.

Origin.—Phenol occurs in castoreum, in the urine of man and of herbivorous animals, and in the products of the dry distillation of various organic substances, such as resins, bones, wood, and more especially coal. It is from the latter source that it is obtained in the arts. It was obtained first by Runge (1834), and in a purer condition by Laurent (1840), who ascertained its composition and chemical behavior.

Preparation.—That portion of coal-tar collected by distillation between 100° and 250° C. (212° and 482° F.) is known as *light oil*. It has a specific gravity of 0.94–0.99, and contains from 4 to 10 per cent. of acid. This fraction is agitated with a 10 per cent. sodium hydroxide solution (a stronger solution is not desirable, since it would dissolve naphthalene and other impurities contained in the oil), and upon standing separates into two layers, the lower being a solution of sodium-phenol, while the upper consists of the extracted oil. The lower layer is carefully drawn off and treated with hydrochloric or sulphuric acid in such quantity as has been ascertained (by a previous test) to be sufficient for exact decomposition. In some cases the sodium-phenol solution for the purpose of purification is treated first with about one-eighth of the necessary quantity of acid, whereby homologous phenols are separated, and after the removal of these the solution is decomposed completely by acid. The impure phenol thus liberated rises as an oily layer to the surface, which, after removal, is washed by agitation with concentrated solution of common salt, freed from water by means of calcium chloride, and then distilled between 180° and 190° C. (356° and 374° F.). Upon exposure in cool places the distilled phenol congeals to a crystalline mass, which, after being freed from adhering liquid, is again distilled, that portion coming over below 185° C. (365° F.) being carefully collected and crystallized. Sometimes the phenol before final distillation is treated with potassium dichromate and sulphuric acid. In order to obtain phenol in colorless loose crystals, it may be recrystallized from boiling petroleum benzin.

While the above method is the one now generally followed, some manufacturers in Europe extract phenol from a smaller fraction of the coal-tar distillate, known as *heavy oil*, and collected between 160° and 220° C. (320° and 428° F.), the treatment being practically identical with that given above.

The bulk of phenol is manufactured in Europe, particularly in England, little of the crystallized acid being made in this country.

Absolutely pure phenol was obtained by Church (1871) from the nearly pure commercial product by treating it with a quantity of water (about 20 parts) insufficient to dissolve it completely, removing the undissolved portion, and saturating the clear aqueous solution with pure table-salt, when the phenol separated as an oily layer, requiring distillation over quicklime to obtain it crystallized. The portion passing over up to 185° C. (365° F.) has, at ordinary temperatures, merely a very faint aromatic odor.

SYNTHETIC PHENOL.—Since 1888 considerable quantities of synthetic phenol have been placed upon the market. This is prepared directly from benzene (benzol) by first treating it with fuming sulphuric acid and moderately warming the mixture, whereby benzene-sulphonic acid is produced: $C_6H_6 + H_2SO_4 = C_6H_5SO_2OH + H_2O$. The acid thus formed is neutralized with potassium carbonate, yielding potassium benzene-

sulphonate, and this compound then fused with a large excess of potassium hydroxide, whereby potassium sulphite and potassium-phenol are formed: $2(C_6H_5SO_2OK) + 4KOH = 2H_2O + 2K_2SO_3 + 2C_6H_5OK$. The potassium-phenol finally is treated in solution with hydrochloric acid, in order to liberate the phenol or carbolic acid, which is purified further by distillation: $C_6H_5OK + HCl = C_6H_5OH + KCl$. The advantages of the synthetic method are chiefly the absence of homologous products (cresol, xyleue, etc.), as the benzene can be procured of great purity by means of crystallization.

Properties.—Pure phenol has a faint aromatic odor, is colorless, crystallizes in needles, and does not absorb moisture from the atmosphere (Moss, 1875). Usually, however, it retains a minute quantity of water, by which it becomes deliquescent; with a little more water it forms an oily liquid, which crystallizes at a lower temperature; and if traces of the tar-products are present, it acquires a reddish color on exposure, and deliquesces to a brown-colored oil. This peculiar red color has been investigated by E. Fabini, and, according to that author, it is due to the formation of an organic coloring-matter, named by him *phenerythen*, caused by the presence of minute quantities of metal (probably copper) in the phenol. Hydrogen peroxide, metal, and ammonia must be present to produce the color; ammonium-phenol, being formed by absorption of ammonia from the air, reacts with the metal present, forming a metal carbolate, and this in turn is acted on by hydrogen peroxide, yielding the characteristic red color. The odor is modified by the presence of a little cresol. Phenol is insoluble in petroleum benzin, but freely soluble in alcohol, ether, glycerin, the volatile and fatty oils, in glacial acetic acid, caustic alkalies, carbon disulphide, and chloroform, the solutions in the last two liquids separating all the water present, the amount of which may thus be determined. Phenol dissolves at 15° C. (59° F.) in about 15 parts of water. It is soluble in 19.6 parts of water at 25° C. (77° F.), the solubility varying according to the degree of hydration of the phenol (U. S.). The solution is perfectly transparent, and has only a faint action upon blue litmus-paper. Phenol is less soluble in many saline solutions than in water; it yields, with a limited amount of concentrated solutions of the fixed alkalies, a crystalline mass, which, after being pressed, consists merely of phenol, and is almost free from potassa (Calvert, 1865). The fusing-point of crystallized phenol is influenced by the amount of water with which it is combined; the U. S. P. does not specify the melting-point, but demands that the congealing- or crystallizing-point shall not be below 40° C. (104° F.), while the melting-point is placed not lower than 38.8° C. (102° F.) (Br.). Phenol melting at about 40° C. (104° F.) (F. It., P. A.), between 40° and 42° C. (104° and 107° F.) (P. G.), represents almost absolute acid. The boiling-point of phenol is given at not higher than 188° C. (370.4° F.) (U. S.), not higher than 182° C. (359° F.) (Br.), about 180° C. (356° F.) (F. It., P. A.), between 178° and 182° C. (352.4° and 359° F.) (P. G.). It should be borne in mind that cresols which may be present have a higher boiling-point, that phenol contains variable proportions of water, and that a lower boiling-point or a higher melting-point indicates a purer and less hydrated phenol. Phenol volatilizes slowly at ordinary temperatures, rapidly at the temperature of boiling water, without residue. "When gently heated, phenol melts, forming a highly refractive liquid. It is also liquefied by the addition of about 8 per cent. of water. If the phenol be liquefied by a gentle heat, and then slowly cooled with constant stirring until it is partly recrystallized, the semi-liquid mass should have a temperature (remaining stationary for a short time) not lower than 40° C. (104° F.). On adding to 10 Cc. of an aqueous 1 per cent. solution of phenol 1 drop of ferric chloride test-solution, the liquid acquires a violet-blue color, which is permanent."—U. S. It has the specific gravity 1.060–1.066 at the melting-point, separates nitrocellulose in a gelatinous form from collodion, coagulates albumin, and has a caustic, acrid taste, but when largely diluted with water tastes sweetish and smoky. The vapor of phenol is inflammable.

A piece of pine wood dipped into an alkaline solution of phenol, and afterward into hydrochloric acid, assumes in the course of half an hour a deep-blue color. According to Tiemann and Haarmann, this color is a characteristic reaction of coniferin. The solution of phenol has no effect on polarized light. The concentrated alcoholic solution yields with ferric chloride a brown liquid, which on the addition of much water remains transparent and assumes a beautiful and permanent violet-blue color (Flückiger, 1872). When heated in sealed tubes with ammonia it yields but small quantities of phenylamine (aniline, $C_6H_5NH_2$). Fused with excess of potassium hydroxide, oxybenzoic and salicylic

acids are found among the products of decomposition. It is oxidized by potassium permanganate, yielding carbon dioxide and oxalic acid. Concentrated sulphuric acid converts it into phenolsulphonic (sulphocarbolic) acid, $C_6H_5OHSO_3$. Under the influence of nitric acid several substitution-products are formed, the most important of which is picric acid. Substitution-compounds are formed likewise with chlorine, iodine, and bromine. The last-named element, acting either in the form of vapor or as bromine-water upon an aqueous solution of phenol, produces a flocculent white precipitate of tribromophenol, $C_6H_2Br_3OH$, which crystallizes from alcohol in silky needles, melting at 98° C. (208.4° F.). This reaction is so delicate that a solution of phenol in 50,000 parts of water is still rendered turbid; it should, however, be remembered that alkaloids, cresols, and various other compounds are precipitated likewise by bromine-water.

Tests.—The purity of phenol is recognized by the properties described above, by the absence of all reaction upon red litmus-paper, and by the non-production of a dark color or precipitate in the aqueous solution by hydrogen sulphide, proving the absence of metallic compounds. The absence of cresol (cresylic acid) may be determined by mixing 1 volume of glycerin with 1 volume of cold liquefied phenol (rendered liquid by the addition of 8 (10, Br.) per cent. of water); a clear liquid should result, which is not rendered turbid by the addition of 3 volumes of water (U. S.).

The valuation of phenol is prescribed by the U. S. P. to be made with tenth-normal bromine solution (Koppeschaar's Solution), each Cc. of which corresponds to 0.001556 Gm. of absolute phenol. The solution is not, strictly speaking, a tenth-normal bromine solution, which would be very unstable, but is a solution of sodium bromate and bromide of such strength that upon addition of hydrochloric acid the quantity of bromine liberated shall correspond to that required for a tenth-normal solution, namely, 0.007936 Gm. per Cc. The test depends upon the formation of tribromophenol, and is made by adding to an aqueous solution of phenol a slight excess of the bromine solution, adding hydrochloric acid and potassium iodide, and, finally, titrating the iodine liberated by the excess of bromine by means of tenth-normal sodium thiosulphate solution. The reactions involved in this test are as follows: 1. The liberation of bromine by means of hydrochloric acid; thus, $NaBrO_3 + 5NaBr + 6HCl = Br_6 + 6NaCl + 3H_2O$. 2. The precipitation of tribromophenol; thus, $C_6H_5OH + Br_6 = C_6H_2Br_3OH + 3HBr$. 3. The liberation of iodine from the potassium iodide added; thus, $2KI + Br_2 = I_2 + 2KBr$. 4. The decoloration of the iodine solution formed; thus, $2Na_2S_2O_3 + I_2 = 2NaI + Na_2S_4O_6$. The second equation shows that 93.34 parts of absolute phenol require 476.16 parts of bromine for complete precipitation. Having found the excess of bromine solution, the calculation for percentage of absolute acid in the sample is easily made; for instance, if 0.05 Gm. of carbolic acid should require exactly 30 Cc. of tenth-normal bromine solution for precipitation, the sample would be said to contain 93.36 per cent. of absolute phenol. The U. S. P. demands at least 96 per cent. as ascertained by the following method: Dissolve 1.556 Gm. of the phenol to be valued in a sufficient quantity of water to make 1000 Cc. Transfer 25 Cc. of this solution (containing 0.0389 Gm. of the phenol) to a glass-stoppered bottle having the capacity of about 200 Cc., and add 30 Cc. of tenth-normal bromine solution (which is 5 Cc. more than would be required if the phenol in the solution were absolutely pure, the excess being added to promote the formation and separation of tribromophenol), then 5 Cc. of hydrochloric acid, and immediately insert the stopper. Shake the bottle repeatedly in the course of half an hour, then remove the stopper just sufficiently to introduce quickly 5 Cc. of a 20 per cent. aqueous solution of potassium iodide, being careful that no bromine vapor escapes, and immediately stopper the bottle. Shake the latter thoroughly, remove the stopper, and rinse it and the neck of the bottle with a little water, so that the washings may flow into the bottle, and then add 1 Cc. of chloroform and shake well. Add from a burette tenth-normal sodium thiosulphate solution until the iodine tint is exactly discharged and does not reappear after thorough agitation. Note the number of Cc. of tenth-normal sodium thiosulphate solution consumed. Deduct this from 30 (the number of Cc. of bromine solution originally added), and multiply the remainder by 4. The product will, approximately, represent the percentage of absolute phenol in the sample tested.

To estimate the quality of commercial phenol, Shoedler (1872) recommended its conversion into phenolsulphonic acid by heating it with an equal weight of sulphuric acid to 50° or 60° C. (122° or 140° F.), treating with barium carbonate, precipitating

the filtrate by sulphuric acid, and weighing the ignited barium sulphate, 100 parts of which correspond to 80.69 parts of anhydrous phenol.

The presence of phenol in watery solution may be detected, according to E. Hoffmann (1879), by pouring into a test-tube 1 or 2 Cc. of pure sulphuric acid, adding but not mixing an equal volume of aqueous liquid, and dropping in small particles of potassium nitrate, each of which will produce a deep-violet streak; on agitation the liquid becomes violet, and on the addition of water assumes a red-orange color; 0.1 per cent. of phenol may thus be detected. Salkowski's (1872) process consists in adding to the suspected liquid one-fourth its volume of ammonia, and then a few drops of solution of chlorinated lime (1 part in 20 parts of water). On the application of moderate heat, a blue or greenish color will be produced, either immediately or in the course of 15 minutes, the color changing to red upon acidulating with sulphuric or hydrochloric acid; 1 part of phenol in 4000 may thus be detected. Bromine may be used in place of the chlorinated solution; the blue compound is insoluble in ether and chloroform, dissolves in alcohol with a green color, and changes with acids to red, but becomes blue again by ammonia. Of still greater delicacy (1 in 200,000) is the test suggested by Plugge (1872): when a liquid containing phenol is boiled with a little solution of mercurous nitrate containing a trace of nitrous acid, reduction of the mercurous salt occurs, and the liquid assumes, sooner or later, an intense red color.

Under the name of *Crude carbolic acid, Acide phénique cru*, Fr., *Rohe Karbolsäure*, G., the Pharmacopœia of 1890 recognized a liquid consisting of various constituents of coal-tar, chiefly cresol and phenol, obtained by fractional distillation, and described it as colorless or of a reddish or brownish-red color and of a strongly empyreumatic taste and creosote-like odor. The commercial crude carbolic acid does not conform to this description, being usually of very dark color, almost black, and very disagreeable odor; in all probability it represents the residuary tarry liquor from which the phenol and cresol have almost wholly been abstracted. The former official crude acid corresponded to the commercial varieties known as Calvert's No. 4 and No. 5 carbolic acid. Crude carbolic acid as formerly sold, and still offered in the English market, is composed of varying proportions of crude phenol, cresol, rosolic acid, naphthalene, etc., besides water, and certain portions of it will crystallize at from 10° to 22° C. (50°–71.6° F.). It should not be soluble in less than 15 parts of cold water, and the aqueous solution should not show an alkaline reaction. If 50 volumes of the crude acid be agitated with 950 volumes of water and the mixture allowed to separate, not more than 5 volumes (10 per cent. of the acid used) should remain undissolved.

Aqua Carbolisata, P. G.; *Carbolized water, Phenol water*, E.; *Eau phéniquée*, Fr.; *Carbolwasser, Phenolwasser*, G.—Mix 22 parts of liquefied carbolic acid with 978 parts of distilled water. It contains 2 per cent. of pure carbolic acid by weight, or practically 146 grains in a pint. The preparation of the French Codex contains only 0.1 per cent. of phenol for internal use, and 1 per cent. if for external use.

Pharmaceutical Preparations.—Carbolized Gauze, Carbolized Oil, Iodized Phenol, N. F.; Carbolized Water, P. G.; Glycerite of Phenol, Ointment of Phenol, U. S.; Troches of Phenol, Br.

Lister's Catgut, for ligatures, is prepared by immersing for 2 days 200 parts of catgut in a freshly prepared mixture of 200 parts of phenol with 400 parts of water containing 1 part of chromic acid in solution; the gut is then dried without untwisting it, and preserved in a solution of 1 part of phenol in 5 parts of olive oil.

(See, also, Preparations of the National Formulary in Appendix.)

Action and Uses.—When locally applied to the skin, phenol produces burning pain, which is followed shortly by loss of tactile sensibility. The tissue at first is reddened, but later becomes blanched and anæsthetic. Burns from this drug are superficial, because it coagulates the albumin in the part it touches.

Phenol was at one time exclusively used as the antiseptic in surgical operations, but at present its use is limited chiefly to the cleansing of instruments and utensils. Because of its irritant action upon living tissues and its ready absorption from wounds, thereby causing symptoms of poisoning, and especially anuria, its use has been largely abandoned in surgical antisepsis.

Locally phenol is a caustic and anæsthetic. Its superficial action, however, renders it unfit for many of the conditions in which caustics are employed. 1 per cent. solutions

in water or olive oil are frequently employed in pruritus ani and vulvæ. 2 per cent. solutions often relieve the itching of jaundice and of many skin eruptions. It has many advocates in the treatment of parasitic skin diseases, and ointments containing from 5 to 10 per cent. of phenol form an excellent dressing in chronic, sluggish ulcers. 1 per cent. solutions may be employed in stomatitis and in the various acute inflammatory conditions of the throat as a mouth-wash or gargle. Care should be exercised in using phenol not to allow it to remain in contact with the skin of the fingers or toes, even in weak solutions, as it may cause gangrene or sloughing. In the form of Dobell's Solution it has been largely used in chronic nasal catarrh. A solution containing 8 grains (0.5 Gm.) of phenol to 1 fluidounce (30 Cc.) of water may be employed hypodermically in the abortive treatment of inguinal buboes. Injections of the pure phenol have been recommended in the treatment of hemorrhoids and hydrocele, but they often fail, and are always attended with a certain amount of danger. Phenol enters into the composition of Schleich's Fluid, a solution now largely employed in infiltration anæsthesia. 5 per cent. solutions may be used in the sick-room to disinfect the urine, stools, and soiled linen, but more potent preparations, such as solutions of formaldehyde, have largely supplanted it.

Internally, in the dose of from 1 to 2 grains (0.06–0.12 Gm.), it does good in obstinate vomiting, especially when it is due to gastric irritability; and combined with 15 to 20 grains (1.0–1.3 Gm.) of bismuth it is of service in fermentative diarrhœa.

Phenol depresses the peripheral sensory nerves when locally applied, and given internally in overdoses causes mental stupor which may be accompanied by clonic convulsions. Respiration and circulation are accelerated at first, but eventually the breathing becomes shallow and irregular, and the pulse running, rapid, and thready, death being due to respiratory failure. In fever it increases heat radiation and lessens its production in ordinary doses, but in poisonous amounts the great reduction in temperature which occurs is probably due in part to the collapse induced by the drug. It is eliminated by the kidneys as glycouronic acid, hydroquinone, and the sulphocarbolates of sodium and potassium. Large amounts irritate the kidneys, producing albuminuria and smoky colored urine. The urine sometimes causes reduction of Fehling's Solution.

Large lethal doses of phenol may produce immediate death, which is due to paralysis of the respiratory centre, or the individual may live for a number of hours, during which time he suffers from violent gastro-enteritis and burning pain throughout the gastro-intestinal tract. The mucous membrane of the mouth shows a wide eschar if the phenol be pure, a black or brown one if the phenol be impure, surrounded by a reddened zone of inflammation. In many cases vomiting and purging occur, but in some persons these symptoms are absent. Collapse usually appears early; the temperature falls; the skin is cold, clammy, and pallid; the face has an anxious expression; the respirations become rapid and shallow, and the pulse running, rapid, and thready, or even imperceptible. This condition is treated by the application of external heat, the administration of demulcents and opium to relieve pain, of stimulants to prevent or overcome shock, and of large quantities of any soluble sulphate, especially magnesium or sodium sulphate, which is the chemical antidote. The effects of phenol upon the skin may be neutralized completely by bathing the part in pure alcohol. Glycerin may also be employed, and is almost equally efficient.

Derivatives. — PHENOLSULPHONIC ACID.—*Sulphocarbolic acid, Sulphophenol, Sulphocarbol.* $C_6H_4(SO_3H)OH$. Molecular weight, 173.64.—Three different substitution-compounds of carbolic acid and sulphuric acid are known, distinguished by the prefixes ortho-, meta-, and para-. Orthophenolsulphonic acid is formed in the cold when equal parts of carbolic and sulphuric acids are left together for a week, whereas if the mixture be heated for 6 hours on a boiling water-bath, only the para- variety is produced; in either case the excess of sulphuric acid is removed by barium carbonate. The resulting sulphate is filtered out and the filtrate decomposed by addition of an exact amount of sulphuric acid, ascertained by a previous test, whereby the phenolsulphonic acid is liberated. It is a reddish- or amber-colored viscous liquid, of carbolic-acid-like odor and a caustic taste. It is readily soluble in water, alcohol, and glycerin. The ortho- acid in aqueous solution is gradually changed into the para- acid. The names *aseptol* and *sozolic acid* have been given to a 33⅓ per cent. solution of orthophenolsulphonic acid. It is a colorless or yellowish liquid of slight acid reaction and faint odor, which darkens upon exposure to light.

PHENOLPHTHALEIN. $C_{20}H_{14}O_4$.—Although not used in medicine, phenolphthalein is of considerable interest on account of its extensive use as an indicator in volumetric analysis. It is prepared by heating 10 parts of phenol with 5 parts of phthalic anhydride and 4 parts of

strong sulphuric acid to 120° C. (248° F.) for about 10 hours, exhausting the resulting product with boiling water, dissolving the residue in dilute sodium hydroxide solution, and precipitating with acetic acid. It may be purified by boiling its alcoholic solution with animal charcoal, and precipitating the filtrate with water, when it separates as a white or yellowish-white amorphous (or crystalline, if heated) powder. Phenolphthalein is almost insoluble in water, but readily soluble in alcohol, forming colorless solution. With alkalies it yields a red color, which is discharged by the slightest excess of acid, even carbon dioxide, but is not suited for determination of ammonia. The color is caused by formation of an alkali salt of phenolphthalein, which undergoes ionization in the presence of water. Phenolphthalein may be used in boiling as well as in cold liquids, and is employed in form of a solution in strong or diluted alcohol by dissolving 1 Gm. in 100 Cc. of the liquid. It is used as a delicate test for acids and alkalies.

TETRAIODOPHENOLPHTHALEIN.—*Nosophen; Iodophen.* $C_{20}H_{10}O_4I_4$.—A brownish-yellow, odorless, tasteless powder, obtained by adding a solution of 20 Gm. each of iodine and potassium iodide in 100 Cc. of water to a solution of 6 Gm. of phenolphthalein in 100 Cc. of water containing 8 Gm. of sodium hydroxide. The color of the latter solution changes from red to blue, and finally to yellow. Upon addition of hydrochloric acid the newly formed compound is precipitated, and may be further purified by resolution in sodium hydroxide solution and precipitation by acid. Nosophen is insoluble in water and acids, difficultly soluble in alcohol, but readily in ether, chloroform, and glacial acetic acid. It has been used both externally and internally as a non-toxic antiseptic agent. Compounds of tetraiodophenolphthalein with metals have been introduced under the following fanciful trade-names: Antinosin, sodium nosophenate or nosophen-sodium; Eudoxin, bismuth nosophenate or nosophen-bismuth; Apallagin, mercury nosophenate or nosophen-mercury; Asklepin, lithium nosophenate or nosophen-lithium. Eudoxin is used as an intestinal antiseptic in fermentative diarrhœa.

PHENACETOLIN or *Phenacetein*, $C_{16}H_{12}O_2$, is of interest in volumetric analysis as an indicator, since it permits the determination of caustic alkalies in the presence of alkali carbonates. It is obtained by boiling a mixture of 10 parts of phenol and 20 parts each of zinc chloride and acetic anhydride for 20 or 30 minutes, washing the resulting mass with water, and then digesting it with 5 per cent. nitric acid. After the solution has become clear, it is neutralized with ammonia, which causes the separation of phenacetolin in the form of red flocculi, which are insoluble in water, but soluble in alcohol. Solutions of phenacetolin are colored yellow by acids and caustic alkalies, but red by alkali carbonates.

CHLOROPHENOLS.—By action of chlorine on phenol, substitution compounds are obtained, some of which have been used medicinally, thus: Ortho-, Meta-, and Para-monochlorophenol, C_6H_4ClOH, the former a colorless liquid boiling at 175° C. (348.8° F.), the two latter, colorless crystals; Trichlorophenol, also known as Omal, $C_6H_2Cl_3OH$, colorless crystals, sparingly soluble in water, but soluble in alcohol, ether, and glycerin. It has been used as an antiseptic.

PHENOL LIQUEFACTUM, *U. S.*—Liquefied Phenol.

Acidum carbolicum liquefactum, Br., P. G.—*Liquefied carbolic acid*, E.; *Verflüssigte Karbolsäure*, G.

Preparation.—Phenol, a convenient quantity; distilled water, a sufficient quantity. Liquefy the phenol by placing the unstoppered container in a water-bath, and heat gradually until the crystals have melted; transfer the liquid to a tared vessel and weigh; then add for each 9 Gm. of phenol 1 Gm. of distilled water, and mix thoroughly. It should be kept in dark amber-colored, well-stoppered bottles.—U. S.

The directions of the Br. and P. G. are very similar, except that they direct 100 parts of phenol in crystals and 10 parts of water, thus making the finished product a trifle stronger in phenol.

Properties.—Liquefied phenol is a clear colorless liquid, which may develop a slight pinkish tint, and has a decided odor of phenol. It has a specific gravity of 1.070 at 15° C. (59° F.), 1.064 to 1.069 at 15.5° C. (60° F.), Br., 1.068 to 1.069, P. G., or 1.065 at 25° C. (77° F.), U. S., and boils at about 115° C. (239° F.) (boiling-point gradually rising to a temperature not higher than 188° C. (370.4° F.), U. S., or 182° C. (359.6° F.), Br.). Crystallization begins when the temperature of the liquid is lowered to about 13.5° C. (56.2° F.). It is soluble in 12 parts of water at 25° C. (77° F.), and is miscible with alcohol, ether, and glycerin in all proportions. 1 part of liquefied phenol acquires a permanent cloudiness when mixed respectively with 2 parts of chloroform, 1.5 parts of benzene, 2.5 parts of carbon disulphide, 2 parts of oil of turpentine, and 2.5 parts of olive oil. When thus deprived of water, it should respond to the tests given under PHENOL.—U. S. It forms a clear solution on the addition of 18 to 27 per cent. of water at 15.5° C. (60° F.).—Br. 10 Cc. of liquefied phenol should not become turbid upon addition of 2.3 Cc. of water at 15° C. (59° F.), but will do so upon further addition of 8 or 10 drops of water. If to the turbid mixture

not less than 135 Cc. nor more than 140 Cc. of water be added, a clear solution should result.—P. G.

Liquid phenol is composed of not less than 86.4 per cent. by weight of absolute phenol and about 13.6 per cent. of water, on which latter account it will not be possible to make perfectly clear solutions of the same with oil.

Action and Uses.—For the action and uses of Phenol Liquefactum, see PHENOL.

PHENYLIS SALICYLAS, *U. S.*—Phenyl Salicylate.

Salol, Br. (U. S. 1890); *Phenylum Salicylicum*, P. G.; *Salicylate de phénol*, Fr. Cod. —*Salol*, E.; *Salicylate de phényle*, Fr.; *Salol, Phenylsalicylat, Salicylsäurephenylester*, G.

Formula, $C_6H_4(OH)CO.OC_6H_5$ or $C_6H_5C_7H_5O_3$. Molecular weight, 212.47.

Phenyl salicylate was first introduced into medicine by Sahli in 1886, under the name of salol.

An ester obtained by the action of condensing agents upon a mixture of salicylic acid and phenol or the sodium compounds of the same.

Preparation.—When dehydrating agents are made to act upon a mixture of phenol and salicylic acid, phenyl salicylate is formed and water eliminated, For this purpose a mixture of sodium-phenol and sodium salicylate in molecular proportions may either be treated for some time with phosphorus oxychloride or a slow current of phosgene gas (carbonyl chloride) may be passed into a warmed mixture of the two salts: in the first case the secondary or by-products consist of sodium chloride and metaphosphate, and in the second case of sodium chloride and carbon dioxide. These are removed by washing the mass repeatedly with water, and recrystallizing the residuary salol from alcohol.

A later process, which has been patented, consists in heating pure or even crude salicylic acid in a flask with a long narrow neck in a bath to 220°–230° C. (428°–446° F.); air is excluded by keeping the flask filled with carbon dioxide, and the length of the neck permits only vapors of water and carbon dioxide to escape. The theory underlying the reaction is the conversion of some of the salicylic acid into phenol and carbon dioxide, the phenol reacting with the remainder of the salicylic acid forming phenyl salicylate with elimination of water, thus: $C_6H_4OHCOOH = CO_2 + C_6H_5OH$;—$C_6H_4OH + C_6H_4OHCOOH = C_6H_4OHCOOC_6H_5 + H_2O$.

Properties.—Phenyl salicylate occurs as a colorless, crystalline powder (colorless crystals, Br.), having a faint aromatic odor and very little taste. It is almost insoluble in water (1 in 2333), soluble in 5 parts of alcohol at 25° C. (77° F.), very soluble in hot alcohol, in ether, chloroform, and fixed and volatile oils (10 parts of 90 per cent. alcohol or ⅓ part of ether, at 15° C. (59° F.), Br., P. G.). When heated to 42° C. (107.6° F.) it melts, and at a higher temperature burns, leaving no weighable residue (melting-point 42°–43° C., Br.). If to an alcoholic solution be added diluted ferric chloride test-solution, a violet coloration is produced. If 0.2 to 0.3 Gm. of phenyl salicylate be dissolved in a little warm sodium hydroxide solution, and the solution be then acidified with hydrochloric acid, salicylic acid separates out and the odor of phenol is recognizable at the same time.—U. S. An alcoholic solution of salol gives a white precipitate with solution of bromine. On melting together salol and sodium hydroxide, and then acidulating with hydrochloric acid, a white precipitate is produced and phenol is evolved.—Br.

Tests.—Phenyl salicylate placed upon moistened blue litmus-paper should not produce any reddish coloration (absence of free acid). If 1 Gm. of phenyl salicylate, shaken with 50 Cc. of water, be filtered, the filtrate should show no color, or at most a trace, with ferric chloride test-solution previously diluted with 20 volumes of water (limit of uncombined salicylic acid and phenol). If a portion of the same filtrate be tested with barium-nitrate test-solution and silver-nitrate test-solution, it should show no turbidity (absence of sulphates and chlorides).—U. S.

Action and Uses.—Phenyl salicylate depends for its value upon its salicylic acid and phenol, into which it is decomposed in the alkaline secretions of the small intestine. Employed in the treatment of acute rheumatic fever, it can not be safely ingested in as large doses as the other salicylates, for the phenol liberated in the bowel may be sufficient in quantity to produce untoward effects. Even in somewhat smaller amounts it is apt to irritate the kidneys and darken the urine through the phenol oxidation products which are eliminated in this secretion, and must be given cautiously, if at all, when the kidneys are diseased. Because of its insolubility in the acid juices of the stomach it is adminis-

tered when this organ can not bear the other salicylates. In muscular and chronic articular rheumatism it is sometimes preferable to salicylic acid. Salol is one of the best intestinal antiseptics, and is of the greatest value in the treatment of duodenal catarrh, intestinal indigestion and fermentation, and all forms of choleraic diarrhœa. Its usefulness in typhoid fever is disputed. Being eliminated as educts of salicylic acid and phenol by the kidneys, it sterilizes and clears the turbid and ammoniacal urine of chronic cystitis, and in gonorrhœal urethritis tends to disinfect the urethra during each act of micturition. As a local antiseptic its slight solubility renders it of doubtful utility. Its dose is from 15 to 45 grains (1–3 Gm.) daily, in powders, pills, or capsules.

Allied and Derivative Compounds.—A number of compounds analogous to salol are in use among physicians, and at least two of them have been introduced into the French Pharmacopœia.

Cresyl Salicylate. Cresalol.—*Salicylate de Cresol*, Fr. Cod.—$C_6H_4(OH)CO_2C_6H_4CH_3$.—Cresalol is a crystalline compound obtained by the interaction of salicylic acid and cresol in the form of their respective sodium salts in the presence of phosphorus oxychloride. Three varieties are formed, depending on the particular sodium salt (ortho-, meta-, or para-) used. All are insoluble in water, but soluble in alcohol and ether. Paracresol salicylate is the kind generally employed; it occurs in colorless crystals which melt at 40° C. (104° F.).

Naphthyl Salicylate. Betol.—*Salicylate de Naphthol β*, Fr. Cod.—$C_6H_4(OH)CO_2C_{10}H_7$.—This compound, also known as naphthalol, naphthosalol, and salinaphthol, is prepared in a manner analogous to that followed for cresalol, simply substituting β-naphthol-sodium for cresol-sodium. It is a crystalline powder, without color, odor, and taste, and melts at 95° C. (203° F.). Insoluble in cold and hot water as well as glycerin, difficultly soluble in cold alcohol, but soluble in 3 parts of boiling alcohol, also in ether and benzene. Betol may be distinguished from salol by adding 2 or 3 Cc. of sulphuric acid to 0.1 Gm. of the salt, which yields a lemon-yellow solution in a very short time; upon addition of a trace of nitric acid to the solution, the color changes to olive green.

Salophen. *Acetylpara-amidophenol salicylate. Acetpara-amidosalol.* $C_6H_4.OH.CO_2.C_6H_4.NH.COCH_3$.—This compound was introduced in 1891 as a substitute for salol, from which it differs chiefly in yielding harmless acetylpara-amidophenol, instead of toxic phenol when decomposed in the human organism. It is prepared by a complicated process, the first step being the preparation of paranitrophenol salicylate in a manner similar to the production of salol; then converting this into para-amidophenol salicylate by means of reducing agents, and, finally, by the action of acetic acid, into acetylpara-amidophenol salicylate or salophen, which is purified by crystallization from benzene or alcohol. It occurs as minute white scales containing 50.9 per cent. of salicylic acid, is of neutral reaction, and is free from odor and taste. Salophen melts at 187° to 188° C. (368.6°–370.4° F.). It is insoluble in cold, but somewhat soluble in hot water, and is readily taken up by alcohol, ether, and solution of the alkalies. It is soluble in benzene, but not in petroleum ether. When salophen is heated with sulphuric acid and alcohol, the odor of acetic ether is developed. Ferric chloride added to an alcoholic solution of salophen produces a violet color, changing gradually to brownish yellow. Salophen dissolves colorless in concentrated sulphuric acid. The filtrate obtained after shaking salophen with water and filtering should give no color reaction with ferric chloride, or reaction for chlorides with solution of silver nitrate. If .10 Gm. of salophen be boiled for 1 minute with a solution of sodium hydroxide (1:2), cooled, and 5 Cc. of solution of chlorinated soda then added, a deep green will appear, changing to brown. On adding an excess of hydrochloric acid a bright scarlet color is developed, which changes to red orange (G. Beringer). Salophen boiled with a dilute aqueous solution of sodium hydroxide and allowed to cool, a blue color is gradually developed, beginning at the top. The color is discharged on again boiling the solution, and reappears on cooling. If now a few drops of dilute solution of carbolic acid and chlorinated lime be added to the solution a red color is developed, which turns to blue on adding excess of ammonia. Salophen should not be confounded with "saliphen," the name given to salicyl-phenetidin, a compound of salicylic acid and phenetidin introduced in 1890, and having the formula $C_6H_4OC_2H_5NHC_6H_4(OH)CO$.

Salicylamide. $C_6H_4(OH)CONH_2$.—This compound is produced by the action of dry ammonia gas on methyl salicylate in the form of oil of wintergreen. It is a colorless or slightly yellowish-white crystalline powder, melting at 138° C. (280.4° F.), and soluble in alcohol and ether; it requires about 250 parts of cold water for solution. Salicylamide is quite tasteless, but produces a gritty feeling between the teeth; treated with caustic soda, it is converted into sodium salicylate and ammonia.

Salol-camphor, *Camphol*, is a colorless or pale-yellow oily liquid, obtained by mixing 3 parts of salol with 2 parts of camphor, and heating gradually to complete fusion; it should be preserved in yellow hermetically sealed bottles, as it readily decomposes when exposed to light and air.

Diiodosalol. *Phenyl diiodosalicylate.* $C_6H_2I_2(OH)CO_2C_6H_5$.—A tasteless and odorless crystalline powder, obtained as a condensation-product of phenol with diiodosalicylic acid; it fuses at 133° C. (271.4° F.).

PHOSPHORUS, *U. S., Br., P. G.*—Phosphorus.

Phosphore, Fr.; *Phosphor*, G.; *Fosforo*, It., Sp.

Symbol, P. Atomicity, trivalent and quinquivalent. Atomic weight, 30.77.

Phosphorus should contain not less than 99.5 per cent. of the pure substance, and be carefully kept under water in a secure and moderately cool place, protected from light.—U. S.

Origin and Preparation.—Owing to its great activity, phosphorus occurs only in the combined state in nature, principally as tricalcium phosphate (*phosphorite, apatite*, etc.), also as aluminum phosphate (*wavellite*), and as iron phosphate (*vivianite*). The largest phosphate beds are in Florida. Phosphorus occurs in small quantities in all rocks, and, through weathering of these, in soils. It is an essential constituent of all fertile soils, especially so for the development of seeds. It plays a still more important rôle in the animal body, as it takes part in the formation of all parts of the organism, being found in bones to the extent of about 60 per cent. as calcium phosphate, and as an organic phosphorus compound (lecithine) in egg-white, muscle, nerve and brain substance, yolk of egg, etc. Phosphorus was discovered by Brandt (1669), of Hamburg, among the products of the dry distillation of urine, and about 1769 Gahn and Scheele detected the presence of phosphoric acid in bones, and the latter succeeded in isolating it in 1771. Up to about 6 years ago all phosphorus was prepared by treating calcined bones with sulphuric acid, decanting from the calcium sulphate, evaporating the solution of acid calcium phosphate, after mixing it with powdered charcoal and sand, to complete dryness, gently igniting and distilling the residue, composed of calcium metaphosphate, charcoal, and sand, in a stoneware retort. The different steps in the manufacture of phosphorus may also be explained by the following chemical equations: (1) $Ca_3(PO_4)_2 + 2H_2SO_4 = CaH_4(PO_4)_2 + 2CaSO_4$; (2) $CaH_4(PO_4)_2 = Ca(PO_3)_2 + 2H_2O$; (3) $2Ca(PO_3)_2 + 2SiO_2 + 10C_2 = P_4 + 2CaSiO_3 + 10CO$. In case the organic matter of bones is to be utilized in the manufacture of glue, the bones are treated with hydrochloric acid and the liquid treated as stated. The retort is connected with a wide bent tube which dips into water; a number of retorts are placed in each furnace, and after the distillation is completed the melted phosphorus is strained under water and run into tubes of suitable size, where it congeals. This process is now practically superseded by the one introduced by Readman, which consists in preparing phosphorus directly from calcium phosphate or aluminum phosphate mixed with carbon and sand or clay by heating in an electric furnace. The method is not one of electrolysis, but simply the utilization of the high temperature which is produced by an electric current. A very pure and large yield of phosphorus is obtained. The works at Niagara Falls supply the domestic needs. The chief application of phosphorus is for making matches, smaller quantities being used in the manufacture of phosphor-bronze, rat poisons, compounds of phosphorus, and for medicinal purposes.

Properties.—Phosphorus occurs in commerce in the form of cylindrical sticks, which are nearly colorless or pale-yellow, transparent or translucent, of a waxy lustre, and about as hard as beeswax, and flexible at ordinary but brittle at low temperatures. It is inodorous and tasteless, but in contact with air it has an alliaceous odor and taste, and emits white vapors, which are luminous in the dark (phosphorescence). It is very easily inflammable in the air, burning with a brilliant white flame and giving off dense white vapors of phosphoric anhydride, and must be preserved and cut under water, in which it is insoluble. Its specific gravity is 1.830 at 10° C. (50° F.), and 1.820 at 25° C. (77° F.), U. S.; 1.77 at 15.6° C. (60° F.), Br.; and when fused at 44° C. (111.2° F.) is 1.743. It melts at 44° C. (111.2° F.), U. S., P. G.; at 43.3° C. (110° F.), Br.; and may be cooled to 40° C. (104° F.) before it congeals again—under certain circumstances even to 4° C. (39.2° F.), as observed by Bellani (1813). The boiling-point of phosphorus is 288° C. (550° F.), according to Dalton; 290°C.(554° F.), Hager; Mitscherlich found it at 260°C. (500° F.); but it volatilizes slowly with the vapors of boiling water; the density of its vapor is 4.3. According to Joubert, phosphorus is not luminous in pure oxygen below 14° C. (57° F.) unless the pressure is diminished or the oxygen is mixed with an indifferent gas; the luminosity is prevented in the presence of hydrogen sulphide, of vapors of alcohol, ether, and other compounds. Phosphorus is soluble in alcohol, ether, fixed and volatile oils; it dissolves in 350 parts of absolute alcohol at 15° C. (59° F.), in 240 parts of boiling absolute alcohol, in 80 parts of absolute ether, in about 50 parts of any fatty oil, in about 25 parts of chloroform, and in about half its weight of carbon disulphide, the latter

yielding a solution which must be handled with the greatest care to prevent evaporation, which is followed by instant ignition.—U. S. It is more freely soluble in sulphur chloride and in benzene. Phosphorus crystallizes after fusion when slowly cooled, and from its solutions in volatile oils and carbon disulphide. It unites directly with oxygen, sulphur, chlorine, iodine, bromine, and with many metals, and precipitates some of the latter from their solutions. When kept in water and exposed to light and air it is superficially corroded, and becomes white and opaque (Baudrimont, 1865), while phosphorous acid is found in the water; the change does not take place in water which is free from air, nor does phosphorus lose its transparency when kept in the dark. Commercial phosphorus frequently contains a little arsenic, from which it can not be freed by distillation.

Tests.—The impurities likely to be present in phosphorus are derived from the sulphuric acid used in its preparation, and are mainly arsenic and sulphur; a small proportion of the latter renders phosphorus hard and rather brittle at ordinary temperatures. In the following test the U. S. P. has adopted a limit of 0.05 per cent. of arsenic, or 1 part in 2000 of phosphorus: Add 1 Gm. of phosphorus to a mixture of 10 Cc. each of nitric acid and distilled water, contained in a flask having the capacity of 50 Cc., and digest at a gentle heat on a water-bath while passing a current of carbonic acid gas into the flask over the surface of the fluid, until the phosphorus is dissolved. Transfer the solution to a capsule, and evaporate it until no more nitrous vapors are given off, and then dilute the solution to 100 Cc. with distilled water. 1 Cc. of this solution should not respond to the modified Gutzeit's test for arsenic (see Arseni Trioxidum). The official limit of sulphur is determined by adding barium chloride test-solution to the remainder of the liquid, when not more than a slight opalescence should be produced.

Amorphous or Red Phosphorus.—This was discovered by Schrötter (1848) by heating ordinary or vitreous phosphorus for a long time to 250°–260° C. (482°–500° F.) in an atmosphere in which it can not burn. It is an amorphous dark-red mass or powder, becomes nearly black on being boiled with potassium hydroxide solution, is insoluble in simple solvents, remains unaltered in dry air, and enters into chemical combinations less readily than the ordinary variety. According to Hittorf (1865), it has the specific gravity 2.19, is infusible, volatilizes slowly above 260° C. (500° F.), and, according to Lemoine (1867), is best converted into ordinary or vitreous phosphorus by heating to near 450° C. (842° F.) in an atmosphere of nitrogen. At the temperature stated, Hittorf observed it to be converted into another modification, which forms black laminæ of a metallic lustre, is less volatile than amorphous phosphorus, but, like the latter, is gradually converted by heat into ordinary vitreous phosphorus.

Black Phosphorus.—As long ago as 1800 it was reported that phosphorus when treated with ammonia gas would deposit a brownish-black powder; the same phenomenon was observed later on by Thenard, Vogel, Wild, and in 1865 by Blondlot. Flückiger, who carefully examined the subject in 1892, came to the conclusion that the so-called black modification of phosphorus is nothing but arsenic in metallic form; by treating ordinary phosphorus repeatedly with ammonia-water of 0.920 specific gravity until all phosphorus has been removed, mainly in the form of phosphine, a black residue in powder-form eventually remains, which is permanent in the air and was proved to be arsenic (*Arch. d. Phar.*, 1892).

Detection of Phosphorus in Poisoning.—A preliminary step is to examine carefully the vomit, contents of the stomach, or residual food, in order to observe any odor of phosphorus, or any luminosity on stirring the matter in the dark, or the presence of pieces of phosphorus or residues of matches. If this examination proves negative, the distillation-test of Mitscherlich is tried, which must be conducted in a dark room. The material to be tested is acidified with tartaric or sulphuric acid, introduced into a flask with sufficient water to make a soft, pasty mass, the flask is closed with a 3-hole stopper and connected by an inverted U-tube with an upright Liebig condenser, the lower end of which dips under water contained in a flask. By tubes passing through the stopper the distilling flask is connected with a carbon dioxide generator and a steam supply. After filling the apparatus with carbon dioxide the flask is heated to boiling and steam passed through it. If phosphorus is present, it is volatilized and produces a faint yellowish-green glow at the point where the steam begins to condense. If phosphorus is present in sufficient quantity, small granules may collect in the receiver. To obtain the glow, the carbon dioxide should be shut off when distillation begins. For additional proof of phosphorus, a portion of the distillate is treated with 200 Cc. of strong chlorine-water,

set aside in a corked flask for some time, evaporated to 10 Cc. on a water-bath, and tested for phosphoric acid by ammonium molybdate solution. After 12 hours the yellow precipitate may be filtered, washed, dissolved in ammonia-water, precipitated by magnesia mixture, and the crystals of ammonium magnesium phosphate examined under the microscope for the characteristic "coffin-lid" shape.

In the above distillation-test the luminosity may be diminished or entirely prevented by the presence of alcohol, ether, chloroform, benzin, petroleum, turpentine, hydrogen peroxide, corrosive sublimate, carbolic acid, and when the mass in the flask is alkaline. Hypophosphorous, phosphorous, and phosphoric acids are not volatilized by steam, but yellow phosphorus is.

The method of Dusart-Blondlot may be employed if no luminosity appeared in Mitscherlich's method because of disturbing factors mentioned above or of the oxidation of phosphorus to phosphorous acid before it is tested. Some of the original material rubbed up with water and filtered, is introduced into a hydrogen-generating apparatus with pure zinc and sulphuric acid, the exit-tube of which dips under a 5 per cent. solution of silver nitrate. Phosphorus and the acids of phosphorus lower than phosphoric, are converted to phosphine gas, PH_3, which acts on silver nitrate, forming a black precipitate of silver phosphide, PAg_3. The generation of hydrogen should last for 12–24 hours, in a dark place. The PAg_3 is gathered in a porcelain dish, washed several times, and introduced into another hydrogen apparatus, to which is attached a U-tube filled with pumice-stone moistened with caustic alkali, to absorb any hydrogen sulphide, and a right-angle tube tipped with platinum. If phosphorus is present in the silver precipitate, PH_3 is formed, which gives a green color to the hydrogen flame at the platinum tip. Of course, a blank experiment should be made to test the color of the flame before introducing the silver phosphide precipitate, and the possibility of the patient having taken hypophosphites as medicine should not be overlooked. All substances which give a green-colored flame, such as hydrochloric acid, chloroform, and similar organic chlorine products, must not be present in the test. For fuller details of the above tests, the reader is referred to text-books on chemistry or toxicology.

Pharmaceutical Preparations.—Phosphorated Oil, Br.; Pills of Phosphorus, U. S.

Action and Uses.—Phosphorus is an exceedingly lethal poison. While it is true that when large masses are swallowed it will escape through the intestines without being dissolved, when in a finely divided state it is absorbed with sufficient rapidity to produce death by reason of the inflammatory changes which it causes, and because of the widespread fatty degeneration which takes place in all the organs of the body. Phosphorus is most frequently taken as a poison from matches, and has often been called the "servant girls' poison," because it has been used so frequently with suicidal intent by this class of persons.

There are two peculiar features of phosphorus-poisoning. The symptoms frequently do not manifest themselves for 8 or 12 hours after the drug has been swallowed, unless perchance vomiting comes on, when the vomit may be phosphorescent when examined in a dark room. The early symptoms consist in abdominal pain which is severe, vomiting, collapse, and a tenderness of the belly-walls; the urine becomes scanty and it may be albuminous, and fat-globules may appear in it. Another peculiarity of the poison is that after 24 to 36 hours the symptoms of poisoning undergo a marked remission, so that every one feels encouraged for the patient's recovery. A few hours after this, however, the symptoms return with greater violence than before, coffee-ground vomit is expelled, and death almost inevitably occurs. Diarrhœa is rarely met with. Constipation, however, is frequent, and the stools after the first few days are clay colored, owing to the action of the phosphorus upon the liver, which organ is frequently swollen and tender. The urine becomes scanty, owing to the action of the drug on the kidneys. Convulsive seizures are rarely met with. The antidote to phosphorus is potassium permanganate or hydrogen peroxide, which act by virtue of their oxidizing properties. French ozonized oil of turpentine and sulphate of copper, which have been recommended as antidotes, are useless. The former because it is not a true antidote so far as the chemical influence is concerned, and the second because it is a more rapidly acting poison than the phosphorus itself if given in quantities which are sufficiently large to influence the phosphorus.

Phosphorus is employed in medicine in the dose of $\frac{1}{100}$ grain (0.0006 Gm.), 3 times

a day, in cases of nervous exhaustion, sexual impotence, in rickets, and in other disorders of the nervous and bony systems characterized by poor development. Its exact value as a medicine is under discussion, some practitioners regarding it highly and others thinking it of little value. Owing to its very disagreeable taste, it had better be given in pill-form, although it may be administered in the form of the oil (Oleum Phosphoratum).

PHYSOSTIGMA, *U. S.*—Physostigma.

Physostigmatis semina, Br.; *Semen Calabariensis*, Belg.; *Faba Calabarica.—Calabar bean, Ordeal bean, Chopnut*, E.; *Kalabarbohne*, G.; *Fève de Calabar*, Fr.; *Haba del Calabar, Esere*, Sp.; *Favo de Calabar*, Port.

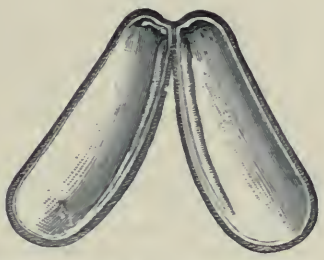
The dried ripe seed of *Physostigma venenosum* Balfour (Fam. *Leguminosæ*), yielding, when assayed by the U. S. P. process, not less than 0.15 per cent. of ether-soluble alkaloids.

Calabar bean is official in nearly all pharmacopœias. The Portuguese mentions that the episperm should be removed upon being used.

FIG. 304.

Calabar bean: view from the side and edge, showing length of hilum.

FIG. 305.



Calabar bean, split, showing cotyledons.

FIG. 306.

Physostigma cylindrosperma seed.

Origin.—From a high-climbing, woody twiner, native of western tropical Africa, somewhat naturalized in India and Brazil. It resembles the Scarlet runner and Lima bean, bearing pendulous racemes of handsome dark-purple, bean-like flowers and short, broad, 2- to 3-seeded pods.

Description.—2 to 3 Cm. (about 1 In.) long, 1.5 to 2 Cm. (about ¾ In.) broad, and 1 to 1.5 Cm. (about ½ In.) thick, oblong and subreniform, a broad furrow extending along the entire length of the convex edge, its reddish, rounded margins elevated and somewhat thickened; externally of a deep-chocolate color, shining, finely granular-tuberculate; embryo with a short, curved caulicle, and 2 large, white, concavo-convex cotyledons, enclosing an oblong cavity; inodorous; taste bean-like.

On moistening the embryo with potassium hydroxide test-solution, it becomes pale yellow.

The seed of *P. cylindrosperma*, often substituted, is here shown (Fig. 301). The seeds of a *Mucuna*, and those of *Entada scandens* Benth., both of the same family, have been reported as offered in place of Calabar beans. Both are lenticular, the latter very large, and neither could deceive the purchaser.

Constituents.—The important constituent of Calabar bean is *physostigmine (eserine)*, considered below. With it are associated 3 other alkaloids, as follows: *Calabarine*, not yet obtained in a pure condition, is a liquid, soluble in alcohol and water, but not in ether. Its presence is important, since it acts in some respects antagonistically to physostigmine. *Eseridine* ($C_{15}H_{23}N_3O_3$) occurs in white 4-sided crystals, soluble in alcohol, ether, and chloroform, and melting at 132° C. (269.6° F.). It acts similarly to physostigmine. *Eseramine* ($C_{16}H_{25}N_4O_3$) is crystalline and devoid of physiological activity. *Phytosterin* is a neutral body resembling cholesterin, crystallizing from ether, chloroform, and petroleum benzin in silky needles and from hot alcohol in scales. It is apparently inactive. Calabar bean also contains about half its weight of starch and 23 per cent. of proteids, with a little gum and fat. The ash amounts to between 3 and 4 per cent. The alkaloids exist mainly in the cotyledons, but the testa also possesses medicinal activity.

The alkaloid physostigmine, recognized in the French Pharmacopœia as ésérine, $C_{15}H_{21}N_3O_2$, was first found in the seed of the Calabar-bean plant by Jobst and Hesse in 1864. It is present to the extent of 0.1 per cent. and may be extracted by exhausting the powdered seed with warm alcohol containing about 1 Gm. of tartaric acid per litre. After recovery of the alcohol, the residue is taken up with water and filtered to remove resinous matter; the solution is then treated twice with ether, as long as this becomes colored, after which it is rendered alkaline by addition of sodium bicarbonate, and finally repeatedly shaken out with ether. Upon spontaneous evaporation of the ethereal liquid, the alkaloid will be obtained in the form of scaly crystals which may be further purified by recrystallization from ether.

Physostigmine occurs in thin rhomboidal lamella, which are colorless, but gradually assume a rose tint and even a yellow color, especially when exposed to air. By spontaneous evaporation of a solution in benzene, large crystals melting at 105° to 106° C. (221°–222.8° F.) may be secured. If crystallized from ether saturated with water, physostigmine takes up a molecule of water, which is, however, lost upon heating to 100° C. (212° F.). It is difficultly soluble in water, but readily so in alcohol, ether, chloroform, benzene, and carbon disulphide. Physostigmine is lævogyrate, and possesses a strong alkaline reaction. It is colored red by dilute solutions of caustic alkalies. When dissolved in concentrated sulphuric or nitric acid a yellow solution is produced, which in the latter case soon changes to olive green.

The alkaloid is readily decomposed. Its aqueous solution soon assumes a red color, more readily when heated, and leaves upon evaporation a cherry-red, amorphous residue, which is insoluble in ether, but soluble in chloroform, and which has been given the name *rubreserine*. Solutions of salts of physostigmine behave in like manner.

Assay of Calabar Bean.—Calabar bean in fine (No. 60) powder, 20 Gm.; ether, solution of sodium bicarbonate, 5 per cent.; normal sulphuric acid, distilled water, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, hematoxylin or iodeosin test-solution, each a sufficient quantity. To 20 Gm. of powdered physostigma add 200 Cc. of ether and shake well for 10 minutes. Then add 10 Cc. of a 5 per cent. sodium bicarbonate solution, and shake vigorously at intervals for 4 hours. Let settle, and decant 100 Cc. of the ethereal solution into a separator, to which add sufficient normal sulphuric acid to make it acid, and add 10 Cc. of distilled water. Shake well for several minutes, and draw off the aqueous layer into another separator. Repeat the extraction, using 2 Cc. of normal sulphuric acid and 8 Cc. of distilled water, and adding the acid aqueous layer to the second separator. Finally, repeat again, using 1 Cc. of normal sulphuric acid and 9 Cc. of distilled water, and draw this also off into the second separator. To the combined acid liquids in the second separator add 25 Cc. of ether and sufficient 5 per cent. sodium bicarbonate solution to make them alkaline. Shake for a few minutes, let separate, and draw off the ether into a beaker. Repeat with 20 Cc. and again with 15 Cc. more of ether, added to the separator, shake for 2 minutes, let separate, and draw off into the beaker. Evaporate the ether from the combined ethereal solutions in the beaker carefully on a water-bath, and when dry, dissolve in 5 Cc. of one-tenth normal sulphuric acid and 20 Cc. of ether, which must be strictly neutral, and transfer this solution to a bottle, rinsing with 80 Cc. of water; add 5 drops of iodeosin test-solution and titrate the excess of acid with fiftieth-normal potassium hydroxide solution until, after shaking, the aqueous liquid just acquires a pink color. Divide the number of cubic centimetres of fiftieth-normal potassium hydroxide solution used by 5, subtract this number from 5 (the 5 Cc. of one-tenth normal acid used), multiply the remainder by 0.0273, and this product by 10 (or multiply at once by 0.273), which will give the percentage of ether-soluble alkaloids in the drug.—U. S.

Pharmaceutical Preparations.—Extract of Physostigma, Tincture of Physostigma, U. S. P.

Action and Uses.—Physostigma when taken in poisonous dose by man produces vomiting, pain in the belly, dyspnœa, vertigo, and great weakness, with contraction of the pupil and an increase in salivary and dermal secretion. Often marked muscular twitching develops, and this is followed by collapse. The pulse is usually quite slow. Consciousness usually remains intact until the near approach of death.

The dominant action of the drug upon the nervous system is to depress the motor portions of the spinal cord, and death is due to paralysis of the respiratory centres. The slow pulse is due to a direct action of the drug on the heart muscle.

Upon the unstriped muscular fibres of the stomach and bowels the drug acts as a powerful stimulant, and it increases practically all the secretions. In the eye the contraction of the pupil is due to stimulation of the oculomotor nerves peripherally, and intra-ocular tension is decreased.

The treatment of poisoning by physostigma consists in the free use of its physiological antidote atropine, and the use of internal heat and respiratory and cardiac stimulants, such as ammonia, ether, and digitalis.

When the alkaloid calabarine is present in excess in the drug, and it is taken in overdose, convulsions develop.

Physostigma is used for several therapeutic purposes. It is often added to laxative pills to increase their efficacy, and may be used to aid in the expulsion of flatus. It may also be employed in cases of chronic bronchitis to aid expectoration. The most common use of the drug is in the form of its alkaloid physostigmine, or eserine, as a myotic to contract the pupil and to decrease intra-ocular pressure in glaucoma. For this purpose the strength of the solution is about 1 to 2 grains (0.06–0.12 Gm.) to the ounce (30 Cc.) of water.

The dose of the extract is $\frac{1}{8}$ of a grain (0.008 Gm.); of the tincture, 5 to 20 minims (0.3–1.30 Cc.). The alkaloid physostigmine is given in the dose of $\frac{1}{80}$ of a grain (0.0008 Gm.).

Tanghinia seeds (see *Cerbera*, under APOCYNACEÆ) are also used as an ordeal poison, in Madagascar, much as Calabar beans are employed.

PHYSOSTIGMINÆ SALICYLAS, *U. S.*—Physostigmine Salicylate.

Physostigminum Salicylicum, P. G.—*Eserine salicylate*, E.; *Salicylate d'ésérine*, Fr.; *Physostigminsalicylat, Eserinsalicylat*, G.

Formula, $C_{15}H_{21}N_3O_2C_7H_6O_3$ or $C_6H_4(OH)COOH.C_{15}H_{21}N_3O_2$. Molecular weight, 410.21.

The salicylate of an alkaloid obtained from physostigma.—U. S.

Preparation.—No official process of manufacture is given. Hager recommends to neutralize a solution of 2 parts of physostigmine in warm ether with a solution of 1 part of salicylic acid in ether, and to allow the newly formed salt to crystallize.

Properties.—Physostigmine salicylate occurs in colorless or faintly yellowish, shining, acicular or short columnar crystals, without odor, and having a slightly bitter taste. When long exposed to light and air, it acquires a reddish tint, which change is hastened by the presence of ammoniacal vapors. The salt is usually slightly acid and dissolves at 15° C. (59° F.) slowly in 85 parts of water, and rapidly in 12 parts of alcohol. "It is soluble at 25° C. (77° F.) in 72.5 parts of water, and in 12.7 parts of alcohol; at 80° C. (176° F.) in 15 parts of water, and at 60° C. (140° F.) in 4 parts of alcohol; also soluble at 25° C. (77° F.) in 175 parts of ether and in 8.6 parts of chloroform. Its aqueous solution is acid to litmus-paper, and turns pink on standing 24 hours. When heated, the salt begins to soften, and turns slightly yellow at 160° C. (320° F.), and melts at 178.9° C. (354° F.). It leaves no residue on incineration. The addition of ferric chloride test-solution to an aqueous solution of the salt produces a deep-violet color, while calcium hypochlorite solution causes a red color. Aqueous solutions of the salt turn cherry red upon addition of a drop of caustic alkali solution, changing to a darker red, and finally to a green color. On evaporating aqueous solutions of the salt to dryness with a few drops of ammonia-water, a blue residue is produced, which is soluble in alcohol, and when so dissolved, yields a red fluorescent solution on the addition of an excess of acetic acid. If a few milligrammes of the salt be dissolved in nitric acid, a yellow solution results, which on being heated changes to orange and then blood red, and on evaporation to dryness, yields a green residue. When exposed to the fumes of nitric acid, this residue becomes violet blue, and when a drop of nitric acid is added to it, it forms a beautiful reddish-violet solution, which soon changes to blood red, and, finally, on standing, or on dilution, becomes greenish yellow. Sulphuric acid containing in each Cc. 1 drop of formaldehyde solution gives a bright-pink color when added to the salt; if sulphuric acid and a few grains of cane-sugar be added, a yellow color is produced, turning to brown, then to purple, and finally to greenish black."—U. S.

Tests.—Physostigmine salicylate should have all the properties described above. Platinic chloride test-solution produces no precipitate in solutions of the salt (distinction from *physostigmine sulphate*).

The salicylate of physostigmine is preferred to other salts of the alkaloid on account

of its greater stability. It should be kept in small, dark amber-colored, well-stoppered vials.

Action and Uses.—Physostigmine salicylate is used to contract the pupil of the eye, and to decrease intra-ocular tension in glaucoma. The solution freshly made should contain from 1 to 2 grains (0.06–0.12 Gm.) to the fluidounce (30 Cc.) of water. It is given hypodermically in the dose of $\frac{1}{64}$ to $\frac{1}{12}$ of a grain (0.001–0.005 Gm.) as a prophylactic and a cure for distention of the bowel, particularly after ether anæsthesia.

PHYSOSTIGMINÆ SULPHAS, *U. S., Br.*—Physostigmine Sulphate.

Physostigminum sulfuricum, P. G.; *Sulfate d'ésérine*, Fr. Cod.; *Eserine sulphate*, E.; *Physostigminsulfat, Eserinsulfat*, G.

Formula, $(C_{15}H_{21}N_3O_2)_2H_2SO_4$. Molecular weight, 643.75.

The sulphate of an alkaloid obtained from physostigma.—U. S.

Preparation.—The French Pharmacopœia alone directs the preparation of the salt, as follows: To a solution of physostigmine in ether is added, drop by drop, 10 per cent. sulphuric acid until separation of the newly formed salt no longer occurs. After filtration the physostigmine sulphate is carefully dried at a temperature of about 40° C. (104° F.).

Properties.—Physostigmine sulphate occurs as a white or yellowish-white, microcrystalline powder, odorless, and having a bitter taste. It is very deliquescent when exposed to the air, and gradually turns reddish by exposure to air and light. The salt is very soluble at 25° C. (77° F.) in water and in chloroform, in alcohol at 60° C. (140° F.). It is also soluble in 1200 parts of ether. When heated to 130° C. (266° F.) the salt becomes soft, and melts at about 140° C. (284° F.). Upon ignition, it is slowly consumed, leaving no residue. Its aqueous solution is acid to litmus-paper. Barium chloride test-solution produces a white precipitate, insoluble in hydrochloric acid. Aqueous solutions of the salt yield, with alkalies, a white precipitate, which immediately turns pink, and dissolves in excess of the alkali, forming a pink or red solution, which soon fades to a yellowish green. Gold chloride test-solution gives with aqueous solutions of the salt a beautiful purple color. Sulphuric acid added to the salt produces only a faint yellow color; but if the acid contain a crystal of potassium iodate, on being added to a crystal of the salt it gives a light-purple color, immediately changing to yellowish red, with a bordering ring of lavender.—U. S. "An aqueous solution of physostigmine sulphate, when shaken with a dilute solution of potassium hydroxide, becomes red; and when mixed with a solution of ammonia and evaporated to dryness on a water-bath it leaves a bluish residue, the solution of which in dilute acids is dichroic, being red by reflected and blue by transmitted light. A dilute aqueous solution applied to the eye causes contraction of the pupil."—Br. The salt dissolves in fuming nitric acid with a yellow color, which upon evaporation and drying turns to green.

Tests.—Platinic chloride test-solution added to aqueous solutions of physostigmine sulphate causes a yellowish-white precipitate (distinction from *physostigmine salicylate*).

Like the preceding salt, physostigmine sulphate must be preserved in small well-stoppered, dark amber-colored vials. Owing to its very hygroscopic character, weighing of the salt must be done with care and is best carried out on a tarred watch-glass.

Action and Uses.—(See PHYSOSTIGMINÆ SALICYLAS.)

PHYTOLACCA, *U. S.*—Phytolacca.

Virginia poke, Garget, Scoke, American or *Red nightshade, Coakum*, E.; *Scharlachbeere, Kermesbeere*, G.; *Agouman, Morelle a grappes*, Fr.; *Mazorquilla, Namoli, Jabonera*, Sp.

1. PHYTOLACCÆ RADIX, U. S., *Poke-root, Garget-root, Jalap Cancer-root, Mechoacan.* The dried root of *Phytolacca decandra* L. (Fam. *Phytolaccaceæ*).

2. PHYTOLACCÆ FRUCTUS (*P. Bacca*, U. S. 1880).—*Pokeberry, Garget-berry, Pigeon-berry, Red-ink berry*, E.; *Amerikanische Kermesbeere*, G.; *Raisin d'Amérique*, Fr. The fruit of *Phytolacca decandra* L. (Fam. *Phytolaccaceæ*).

Phytolacca is not official in any other pharmacopœia.

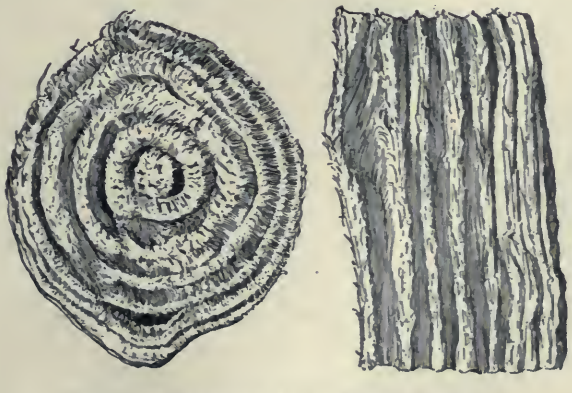
Origin.—The Poke-root plant is a very common, smooth perennial roadside weed in eastern and central North America, of which region it is the largest herb. In the Southern States it frequently reaches a height of 10 or 12 feet and a breadth almost as great. The stem is often several inches in diameter, purplish green and hollow, with thin, transverse partitions at intervals. The habit of foliage, inflorescence (greenish white), and fruit (deep crimson) are shown in the accompanying illustration. The root is very long, thick, and fleshy, considerably resembling horse-radish root, a resemblance which has been the occasion of numerous poisoning accidents, and which is aided by the acrid taste in deceiving those unfamiliar with it. The young shoots of spring are often eaten like Asparagus, but care is taken not to cut too deeply, and that they be thoroughly cooked. The rich purple juice of the berries is largely used in Europe for coloring wine, its color brightened by acids and turned bottle green by alkalies. Although the berries are reported somewhat poisonous, and this view is supported by evidence, this is apparently not true of their juice, since Eymard found that 80 Gm. (about 2½ ounces) were required to act as a cathartic. For medicinal purposes, the root should be collected in the fall.

FIG. 307.

Phytolacca: flowering branch and fruit (⅔ Nat.).

Description.—*Phytolacca fruit* forms a close and heavy, agglutinated, purple-black mass, the stones conspicuous as brightly shining particles. There is little odor, but a fruity, acidulous and sweetish, somewhat acrid taste. An individual fruit, in the fresh condition, or after being soaked, is a depressed-globular compound drupe, about 8 Mm. (⅓ In.) broad, consisting of 10 carpels, each possessing a fleshy outer portion (sarcocarp), enclosing a thin putamen containing

FIG. 308.



Phytolacca: transverse and longitudinal sections.

a seed in which the embryo is curved around a mealy albumen. The fleshy portions of the carpels are confluent around a short axis.

The *root* occurs mostly in transverse or longitudinal slices of sparingly branched, cylindrical, somewhat tapering, usually twisted roots, rarely exceeding 7 Cm. (3 In.) in diameter, externally of a rich or yellowish brown, finely longitudinally or spirally wrinkled and thickly annulate with lighter colored, low ridges; transverse slices exhibiting several concentric rings of interrupted wood-wedges, the intervening zones much retracted; longitudinal slices exhibiting the wood-bundles as bands, with the intervening medullary tissue greatly retracted; fracture fibrous; internally yellowish gray; inodorous, the powder highly sternutatory; taste sweetish, afterward highly acrid.

The powder is light gray. It contains numerous rounded or oval starch-grains measuring 10 to 20 mikrons, the hilum somewhat eccentric and slightly fissured, the rings indistinct except in the larger grains. Numerous acicular raphides are found, the bundles 50 to 75 mikrons long, 25 to 40 mikrons broad (*Nelson*).

Constituents.—The chemical composition of Poke-root is very peculiar. Its important active and poisonous constituent is an amorphous, bitter, and acrid substance very similar to, if not identical with, saponin. This is probably the glucoside reported by Coscera. The alkaloid *phytolaccine* exists in very small amount. It occurs in white crystals, soluble in alcohol and somewhat in water, nearly insoluble in ether and chloroform. *Phytolaccic acid* is amorphous, soluble in water and alcohol, reduces silver salts, and yields with earths and alkalies soluble salts, from which boiling hydrochloric acid separates the acid as a jelly. Sugars exist to the extent of nearly 10 per cent., and of starch there is an equal or greater amount. A little free formic acid, besides nearly 2 per cent. of potassium formate was obtained by Frankforter, as well as 6.2 per cent. of calcium oxalate. The same chemist found more than 13 per cent. of ash, nearly half of which was potassium oxide. The important constituent of the fruit, aside from the coloring-matter, is phytolaccic acid. Various fruit-acids occur. The coloring-matter is soluble in water, but not in alcohol, ether, or chloroform. Phytolaccin is a tannin-like substance. The ash amounts to 8 or 10 per cent. The poisonous constituents of the fruit are apparently confined almost, if not wholly, to the seed.

Pharmaceutical Preparation.—Fluidextract of Poke Root.

Action and Uses.—Phytolacca is rarely used in medicine. At one time it enjoyed quite a reputation in the treatment of chronic rheumatism, particularly that of syphilitic origin. Internally in the form of the tincture or decoction and externally in an ointment (1 drachm to the ounce—4–30 Gm.) it has been employed with some success in tinea, favus, scabies, and other skin diseases. Although used as an emetic, it is not a safe drug for this purpose. Toxic doses produce vomiting, purgation, great prostration, and in some instances death.

The dose of the powdered root, as an emetic, is 10 to 30 grains (0.60–2 Gm.). A saturated tincture is given in the dose of 1 drachm (4 Cc.) 3 or 4 times a day.

Allied Species.—The genus *Phytolacca* L. contains about a dozen species, mostly of tropical America. They are mostly similar in all respects to the official, and apparently contain the same constituents and possess the same active properties. The saponin constituent causes the roots to be largely used in many frontier regions as a substitute for soap. The poisonous constituent of *P. acinosa* Roxb. (*P. esculenta* Haw.; *Pircunia e.*—Moq.) has been called *phytolaccatoxin*, ($C_{24}H_{38}O_8$), and is resinous in nature.

Phytolaccaceæ.—The Pokeberry Family is regarded by Heimerl as containing 22 genera and about 70 species of plants of very diverse habits, constituents, and properties. So far as generalization regarding properties can go, it may be said that drastic properties, similar to those of Phytolacca, prevail. This is true of the Chilean plants *Pircunia littoralis* Poepp. and *Anisomeria drastica* Moq. (*Pircunia d.*—Poepp.; *P. suffruticosa* Bert.).

Petiveria alliacea L., the *Guinea-hen, Strong-man's weed*, or *Cino d'Alho*, of tropical and subtropical America, is a perennial herb, or somewhat suffrutescent, of a strong garlicky odor. It is largely used by the natives of the country where it grows for many purposes, mostly depending upon its antispasmodic properties. It is said to be diaphoretic, diuretic, emmenagogue, abortifacient, and anthelmintic. It is used to relieve toothache and, it is said, as an antidote to curare-poisoning. *P. hexaglochin* Fisch., the *Pipi-root* of Brazil, has similar properties, and *Gallesia Scorododendrum* Casar (*G. Garazema* Moq.), of Brazil, and several species of *Seguiera* are similarly used.

PICROTOXINUM, *Br.*—Picrotoxin.

Picrotoxine, Fr. Cod.; *Pikrotoxin*, G.

A neutral principle obtained from the fruits of *Anamirta paniculata*, Colebr.

Origin.—Anamirta paniculata is a tall climbing shrub, with broad heart-shaped leaves and long drooping racemes of small greenish dicœcious flowers, indigenous to India and some of the East Indian islands. The fruit is known as

Cocculus Indicus or *Fructus cocculi.*—*Fishberries*, E.; *Coque du Levant*, Fr.; *Kokkelskörner, Fischkörner*, G.—It is globoidally, kidney-shaped, about 6 Mm. ($\frac{1}{4}$ In.) in diameter and 10 Mm. ($\frac{2}{5}$ in.) in length, blackish brown, and wrinkled. The base and apex of the fruit are close together on one side of the fruit, separated from each other by a shallow sinus and connected by an obscure ridge running around the convex side. The endocarp or shell is whitish, thin, and on the narrow concave side folded inward, forming a double projection into the interior of the fruit, and causing the embryo to assume a semilunar shape upon longitudinal section. The fruit is inodorous and almost tasteless, with the exception of the shrivelled oily embryo, which is disagreeably bitter. Cocculus differs in the characters described from all other fruits usually met with in drug-stores. According to Schmidt and Rolmer (1883), the fruit contains 23.6 per cent. of fat, over one-third of which is free stearic acid. Pelletier and Couërbe (1833) isolated from the integuments of the fruit the crystalline and tasteless alkaloid *menispermine*, $C_{18}H_{24}N_2O_2$, and *paramenispermine*, which has the same composition, but differs from the former in being insoluble in ether, sublimable, and in failing to neutralize acids. These bodies are associated with the amorphous brown *hypopicrotoxic acid*, which is insoluble in ether and water. The poisonous principle, picrotoxin, is contained in the kernel, and was first isolated by Boullay in 1819. Picrotin was found in the kernel by Barth and Kretschy in 1880, and anamirtin, $C_{19}H_{26}O_{10}$, a non-poisonous principle, was also isolated by the same investigators.

FIG. 309.

Cocculus Indicus: fruit and longitudinal section.

Preparation.—Bruised cocculus indicus is exhausted by boiling alcohol, specific gravity 0.85; the tincture is concentrated by distillation to about one-third the weight of the fruit; after cooling, the fat is removed and the residue boiled with one-half its weight of water; the decoction is filtered while hot, the filtrate slightly acidulated and crystallized; the crystals require to be purified from hot alcohol. The portion insoluble in water contains menispermine, paramenispermine, and hypopicrotoxic acid.

Properties.—Picrotoxin occurs in colorless and inodorous prismatic crystals, possessing a bitter taste. It dissolves in 330 parts (150 parts, Fr. Cod.) of cold, or 35 parts (25 parts, Fr. Cod.) of boiling water, and in 13 parts (10 parts, Fr. Cod.) of cold, or 3 parts of boiling 90 per cent. alcohol. Picrotoxin melts at 192.2° C. (378° F.) (about 200° C. (392° F.), Fr. Cod.). It is soluble in 10 parts of potassium hydroxide solution, the resulting liquid immediately, on boiling, reducing Fehling's Solution. If heated on platinum foil, the crystals melt to a yellow liquid, which on further heating becomes charred, and is finally completely dissipated. Picrotoxin dissolves in sulphuric acid with a saffron-yellow color.—Br. It is soluble in acids and in alkaline solutions, without combining with these, and is precipitated from the latter solutions by carbonic acid; also soluble in amyl alcohol, benzene, and chloroform. These latter solvents extract picrotoxin from acidulated aqueous solutions, but not from alkaline solutions. The French Pharmacopœia gives the solubility in ether as 1 in $2\frac{1}{2}$, and states that nitric acid converts picrotoxin into oxalic acid. A trace of picrotoxin treated with a 20 per cent. solution of benzaldehyde in alcohol, and a drop of concentrated sulphuric acid added thereto, produces a red color, which on gentle stirring forms red streaks through the liquid (H. Meltzer, *Zeitschr. anal. Chem.*, 37, pp. 345–358).; cholesterol and physosterol give a similar color reaction. If a mixture of picrotoxin and 3 times its weight of potassium nitrate be moistened with strong sulphuric acid, and a strong solution of sodium hydroxide be then added, an intense red color will be developed.—*Langley's* reaction.

Tests.—Besides possessing the above-mentioned properties, picrotoxin should not be precipitated in aqueous solution by mercuric chloride, platinic chloride, or tannic acid, showing difference from and absence of alkaloids.

Picrotoxin by treatment with boiling benzene, by bromination, or by the action of hydrochloric acid upon its ethereal solution is readily decomposed into *picrotoxinin* and *picrotin:* $C_{30}H_{34}O_{13}$ (picrotoxin) $= C_{15}H_{16}O_6$ (picrotoxinin) $+ C_{15}H_{18}O_7$ (picrotin). R. J. Meyer and P. Bruger (*Ber.*, 1898, 31, pp. 2958–2974) assert that picrotoxin is simply a mixture of 54–55 per cent. of picrotoxinin and 45–46 per cent. of picrotin, but their evidence is by no means conclusive.

Picrotoxinin is intensely bitter and poisonous. It crystallizes from water in the cold with 1 molecule of water, becomes anhydrous at 100° C. (212° F.), soluble in about 700 parts of water at 15° C. (59° F.), readily soluble in boiling water, benzene, ether, and chloroform. It gives color reactions similar to picrotoxin, and reduces ammoniacal silver solution in the cold, and Fehling's Solution on the application of heat.

Picrotin crystallizes from aqueous solution with varying amounts of water of crystallization. It melts at 250° C. (482° F.), is soluble in about 600 parts of water at 15° C. (59° F.), has an intensely bitter taste, but is non-poisonous. It is crystallizable from water in the form of delicate white needles or thick glistening prisms, according to concentration. It reduces ammoniacal silver solution and Fehling's Solution.

Anamirtin, a minor constituent found in the mother liquors from picrotoxin, is difficultly soluble in chloroform and benzene, decomposes at 200° C. (392° F.) without previous melting, and does not reduce Fehling's or ammoniacal silver solution.

Action and Uses.—Picrotoxin is a powerful poison to all animal life. Large doses produce vomiting, salivation, accelerated respiration, a slowed pulse, and a rise in arterial pressure, followed by stupor and epileptiform convulsions, great depression, coma, and death. The convulsions are characterized by marked clonic movements which follow a period of tonic muscular contraction. They are due to irritation of the motor cells in the medulla and spinal cord. During the spasms the breathing is interrupted, but it returns during the intervals of quiet and collapse which follow. The respiratory depression gradually increases until respiration fails to return after a spasm, and death from asphyxia results. The vomiting, acceleration of respiration, and rise in blood-pressure, which appear before the onset of the convulsions, are produced by stimulation of the centres in the medulla, which respectively preside over these functions. The slow pulse is accounted for principally by the stimulation of the cardiac inhibitory centre in the medulla, and after large doses in part to direct depression of the heart muscle. The employment of the drug in internal medicine has met with little success. Recommended in the treatment of epilepsy, chorea, and paralysis, its use has not borne out the claims made for it. Cocculus Indicus, one of the drugs yielding picrotoxin, is used in tincture, decoction, or ointment to destroy lice. The dose of picrotoxin is from $\frac{1}{64}$ to $\frac{1}{20}$ grain (0.001–0.003 Gm.).

PILOCARPINÆ HYDROCHLORIDUM, *U. S.*—Pilocarpine Hydrochloride.

Pilocarpinum hydrochloricum, P. G.—*Chlorhydrate de pilocarpine*, Fr.; *Pilokarpinhydrochlorid, Salzsaures Pilokarpin*, G.

Formula, $C_{11}H_{16}N_2O_2HCl$. Molecular weight, 242.81.

The hydrochloride of an alkaloid obtained from pilocarpus. It should be kept in well-stoppered, amber-colored vials.—U. S.

Preparation.—Pilocarpine hydrochloride is made by neutralizing diluted hydrochloric acid with pure pilocarpine, concentrating the solution, and setting the same aside over sulphuric acid to crystallize. 10 parts of the free alkaloid will require about 17.5 parts of the official 10 per cent. acid.

Properties.—The salt occurs in colorless or white, transparent crystals, odorless, and having a faintly bitter taste. It contains no water of crystallization and deliquesces on exposure to damp air. It is soluble at 25° C. (77° F.) in 0.3 part of water and in 2.3 parts of alcohol; very soluble in water at 80° C. (176° F.), and in 1.1 parts of alcohol at 60° C. (140° F.); at 25° C. (77° F.) insoluble in ether and soluble in 540 parts of chloroform. After drying the salt at 100° C. (212° F.) for several hours, it melts at 195.9° C. (384.5° F.) (193°–195° C., P. G., 204°–205° C. (corr.) Jowett). Upon ignition it is entirely consumed. Its aqueous solution is neutral, or at times has a faintly acid reaction toward litmus-paper. Sulphuric acid dissolves the salt, with elimination of hydrochloric acid gas and the formation of a colorless liquid. On adding to this liquid a small fragment of potassium dichromate on a white porcelain surface a bright, grass-green color is produced. Silver nitrate test-solution produces a white precipitate insoluble in nitric acid, if added to a solution of the salt. On rubbing together equal parts of pilocarpine hydrochloride and calomel, a black color is produced.—U. S. The salt is easily obtained pure in very large crystals by crystallization from strong alcohol and has a specific rotation of + 91.74° (Jowett). "If some of the salt be

added to fuming nitric acid, a pale-green solution results. A 1 per cent. aqueous solution of the salt is not affected by addition of ammonia-water, nor of potassium dichromate solution. Sodium hydroxide solution causes turbidity only in a concentrated aqueous solution of the alkaloidal salt."—P. G. The mixture of pilocarpine hydrochloride and calomel mentioned above requires moistening with alcohol before it will blacken.

Tests.—Besides possessing the properties mentioned, pilocarpine hydrochloride should respond to the following test, which distinguishes it from all other alkaloids: "Dissolve 0.01 to 0.02 Gm. of the salt in 2 Cc. of water in a test-tube, add 2 Cc. of a solution of hydrogen peroxide (slightly acid), and carefully pour on top of the liquid a small layer of benzene; then add 3 or 4 drops of a 0.3 per cent. solution of potassium dichromate and shake gently. The benzene layer will turn violet, while the aqueous layer will remain yellow. (If more than 0.02 Gm. is used, the benzene turns blue, and the reaction is no longer characteristic.")—U. S.

Action and Uses.—Pilocarpine hydrochloride possesses the same medicinal properties as pilocarpus. In solution of 1 to 4 grains (0.06–0.25 Gm.) to the ounce (30 Cc.) of water it is used as a myotic. The dose is from $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.03 Gm.) hypodermically, or $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015–0.03 Gm.) by mouth.

PILOCARPINÆ NITRAS, *U. S., Br.*—Pilocarpine Nitrate.

Azotate de pilocarpine, Fr.; *Pilocarpinnitrat*, G.

The nitrate of an alkaloid obtained from Pilocarpus, U. S.

Formula, $C_{11}H_{16}N_2O_2HNO_3$. Molecular weight, 269.20.

Preparation.—Pilocarpine nitrate may be made in a manner analogous to that suggested for the hydrochloride—namely, by neutralizing diluted nitric acid with pure pilocarpine. 121 parts of the official 10 per cent. acid will require about 40 parts of the free base. After a neutral solution has been obtained, the same is slowly evaporated to dryness, redissolved in hot alcohol (90 per cent.), and allowed to crystallize.

Properties.—The salt occurs as colorless or white shining crystals (white crystalline powder, Br.), odorless, and having a faintly bitter taste. It is permanent in the air and contains no water of crystallization. Soluble at 25° C. (77° F.) in 4 parts of water (8 or 9 parts of cold water, Br.) and in 60 parts of alcohol (slightly soluble in cold 90 per cent. alcohol, Br.); at 80° C. (176° F.) very soluble in water and at 60° C. (140° F.) soluble in 16 parts of alcohol (freely soluble in hot 90 per cent. alcohol, Br.); insoluble in ether and chloroform. It melts at 170.9° C. (339.7° F.) and is quickly consumed upon ignition, leaving no residue. The aqueous solution of the salt (1 in 100) is acid to litmus-paper. Sulphuric acid dissolves the salt without color, and on adding a fragment of potassium dichromate to the solution, a bright grass-green (emerald-green, Br.) color is produced. An aqueous solution of the salt mixed with an equal volume of ferrous sulphate test-solution, and underlaid with a layer of sulphuric acid, gives a brown ring at the juncture of the two layers. On rubbing together equal parts of the salt and of calomel, no black color is produced (difference from *pilocarpine hydrochloride*).—U. S. According to Jowett (*Trans. Chem. Soc.*, 1900), commercial pilocarpine nitrate contains variable amounts of isopilocarpine nitrate, which lowers the melting-point. The pure salt melts at 178° C. (352.4° F.), corr., and has a specific rotation of + 82.9°.

Tests.—Pilocarpine nitrate should possess the properties mentioned and correspond to the specific test mentioned under the preceding salt, which distinguishes it from all other alkaloids and is characteristic of the salts of pilocarpine.

Action and Uses.—The action and uses of pilocarpine nitrate are the same as of the hydrochloride. (See also PILOCARPUS.)

Other Salts of Pilocarpine.—Besides the hydrochloride and nitrate, the hydrobromide and salicylate of pilocarpine have also been used. They may be readily prepared by neutralizing dilute solutions of the respective acids with pilocarpine, and treating the solutions thus obtained as directed under the nitrate.

PILOCARPINE-PHENOL is a colorless oily liquid obtained by fusing a mixture of 10 parts of pilocarpine and 4.5 parts of phenol. It is soluble in water and in alcohol, and is used subcutaneously.

ESERINE-PILOCARPINE is the name applied to a crystalline powder obtained by dissolving a mixture of 1 part of physostigmine salicylate and 2 parts of pilocarpine hydrochloride and allowing the solution to crystallize.

PILOCARPUS, *U. S.*—Pilocarpus; Jaborandi.

Jaborandi Folia, Br., Fr. Cod.; *Folia Jaborandi*, P. G.

The dried leaflets of *Pilocarpus microphyllus* Stapf. (*Small-leaved* or *Maranham Jaborandi*) or of *Pilocarpus Jaborandi* Holmes (*Pernambuco Jaborandi*) (Fam. *Rutaceæ*), yielding, when assayed by the U. S. P. process, not less than 0.5 per cent. of alkaloids.

Pilocarpus is official, under that title, in nearly all pharmacopœias. The British recognizes only the second-named species; the German includes "species with imparipinnate leaves," and relies upon the description to exclude undesirable species; a number name *P. pinnatifolius* Lem., evidently regarding this name as synonymous with *P. Selloanus* Engler, an idea which is by no means well proved. The Portuguese cautions against confusing this drug with the leaves of *Monniera trifolia* Nees et Mart., of the same family (*Para Jaborandi* or *Alfacaca de Cobre do Brazil*), and with those of *Piper Jaborandi* Vell. (Fam. *Piperaceæ*).

The inclusion of Rio Jaborandi (*P. Selloanus* Engler) in the definition of our Pharmacopœia of 1890 was unquestionably ill-advised, since these leaves are very irregular and deficient in quality, sometimes almost worthless.

Origin.—These plants are good-sized shrubs. The precise regions of growth are not known, but are, not with the best of reasons, assumed to be in the general vicinity of the cities named, from which they are respectively exported. Both of the official species are commonly scarce and high-priced and others are very frequently substituted for them in commerce. All Jaborandi leaves should be collected when fully grown, after the close of the rainy season, and when of thick texture, and should be thoroughly dried before packing, as they are very subject to mustiness.

The cultivation of Jaborandi is as yet a wholly undeveloped industry, but one of great promise, in view of the requirements for a more uniform and better drug, and also considered as a financial investment. Experiments made in Italy in the cultivation of the Rio Janeiro jaborandi resulted very favorably.

FIG. 310.

Jaborandi: *A*, Pernambuco; *B*, small-leaved; *C*, Aracati; *D*, Rio; *E*, Ceara.

Description.—*P. Jaborandi:* Very shortly and stoutly petioled, the blades 6 to 12 Cm. (2½ to 5 In.) long and 2 to 4 Cm. (¾ to 1½ In.) broad, oblong or oval, occasionally a very

little narrower above or below the middle, usually slightly inequilateral at the base, blunt and retuse at the summit, entire and narrowly revolute at the margin, yellowish or brownish green, smooth and somewhat shining, especially underneath, thick and coriaceous, not much wrinkled, the reticulate venation prominent on both surfaces, especially underneath; strongly pellucid-punctate; somewhat and peculiarly aromatic when crushed and warmed in the hand; taste bitterish, somewhat salty, aromatic, later somewhat pungent and sialagogue.

P. microphyllus: Leaflets 1.2 to 3.7 Cm. (½ to 1½ In.) long and 0.8 to 1.6 Cm. (⅓ to ⅔ In.) broad; the lateral, which are about twice as numerous as the terminal, without petiolules, rhomboidally oval to obovate, acute at the base, blunt, and unequally emarginate at the summit; the terminal on short margined petiolules, almost equally oval to obovate, and rather narrower than the lateral, with which they otherwise agree; all thickish and rigid, entire at the margin, smooth, dull-green, finely pellucid-punctate; midrib stout and veins rather coarsely reticulate, lightly prominent; odor and taste similar to those of *P. Jaborandi.*

The powder of small-leaved Jaborandi is of a grayish green, that of Pernambuco yellowish green. Schneider gives the following measurements as characteristic of the elements of the powder of the two varieties, the material examined having been supplied by ourselves and thoroughly authenticated. Of the small-leaved Jaborandi the upper epidermis-cells 23 to 35 by 15 to 17 mikrons; average length of outer palisade-cells 45 mikrons; crystals few and small. The corresponding measurements for Pernambuco Jaborandi he gives as follows: upper epidermis-cells 45 to 55 by 18 to 22 mikrons; outer palisade-cells 30 to 35 mikrons; crystals, large, 30 mikrons. Geiger gives the length of hairs of the Pernambuco variety from 440 to 600 mikrons.

Adulteration.—The practice of supplying one variety for another can be stated as far more common than that of supplying the article called for. The recognition of such substitution will be considered under *Allied Species.* A few substances, not Jaborandis at all, may here be considered. The leaflets of one or more species of *Swartzia* (Fam. *Leguminosæ*), have been supplied under the name of "Maranham Jaborandi," which differ from that article notably in the presence of some small leaflets, ranging down to only ⅓ of an inch in length. These leaflets are somewhat rhomboidally ovate, upon a short hairy petiole, the upper surface shining, the lower minutely hairy on the principal veins, the finer venation pellucid, but pellucid oil-dots entirely wanting. The leaves of *Piper Jaborandi* and of some other species of Piper may be recognized by the absence of the notch at the summit, as well as of the pellucid dots. Under the name of "Jaborandi Bark," *Alcornoco Bark* (from *Bowdichia virgilioides* Kunth, Fam. *Leguminosæ*) has been offered as a substitute for Jaborandi.

Constituents.—The most important constituent of Jaborandi is the alkaloid PILOCARPINE, discovered in 1874 by Hardy. Its yield from good Pernambuco leaves ranges from a little less than 0.5 to nearly 1 per cent. In the small-leaved variety the amount is believed to average somewhat higher. The stalks, which exist in large amount in some lots of drugs, contain about half as much alkaloid as the leaves. The free base is recognized only by the French Pharmacopœia. It may be obtained by moistening the finely ground leaves with solution of sodium carbonate and extracting the same with warm benzene. The benzene solution is shaken out with diluted hydrochloric acid, and, after separation, the acid liquids are made alkaline with sodium carbonate solution and shaken out with chloroform. Upon evaporation of the chloroformic liquid the residue, consisting of crude alkaloids, is neutralized with diluted nitric acid, and the solution evaporated to dryness and purified by repeated crystallization from alcohol. Finally, the pilocarpine nitrate is dissolved in water, made alkaline with ammonia, and shaken out with chloroform. Evaporation of the chloroformic solution yields the pure alkaloid in the form of a colorless syrupy liquid. Pilocarpine is readily soluble in water, alcohol, and chloroform, but scarcely at all in ether. It possesses strong basic properties and forms readily crystallizable salts, which show more or less of an acid reaction toward litmus. In contact with potassium, sodium, or barium hydroxide, pilocarpine is converted into an acid and forms salts of the respective alkalies, from which the base may be again regenerated by acids, even carbonic acid. Regarding the other constituents, some of the conflicting statements have probably originated in the use by the analysts of different varieties of leaves. Up to 1900 it was asserted that, besides pilocarpine, 2 other alkaloids, pilocarpidine and jaborine, were present in jaborandi leaves, to which the formulas $C_{10}H_{14}N_2O_2$ and $C_{22}H_{32}N_4O_4$ were respectively assigned. The former was isolated by Harnack and described as a liquid body, differing from pilocarpine in that its aqueous solution is not precipitated by auric chloride. Jaborine was said to occur in the leaves of *Pilocarpus pinnatifolius* and also in false jaborandi (*Piper reticulatum*). It was also

said to be formed upon evaporation of acid solutions of pilocarpine, as an amorphous substance, more difficultly soluble in water than pilocarpine. H. A. D. Jowett has recently subjected the alkaloidal constituents of pilocarpus to a careful study and published the results of his investigations in *Trans. Chem. Soc.* for 1900, 1901, 1903. He has shown that a basic substance isomeric with pilocarpine is present in jaborandi leaves and that this base, which he calls isopilocarpine, is present in variable amounts in commercial pilocarpine nitrate. It was obtained as a colorless viscid oil, boiling at 261° C. (501.8° F.) under 10 millimeters pressure, and can be distilled without decomposition. Isopilocarpine can also be obtained by the action of heat or alkali on pilocarpine. Jowett was not able to obtain jaborine from either *Pilocarpus pinnatifolius* or *P. microphyllus*, and upon examination of the commercial article of that name found it to be a brown oil, which proved to be not homogeneous, but a mixture of isopilocarpine, pilocarpidine, and possibly pilocarpine, together with a little coloring-matter. Jowett states that while it is possible that such an alkaloid as jaborine may have existed in *P. Jaborandi*, it is certain that no such body exists in the jaborandi leaves at present obtainable. Furthermore, he has found that while pilocarpidine is not present in the leaves of *P. microphyllus*, it was no doubt obtained from *P. Jaborandi*, which was formerly plentiful, but has become scarce. There is also present in pilocarpus about 0.5 per cent. of a volatile oil, which has been called pilocarpene, a little resin, tannin, etc.

Jaborandine was extracted from the leaves of *Piper Jaborandi*, but there is no reason to believe in its existence in any *Pilocarpus*.

The Pharmacopœia requires that when assayed by the process which follows, pilocarpus should contain not less than 0.5 per cent. total alkaloids.

Assay of Pilocarpus.—Pilocarpus, in fine No. 60 powder, 10 Gm.; chloroform, ammonia-water, normal sulphuric acid, tenth-normal sulphuric acid, fiftieth-normal potassium hydroxide solution, cochineal or iodeosin test-solution, each, a sufficient quantity. Moisten 10 Gm. of powdered pilocarpus thoroughly with 2 Cc. of ammonia-water and sufficient chloroform to wet it well, and at once pack it firmly in a small tubular percolator, the tube of which has been firmly plugged with absorbent cotton. Percolate with chloroform containing about 2 per cent. of ammonia-water until the powder has been exhausted, for which purpose about 100 Cc. will usually suffice. Pour the percolate into a separator, and shake out with 15 Cc. of normal sulphuric acid, drawing off the acid aqueous solution into another separator, and repeating the shaking out with 2 Cc. more of normal sulphuric acid, mixed with 8 Cc. of distilled water. Add the acid solution to the second separator, and repeat the shaking out again with 10 Cc. of distilled water, adding the aqueous liquid again to the second separator. Add 20 Cc. of chloroform to the second separator, make alkaline with ammonia-water, shake well, and draw off the chloroform into a beaker. Repeat the shaking out twice with 15 Cc. and 10 Cc. of chloroform, and add the chloroform to the beaker. Evaporate off the chloroform in water-bath, and dissolve the residual alkaloids in 5 Cc. of tenth-normal sulphuric acid. Add 5 drops of cochineal or iodeosin test-solution, and titrate the excess of acid with fiftieth-normal potassium hydroxide solution. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide solution used by 5, subtract this number from 5 (the 5 Cc. of tenth-normal acid used), multiply the remainder by 0.02, and this product by 10 (or multiply at once by 0.2), which will give the percentage of total alkaloids in the drug.—U. S.

Pharmaceutical Preparations.—Fluidextract of Pilocarpus, U. S. P.; Tincture of Jaborandi, Br.

Action and Uses.—Pilocarpus and its alkaloid pilocarpine have an effect almost identical in character. Jaborine is an irritant to the stomach, and is apt to cause nausea and vomiting. The chief effect produced by pilocarpine when given to man is profuse sweating and salivation. When the sweating is not very marked, salivary flow is more than usually profuse. Small doses not sufficiently large to cause free sweating sometimes cause profuse diuresis. The profuse flow of sweat is due to the stimulating effect of the drug upon the ends of the nerves in the sweat-glands and of the sweat-glands themselves. Sometimes the drug increases the secretion of milk in nursing women.

The effect of pilocarpus in man is quite different from its influence upon animals, for in the latter its effect seems to be stimulant so far as the circulation is concerned, whereas in man it nearly always acts as a depressant.

Upon the pupil pilocarpine acts as a myotic in the strength of 1 to 4 grains to the ounce (0.06–0.25 Gm. to 30 Cc.), and is often employed in medicine for this purpose.

Medicinally, pilocarpus is used to relieve uræmia, but its use must be most cautious lest it cause pulmonary œdema. It has also been used with care in cardiac and renal dropsy. Hypodermically pilocarpine is employed to remove opacities in the vitreous humor of the eye and for the relief of thickening of the tympanic membrane. DaCosta and others have obtained good results from its use in full, repeated, hypodermic doses in erysipelas.

This drug also often acts as a powerful stimulant to the growth of the hair, whether it be applied to the scalp or taken internally, and the new growth is often very dark in hue.

Pilocarpus is the physiological antidote to atropine and agaricin.

The dose of fluidextract of pilocarpus is from 10 to 30 minims (0.60–2 Cc.). Pilocarpine hydrochloride is used in the dose of from $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.03 Gm.); and the tincture of jaborandi of the B. P. is given in the dose of from 2 to 4 drachms (8–16 Cc.). The nitrate of pilocarpine is given in the same dose as the hydrochloride.

Allied Species.—There are about 15 species of *Pilocarpus* Vahl., several of them bearing leaves possessing but a single leaflet. Of the latter, only 2, *P. spicatus* A. St. Hil. and *P. racemosus* Vahl., have entered commerce as Jaborandi. The first named (Fig. 305, C) is a short, broad, thickish, dark-brown, smooth, and slightly glossy leaf, and is marketed as *Aracati Jaborandi.* The mass is coarsely stemmy and the leaves usually much folded or bent. Its powder is of a dull-brown color. The upper epidermal cells measure 18 to 30 mikrons broad, the lower about the same, the outer palisade-cells 45 to 70 mikrons long, the crystals few and small. It is said (Paul and Cownley) to contain 0.16 per cent. of alkaloid, having a melting-point of 151.5° C. *P. racemosus* is a West Indian species, the leaf large and thin and somewhat resembling the Rio. Its histology and powder have not been investigated. Rocher reports it as containing 1 per cent. of alkaloid, of which two-thirds is pilocarpine, the remainder jaborine. If this were correct, it would be one of the best of all the Jaborandis, but the statement has recently been positively denied. Of the unofficial species possessing leaves with 3 or more leaflets, the most important, pharmaceutically and commercially, is the Rio Janeiro variety (Fig. 305, D), produced by *P. Selloanus*, or *P. pinnatifolius* Lem., according to different views. This variety so closely resembles the Pernambuco as to be most readily mistaken for it, and it is very largely supplied under that name. It is almost as long, but is relatively narrower, and is much more inclined toward the oblanceolate form. It is little inclined toward the yellow tinge of the Pernambuco (Fig. 305, A), unless over-mature, but is of a dull green. It is far less thick and tough, and less prominently veiny. Its powder is green to slightly grayish green. Schneider gives it the following characters: upper epidermal cells 21 to 33 by 13 to 15 mikrons; average length of outer palisade-cells 45 mikrons; crystals numerous, small.

Paraguay Jaborandi is by many considered specifically identical with the preceding, a view which we do not share. It is narrower, thinner, less tough and veiny, and of a duller green than the Rio. Both, but especially the latter, are poor in pilocarpine.

P. trachylophus Holmes has 5 leaflets (Fig. 305, E). It is well distinguished by its very peculiar dark and somewhat smudgy brown-green color, its thickish texture, strongly revolute margin, and densely hairy lower surface. It is not to be mistaken for the yellowish-green leaves with a yellowish velvety lower surface occasionally found mixed with the Pernambuco leaves and of similar form and size with the latter. It is commercially known as *Ceara Jaborandi.* It yields a dark-green powder. Its upper epidermal cells are from 30 to 40 mikrons broad, the lower somewhat smaller, the outer palisade-cells about 100 mikrons long, the crystals few and small, the hairs very abundant, about 300 mikrons long. Paul and Cownley found it to contain 0.4 per cent. of alkaloid, but of a very different character from that of pilocarpine. This variety is quite abundant in commerce.

The above are the only species which have as yet reached any commercial importance, but there is little doubt that others will do so.

PILULÆ.—Pills.

Pilules, Fr.; *Pillen*, G.

Pills are a very convenient mode of administering medicines, the chief advantage lying in the small bulk to which the medicine is reduced and in the almost complete disguise of bitter and nauseous remedies by reason of their being swallowed without previous mastication. Pills are admirably adapted for the administration of heavy metallic substances not readily suspended in liquids, and also in cases where the action of the medicine is to be slow, or even retarded until it reaches the lower bowel. The usual shape given to pills is that of a sphere or globe, although an ovoid shape is also sometimes resorted to, and in a few cases even the lenticular shape is preferred. Their

weight ranges from less than 1 to 5 grains (0.06–0.3 Gm.) for vegetable substances, or about 8 or 10 grains (0.5 or 0.6 Gm.) for heavy mineral compounds; if a pill exceeds this weight, it is called a *bolus*. Boluses are occasionally made weighing 20 or 30 grains (1.3 or 2.0 Gm.) each, and are often of a softer consistence than pills. Very small pills coated with sugar are called *granules*.

Preparation.—The most important step in the preparation of pills is the formation of a proper mass, which should consist of a firm, consistent paste, sufficiently plastic to admit of being molded without adhering to the molds, and sufficiently firm to prevent the pills from losing their original shape. Plasticity is that peculiar condition where adhesiveness and firmness are properly balanced: the former of these properties is due to a partial softness, which enables the particles of the mass to adhere to each other, thus imparting tenacity to the whole. Some substances possess this adhesiveness in themselves, but require the addition of a liquid—water or alcohol—in order to develop it, as, for instance, gums and resinous drugs. Other substances possess no inherent adhesive properties, and in such cases it becomes necessary to impart tenacity to them by the addition of some liquid or solid material, called the excipient; such substances are camphor, calomel, bismuth salts, some saline or vegetable powders, reduced iron, and the like. Firmness in a pill-mass is as essential as adhesiveness, and, while the latter is brought about by a state of partial solution or fluidity, so, inversely, the insolubility of some particles is necessary for the required firmness. The addition of excipients must be made judiciously, so that the constituents of the mass be not modified in their action nor the bulk be unnecessarily increased; and after each addition the mass should be well kneaded, which, itself having a softening influence on the mass by reason of the heat generated, enables the operator to judge of the true condition of the mixture. Whenever possible all constituents of a pill-mass should be reduced to very fine powder before the addition of any excipient, as only in this condition can the homogeneity of the mass be assured, as also the subsequent accurate division of doses. Small quantities of potent remedies, such as alkaloids, narcotic extracts, toxic chemicals, etc., are preferably triturated with a little sugar of milk before mixing them with the other ingredients, to facilitate uniform distribution.

For the proper incorporation of volatile oils in pill-masses powdered soap is to be preferred, which completely emulsionizes the oil and prevents its separation during the subsequent manipulations; soap, however, should never be employed in pill-masses containing heavy metallic salts, such as iron, lead, etc., as decomposition will take place and cause the mass to crumble: in such cases the addition of an absorbent powder is preferable. As an absorbent for large quantities of volatile oils or as an excipient for heavy metallic salts or troublesome combinations, such as capsicum, lead acetate, and extract of hyoscyamus, and the like, the powder suggested some years ago by Mr. Mattison will be found very serviceable: it consists of 1 part of powdered tragacanth and 7 parts of finely powdered (No. 80) elm-bark; and the following quantities will be found sufficient for making a good pill-mass with the aid of a little syrup: 3 grains of the powder for 60 grains of iron by hydrogen, or bismuth subnitrate, or calomel, or equal parts of camphor and extract of henbane, or equal parts of camphor and lead acetate; 6 grains of the powder for 60 grains of dried ferrous sulphate or scale salts of iron, or equal parts of camphor and capsicum, etc. As an absorbent for soft masses, or such as contain large amounts of extracts, powdered liquorice-root will be found a better drying agent than marshmallow-root or elm-bark, and less likely to increase the bulk, as it contains little or no mucilaginous matter. For creosote soap may be used if in combination with other drugs, but if prescribed alone, powdered liquorice-root or the mixture of tragacanth and elm-powder with syrup will be found to answer well: 2 or 3 grains of the powder should be used for each drop of creosote. For tar, Peru balsam, and similar substances, clay (kaolin or fuller's earth) will be found a good absorbent, the mass to be made with soap. For the salts of quinine, glycerin and acacia or tragacanth, or even glycerite of starch, will be found desirable excipients; for cinchonidine or its sulphate, however, honey with a little acacia will be found preferable to glycerin. Diluted alcohol and soap and water are the best excipients for gum-resins, such as asafetida or galbanum, and even for powders like aloes, as is shown in the Pharmacopœia. Although the use of wax has at times been recommended for pill-masses containing volatile oils, balsams, etc., we think it should only be employed in extreme cases, as pills made with wax freqently fail to give up the active ingredients in the liquids of the stomach or bowels, owing to their higher melting-

point. For pills of readily reducible substances, as potassium permanganate, silver nitrate, silver oxide, gold chloride, etc., all contact with organic matter should be avoided, and hence the best excipients would be white clay and water, which form a plastic mass, but require quick manipulation, as it soon becomes crumbly; a better excipient is a mixture of equal parts of kaolin, soft petrolatum, and paraffin, which forms a mass that readily gives up the active constituent, at the temperature of the body, in the presence of moisture. Potassium permanganate can be readily formed into a pill-mass by triturating with one-half its weight of kaolin, and then adding one-sixth or one-fourth its weight of petrolatum.

Pills containing free iodine should invariably be made with the addition of starch, so as to combine with the iodine and prevent its irritating effect on the mouth and throat; the union is very feeble, and the iodine will be readily liberated by the warm liquids of the stomach.

When deliquescent substances are ordered in pill form or such as are slowly volatilized upon exposure to air, a mixture of potassium borotartrate with half its weight of water will prove a good excipient: about one-sixth of a grain of powdered tragacanth should be added to each pill, and the mass must be quickly formed and rolled out. 60 grains of chloral hydrate or 30 grains of potassium iodide require 2 drops of the excipient. Such pills, if they are to be kept on hand for some time, require a protective coating.

It is obvious, from the foregoing, that there can not be an excipient which would be alike serviceable for all medicinal substances, or even for all drugs, capable of being reduced to powder. The choice of the excipient is very frequently left to the pharmacist, and involves a knowledge not only of the constituents of the drugs, but also of the reactions which may take place between the different ingredients in the presence of moisture. *Mucilage of acacia* or of *tragacanth* serves a good purpose if the pills are to be used in a short time, but if kept on hand they become hard and dissolve very slowly. This may be prevented by replacing about one-half or more of the water with *glycerin*. The *glycerite of starch* (see p. 728) and various combinations of it with gum-arabic, tragacanth, and sugar have been used for the same purpose. Commercial syrupy *glucose*, *manna*, the official *pill-masses*, most of the official *confections*, and more particularly those of rose, of hips, and of senna, will render powders adhesive, and if *extracts* are not inadmissible they will be found to yield good pill-masses with a comparatively large amount of powder; a rather soft extract is capable of serving as an excipient for its own weight of vegetable powder and three or four times its weight of resins and insoluble salts, and with the addition of a little syrup or honey twice the weight indicated may be incorporated.

As a rule, it will be found desirable for the physician to order some adhesive material, like extracts, together with the other ingredients of pills, but the former should not be in excessive quantities, so as not to require the addition of inert absorbent powder. When no excipient is directed, the pharmacist should select one which is simple in composition, does not increase the bulk of the mass, and is not liable to become very hard. When resinous extracts and similar materials are ordered, an excipient is not often required, but the powders may be triturated together in a warm mortar and the plastic mass rolled out into pills while still warm. The compound cathartic pills furnish an example of this kind.

Pill-masses should always be made in a Wedgewood or iron mortar, except in the case of very simple combinations, for trituration by means of a pestle is essential to produce a uniform mixture of the ingredients, and it will be found that a mass can be formed in less time and with less excipient and labor in the mortar than on the pill-tile. After the mass has been properly prepared, it is transferred to a regular pill-machine or graduated glass or porcelain tile to be rolled out, by means of a flat piece of hard wood (Fig. 316), into a cylinder of uniform thickness, which is then divided into the requisite number of pieces.

A small number of pills may be conveniently divided on a pill-tile (Fig. 315), but for a larger number a pill-machine will be found preferable, particularly if the weight of the pills corresponds to the size of the grooves, for then the perfect rounding of the pills can be readily effected by continued rolling in these grooves. In order to insure greater uniformity in cutting the mass on a pill-tile into the required number of parts, use may be made of either of the two devices shown in Figs. 311 and 312. The Liv-

ingston pill-cutter may be used to cut 24 parts at one time by simply pressing the steel cutters into the pill-mass after the same has been rolled out to the required length by

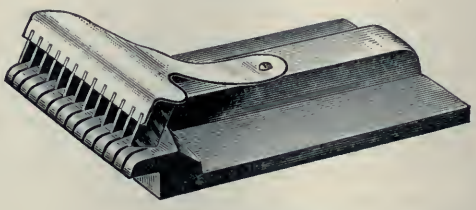
Fig. 311.

Livingston pill-cutter.

means of a wooden pill-paddle; the separate pieces may then be quickly ejected by means of a slotted metallic strip operated by a spring on the top of the bar. The Diamond pill-cutter is combined with a flat wooden roller for rolling the mass out to the required length, which is then brought under the projecting cross-piece and the metal cutters pressed down upon it; as the metal plate, to which the cutters are attached, rebounds to its original position, the latter are stripped of any adhering pieces of mass by the projecting cross-piece, through the slots of which the cutters pass.

The best pill-machine is the "Cooper patent" (Fig. 313), the woodwork being of mahogany and the metallic parts of brass. This machine has two sets of reversible grooved plates, on which four different sizes of pills can be made—1, 2, 3, and 5 grains; the plates being quickly removable and adjustable. The sides of the rolling-board are so constructed that they can be raised or lowered by means of winged screws, which

Fig. 312.

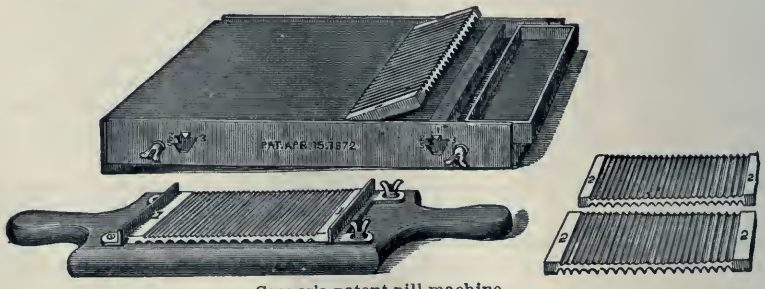


Diamond pill-cutter.

allows the mass to be rolled just the thickness required for each respective size of pill, thereby insuring always the full number of perfectly round pills.

After the mass has been properly rolled out to the length of the desired number of pills, it is laid upon the grooved plate of the board, and divided by placing the other cutter over it and drawing the same forward and backward with slight pressure.

Fig. 313.



Cooper's patent pill-machine.

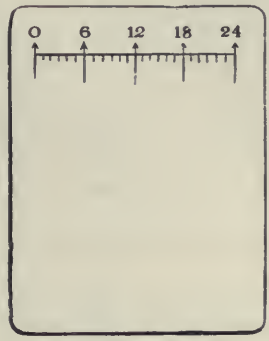
When the pill-mass has been divided on a pill-tile, and also when the pills are larger or smaller than the grooves of the machine, it becomes necessary to impart a spherical shape to the pieces, by appropriate rolling between the thumb and first and second fingers, after which the pills should be placed under a pill-finisher and completely rounded by rotary motion of the same with some pressure. It is better to move the finisher about in curvilinear figures like the figure 8, instead of giving it a constant circular motion, so that the pressure may be uniform at all points. Pill-finishers usually consist of a circular piece of hard wood, with a smooth rolling surface and a projecting margin for

the purpose of confining the pills; several sizes are required to suit different sizes of pills. Fig. 314 represents a convenient pill-finisher suitable for two different sizes, as the upper and lower margins project to different lengths.

Fig. 314.

Hard-wood pill-finisher.

Fig. 315.



Pill-tile, graduated.

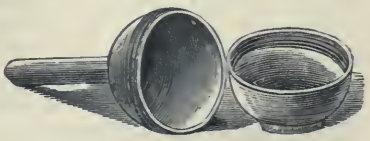
Fig. 316.

Pill-roller.

Pill-dusting.—The pill-mass, being plastic and adhesive, is apt to adhere to the slab and the fingers while being rolled out and shaped into pills. This is prevented by the use of a fine powder, which should be strictly inert unless otherwise directed by the physician. Among the most suitable powders are lycopodium, liquorice-root, and starch; the former is particularly desirable on account of its fineness and uniformity, its slight adhesiveness, and its utter tastelessness. Powdered starch should be used with all white pill-masses, Bermuda arrow-root being the best for the purpose. Only in exceptional cases is the addition of dusting-powder to the pills in the box justifiable: the pills should receive a sufficient coating of the powder under the finisher, and if the mass has been properly made there is no danger of the pills adhering, and hence there is no occasion for putting an excess of powder in the box. Magnesia and magnesium carbonate should be used with due care on account of the possible chemical effect upon the ingredients of the pills. Powdered talc (soapstone) is likewise serviceable, and has the advantage of imparting a very thin opaque and tasteless coating to the pills without impairing their solubility in the stomach; it is particularly suited for pills of silver nitrate and the like. When asafetida or other substances of a nauseous odor are given in the form of a pill, the odor may either be entirely covered or considerably modified by the use of powdered cinnamon, aromatic powder, ginger, or a similar powder.

Pill-coating.—If the pill-mass be not too soft, the amount of powder adhering to the surface of the finished pill is quite small, though generally sufficient, if quickly swallowed, to cover the taste of bitter and nauseous ingredients. More perfect coverings may be obtained in various ways, an ordinary rather deep pill-box being used, or preferably an apparatus made of hard wood consisting of two hollow hemispheres, to one of which a short handle is attached. For *silvering* or *gilding* the pills are made firm, if possible rolled out and shaped without using any powder, and after a perfectly smooth surface has been obtained they are slightly dampened and introduced into the apparatus, together with the requisite quantity of gold- or silver-leaf; after a rapid rotary motion for a few seconds the pill will be found uniformly coated with the thin metal. Glycerin should not be used as an excipient or only in a very small quantity, as it lessens the brightness of this kind of coating.

Fig. 317.



Apparatus for coating pills.

Sugar-coating is a process which is not readily applicable to the operations of the pharmacist, requiring experience and practice to insure success. It partakes of the confectioner's art, although the coating of pills with sugar requires somewhat more care, on account of the absence of starch or flour, which generally makes up a part of the confectioner's coating. Sugar-coating of pills on a large scale is done in hemispherical copper pans made to revolve slowly within a coil of steam-pipe supplying the necessary

heat for evaporation of the moisture; the pills, which should be well air-dried, are placed in the pan, and a quantity of simple syrup or of a mixture of syrup and mucilage of acacia is poured on, the pan being kept in constant rotary motion until the pills are dry. The addition of syrup is repeated until a sufficiently thick coating has been deposited on the pills, and this can be determined only by experience.

Sugar-coating can be more successfully performed with a large quantity of pills than with a small number, as the deposit of sugar takes place more uniformly, and the mutual attrition of many pills insures a smooth surface. For small operations it will be found desirable to dampen the pills with diluted mucilage of acacia or egg-albumen and then rotate them in a tinned-copper or porcelain dish containing either finely bolted sugar or a mixture of acacia 1 part and sugar 5 parts, or of sugar 2 parts, sugar of milk 1 part, and purified talcum 1 part. With care and practice fair results may be obtained, although the pills should not be expected to look so perfect as those coated by machinery.

In France sugar-coated pills are called *dragées*, and when of very small size, *granules*.

Gelatin-coating is more readily applied than sugar-coating, but, like the latter, requires practice to insure proficiency. The chief difficulty lies in the drying of the coating after the pills have been dipped into the solution of gelatin; the pills must be kept in motion while the gelatin cools, otherwise the coating will not be uniform. Pills to be gelatin-coated must be firm, dry, and free from dusting-powder; if glycerin is used as an excipient, it is likely to soften the gelatin-coating, causing the pills to stick together. For pills containing strongly odorous substances, such as asafetida, sumbul, iodoform, the valerianates, etc., gelatin-coating is decidedly inferior to sugar-coating, as the odor penetrates gelatin far more rapidly than sugar. The manner of coating the pills on a large scale is identical with that used for only a dozen pills, namely, the pills are impaled upon long, thin needles, to the depth of about $\frac{1}{16}$ of an inch, and then immersed in a solution of gelatin kept fluid by means of a water-bath; in order to avoid contraction and cracking of the gelatin upon cooling, mucilage of acacia is usually added to the solution, and, by some, syrup also. The rapid drying on a large scale is effected by placing the pills soon after they have been dipped, while still on the needles, in specially constructed drying cases connected with an exhaust fan, by means of which air is rapidly drawn through the cases, and the moisture is thus removed.

The application of a continuous coating of gelatin to pills without the use of needles is in successful operation at several large manufacturing establishments, but is not available at the dispensing counter, since extensive steam-power machinery is necessary for the work.

In place of gelatin-coating at the dispensing counter, the plan prevails in this country of disguising the disagreeable odor and taste of pills by enclosing them in gelatin capsules. These gelatin capsules are sold under the name of *empty capsules*, and consist of small cylinders closed at one end and provided with a shorter cylindrical cover; they occur in 7 sizes, ranging from $\frac{3}{8}$ inch to 1 inch in length, and are numbered respectively from No. 5 to No. 00; they are sold at fabulously low prices. The composition of the empty capsules made in this country is a mixture of gelatin and glycerin in variable proportions, dependent upon the character of the gelatin.

Pills are occasionally coated with tolu or collodion: the former coating is directed officially for the pills of phosphorus and those of iodide of iron. Instead of using the pharmacopœial solution of tolu in ether, the following, suggested by Prof. Patch, will be found to give better results: 540 grains of balsam of tolu, 180 grains of mastiche, 2 fluidounces of alcohol; dissolve and filter. Coat the interior of two flat evaporating dishes with a thin film of oil of sweet almond or petrolatum; place the pills in one of the dishes, and add a few drops of the solution; cover with the second dish, and rotate rapidly until the pills are coated, then put on a tray to dry.

The so-called "pearl-coating" is applied in a manner similar to that used for gilding or silvering; the pills, having been evenly dampened with a very thin adhesive liquid (mucilage of acacia 1 drachm, syrup 1 drachm, and water 6 drachms, or tragacanth 4 grains, syrup $\frac{1}{2}$ drachm, and water $7\frac{1}{2}$ drachms), are rotated in a globular box with purified talcum or a mixture of talcum and sugar in the form of an impalpable powder. If a high polish is desired, this can be obtained by rotating them afterward in another globe coated on the inside with paraffin.

Keratin coating has been especially recommended for pills which are not to be acted upon in the stomach, but to be dissolved in the intestinal fluids. Keratinized pills were first introduced by Dr. Unna, of Germany, but have not met with much favor, on account of the tedious process of coating. Keratin is a constituent of all horny matter, and is obtained from the same, after removal of fat with ether, by digestion, in the form of shavings or turnings with a mixture of pepsin, hydrochloric acid, and water, for 24 or 36 hours: this treatment removes all matter soluble in the gastric juice. The residue, having been well washed with water, is digested with 8 or 10 times its weight of 5 per cent. ammonia-water in a loosely stoppered flask, at a moderate heat, until a nearly complete solution results, which is then filtered and evaporated to dryness. Keratin, as thus prepared, is a commercial article; both acid and alkaline solutions of it are used for coating pills.

Ammoniacal solution of keratin is prepared by dissolving 7 parts of keratin in a mixture of 50 parts of 10 per cent. ammonia-water and 50 parts of 60 per cent. alcohol (solution may be facilitated by warming). This alkaline solution should be used for pills containing trypsin, pancreatin, metallic sulphides, etc.

Acetic solution of keratin, made by dissolving 7 parts of keratin in 100 parts of glacial acetic acid (if necessary, by the aid of moderate heat), is adapted for pills containing ferric chloride, tannin, salicylic acid, arsenic, creosote, and the salts of mercury, gold, and silver.

For chemically indifferent substances, either the alkaline or acid solution of keratin may be employed.

All pills intended to be coated with keratin must be made with some fatty excipient and contain no appreciable moisture; the mass is best made with cacao-butter and oil of sweet almond, or a mixture of purified mutton-tallow or cacao-butter 10 parts, and white or yellow wax 1 part. After the pills have been rounded they should be dipped in melted cacao-butter, which is allowed to harden; they are then placed in a porcelain dish, the keratin solution added (about 30 to 40 drops for 100 pills of medium size), and rotated until the pills have become thoroughly moistened, after which they are dried on parchment paper, to which they will not adhere. The application of keratin solution must be repeated three or four times and allowed to dry each time.

To avoid the tediousness of coating with keratin, salol coating has been recommended, which is best applied by melting salol in a dish and dipping the pills, fixed on needles, into it, afterward closing the small needle-holes separately. Salol, like keratin, is insoluble in the gastric juice, but the coating has not been found so satisfactory.

Preservation.—Uncoated pills are best preserved in lycopodium or other powder, and in a vessel which does not prevent the exchange of air. Moist pills kept in well-closed vessels are apt to become mouldy.

It should be mentioned that the British Pharmacopœia directs only *pill-masses*, leaving the final division to be specially ordered by the physician. The U. S. Pharmacopœia, on the other hand, besides recognizing two pill-masses, directs *pills* of a certain weight; for convenience of dispensing, however, the mass of some of these is sometimes kept on hand undivided.

PILULÆ ALOES, *U. S.*—Pills of Aloes.

Pilula Aloes Barbadensis.—Pill of Barbadoes Aloes; Pilula Aloes Socotrinæ.—Pill of Socotrine Aloes, Br.; *Pilules d'aloès et de savon*, Fr. Cod.—*Pilules aloétiques savonneuses*, Fr.; *Aloepillen*, G.

Preparations.—Purified aloes, in fine powder, 13 Gm.; soap, in fine powder, 13 Gm., to make 100 pills. Beat them together with water, so as to form a mass, and divide it into 100 pills.—U. S. For 12 pills use aloes and soap, of each 24 grains (1.55 Gm.).

Pill of Barbadoes aloes is made by forming a mass out of Barbadoes aloes, in powder, 2 ounces; hard soap, in powder, 1 ounce; oil of caraway 1 fluidrachm, and confection of roses 1 ounce.—Br.

Pill of Socotrine aloes is made exactly like the preceding, except that Socotrine aloes is used in place of the Barbadoes, and volatile oil of nutmeg in place of the oil of caraway.

The French Pharmacopœia also recognizes simple pills of aloes under the name of

Pilules Aloès Simples, which are made by mixing Cape aloes (10 Gm.) with sufficient honey to make a mass and dividing this into 100 pills.

Uses.—Dose, 1 to 3 pills at bedtime, for constipation.

PILULA ALOES ET ASAFŒTIDÆ, *Br.*—Pill of Aloes and Asafetida.

Pilules d'aloès et asefétide, Fr.; *Aloe- und Asafœtidapillen*, G.

Preparation.—Take of Socotrine aloes, in powder, asafetida, hard soap, in powder, confection of roses, each 1 ounce. Mix to form a mass.—Br.

Uses.—These pills may take the place of the simple aloetic pill in cases of constipation attended with flatulence, and especially in nervous or hysterical persons. Dose, 2 to 5 pills.

PILULÆ ALOES ET FERRI, *U. S., Br.*—Pills of Aloes and Iron.

Pilulæ aloëticæ ferratæ, P. G.; *Pilulæ Italicæ nigræ.—Pilules d'aloès et de fer*, Fr.; *Eisenhaltige Aloepillen, Italienishe Pillen*, G.

Preparation.—Purified aloes, in fine powder, 7 Gm.; exsiccated ferrous sulphate 7 Gm.; aromatic powder 7 Gm.; confection of rose a sufficient quantity to make 100 pills. Beat the powders together with confection of rose so as to form a mass, and divide it into 100 pills.—U. S. For 12 pills use aloes, exsiccated sulphate of iron, and aromatic powder, of each 13 grains (0.84 Gm.).

Exsiccated ferrous sulphate 1 ounce; Barbadoes aloes, in powder, 2 ounces; compound powder of cinnamon 3 ounces; syrup of glucose 3 ounces, or a sufficient quantity. Mix to form a mass.—Br.

Exsiccated sulphate of iron and powdered aloes equal parts; mix, form a mass with spirit of soap, and divide into pills, each weighing 0.10 Gm. Moisten the pills with tincture of aloes to make the surface black and glossy.—P. G.

Uses.—This combination is of value in amenorrhœa due to anæmia associated with constipation. The aloes aids the absorption of the iron and counteracts its constipating tendency. Dose, 1 to 3 pills.

PILULÆ ALOES ET MASTICHES, *U. S.*—Pills of Aloes and Mastic.

Lady Webster's dinner pills, E.; *Pilules d'aloès et de mastic*, Fr.; *Aloe- und Mastix-Pillen*, G.

Preparation.—Purified aloes, in fine powder, 13 Gm.; mastic, in fine powder, 4 Gm.; red rose, in fine powder, 3 Gm.; to make 100 pills. Beat them together with diluted alcohol so as to form a mass, and divide it into 100 pills.—U. S. For 12 pills use aloes 24 grains (1.56 Gm.), mastic 7½ grains (0.48 Gm.), and red rose 5½ grains (0.36 Gm.).

Uses.—The addition of mastic in this pill retards the solution of the aloes in the small intestine, thereby increasing the action of the latter drug in the large bowel. These pills are used as a laxative and are to be taken before or after the principal meal or at bedtime. Dose, 1 to 3 pills.

PILULÆ ALOES ET MYRRHÆ, *U. S., Br.*—Pills of Aloes and Myrrh.

Rufus's pills, E.; *Pilules d'aloès et myrrhe, Pilules de Rufus*, Fr.; *Rufussche Pillen*, G.

Preparation.—Purified aloes, in fine powder, 13 Gm.; myrrh, in fine powder, 6 Gm.; aromatic powder 4 Gm.; syrup a sufficient quantity; to make 100 pills. Beat them together so as to form a mass, and divide it into 100 pills.—U. S. For 12 pills use aloes 24 grains (1.56 Gm.), myrrh 12 grains (0.72 Gm.), and aromatic powder 8 grains (0.48 Gm.).

Socotrine aloes, in powder, 2 ounces; myrrh, in powder, 1 ounce; syrup of glucose 1½ ounces, or a sufficient quantity. Mix to form a mass.—Br.

Uses.—This pill is useful in constipation attended with flatulence. The myrrh is supposed to enhance the value of the aloes in the treatment of amenorrhœa and uterine catarrh. The dose is from 3 to 6 pills.

PILULÆ ASAFŒTIDÆ, *U. S.*—Pills of Asafetida.

Pilule d'asefétide, Fr.; *Asafœtidapillen*, G.

Preparation.—Asafetida 20 Gm.; soap, in fine powder, 6 Gm.; to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—U. S. For 12 pills use asafetida 36 grains (2.40 Gm.), and soap 12 grains (0.72 Gm.).

Uses.—These pills, each containing 3 grains (0.20 Gm.) of asafetida, present a convenient form of administering the drug. Dose, 1 to 3 pills.

PILULA CAMBOGIÆ COMPOSITA, *Br.*—Compound Pill of Gamboge.

Pilules de gomme-gutte composées, Fr.; *Gummiguttpillenmasse*, G.

Preparation.—Take of gamboge, in powder, Barbadoes aloes, in powder, compound powder of cinnamon, each 1 ounce; hard soap, in powder, 2 ounces; syrup of glucose, 1 ounce, or a sufficient quantity. Mix to form a mass.—Br.

Uses.—This is an efficient purgative in the dose of from 5 to 10 grains (0.30–0.60 Gm.).

PILULÆ CATHARTICÆ COMPOSITÆ, *U. S.*—Compound Cathartic Pills.

Antibilious pills, E.; *Pilules cathartiques composées*, Fr.; *Abführpillen*, G.

Preparation.—Compound extract of colocynth, 80 Gm.; resin of jalap, 20 Gm.; mild mercurous chloride, 60 Gm.; gamboge, in fine powder, 15 Gm.; to make 1000 pills. Mix the powders intimately; then gradually incorporate them with sufficient diluted alcohol to form a mass, and divide it into 1000 pills.—U. S. For 12 pills use compound extract of colocynth, 15 grains (0.975 Gm.); resin of jalap, 4 grains (0.260 Gm.); calomel, 12 grains (0.780 Gm.); gamboge, 3 grains (0.195 Gm.).

In making this pill-mass it is advisable to use a warm mortar and add very little water; while still warm it may be formed into pills which will better retain their shape than if made with more water at the ordinary temperature. The composition of these pills is almost exactly the same as in the previous Pharmacopœia, a lesser quantity of resin of jalap having been substituted for the extract.

Uses.—It is a well-recognized fact that a combination of purgatives, each in a small dose, produces a more uniform and thorough result with less irritation and discomfort than a large dose of any one of its component ingredients given alone. The combination of cathartics represented in this pill probably operates upon the entire intestinal tract, producing bilious stools, usually attended with little or no griping or gastric disturbance. It can be employed in nearly all cases requiring thorough purgation, and is of particular value in those conditions resulting from a torpid liver or congested portal circulation. Each pill weighs about 3 grains (0.20 Gm.). One pill is the usual laxative dose; 3 pills produce active catharsis.

PILULÆ CATHARTICÆ VEGETABILES, *U. S.*—Vegetable Cathartic Pills.

Pilules cathartiques végétables, Fr.; *Vegetabilische Abführpillen*, G.

Preparation.—Compound extract of colocynth, 60 Gm.; extract of hyoscyamus, 30 Gm.; resin of jalap, 20 Gm.; extract of leptandra, 15 Gm.; resin of podophyllum, 15 Gm.; oil of peppermint, 8 Cc.; diluted alcohol, a sufficient quantity to make 1000 pills. Mix the compound extract of colocynth intimately with the resin of podophyllum, resin of jalap, and extract of leptandra, and incorporate the oil of peppermint. Rub the extract of hyoscyamus with enough diluted alcohol to render it plastic; then beat it together with the mixture first prepared, using a sufficient quantity of diluted alcohol so as to form a mass to be divided into 1000 pills.—U. S.

For 12 pills use compound extract of colocynth, 12 grains (0.780 Gm.); extract of hyoscyamus, 6 grains (0.390 Gm.); resin of jalap, 4 grains (0.260 Gm.); extract of leptandra and resin of podophyllum, of each 3 grains (0.195 Gm.); oil of peppermint, 3 drops.

Uses.—This pill is employed for the same purpose as the compound cathartic pill. It is, however, probably less effective, and certainly not as generally used as the pill containing calomel. The dose is 1 pill as a laxative and 3 pills as a cathartic.

PILULA COLOCYNTHIDIS COMPOSITA, *Br.*—Compound Pill of Colocynth.

Pilules de coloquinte composées, Fr. Cod.—*Pilules cochées mineures*, Fr.; *Zusammengesetzte Koloquintenpillen*, G.

Preparation.—Colocynth pulp, in powder, 1 ounce; Barbadoes aloes, in powder, 2 ounces; scammony resin, in powder, 2 ounces; potassium sulphate, in very fine powder, ¼ ounce; oil of cloves, 2 fluidrachms; distilled water, a sufficient quantity. Triturate the oil of cloves with the potassium sulphate; add the colocynth pulp; mix; add the Barbadoes aloes and scammony resin; after mixing intimately add the distilled water and beat to form a mass.—Br.

The formula of the French Codex directs colocynth, aloes, and scammony, of each 10 Gm., oil of cloves, 0.05 Gm., and honey sufficient to make a mass to be divided into 200 pills.

Uses.—This is an active cathartic mass, given in the dose of from 5 to 10 grains (0.30–0.60 Gm.).

PILULA COLOCYNTHIDIS ET HYOSCYAMI, *Br.*—Pill of Colocynth and Hyoscyamus.

Pilules de coloquinte et d'extrait de jusquiame, Fr.; *Koloquinten-Bilsenkrautpillenmasse*, G.

Preparation.—Take of compound pill of colocynth, 2 ounces; extract of hyoscyamus, 1 ounce. Beat them into a uniform mass.—Br.

Uses.—The extract of hyoscyamus is added to this purgative combination to prevent griping. The dose is from 5 to 10 grains (0.30–0.60 Gm.).

PILULÆ CREOSOTI, *P. G.*—Pills of Creosote.

Pilules de Créosote, Fr. Cod.; *Kreosotpillen*, G.

Preparation.—Creosote, 10 parts; glycyrrhiza, in fine powder, 19 parts; glycerin, 1 part. Mix to form a mass, to be divided into pills weighing 0.15 Gm. each. Coat with powdered cinnamon.—P. G.

Each pill contains 0.05 Gm. of creosote.

Creosote pills of the French Pharmacopœia are of double the strength of the preceding, containing 0.10 Gm. of creosote each, and are made with dried almond soap.

Uses.—This pill presents a convenient form of administering creosote. Dose, 1 to 5 pills.

PILULÆ FERRI CARBONATIS, *U. S.*—Pills of Ferrous Carbonate.

Pilula ferri—Iron pill, Br.; *Pilules ferrugineuses de Blaud*, Fr. Cod.; *Pilulæ ferri carbonici Blaudii*, P. G.—*Ferruginous pills, Chalybeate pills, Blaud's pills*, E.; *Pilules chalybés de Blaud*, Fr.; *Blaudsche Pillen*, G.

Preparation.—Ferrous sulphate, in clear crystals, 16 Gm.; potassium carbonate, 8 Gm.; sugar, 4 Gm.; tragacanth, in fine powder, 1 Gm.; althæa, in No. 60 powder, 1 Gm.; glycerin, water, each a sufficient quantity to make 100 pills. Rub the potassium carbonate in a mortar, with a sufficient quantity (about 10 drops of each) of glycerin and water, then add the ferrous sulphate and sugar, previously triturated together to a uniform powder, and beat the mass thoroughly until it assumes a greenish color. When the reaction appears to have terminated, incorporate the tragacanth and althæa, and, if necessary, add a little more water, so as to obtain a mass of pilular consistence. Divide this into 100 pills. These pills should be freshly prepared when wanted.—U. S.

For 12 pills use ferrous sulphate crystals, 30 grains (1.920 Gm.); potassium carbonate, 15 grains (0.960 Gm.); sugar, 7½ grains (0.480 Gm.); tragacanth and althæa, of each 2 grains (0.128 Gm.); glycerin and water, of each 1 drop or a sufficient quantity.

Take of exsiccated ferrous sulphate, in fine powder, 150 grains; exsiccated sodium carbonate, in fine powder, 95 grains; acacia, in powder, 50 grains; tragacanth, in powder, 15 grains; syrup, 150 grains; glycerin, 10 grains; distilled water, 20 grains or a sufficient quantity. To the syrup, glycerin, and water, previously mixed, add the ferrous sulphate; mix and add quickly the sodium carbonate; after mixing, set aside until the reaction is complete; then add the acacia and tragacanth and mix thoroughly.—Br.

The formulas of the French and German pharmacopœias are similar to the above. The former directs the mass to be divided into pills weighing about 6 grains (0.40 Gm.), and the latter into pills weighing about 4 grains (0.25 Gm.). The P. G. orders for 9 parts of dried ferrous sulphate, 3 parts of sugar, 7 parts of potassium carbonate, 0.7 part of calcined magnesia, 1.3 parts of finely powdered althæa, and 4 parts of glycerin.

The official Blaud's pill is intended to contain about 1 grain (about 0.0667 Gm.) of ferrous carbonate, but unless protected by some suitable coating will undergo change after a short time, becoming oxidized and turning red. Hence the Pharmacopœia directs that the pills shall be made fresh when wanted.

H. A. B. Dunning (1900) suggested the following formula, which eliminates the tragacanth and althæa, as these have a tendency to make the pills tough and hard: Take of ferrous sulphate, in crystals, 15 Gm., potassium carbonate, 8.75 Gm., sugar, 1.25 Gm., powdered glycyrrhiza, 6.25 Gm. Rub the iron and sugar into fine powder, add the potassium carbonate, previously powdered, and mix with 40 minims of water. Triturate the mixture until dry and in powder, add the glycyrrhiza and sufficient glucose to make a smooth mass, which divide into 100 pills. Pills made by this formula retain their shape and green color for a long time, and while assuming a darker color on the outside, due to gradual drying, the interior remains fairly soft.

Uses.—Commonly known as Blaud's pill, it is largely used as a chalybeate tonic in chlorosis and other chlorotic anæmias. It approximately represents in pill form the Mistura Ferri Composita, or Griffith's Mixture. When prescribed the pills should be freshly prepared in a quantity to last only a few days. If kept on hand for a long time the ferrous carbonate changes to the ferric salt, and the pills become so hard that they do not readily disintegrate in the alimentary canal. The dose is from 1 to 6 pills three or four times a day.

PILULÆ FERRI IODIDI, *U. S.*—Pills of Ferrous Iodide.

Pilules d'iodure ferreuse, Fr. Cod.—*Pilules de Blancard*, Fr.; *Eisenjodürpillen*, G.

Preparation.—Reduced iron, 4 Gm.; iodine, 5 Gm.; glycyrrhiza, in No. 60 powder, 4 Gm.; sugar, in fine powder, 4 Gm.; extract of glycyrrhiza, in fine powder, 1 Gm.; acacia, in fine powder, 1 Gm.; water, balsam of tolu, ether, each a sufficient quantity to make 100 pills. To the reduced iron, contained in a porcelain capsule, add about 6 Cc. of water, and gradually add the iodine, constantly triturating, until the mixture ceases to have a reddish tint. Then add the remaining powders, previously mixed, and evaporate the excess of moisture on the water-bath, constantly stirring, until the mass has acquired a pilular consistence. Lastly, divide it into 100 pills. Dissolve 10 Gm. of balsam of tolu in 15 Cc. of ether; shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring them until the drying is completed. Keep the pills in a well-stoppered bottle. —U. S.

Pills of ferrous iodide should be devoid of the smell of iodine. If a few pills be triturated with water, the filtrate should not assume more than a light blue tint on the addition of starch test-solution (absence of more than traces of free iodine).—U. S.

To make 12 pills use reduced iron, 7¼ grains (0.480 Gm.); iodine, 9¼ grains (0.60 Gm.); glycyrrhiza and sugar, of each 7½ grains (0.480 Gm.); extract of glycyrrhiza and acacia, of each 2 grains (0.128 Gm.).

An excess of iron is ordered in the formula, which is subsequently incorporated in the pill-mass. If the reduced iron were perfectly pure, 1.104 Gm. would be sufficient to combine with 5 Gm. of iodine, yielding 6.104 Gm. of ferrous iodide.

Owing to the heat produced by the reaction the iodine should be cautiously added in small quantities, to avoid loss by vaporization. Due precaution being exercised, the quantity of water directed in this part of the process may even be reduced a little, whereby subsequent evaporation may be avoided or materially lessened; if evaporation be necessary, the ferrous iodide is sufficiently protected by the excess of iron and by sugar, and without the presence of the other vegetable powders, which may be easily incorporated with the syrupy liquid. Owing to the gradual oxidation when exposed to the air, the pill-mass should not be kept on hand, but should be at once made into pills. To protect these against the influence of the air, they are directed to be coated with a thin layer of tolu balsam, or, according to the French Codex, with tolu balsam and mastic, used

in ethereal solution. The latter authority—whose process has, in the main, been adopted by the U. S. P., with several improvements—does not require an excess of iron to be incorporated with the pill-mass, but directs the freshly made pills to be rolled in finely powdered iron, and afterward to be coated as stated, thus affording an additional protection to the surface of the pill.

If properly made and preserved, these pills will keep for years without acquiring the smell of iodine or tarnishing a strip of bright metal suspended in the vial. Should oxidation take place to the extent of liberating iodine, distilled water on being triturated with a few of the pills will yield a filtrate which, on the addition of gelatinized starch, will acquire a more or less distinct green tint, resulting from the brown-yellow color of the extractive matter and the blue color of iodide of starch.

Each pill contains very nearly 1 grain (0.061 Gm.), U. S. P., or about ¾ grain (0.05 Gm.), Fr. Cod., of ferrous iodide.

Uses.—For action and uses, see SYRUPUS FERRI IODIDI. Each pill contains about 1 grain (0.06 Gm.) of ferrous iodide. Dose, 2 to 10 pills.

PILULA GALBANI COMPOSITA, *Br.*—Compound Pill of Galbanum.

Compound pill of asafetida, E.; *Pilules de galbanum composées*, Fr.; *Galbanumpillenmasse*, G.

Preparation.—Take of asafetida, galbanum, myrrh, of each 2 ounces; syrup of glucose, 1 ounce or a sufficient quantity. Heat all together on a water-bath, and stir the mass until it assumes a uniform consistence.—Br.

A similar pill was formerly official in France as *Pilules antihystériques*.

Uses.—This pill is rarely employed. It may be of value in functional nervous disorders as a sedative, in the dose of from 5 to 20 grains (0.30–1.30 Gm.).

PILULA HYDRARGYRI SUBCHLORIDI COMPOSITA, *Br.*—Compound Pill of Mercurous Chloride.

Pilulæ Antimonii Compositæ, U. S. 1890; *Pilulæ Calomelanos Compositæ.—Compound pills of antimony, Compound calomel pills, Plummer's pills*, E.; *Pilules altérantes composées, P. antidartreuses, P. de Plummer*, Fr.; *Zusammengesetzte Calomelpillen, Plummersche Pillen*, G.

Preparation.—Take of mercurous chloride, sulphurated antimony, of each 1 ounce; guaiacum resin, in powder, 2 ounces; castor oil, 180 grains; alcohol, 1 fluidrachm or a sufficient quantity. Mix to form a mass.—Br.

The U. S. P. 1890 directed sulphurated antimony, 4 Gm., mild mercurous chloride, 4 Gm., and guaiac, in fine powder, 8 Gm., to be made into a mass with castor oil, added drop by drop, the mass then to be divided into 100 pills.

Uses.—This pill has been used with some success in the treatment of chronic rheumatism and skin eruptions, especially those due to syphilis. The dose is from 3 to 10 grains (0.20–0.60 Gm.), or 1 to 3 pills.

PILULA IPECACUANHÆ CUM SCILLA, *Br.*—Pill of Ipecacuanha and Squill.

Pilules d'ipécacuanha et de scille, Fr.; *Brechwurzel-Meerzwiebelpillen*, G.

Preparation.—Take of compound powder of ipecacuanha, 3 ounces; squill, in powder, ammoniacum, in powder, each 1 ounce; treacle, a sufficiency. Mix the powders, and beat into a mass with the treacle.—Br.

Uses.—This pill exercises an expectorant effect in chronic bronchitis, especially when it occurs in the aged. Dose, 5 to 10 grains (0.30–0.60 Gm.).

PILULÆ JALAPÆ, *P. G.*—Pills of Jalap.

Pilules de jalap, Fr.; *Jalapenpillen*, G.

Preparation.—Resin of jalap, in fine powder, and soap, in fine powder, of each 1.5 parts; jalap, in fine powder, 1 part. Mix thoroughly and add alcohol sufficient to make a firm mass, which is to be divided into pills weighing 0.1 Gm. each.—P. G.

Uses.—The dose is from 1 to 5 pills. (See JALAPA.)

PILULÆ LAXATIVÆ COMPOSITÆ, *U. S.*—Compound Laxative Pills.

Pilulæ Aloini, Belladonnæ et Strychninæ Compositæ.—Compound Pills of aloin, belladonna, and strychnine, E.; *Pilules laxatives composées,* Fr.; *Zusammengesetzte Laxirpillen,* G.

Preparation.—Aloin, 1.3 Gm.; strychnine, 0.05 Gm.; extract of belladonna leaves, 0.8 Gm.; ipecac, in fine powder, 0.40 Gm.; glycyrrhiza, in fine powder, 4.6 Gm.; syrup, a sufficient quantity to make 100 pills. Triturate the aloin, strychnine, ipecac, and glycyrrhiza together thoroughly, so as to produce a uniform powder. Incorporate with this the extract of belladonna leaves and sufficient syrup to form a mass, and divide it into 100 pills.—U. S.

Action and Uses.—These pills, although favorably known to physicians for many years, appear for the first time in the Pharmacopœia. In order to insure perfect blending of the ingredients, the strychnine and ipecac should be mixed first, then the aloin added in divided portions, and finally, the glycyrrhiza, also in divided portions, triturating well after each addition. If powdered extract of belladonna leaves be used, this may be added to the mixture of strychnine and ipecac before the aloin. Each pill contains about $\frac{1}{3}$ grain (0.012 Gm.) of aloin; about $\frac{1}{13}$ grain (0.0005 Gm.) of strychnine; about $\frac{1}{8}$ grain (0.008 Gm.) of extract of belladonna leaves; about $\frac{1}{16}$ grain (0.004 Gm.) of ipecac; about $\frac{3}{4}$ grain (0.045 Gm.) of glycyrrhiza.

PILULÆ OPII, *U. S.*—Pills of Opium.

Pilules d'opium, Fr.; *Opiumpillen,* G.

Preparation.—Powdered opium, 6.50 Gm.; soap, in fine powder, 2 Gm.; to make 100 pills. Beat them together with water, so as to form a mass, and divide it into 100 pills.—U. S. For 12 pills use powdered opium, 12 grains (0.80 Gm.), and soap, 3 grains (0.20 Gm.).

Uses.—The dose is from 1 to 2 pills. (See Opium.)

PILULÆ PHOSPHORI, *U. S.*—Phosphorus Pills.

Pilula Phosphori—Phosphorus Pill, Br.—*Pilules au phosphore, Pilules phosphorées,* Fr.; *Phosphorpillen,* G.

Preparation.—Phosphorus, 0.06 Gm.; althæa, in No. 60 powder, 6 Gm.; acacia, in fine powder, 3 Gm; chloroform, glycerin, water, balsam of tolu, ether, each a sufficient quantity to make 100 pills. Dissolve the phosphorus, in a test-tube, in 5 Cc. of chloroform, with the aid of a very gentle heat, replacing from time to time any of the chloroform which may be lost by evaporation. Mix the althæa and acacia in a mortar, next add the solution of phosphorus, then immediately afterward a sufficient quantity (about 4 Cc.) of a mixture of 2 volumes of glycerin and 1 volume of water, and quickly form a mass, to be divided into 100 pills. Dissolve 10 Gm. of balsam of Tolu in 15 Cc. of ether, shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally rolling them about until the drying is completed. Keep the pills in a well-stoppered bottle.—U. S.

Take of phosphorus, 10 grains; white beeswax, melted, and lard, melted, of each 125 grains; kaolin, 115 grains; carbon disulphide, 33 minims or a sufficient quantity. Place the melted wax and lard in a slightly warmed mortar, and stir until the mixture has the consistence of cream. Dissolve the phosphorus in the carbon disulphide and carefully mix the solution with the melted fats, after which add the kaolin and mix well together. Keep the mixture immersed in cold water in a bottle from which the light is excluded. When dispensed, every 3 grains of the mixture is to be incorporated with 1 grain of acacia, in powder, and the resulting pill is to be varnished.—Br.

Phosphorus requires to be kept under water and to be weighed out under a liquid in which it is not oxidized, either water or chloroform. By melting a small quantity of phosphorus under warm water contained in a vial, and then agitating it well until the phosphorus has solidified, this is obtained in small granules, which are conveniently handled, and after having been rapidly dried with filtering-paper, are at once dropped into the previously tared liquid until the desired quantity has been obtained.

Tolu as a vehicle for phosphorus in pills was proposed by A. C. Abraham (1874), who observed that it will retain 4 per cent. of the latter if combined with it in the melted condition. A. W. Gerrard (1873) had previously made a similar observation with regard to resin, and this preparation became known at the time as *phosphoretted*

resin; it is prepared by melting the resin in a wide-mouthed vial, adding the requisite quantity of phosphorus, and, when it has melted, agitating the stoppered vial until the phosphorus is dissolved. Like resin, it may be powdered, and, like the pill-mass of the British Pharmacopœia, it should be kept under water to prevent oxidation.

Since phosphorus is rapidly oxidized, particularly in a state of fine division, pills of phosphorus should be coated as soon after they have been made as possible; as in the case of pills of ferrous iodide, the alcoholic solution of mastic and balsam of Tolu is preferable to the official ethereal solution.

Uses.—Each pill contains $\frac{1}{100}$ grain (0.0006 Gm.) of phosphorus. The dose is from 1 to 2 pills. (See PHOSPHORUS.)

PILULA PLUMBI CUM OPIO, *Br.*—Pill of Lead and Opium.

Pilules d'acetate de plomb et d'opium, Fr.; *Bleiacetat-Opiumpillenmasse,* G.

Preparation.—Take of lead acetate, in fine powder, 36 grains; opium, in powder, 6 grains; syrup of glucose, 4 grains or a sufficient quantity. Mix to form a mass.—Br.

Uses.—It is unnecessary to have these drugs combined in a fixed formula. The proportions to be employed had better be left to the discretion of the prescriber in each case. The combination is of value in dysentery and diarrhœa, particularly of a chronic character. It should always be preceded by a saline or castor oil purge if used in acute diarrhœa when there is much mucus in the stools. Each 3 grains contain $2\frac{1}{4}$ grains (0.115 Gm.) of lead acetate and $\frac{3}{8}$ grain (0.024 Gm.) of powdered opium. The dose is from 3 to 5 grains (0.20–0.30 Gm.).

PILULÆ PODOPHYLLI, BELLADONNÆ ET CAPSICI, *U. S.*—Pills of Podophyllum, Belladonna, and Capsicum.

Pilules de podophyllum, de belladonne et de poivre de Guinée, Fr.; *Podophyllin-, Belladonna und Spanisch-Pfefferpillen,* G.

Preparation.—Resin of podophyllum, 1.6 Gm.; extract of belladonna leaves, 0.8 Gm.; capsicum, 3.2 Gm.; sugar of milk, 6.5 Gm.; acacia, in fine powder, 1.6 Gm.; syrup, glycerin, of each a sufficient quantity to make 100 pills. Triturate the resin of podophyllum, capsicum, sugar of milk, and acacia together to produce a uniform powder. Incorporate with this the extract of belladonna leaves and sufficient syrup and glycerin (equal parts) to form a mass, and divide it into 100 pills.—U. S.

For 12 pills use resin of podoyhyllum, 3 grains (0.195 Gm.); extract of belladonna leaves, $1\frac{1}{2}$ grains (0.098 Gm.); capsicum, 6 grains (0.390 Gm.); acacia, 3 grains (0.195 Gm.), and sugar of milk, 12 grains (0.78 Gm.).

This pill is one of the new additions to the Pharmacopœia, although the formula has been known to the medical profession for many years. It is sometimes designated as Squibb's podophyllum pill, because the combination was first suggested by the late Dr. E. R. Squibb.

Uses.—This is a useful pill in cases of constipation with hepatic torpor and gastro-intestinal atony. Dose, 1 to 3 pills.

PILULA QUININÆ SULPHATIS, *Br.*—Pill of Quinine Sulphate.

Pilule de quinine sulfate, Fr.; *Chininpillenmasse,* G.

Preparation.—Quinine sulphate, 30 grains; tartaric acid, 1 grain; tragacanth, in powder, 1 grain; glycerin, 4 grains. Triturate the quinine sulphate with the acid; add to the tragacanth and glycerin previously mixed, and form a mass.—Br.

Uses.—The dose is from 2 to 30 grains (0.10–2 Gm.). (See QUININÆ SULPHAS.)

PILULÆ RHEI COMPOSITÆ, *U. S., Br.*—Compound Pills of Rhubarb.

Compound rhubarb pill, E.; *Pilules de rhubarbe composées,* Fr.; *Rhabarber und Aloepillen,* G.

Preparation.—Rhubarb, in No. 60 powder, 13 Gm.; purified aloes, in fine powder, 10 Gm.; myrrh, in fine powder, 6 Gm.; oil of peppermint, 0.5 Cc.; to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—U. S.

For 12 pills use rhubarb, 24 grains (1.56 Gm.); aloes, 18 grains (1.20 Gm.); myrrh, 12 grains (0.78 Gm.); oil of peppermint, about 2 drops.

Take of rhubarb-root, in powder, 3 ounces; socotrine aloes, in powder, 2¼ ounces; myrrh, in powder, hard soap, in powder, each 1½ ounces; oil of peppermint, 1½ fluidrachms; syrup of glucose, 2¾ ounces or a sufficient quantity. Mix the powders with the oil, then add the syrup, and beat the whole into a uniform mass.—Br.

Uses.—These pills are used in chronic constipation with flatulence. Dose, 1 to 4 pills.

PILULA SAPONIS COMPOSITA, *Br.*—Compound Pill of Soap.

Pilules de savon composées, Fr.; *Seifenpillenmasse*, G.

Preparation.—Take of opium, in powder, ½ ounce; hard soap, in powder, 1½ ounces; syrup of glucose, ½ ounce. Mix to form a mass.—Br.

Uses.—Each 5 grains (0.30 Gm.) of this mass contains 1 grain (0.05 Gm.) of opium. It presents the advantage of affording a disguise under which to prescribe opium. The dose is from 3 to 10 grains (0.20–0.60 Gm.).

PILULA SCAMMONII COMPOSITA, *Br.*—Compound Scammony Pill.

Pilules de scammonée composées, Fr.; *Scammoniumpillenmasse*, G.

Preparation.—Take of scammony resin, jalap resin, curd soap, in powder, each 1 ounce; tincture of ginger, 3 fluidounces. Add the tinctures to the soap and resins, and dissolve with the aid of a gentle heat; evaporate on a water-bath until the mass has acquired a suitable consistence for forming pills.—Br.

The process adopted furnishes a very good pill-mass, in which the resins are uniformly divided through the agency of the soap, which also keeps them in suspension when the mass is macerated with water.

Uses.—This mass is a drastic purge, given in the dose of from 3 to 5 grains (0.20–0.30 Gm.).

PILULA SCILLÆ COMPOSITA, *Br.*—Compound Squill Pill.

Pilules de scille composées, Fr.; *Meerzwiebelpillenmasse*, G.

Preparation.—Take of squill, in powder, 1¼ ounces; ginger, in powder, ammoniac, in powder, hard soap, in powder, each 1 ounce; syrup of glucose, 1 ounce or a sufficiency. Mix to form a mass.—Br.

Uses.—In the dose of from 5 to 10 grains (0.30–0.60 Gm.) this pill is a useful stimulating expectorant in chronic bronchitis. (See SCILLA.)

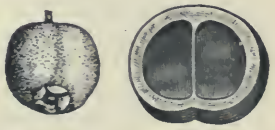
PIMENTA, *U. S., Br.*—Pimenta; Allspice.

Semen amomi, Piper jamaicense.—Pimento, E.; *Nelkenpfeffer, Englisches Gewürz, Neugewürz*, G.; *Pimenta de la Jamaique, Toute-épice*, Fr.; *Pimienta gorda, Malaguecta*, Sp.; *Pimenta de Jamaica*, Port.

The dried, nearly ripe fruit of *Pimenta Pimenta* (L.) Lyons (*Myrtus P.* L.; *Eugenia P.* DC.; *Pimentus P.* Griseb.; *Pimenta officinalis* Lindl.; *P. vulgaris* W. et A.—Fam. *Myrtaceæ*).

Allspice is official in most pharmacopœias, though only the Portuguese employs the correct specific name, and this does so in connection with the incorrect generic name *Eugenia*. The Allspice tree is a native of the West Indies and other parts of tropical America, being especially abundant in Jamaica, where it constitutes the principal forest-tree over large areas. As it grows in Mexico and other parts, it varies considerably, so that questions arise as to whether such forms are not distinct species. In the case of the Mexican form, which has been classed as a distinct species, *P. Tobasco* (W.), *Myrtus T.* W., this question becomes of practical importance, since that tree yields a commercial allspice, "Pimienta de Tobasco," which has been variously classed as a variety and as an adulterant of Allspice. The Allspice tree is cultivated in various tropical countries. In Jamaica, such cultivation consists usually, or has

FIG. 318.



Allspice (× 2): transverse section (Nat.).

done so, in merely clearing out other trees from the forests and allowing the Allspice trees to occupy the ground. The tree begins to fruit when three years old and is in full bearing after four years more. If the fruit is allowed to ripen, it loses almost the whole of its aromatic properties, becoming fleshy, sweet, and of a purple-black color. It is, therefore, collected while yet green, and dried, either by exposure to the sun or in ovens ("Kiln-dried Allspice"). The former method produces the best article, but is tedious and somewhat hazardous, requiring about 12 days, during which the fruit must be carefully guarded against moisture, being housed at night and during rainy and damp weather. The fruit is essentially a 2-celled and 2-seeded drupe.

Description.—About 6 Mm. ($\frac{1}{4}$ In.) in diameter, depressed-globose, slightly flattened, each of the flattened sides bearing an obscure groove, the saucer-shaped and 4-lobed calyx limb and the style, or their remnants, at the summit; dark brown, strongly granular; brittle, 2-celled, and 2-seeded; strongly and peculiarly aromatic in odor and taste.

Allspice is little subject to adulteration in the entire condition. Years ago, when it was scarce and high, the fruit of the common spice bush, *Benzoin Benzoin* (L.) Coulter, was used for this purpose. The ground article, for household consumption as a spice, is, of course, subject to the same low and gross forms of adulteration as other similar substances.

Constituents.—The important constituent of Allspice is its 2 to 4 per cent. of volatile oil (see OLEUM PIMENTÆ), mostly in the pericarp, together with resin, tannin, fat (chiefly in the seed), sugar, mucilage, etc. The ash should amount to little more than 4 per cent.

Pharmaceutical Preparation.—PIMENTO WATER, Br.

Action and Uses.—Pimenta, like other drugs containing aromatic volatile oils, is used as a carminative, a flavoring agent, a stimulant to digestion, and to prevent the griping of purgative medicines. It is one of the ingredients of spice plaster. The dose of the official oil, which is generally employed, is from 2 to 5 minims (0.10–0.30 Cc.), and that of the powdered drug 10 to 40 grains (0.60–2.60 Gm.).

Other Species.—The genus *Pimenta* is credited with 5 species, though the number is somewhat uncertain. They are all more or less aromatic.

In the East Indies the fruits of a related plant, *Eugenia acris* W. et A., are similarly employed. They are more pungent than Allspice, having more of the flavor of Jamaica Bay Leaves and fruit.

PINUS STROBUS.—White Pine.

The inner bark of *Pinus Strobus* L. (Fam. *Pinaceæ*).

This species, the *Northern, Weymouth,* or *Deal Pine,* is a very large and handsome tree of eastern and central North America, formerly so abundant as to supply one of our cheapest, as well as one of our best, soft-wood timbers, now becoming scarce.

Description.—In flat pieces of irregular size and from 1 to 3 Mm. ($\frac{1}{25}$ to $\frac{1}{8}$ In.) thick, the outer surface varying from pale brown to a rather deep yellow brown, when fresh having a pale-pinkish tinge, occasionally bearing small patches of the gray-brown corky layer, fuzzy with partly detached fine bast-fibers, often exhibiting scattered small pits; inner surface either lighter or darker than the outer, nearly smooth, finely striate; fracture very tough-fibrous; transverse section pale yellow in the outer, whitish in the inner layer; odor faintly terebinthinate; taste mucilaginous, sweetish, bitterish, and astringent.

Constituents. The constituents of white pine bark are not well known. Bastin and Trimble found about 9 per cent. of tannin in the stem-bark, about 11 per cent. in the root-bark. The stem-bark yielded to absolute alcohol only 30 per cent. of its weight, and this yielded a little less than a third of its weight to water. The bark also contains gum, resin, and a little of the peculiar body coniferin ($C_{16}H_{22}O_8.H_2O$), which occurs in fine lustrous needles, melting at 185° C. (365 F.), soluble in hot water, and yielding vanillin upon oxidation. It exists in greater quantity in the cambium-layer left attached to the wood, and appears to be widely distributed in the cambium of different genera and species of this family.

Pharmaceutical Preparation.—COMPOUND SYRUP OF WHITE PINE, N. F.

Action and Uses.—Pinus strobus is used as an expectorant, but has little power. It is one of the ingredients of the compound syrup of white pine (N. F.), which is given in the dose of from 1 to 4 drachms (4–16 Cc.).

Pinaceæ.—CONIFERÆ (*The Pine Family*).—The *Cone-bearers*, nearly all of them evergreens, comprise one of the most interesting, as well as one of the most important, families of plants. The principal family of Gymnosperms, they constitute the great connecting link between the flowerless and the flowering plants, and are thus of the greatest botanical interest. The living members of the family are doubtless far fewer, and their natural importance certainly far less, than those which are extinct. The group is, in fact, in the process of suffering extinction, and the careless procedures of mankind concerning them are greatly expediting this *finale*. In economic importance, the timber-product of the family stands first. It contributes most, and the best, of the soft-wood timbers, and there are no others in existence which can compare with them. Paper-pulp is produced in vast quantities from the spruces. Tanning materials, especially hemlock bark, are of great importance. The corky portion of the bark of the Oregon Spruce (*Pseudotsuga Douglasii* Carr.) has been proposed as a substitute for ordinary corks, but is very inferior. Some of the seeds supply highly important foods, especially those of *Araucaria imbricata* Pavon, of Chile; *Pinus Cembra* L., the *Siberian stone-pine* or *cedar* of Europe and northern Asia, yielding the *Zibel Pine-nuts*; *P. pinea* L., of southern Europe, yielding the Italian *Pignone* or *Pinnochi*; *P. edulis* Englm., of the southwestern United States and southward, yielding the *Mexican Pinyon*; *P. cembroides* Zucc. yielding the *Stone-seed pinyon*; *P. Sabiniana* Dougl., the famous *Digger* or *Nut pine*, etc. This family supplies nearly all our turpentine, and by far the largest part of our tar and pitch, apart from that obtained from coal.

From a medicinal standpoint, the general nature of the constituents and products and their properties are elsewhere pretty fully discussed, in connection with JUNIPERUS, TEREBINTHINA, THUJA, PIX BURGUNDICA, PIX LIQUIDA, OLEUM CADINUM, SABINA, RESINA, SANDARACA, etc. Most important of the constituents are the volatile oils, of which oil of turpentine may be regarded as the type. Besides those oils which occur as exudations, a somewhat different class are distilled from the fresh twigs of various species. These will be referred to under OLEA VOLATILIA. Next in importance to the oils is the tannin, which often exists in considerable amount, and which appears to vary inversely in amount, in different seasons and under different conditions, with that of the volatile oil, which thus appears to be a product of the destruction of the former. Glucosides are numerous and widely distributed, though for the most part devoid of important special properties.

Alkaloids are rare in this family, but at least one of them is very poisonous.

The following secondary drugs of the family are worthy of brief notice:

Laricis cortex or *Larch bark* (*Lärchenrinde*, G.; *Écorce de mélèze*, Fr.; *Corteza de alerce*, Sp.) is the bark, deprived of its rough outer layer, of *Larix Larix* (L.) Karsten (*Pinus L.*—L.; *Larix Europœa* DC.; *L. decidua* Mill.; *Abies Larix* Lam.). The European larch is a good-sized tree, occurring in somewhat elevated forests in southern and central Europe, and is well known as a decorative tree in the United States. It is notable for its yield of *Venice turpentine*, and from its sugary exudation known as *Briançon manna*. The bark of the trunk and larger branches is collected in the spring, after the outer corky layer has been shaved off, and dried. The older bark then occurs in flattened or slightly curved pieces, the outer surface varying from a light to a dark red, the inner surface pinkish red. The younger bark is in more or less quilled pieces, is pinkish white on the outer and yellowish white on the inner surface. The fracture is short, but somewhat fibrous, and, excepting the inner layer, is of a carmine red. The transverse section displays rather indistinct medullary rays and some resin-ducts. The odor is somewhat balsamic and terebinthinate, and the taste astringent and somewhat bitter. Larch bark contains a little volatile oil, but principally tannin and resin, together with *laricinic acid* ($C_{10}H_{10}O_5$), the latter mostly in the younger bark. This is volatile and forms long, colorless crystals like those of benzoic acid, subliming at 93° C. (199.4° F.), melting at 150° C. (302° F.), sparingly soluble in ether and freely so in alcohol and hot water, and have a camphoraceous odor and a bitterish and astringent taste. Baryta solution causes a bulky precipitate; nitric acid oxidizes it to oxalic acid; baric salts produce a purple color, and on boiling it with silver salts the metal is separated. It is allied to pyrogallol and pyrocatechin. In the form of an extract and tincture made from the inner bark, Larix is employed in chronic bronchitis with profuse expectoration, in chronic inflammation of the urinary passages, and in purpura hæmorrhagica, hemoptysis, and other hemorrhagic affections. The dose of the tincture is from 30 to 60 minims (2–4 Cc.); of the extract, from 3 to 5 grains (0.2–0.30 Gm.).

Hemlock bark is the bark of *Tsuga Canadensis* (L.) Carr. (*Pinus C.*—L.; *Abies C.*—Mx.), the *Hemlock*, *Hemlock* or *Weeping spruce*, or *Spruce pine*, native of eastern North America, and a large tree. This bark is one of the important tanning products of America. It is inferior to oak bark. For tanning purposes, the entire bark is usually marketed, but in pharmacy the rough outer layer is usually removed, as in case of larch bark. In its general appearance it resembles the latter, but the red of the outer surface is more strongly tinged with yellow or brown, and the inner surface is yellowish white. The fracture is rather more fibrous, and the transverse section is mottled, brownish, and whitish. The odor is slight, the taste strongly astringent. Ordinarily the bark contains very little resin or volatile oil, but

is very rich in tannin, for which it is used as an astringent. Its aqueous extract is an important article of commerce, mostly for tanning, but also for medicinal purposes.

Under natural processes of decay, or as a result of injury to this tree, an oleoresin is freely secreted which is the basis of the PIX CANADENSIS, elsewhere considered. From the twigs of this tree is distilled *Oil of Spruce* or *Hemlock*. Westward this species is replaced by *T. Mertensiana* (Boug.) Carr., the *Western hemlock* or *Patton's spruce*, which is similar in habit, constituents, and uses.

False Balm of Gilead Buds are obtained from *Abies balsamea* (L.) Mill. (*Pinus b.* L.), the Balsam Fir, etc., of Canada and eastern United States. From the twigs of the related species *A. Abies* (L.) Rusby (*Pinus A.*—L.; *P. excelsa* Lam.; *P. Picea* Du Roi) Tanret has separated the glucoside *picein* ($C_{14}H_{18}O_7.H_2O$), which occurs in bitter, silky needles, soluble in water and alcohol, less in ether, and yielding *piceol* on decomposition. It is very likely that the same glucoside occurs in False Balm of Gilead Buds, which are highly aromatic, resinous, bitter, and somewhat astringent.

Cedar apples are the insect galls occurring in the twigs of *Juniperus Virginiana* L. Besides their astringent properties, they are very bitter and are sometimes used in domestic practice as an anthelmintic.

Taxus, or *Yew*, is the leaves of various species of *Taxus*, especially of *T. baccata* L., the *European yew*, *Snottle berry*, *Shin-wood*, or *Globe berry* (*Eibe*, G.; *If commun*, Fr.; *Tejo*, Sp.) of Asia and Europe and extending southward into northern Africa.

Similar properties doubtless pertain to the east American species *T. minor* (Mx.) Britton (*T. baccata minor* Mx.; *T. Canadensis* W.), and to the West American species, the *Oregon yew*, *T. brevifolia* Nutt. The European species, though usually a shrub, sometimes becomes a small tree. That of eastern North America is a stout, prostrate shrub, the branches rooting rather freely. The nearly sessile leaves are crowded in 2 ranks and are about 2.5 Cm. (1 In.) long, linear, pointed, entire, flat, slightly curved, deep green and shining above, pale underneath. It produces globose-ovoid, scarlet-red, wax-like fruits, the fleshy part cup-shaped and open at the top, containing a single large blackish-brown seed, and subtended by several small scales. The leaves are aromatic, terebinthinate, and, like the seed, disagreeably bitter, afterward acrid. The pulp of the fruit is sweetish and not unpleasant, hence has been responsible for various poisoning accidents. Both the leaves and the fruit have been employed to some extent in medicine, but are now scarcely ever used. Besides volatile oil and tannin, the leaves, as well as the seeds and bark, contain the alkaloid *taxine*, which is the poisonous constituent. It occurs in crystals, which melt at 80° C. (176° F.), are soluble in alcohol, ether, and chloroform, slightly in water, insoluble in petroleum-ether, colored purplish red by sulphuric acid, but dissolving without color in other acids. Other nitrogenous constituents have been reported, but their nature is very doubtful.

PIPER, *U. S.*—Black Pepper.

Piper nigrum, Br.; *Poivre noir*, Fr. Cod.; *Schwarzer Pfeffer*, G.; *Pimienta negra*, Sp.; *Pimenta negra*, Port.

The dried unripe fruit of *Piper nigrum* L. (*P. trioicum* Roxb.—Fam. *Piperaceæ*).

Black pepper is official in a number of pharmacopœias, including the British, but not the German.

Origin.—The pepper plant is a woody, evergreen, dicœcious climber, obtaining support from living trees by means of great numbers of small roots. It has been cultivated in the East Indies from prehistoric times, and its nativity was unknown until its identity with a wild plant of India, previously known as a distinct species and called *P. trioicum*, was recognized. Propagation is effected by means of cutting or layering, and the young plants are set out at the roots of trees, specially planted for the purpose or left standing when the land is cleared. This tree is almost invariably the Betel, thus affording two crops from the same land. Fruiting commences in from 3 to 5 years and continues for about 20 years. The habit of leaf, flower, and fruit are indicated in the accompanying illustration. The fruit is at first green, then red, and finally yellowish. If left until it becomes ripe, not only is loss occasioned through its being eaten by birds or falling to the ground, but its quality is greatly impaired. It is therefore gathered when full grown and changing to a red color. It is either dried at once or after a slight boiling.

Several grades of pepper are recognized, in accordance with the relative weight of the grains. That of Penang and Malabar is denominated "heavy," that of India "light," while that of intermediate quality is denominated "half heavy." That of the Straits Settlement, which is at the same time the principal product, is most highly esteemed.

Description.—About 4 Mm. ($\frac{1}{6}$ In.) in diameter, nearly globular, blackish, very strongly reticulate-wrinkled, bearing a low style-base at the summit and consisting of a thin fleshy pericarp and a crustaceous, whitish putamen containing a more or less undeveloped seed; odor characteristic, strong; taste strongly aromatic and pungent.

The outer zone (epicarp) and the middle zone (sarcocarp) are dark colored. Except for the innermost or vascular layer of the sarcocarp, these zones are practically devoid of starch. The vascular layer of the sarcocarp contains some starch. The inner zone of the pericarp (putamen or stone) is light colored. Its outermost layer consists essentially of peculiar stone-cells. The remainder of it is mostly starch-bearing tissue. The seed is also light colored, and contains a great quantity of starch.

The powder is characterized by the great abundance of stone-cells, in masses, and extremely small (0.0005 to 0.005 Mm.), angular, simple and compound starch-grains with nearly central hilum, as well as by the specific constituents of the drug. The stone-cells are large, angular, and highly irregular in form. The parenchymatic tissue varies from yellowish to brown.

FIG. 319.

Piper nigrum L.

Constituents.—The most important constituent of pepper, medicinally, is *piperine* or *piperina*, which, with its derivatives, *piperidine* and *piperic acid*, is separately considered under that title. It exists in nearly all parts of the fruit, though less in the outer zone, and is chiefly (perhaps wholly) responsible for the pungency. The amount of piperine ranges usually from 4.5 to 5.5 per cent., though occasionally as much as 8 per cent. has been reported. A variable amount of pungent resin is present, which is soluble in alcohol, ether, and alkalies. The nature of this resin is not very well known. It is at least possible that its pungency is due to the specific constituents piperine and piperidine carried in it. Black Pepper contains about 2 per cent. of a volatile oil (*Oleum Piperis, Pfefferoel, Essence de poivre*), which imparts the odor but not the pungency. This oil ranges from nearly colorless to yellow or greenish, has a specific gravity of from 0.87 to 0.90, and is soluble in 15 parts of alcohol. It contains dipentene, phellandrene, and a peculiar terpene. Piperine and piperic acid exist free in small quantity. Tannin is wanting. The starch amounts to from 30 to 40 per cent. The ash ranges from 4.5 to 6.5 per cent., and its ordinary legal limit is 6.5 per cent. The older and riper the Pepper. or the greater the amount of outer portion present in it, the larger is the ash percentage.

Adulteration.—Adulteration of Black Pepper in the entire condition is little practised, except by the inclusion of the stalks, chaff, and siftings (see *Allied Products*).

Ground Black Pepper is very heavily and commonly adulterated. It should consist of the entire fruit, ground without change, but the practice largely prevails of grinding with it the outer layers (Pepper shells) removed from other lots for the making of White Pepper. These pepper shells are removed in different layers, preserved separately ("first grinding," "second grinding," etc.), the outermost being successively poorer. By the lighter process the inner or vascular layer of the sarcocarp remains attached to the putamen. Such shells, therefore, contain very little or no starch, but yield a much higher percentage of ash, up to 12 or 13 per cent. or more. From the above, it follows that pepper to which pepper shells have been added, will be darker in color, richer in ash, poorer in starch, and less active. To obviate most of these changes, foreign starch or starchy substances are then often added. This foreign starch can be at once recognized by microscopical examination, owing to the striking peculiarities of Pepper starch. The starches most commonly employed are those of the yam or sweet potato, though rice and damaged flour are not uncommonly used. All these starches are described and figured in the article on AMYLUM. The addition of these foreign starches to pepper shells in sufficient quantity to equal the normal amount can usually be detected by a change in the general appearance of the mass. They impart a lighter color to it than the presence of the same amount of the natural starch and at the same time a dull and

fluffy aspect to its surface. Sand is a very common addition, at once detected upon incineration, and especially upon an examination of the character of the ash. Sand can also be detected by the microscope, though many of the stone-cell masses somewhat resemble yellowish sand particles upon careless examination. Olive-stones are occasionally ground up with pepper. They add a large amount of vascular tissue to the powder. Their stone-cells are mostly lanceolate or lance-ovate and are distinguished by a very slender, straight central lumen, with short straight branches alternating at right angles and at regular distances upon its two sides. There is no coloring-matter within the cells, whereas such coloring-matter exists in the stone-cells of pepper. Aniline acetate gives to the coloring-matter of olive-stones a yellow-brown color, thalline an orange, and naphthylamine a yellowish orange. Numerous other substances are similarly used, such as the shells of walnuts, almonds, and cocoanuts. The last named are largely used, either raw or roasted, for this purpose.

Pharmaceutical Preparations.—Confection of Pepper, Br.; Oleoresin of Pepper, U. S. P.

Action and Uses.—Pepper is a powerful local and general stimulant. It has a burning taste, due to the resin, and in large quantity may cause distinct irritation of the mouth and throat. Internally it produces a sensation of warmth in the abdomen, increases the flow of gastric and intestinal secretions, and reduces flatulence. It may be used in all cases of atony of the mucous membrane of the genito-urinary system, but is contraindicated if any acute inflammation exists, as in acute gonorrhœa. Locally it causes distinct pain and redness of the skin. From the most remote times it has been used as a condiment. At different periods of the past pepper and its principle, piperin, were esteemed in the treatment of intermittent fevers, but in the light of our present knowledge of the cause of this disease, the use of the drug as a cure has been abandoned. However, it is employed in malaria, along with cinchona or its alkaloids, to increase their absorption and efficacy. In the form of a poultice or plaster it relieves headache, colic, muscular rheumatism, and other local pains. The dose of pepper is from 5 to 20 grains (0.30–1.30 Gm.), best given in powder on food or in capsule.

Allied Products.—Pepper-stalks or stems consist of the rachis or stem to which the pepper fruits grow attached. Their presence in the powder is indicated by a great abundance of fibro-vascular tissue. Widmayer has pointed out that the epidermis of these stems exhibits little conical depressions, in each of which there is contained a black, top-shaped mass, excreted through a pore at the point of the cavity. Pepper-chaff consists of light membranaceous matter, largely leaf-fragments, separated by winnowing. Pepper siftings or screenings consist in part of stalks, with various foreign substances, but principally of small, hollow, undeveloped light fruits which are much sunken and dented instead of being merely wrinkled. They are often called, commercially, "pin-heads." Their presence in the powder produces results very similar to those of pepper-shells.

Piper album or *White pepper* is produced in several ways. The Singapore variety consists of young fruit dried without change except that it is often bleached by the use of chlorine or in other ways. These fruits have about half the diameter of black pepper, bear a slight protuberance at the top, are grayish or slightly greenish white, little wrinkled, and slightly shining. Native or "commercial" White Pepper is made by allowing the fruit to get as nearly ripe as possible before collecting, and then, by abrasion before drying, removing the sarcocarp down to the vascular layer, the fruit usually being slightly boiled first to facilitate the process. The third or "machine" form of White Pepper has already been referred to as being made by grinding off the sarcocarp from commercial Black Pepper. It is readily distinguished from the second variety by the irregularly abraded or broken appearance of its outer surface, instead of the roughish-veiny appearance of the native product. The character of ground White Pepper can be readily inferred from what has preceded. Its appearance can be stated as being in all respects the direct opposite of that of ground pepper-shells. The composition of White Pepper will naturally vary according to the method of its production. Native White Pepper, being deprived of its outer portions only, will be very rich in both starch and piperine, with a diminished ash-percentage, ordinarily about 4.5 per cent. The third variety named will be very similar, provided only the outer layers have been ground away. If, however, the process has been carried to the point of grinding down to the putamen, the percentage of piperine will be somewhat less than in the Black Pepper, with an increase in that of the starch. The conflicting statements in works of reference regarding the percentage of piperine in White Pepper doubtless result from the examination of the different varieties here referred to. Vascular tissue will be very slight in amount in the machine variety.

Long Pepper, Piper Longum, or *Elephant Pepper, Piovre long* (Fr.), *Pimienta larga* (Sp.). is the immature and partly grown fruit, still upon the rachis, of *Chavica officinarum* Miq.

(*Piper o.* DC.; *P. Chava* Hunter) or of *C. longum* (L.) Miq. (*Piper l.* L.; *C. Roxburghii* Miq.). Both are produced by shrubs, the first named being native of Java and its product known as Java or Dutch Long Pepper, the second of India and known as Indian or Bengal Long Pepper. Long Pepper is 2.5 to 3.8 Cm. (1 to 1½ In.) long and 3 to 6 Mm. (⅛ to ¼ In.) thick, cylindraceous, very slightly tapering, blunt, borne on a very short and thick stem, and consisting of densely spirally arranged and partly coalescent fruits having the general, though only partly developed, structure of Black Pepper. Both are blackish, the Bengal of a reddish black, the Java usually gray powdery on the surface. The Java averages from a third to a half longer than the Indian and is generally regarded as superior. The odor and taste, as well as the constituents, of Long Pepper are very similar to those of Black Pepper.

Schinus molle L.—In Peru and other parts of tropical America, the fruits of this plant (Fam. *Anacardiaceæ*), the *Pepper tree, Peruvian mastiche tree* or *Arbol del Peru*, have a slight domestic use as a pepper-substitute under the name of *Chilian* or *Peruvian Pepper*. The tree is quite beautiful, somewhat resembling an ash tree, but with very slender, partly drooping branches, and is planted for shade and ornament as far north as California. It bears large drooping panicles of spotted crimson fruits, about as large as pepper, which are somewhat pungent. All parts of the plant are used medicinally, the bark as an astringent, and the leaves as an aromatic, as is the gum-resinous exudation, which has been found to contain 60 per cent. of resin and a little volatile oil.

The genus *Piper* contains nearly 400 species of tropical plants, characterized generally by aromatic or pungent properties, and a large number are in use on this account. The fruit of *P. Guineense* Sch. et Th., used like pepper under the name *Guinea* or *Kissine pepper*, contains 11.5 per cent. of essential oil and 5 per cent. of piperine or about double the amount contained in ordinary black pepper. The root of *P. reticulatum* L. is pungent and is used in Brazil under the name Jaborandi, as are also *P. unguiculatum* R. et P. and others. The fruit of *P. Novæ-Hollandæ* Miq. is very pungent and is used under the name *Australian pepper*. The rhizomes of *P. peltatum* L. and *P. umbellatum* L. are used in the West Indies as diuretics, under the names *Caapeba* or *Periparabo*, or, in English, *Lizard's-tail* or *Asses'-foot*. In the West Indies, the leaves of *P. ovatum* Vahl., under the name *Pot*, are fed to hunting-dogs to improve the scent. It contains the peculiar alkaloidal but non-basic body *Piperovatine* ($C_{16}H_{21}NO_2$), insoluble in water or ether, but soluble in alcohol, chloroform, or acetone. It is allied to piperine. The leaves and fruits of *P. anisatum* Kunth, of tropical America, have an anise-like odor and taste. In the Andes the fruits of *P. crocatum* R. et P. (*Artanthe c.*—Miq.) are used as a pepper-substitute and for dyeing. In all, nearly 100 species of the genus have been recorded as in medicinal use.

Piperaceæ or *Pepper Family.*—The genus Piper comprises about half of the species of this family. METHYSTICUM, CUBEBA, and MATICO are important drugs pertaining to it, and are considered under these titles.

Betel leaves are the product of *Chavica Betle* (L.) Miq (*Piper B.*—L.), a shrubby twiner, native of the East Indies and considerably cultivated for its leaves. The leaves are broadly ovate, obliquely cordate, acuminate, 5- to 7-nerved, coriaceous, smooth, and above shining, and of a burning, aromatic, and bitter taste. They are enormously used by the Malays as a masticatory, being usually chewed with scrapings of Areca, often mixed with slaked lime. The leaves of *C. Siriboa* (L.) Miq. (*Piper S.*—L.) are very similar, though less distinctly cordate, and are similarly employed. A number of species of the genus *Peperomia* are also employed as aromatics.

Saururaceæ (the *Lizard's-tail Family*).—This small family, of 3 genera and 4 species, was long regarded as a part of the preceding. All are medicinally employed. The most important is the *Yerba Mansa*, the rhizome and root of *Houttuynia Californica* B. et H. (*Anemiopsis C.*—H. et A.; *A. Berlandieri C.* DC.), a perennial herb of the southwestern United States and Mexico. It is scarcely an article of general commerce, but is perhaps the favorite antispasmodic of the Mexicans. The herbage is also somewhat employed. The constituents have not been studied. *Saururus cernuus* L. (*Black Sarsaparilla*), of the eastern United States, and *S. lucidus* Don., of South America, are used similarly.

PIPERAZINA.—Piperazine.

Piperazidine; Ethylene-imine; Diethylene-diamine; Dispermine; Arthriticine.

Formula, $(C_2H_4NH)_2 = C_4H_{10}N_2$. Molecular weight, 83.70.

A synthetical compound, at one time supposed to be identical with spermine, but found to differ from the same both in chemical and physiological action.

Preparation.—When ammonia is allowed to act upon ethylene bromide or chloride, a mixture of salts of different bases is obtained, consisting of ethylene diamine, triethylene diamine, diethylene triamine, tetraethylene triamine, and diethylene diamine. In order to separate the last-named base the solution of the mixed salts is treated with an excess of sodium or potassium nitrite and heated to 60° to 70° C. (140°–158° F.),

which causes dinitrosopiperazine to separate as a scaly crystalline mass; this is soluble with difficulty in cold, but readily soluble in hot water, and melts at 154° C. (309.2° F.). This compound, when treated with concentrated acids or reducing agents, yields ammonia and salts of piperazine, from which the pure base is obtained by distillation with alkalies. It is prepared commercially by a number of patented processes—by reduction of ethylene oxamide with zinc dust or metallic sodium (Schering's), and from aromatic disulphone-piperazides by heating with sulphuric acid and subsequent treatment with powdered sodium hydroxide (Marckwald and Haltz).

Properties.—Piperazine occurs in the form of colorless crystalline masses possessing a faint but characteristic odor. Crystallized from water it forms lustrous glassy tablets. When pure it melts at 104° C. (219.2° F.) and boils at 145° C. (293° F.). It is very hygroscopic, absorbing water and carbon dioxide from the atmosphere with avidity. It is soluble in water, and somewhat less so in alcohol, the solutions having an alkaline reaction. It forms a crystalline hydrate ($6H_2O$), which melts at 44° C. (111.2° F.), and which on distillation yields increasing proportions of diethylene-diamine until above 135° C. (275° F.) the anhydrous base is obtained (P. E. Berthelot). The carbonate melts at 162° to 165° C (323.6°–329° F.). It is a strong base, forming crystallizable salts with acids. Its aqueous solution yields precipitates with solutions of mercuric chloride (white), Nessler's Solution (white), cupric sulphate (light blue), picric acid (lemon yellow, crystalline), and a grayish precipitate with tannic acid. In solution acidulated with hydrochloric acid it yields a brick-red precipitate with solution of potassium-bismuth iodide, and yellow crystalline precipitates with platinic chloride and gold chloride. Aqueous solution of chromic acid is without effect on piperazine, but potassium permanganate oxidizes it even in the cold. In contact with uric acid it forms piperazine urate, soluble in 50 parts of water, whereas lithium urate requires 368 parts of water for solution. It is excreted by the urine. Piperazine may be detected in urine by adding a slight excess of sodium hydroxide, heating the mixture, and after cooling and removing the precipitated phosphates by filtration, acidulating with hydrochloric acid and precipitating the piperazine with solution of potassium-bismuth iodide. The brick-red precipitate forms characteristic microscopical crystals.

Action and Uses.—Owing to its property of combining with uric acid to form a urate of piperazine, which is soluble in 50 parts of water, piperazine is used in the uric-acid diathesis for the purpose of preventing the formation of renal and vesical calculi, and also for the relief of irritation of the bladder due to an excess of uric acid in the urine. If calculi have already formed, it is doubtful if piperazine can cause their solution or disintegration, though it may sometimes dissolve uric-acid gravel. Its reputation as a valuable remedy in gout has not been sustained, although it seems to do good in some cases for a short time. A 1 per cent. solution of piperazine has been injected into gouty deposits with the hope of bringing about their solution, but this method of using the drug is both painful and valueless. Ordinary medicinal doses produce no untoward effects, but after large doses tremors, clonic spasms, and general depression have occurred. It is too hygroscopic to be dispensed in powder, capsule, or pill, and its aqueous solution readily decomposes. The menstruum in which it keeps best is composed of 20 parts of alcohol and 80 parts of water. The dose is from 15 to 30 grains (1–2 Gm.) a day, diluted with a large quantity of plain or carbonated water.

Allied Salts.—Piperazine Cinchonate. Sidonal.—*Chinasaures Piperazin*, G. $C_4H_{10}N_2(C_7H_{12}O_6)_2$.—A colorless crystalline powder having an acid taste and reaction, and melting at 168° to 171° C. (334.4°–339.8° F.). It is readily soluble in water.

Dimethylpiperazine Tartrate.—*Lycetol.* $C_6H_{14}N_2C_4H_6O_6$.—A white to colorless crystalline powder, having an acid reaction. It is readily soluble in water, and melts at 250° C. (482° F.). Lycetol is used for the same purposes as piperazine. It is less hygroscopic than the latter drug, and its aqueous solution is more stable. The dose is from 15 to 30 grains (1–2 Gm.) a day, well diluted in carbonated water.

Ethylene-ethynyl-diamine.—*Methylglyoxalidine. Lysidine.* $C_4H_8N_2$.—A monatomic base of strong alkaline reaction, forming colorless hygroscopic crystals which are readily soluble in water, alcohol, and chloroform. Lysidine melts at 105° C. (221° F.) and boils at 195° to 198° C. (383°–388.4° F.). With uric acid it forms a urate which is soluble in 6 parts of water. It gives a reddish-yellow precipitate with potassium bismuth iodide, a lemon-yellow precipitate with phosphomolybdic acid, and a brown precipitate with solution of iodine in potassium iodide. It is claimed that lysidine possesses five times the power of piperazine as a uric-acid solvent. It occurs in the market in a 50 per cent. solution. The dose is from 15 to 60 grains (1–4 Gm.) a day, in an excess of carbonated water.

PIPERINA, *U. S.*—Piperine.

Pipérine, Fr.; *Piperin*, G.

Formula, $C_{17}H_{19}NO_3$ or $CH_2O_2.C_6H_3.CH,CH,CH,CH,CON.C_5H_{10}$. Molecular weight, 283.04.

A feebly basic principle obtained from pepper, and occurring also elsewhere in plants of the family *Piperaceæ*.

Origin.—Piperine was discovered by Oerstedt (1819), and obtained pure by Pelletier and Poutet (1820). It has been prepared from black, white, and long pepper, and by Stenhouse (1855) from the fruit of *Cubeba Clusii*, Miquel.

Preparation.—It is most readily prepared from the alcoholic extract of white pepper by treating it with potassium hydroxide solution, which dissolves the resin, washing the residue with water, and purifying it by repeated crystallization from alcohol. On neutralizing the potassium hydroxide solution with an acid the pungent resin is obtained. Wittstein's process is as follows: 16 parts of black pepper are exhausted with cold water, and afterward with alcohol; the alcoholic extract is washed with water, digested with alcohol and 1 part of slaked lime, and the solution concentrated; the crystals are purified by recrystallization and treatment with animal charcoal. The yield varies between 5 and 9 per cent.

Piperine has been prepared synthetically (Rügheimer, 1882) by effecting the recombination of piperidine with piperic acid.

Properties.—Pure piperine crystallizes in colorless flat, four-sided prisms of a glassy lustre and is almost tasteless. As usually met with, it is of a yellowish color, inodorous, and has at first a slight, but on continued mastication or in alcoholic solution a sharp, peppery taste. It remains unaltered on exposure, dissolved in alcohol, has a neutral reaction to test-paper. "Insoluble in water; soluble at 25° C. (77° F.) in 15 parts of alcohol, and at 60° C. (140° F.) in 4.4 parts; also soluble at 25° C. (77° F.) in 36 parts of ether and in 1.7 parts of chloroform. It melts at 130° C. (266° F.). Upon ignition, it emits alkaline vapors, and is completely consumed. On adding a crystal of piperine to sulphuric acid containing about ½ its volume of solution of formaldehyde, a permanent bright-green solution is obtained. On adding a crystal to sulphuric acid containing a fragment of potassium dichromate, it turns at once purple, and on stirring, dissolves, forming a reddish-brown solution, which becomes dirty green on addition of water. On adding a crystal to sulphuric acid containing a trace of selenous acid, it turns brown, changing at once to violet, and dissolves, forming a brown solution changing to green. When heated with nitric acid, piperine turns, first, orange, then red, and the acid acquires a yellow color, deepening to reddish as the crystals dissolve. On adding to this solution an excess of potassium hydroxide test-solution, the color is at first yellow, but upon boiling it becomes blood red."—U. S. Sulphuric acid colors it blood red, the color disappearing on the addition of water, leaving the piperine unaltered if the action of the acid has not been prolonged (Pelletier). The solution of piperine in sulphuric acid is yellow, becoming dark brown, and finally green brown (Dragendorff). Piperine is a very weak base, and its salts are decomposed by water; crystallizable double salts, soluble in alcohol, may be obtained with the chlorides of mercury, platinum, and cadmium. By dry distillation with soda-lime piperidine is obtained. Boiled with alcoholic solution of potassium hydroxide, piperine was found by Babo and Keller (1856) to be resolved into *piperic acid*, $C_{12}H_{10}O_4$, and *piperidine*, $C_5H_{11}N$. Piperic acid crystallizes in the form of hair-like yellowish needles which fuse at 215° C. (419° F.), and at a higher temperature volatilizes partly unaltered, at the same time giving off a coumarin-like odor. Piperidine is a colorless liquid of an ammoniacal and pepper-like odor, and when largely diluted of a bitter taste. It boils at 106° C. (222.8° F.), has a strong alkaline reaction, dissolves freely in water and alcohol, and yields with acids crystallizable salts; the piperate of piperidine crystallizes in silky scales, which on being heated give off a part of the alkaloid. Ladenburg (1884) obtained a small quantity of piperidine synthetically by treating an alcoholic solution of pyridine with sodium. This method has developed into a commercial process.

Action and Uses.—In the dose of from 3 to 6 grains (0.20–0.40 Gm.), three times a day, piperine has been used as an antiperiodic in malaria without much success.

Derivative Compounds.—Piperonal.—*Heliotropin*. $C_8H_6O_3$.—By boiling piperine for some time (24 hours) with an alcoholic solution of potassium hydroxide, potassium piperate is

formed and crystallizes in shining prisms; this is dissolved in 40 to 50 parts of hot water and slowly mixed, constantly stirring, with a solution of potassium permanganate (2 parts of the latter salt to 1 of the piperate). The resulting magma is put on a strainer and repeatedly washed with hot water until the odor of heliotropin entirely disappears; the united liquids are distilled, and from the first portions of the distillate the larger portion of piperonal separates in crystals: the remainder is obtained by shaking the distillate with ether. Piperonal occurs in small white crystals, soluble in about 600 parts of cold water, and very readily soluble in alcohol and ether. It has been used as an antiseptic and antipyretic in doses of from 10 to 15 grains (0.65–0.97 Gm.) every 3 hours, but is chiefly employed in perfumery.

PISCIDIA.—Piscidia.

Jamaica or *White Dogwood*, E.; *Piscidie*, G., Fr.; *Bois enivrant*, Fr.; *Colorin de peces*, Sp.; *Mulungu*, *Murungu*, Braz.

The bark of the root of *Ichthyomethia Piscipula* (L.) Kuntze (*Erythrina P.* L.; *Piscidia P.* Sargent; *Piscidia Erythrina* Jacq.; *P. toxicaria* Salisb.; *P. inebrians* Medic. —Fam. *Leguminosæ*).

Origin.—The Jamaica Dogwood is a small tree of the West Indies, extending into southern Florida, somewhat resembling the locust. It bears unequally pinnate leaves, paniculate racemes of whitish and deep-red flowers, and 4-winged legumes. It yields a useful timber and the bark is employed as a fish poison.

FIG. 320.

Piscidia, root-bark: A, outer, B, inner surface (⅔ Nat.).

Description.—In irregular quills or curved or flattish sections or strips of variable size and 2 to 6 Mm. ($\frac{1}{12}$ to $\frac{1}{4}$ In.) thick; outer surface varying from pale brownish white to bright orange brown, roughish-wrinkled and somewhat fissured, or, by the removal of the corky layer, dark ash-gray with a brownish or blackish tint, and slightly wrinkled and ridged; inner surface brownish, either smooth or more or less fibrous; either surface may exhibit patches of a peculiar, somewhat metallic bluish-green discoloration; fracture tough-fibrous; transverse section exhibiting the transversely elongated bast-bundles arranged in irregular circles and radial rows; odor narcotic, somewhat opium-like; taste at first slight, becoming bitter and acrid.

The stem-bark is less warped and knotty, in more regular strips, and possesses a green chlorophyll layer.

Constituents.—Besides starch, fat, resin, etc., without tannin, the neutral body *piscidin* ($C_{29}H_{24}O_8$) occurs and may be extracted from the concentrated tincture by treating it with lime, filtering, adding a little water and crystallizing; after recrystallization from alcohol it forms colorless prisms, which melt at 192° C. (277.6° F.), are insoluble in water, slightly soluble in ether and in cold alcohol, and easily soluble in benzene and chloroform. Investigation is yet necessary to prove that piscidin possesses in full the active properties of the drug.

Action and Uses.—Piscidia is used in medicine for its anodyne and hypnotic properties. Its power of relieving pain does not compare with that of opium, but it produces fewer unpleasant after-effects than does the latter drug. From the studies of Ott and Nagle it appears that the analgesia produced by the drug is due to its action upon the sensory centres, not upon the sensory nerves. It has no effect upon motor nerves. It slows the pulse by directly depressing the cardiac muscle, and raises blood pressure by stimulating the vasomotor centres. In full doses it increases the secretion of the salivary glands and skin. In dysmenorrhœa, due to spasm of the cervix uteri, piscidia has produced good results, and it has been used with varying success in neuralgia, toothache,

headache, nervous irritability, and insomnia due to pain. The dose of the unofficial extract is from 2 to 10 grains (0.12–0.60 Gm.); of the fluid extract, from ½ to 2 drachms (2–8 Cc.).

The bark of *Erythrina corallodendron* L., the *Brazilian coral tree*, and that of *E. Mulunga* Mart., are also known in Brazil as Mulungu or Murungu, and are similarly employed. The leaves are also employed as a laxative and diuretic.

PIX BURGUNDICA, *Br.*—Burgundy Pitch.

Poix de Bourgogne, P. des Vosges, P. jaune, Fr. Cod.; *Poix blanche*, Fr.; *Burgunder Harz (-Pech)*, G.; *Pece di Borgogna (dei Vosges), P. Bianca*, It.; *Pez de Borgona, P. amarilla, P. blanca*, Sp.; *Pez de Borgonha, Resina de Abeto*, Port.

The prepared resinous exudation from the spruce fir, *Abies Abies* (L.) Rusby (*Pinus A.* L.; *P. excelsa* Lam.; *P. Picea* Du Roi; *Picea excelsa* Link.—Fam. *Pinaceæ*), a tall and handsome evergreen of the mountains of central and southern Europe, and frequently cultivated for ornament.

The turpentine, known as *Jura Turpentine*, is obtained by making incisions in the bark and collecting the exudate after concretion. Tschirch and Bruening give its composition as volatile oil, 32 to 33 per cent.; *picea-pimarinic acid* ($C_{20}H_{20}O_2$), 2 to 3 per cent.; *picea-pimaric acid* ($C_{20}H_{30}O_2$), 1.5 to 2 per cent.; *α-* and *β-pimarolic acids* ($C_{25}H_{44}O_2$), 48 to 50 per cent.; *resene* ($C_{21}H_{36}O$), 10 to 12 per cent.; traces of succinic acid, coloring-matter, and bitter principle. This, by melting in water and straining, is converted into the substance here considered. It is prepared in many parts of Europe, but not in Burgundy.

Description.—Hard, yet gradually taking the form of the vessel in which it is kept; brittle, with a shining, conchoidal fracture, opaque or translucent, reddish brown or yellowish brown, odor agreeably terebinthinate; taste aromatic, sweetish, not bitter.

It is almost entirely soluble in glacial acetic acid or in boiling alcohol, and partly soluble in cold alcohol.

Composition.—Burgundy pitch consists chiefly of resin. With it are about 5 per cent. of volatile oil, apparently isomeric with oil of turpentine, and a variable amount, up to 10 per cent., of water absorbed during the treatment of the turpentine.

Substitution.—An artificial substitute, variously prepared from common resin, has been extensively supplied. It bears but a poor resemblance to the genuine.

Pharmaceutical Preparations.—Burgundy Pitch Plaster, Cantharidal Pitch Plaster.

Action and Uses.—Applied to the skin in the form of a plaster, Burgundy pitch produces itching, redness, and mild irritation. Upon a delicate skin it may occasion a papular or vesicular eruption, and in some instances a still more severe degree of irritation terminating in vesication, pustulation, or ulceration. It is a fairly useful external remedy in lumbago, chronic rheumatic pains, chronic bronchitis, and pleurisy.

Pix Canadensis.—*Canada*, or *Hemlock pitch* (*Poix de Canada*, Fr.; *Canadisches Pech*, G.; *Pez de Canada*, Sp.), is the prepared resinous exudation from the common Hemlock, Hemlock or Weeping spruce, or Spruce pine, *Tsuga Canadensis* (L.) Carr, (*Pinus C.*—L.; *Abies C.*—Mx.) of northern North America, a good-sized and handsome tree. The oleoresin is obtained either like ordinary turpentine, from small boxes cut into the trunk, or by cutting out and boiling the knotty pieces and skimming off the turpentine from the surface of the water. In either case the product is purified by melting and straining. It then hardens into masses which are reddish brown and opaque or with the superficial portion translucent, brittle at ordinary temperatures, yet taking the form of its container, breaking with a shallow, conchoidal, and glassy fracture and a lighter-colored inner portion, softened by the heat of the hand and of a weakly terebinthinate odor and a terebinthinate taste. It is commonly adulterated to a large extent with common resin, and the artificial compounds mentioned under Burgundy Pitch are also sold for it. The composition of Canada Pitch is identical, for all practical purposes, with that of the preceding. The precise nature of its volatile constituents has not been investigated.

PIX LIQUIDA, *U. S., Br., P. G.*—Tar.

Resina empyreumatica liquida.—Pyroleum Pini Scand.; *Goudron végétal,* Fr. Cod.; *Theer,* G.; *Brea Alquitran,* Sp.; *Catrame vegetale,* It.; *Alcatrao (Carburolao) do Pinheiro, Breu Cru,* Port.

A product obtained by destructive distillation from the wood of *Pinus palustris* Mill. and of other species of *Pinus* (Fam. *Pinaceæ*).

Official in all pharmacopœias, most of which include Pines and Firs as the source, though the Austrian requires it from the Beech (*Fagus*) only.

Origin and Preparation.—The species named under TEREBINTHINA, together with *P. rigida* Mill., the *Pitch, Torch, Fat, Candlewood, Hard* or *Yellow pine,* yield most of the American tar, while *P. sylvestris* L. and *Larix Siberica* Ledeb. yield most of the European.

Most of the wood used for this purpose consists of stumps, roots, and other waste materials of the lumberman. It is said that the dead portions of the tree become more abundantly charged with the resinous matters than the living, and the lumbermen even believe that after the entire tree is dead, the amount continues to increase.

The essential feature in tar-distillation is that the pile of wood be slowly and imperfectly burned from the top downward, the tar being successively driven out of the wood next underneath the burning point and running downward and out at the bottom, where it is collected. This is sometimes performed in furnaces or stills, but the product is not quite the same as that produced from the extemporized stacks of our southern distillers, the latter tar being useful for some purposes for which the former is not. In making these stacks, a circular mound of earth, about 20 feet in diameter, hard-packed and clay-coated, is first formed and surrounded by a ditch from which the tar is to be conveyed away. As the wood is piled upon the mound the diameter of the pile gradually increases to about 25 feet at the top, some 10 or 12 feet high. The top is then covered with a layer of pine-needles, the sides of the stack are protected in some way against a free current of air, and the top is ignited. The tar is barrelled as fast as it runs away. Such a stack burns for a week or 10 days and yields 100 barrels or more of tar.

Description.—Tar is a thick, viscid, semifluid mass, heavier than water, of a deep blackish-brown color, transparent in thin layers if free from water, and has an unpleasant empyreumatic odor and a sharp and bitter taste. On standing, it usually separates a granular crystalline matter consisting of *pyrocatechin* (catechol), and often assumes the consistence of thick honey. It has an acid reaction, which, together with a light-brown color and sharp bitterish taste, is imparted to water agitated with it. On the application of heat, water and acetic acid distil over, together with a yellow volatile oil. Tar is soluble in alcohol, ether, chloroform, fixed and volatile oils, and caustic alkalies. The aqueous infusion of tar is colored transiently green by ferric chloride, due to the presence of pyrocatechin, and with lime-water acquires permanently a brown-red color. An 0.1 per cent. solution of copper acetate colors the petroleum ether extract greenish.

Composition.—Tar is of very complex composition, which varies with the kind of wood, the amount of resins present therein, and the care with which it has been prepared. It contains *acetic acid,* *acetone,* *methyl alcohol,* *mesit,* $C_6H_{12}O_2$, *toluene,* C_7H_8, *xylene,* C_8H_{10}, *cumene,* C_9H_{12}, *methene,* C_9H_{12}; likewise *phenol,* C_6H_6O, *cresol,* C_7H_8O, *creosote, paraffiin, naphtalene, pyrene,* $C_{16}H_{10}$, *chrysene,* $C_{18}H_{12}$, *retene,* $C_{18}H_{18}$, and others. Of the compounds mentioned, the first series up to methene pass over with the light tar oil, which also contains Reichenbach's *eupion,* a very light oily product of low boiling-point. The *heavy tar oil* contains the other compounds named, and in addition *cedriret, kapnomor, picamar,* and *pittakal,* which names were introduced by Reichenbach to designate various substances not yet obtained in a pure state. After distilling from tar the light and most of the heavy oil, a substance is left behind which is still recognized in some pharmacopœias as:

PIX NAVALIS, s. *Pix nigra, P. solida, Resina pina empyreumatica.—Pitch, Black pitch,* E.; *Poix noire,* Fr. Cod.; *Schwarzes Pech, Schiffspech,* G.; *Pez negra,* Sp.—It is a black, resinous, brittle mass, which becomes soft when held in the hand, and has the odor of tar.

Pharmaceutical Preparations.—ALKALINE SOLUTION OF TAR, COMP. ELIXIR OF TAR, GLYCERITE OF TAR, TAR MIXTURE, COMP. TAR OINTMENT, COMP. TAR PLASTER, N. F.; SYRUP OF TAR, TAR OINTMENT, U. S. P.; WINE OF TAR, N. F.

Action and Uses.—The employment of tar in chronic pulmonary affections and in various skin diseases has descended from ancient times. It is an efficient expectorant, used in the treatment of subacute or chronic bronchitis, given in the official syrup, the wine (N. F.) or tar-water. Tar-water is made by shaking 1 part of tar in 4 parts of water several times during 24 hours, decanting, and filtering. It is given in the dose of from 1 to 2 pints (480–960 Cc.) a day as a drink. In dry, scaly skin eruptions, such as psoriasis and lepra, tar, in the form of an ointment, exercises a beneficial effect. Before the tar is applied the scales should be removed by a warm bath. In some cases of persistent eczema, when the skin has become dry, rough, and thickened, tar ointment is often used with advantage when all other remedies have failed. The official ointment may severely irritate a delicate skin and should be diluted before using. Tar should not be applied to the face, as it will stain the skin. The dose of tar is from 1 to 3 grains (0.05–0.20 Gm.) in pills; of the Syrupus Picis, 1 to 4 drachms (4–16 Cc.); of the Vinum Picis (N. F.), 2 to 8 drachms (8–30 Cc.).

Other Tars.—*Beech-wood* (*Fagus*) *Tar*, which is greatly preferred for the manufacture of creosote because of the great richness of the latter in *guaiacol*, is only incompletely soluble in turpentine oil, ether, and chloroform, and does not respond to the last-mentioned test for PIX LIQUIDA.

Birch tar, *Pix betulæ* or *P. betulinum*, *Oleum betulæ empyreumaticum*, or *Oleum rusci* (*Birkentheer*, *Birkenœl*, G.; *Huile russe*, *Huile de bouleau*, Fr.) is prepared in Russia from the wood and bark of *Betula alba* L. (see also under BETULACEÆ). It resembles wood-tar in appearance, but remains liquid and has a peculiar penetrating odor. Sobrero obtained from it a yellowish volatile oil ($C_{10}H_{16}$), of an agreeable odor, like that of birch-bark, and boiling at 156° C. (312.8° F.). (For *Juniper Tar*, see OLEUM CADINUM.)

PLANTAGO.—Plantain.

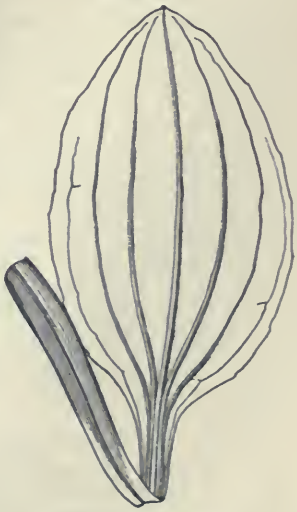
Common, *Door-yard*, *Large-leaved*, *Broad-leaved*, *Round-leaved*, *Greater*, or *Bird-seed plantain*, *Hen-plant*, *Way-bread*, E.; *Grosser Wegerich*, *Sanohr*, G.; *Plantain*, Fr.; *Lauten*, Sp.

The root, the leaves, or the leaves and flower-spikes of *Plantago major* L. (Fam. *Plantaginaceæ*).

Plantago is not official in any pharmacopœia, and is far less used than formerly.

Origin and Description.—The Broad-leaved plantain is a native of Europe and Asia and occurs abundantly in the United States as a common door-yard weed, covering large patches, to the exclusion of about all else. It grows from a very short rhizome, which bears below a great number of long, straight, capillary, yellowish roots, and above a large radical rosette of leaves and a few long, slender, densely flowered spikes. The leaves are ovate, blunt, abruptly contracted at the base into a long, broad, channelled petiole. The blade is 10 to 25 Cm. (4 to 10 In.) long and about two-thirds as broad, usually smooth, thickish, strongly 5- to 11-ribbed, the ribs having a strongly fibrous structure, the margin entire or coarsely and unequally dentate-serrate. The spikes are erect, strongly and long-peduncled, about as long as the leaves, 6 to 8 Mm. ($\frac{1}{4}$ to $\frac{1}{3}$ In.) thick, and usually blunt. The flowers are somewhat purplish green, the calyx 4-parted, the small corolla bell-shaped and 4-lobed, the stamens 4. The fruit is a 2-celled capsule, not enclosed in the perianth, dehiscing transversely at about the middle and containing 4 to 16 seeds. The drug is without odor and has only a slightly astringent, bitterish, and saline taste.

FIG. 321.



Plantago (½ Nat.).

Constituents.—No special constituents have been encountered, a little resin, a very small amount of a bitter principle, citric and oxalic acids, and ordinary plant constituents having been reported.

Action and Uses.—Plantago has been thought to possess curative properties in the treatment of many diseases, including inflammations of the skin, malignant ulcers, inter-

mittent fever, etc., and is still used to some extent. Applied to a bleeding surface the leaves are of some value in arresting the hemorrhage, but they are useless in internal hemorrhage. It is a very feeble remedial agent.

Allied Species.—The genus *Plantago* L. contains more than 200 species, 25 or 30 of which have been reported as in domestic use, though none possesses active properties. Several, like that above considered, are common weeds and are used like or indiscriminately for it. Of these, the most important is *P. lanceolata* L., native of the same region and commonly known as *Black, Long, English,* or *Snake plantain, Rib-* or *Ripple-grass, Ribwort, Black-jack, Jackstraws, Hen plant, Windles,* E.; *Spitzer Wegerich* or *Wegetritt,* G.; *Plantain,* Fr.; *Lauten,* Sp. This is a very dark-green, hairy, slender perennial, growing much taller than the last. Its leaf-blades rarely reach an inch in breadth, are 3- to 5-ribbed, gradually narrowed into the petioles, which are often more than a foot long, the scapes often more than 2 feet long and terminating in ovoid or cylindrical, blunt, dense spikes, ½ to 3 or 4 inches long and ⅛ to ¼ inch thick. The constituents are similar to those of the last. The other species which are commonly used in the United States are similar to *P. major.* Among the homœopaths it is fancied that only the red-stemmed plants are active. In Europe, as well as in southern Asia, *P. Psyllium* L. (*P. Afra* L.), known as *Psyllion, Psyllios, Baraguthi,* etc., is used similarly to *P. major.* The seeds are also used, like flax-seed, for their large yield of mucilage.

In India, the seeds of *P. ovata* Forsk. (*P. Ispaghula* Roxb.), the *Uthamujiram, Ispughul, Spugul, Isafgul,* or *Kaseni,* are used as an antidysenteric and are largely adulterated with various Labiate fruits, especially those of *Ocimum. P. decumbens* Forsk., of South Africa, is regarded by some as the wild plant of which the preceding is a cultivated variety. The seeds of *P. arenaria* Waldst. et Kitt., somewhat smaller, black, and less glossy, and those of *P. Cynops* L., somewhat larger and lighter brown, are used similarly.

PLATINUM.—Platinum.

Platine, Or blanc, Fr.; *Platin,* G.

Symbol, Pt. Bivalent and quadrivalent. Atomic weight, 193.3.

Origin and Preparation.—This metal was apparently observed as early as the sixteenth century, but was more fully described and investigated after the middle of the eighteenth century by Watson, Scheffer, Lewis, Bergman, and others. It is found pure and in combination with palladium, rhodium, osmium, iridium, and other metals in California, in various parts of South America, in the Ural Mountains and other parts of Europe, and in Asia and Africa. It is often met with in auriferous sand, and occasionally in lead, iron, and other ores. The ore is treated with strong hydrochloric acid, well washed by elutriation, the residue treated with nitro-muriatic acid, the acid solution evaporated, redissolved in water, and precipitated with ammonium chloride; on igniting the resulting ammonio-platinic chloride, platinum is obtained in a spongy condition.

Properties.—Spongy platinum is gray, soft, and porous, and fusible only by the aid of the oxyhydrogen blowpipe. The metal is of a silver-white color and metallic lustre, is soft like copper, possesses considerable malleability and ductility, and at a white heat may be forged. Platinum resists the action of most chemicals except mixtures of nitric with hydrochloric or hydrobromic acid, in which the liberated chlorine or bromine dissolves the metal. Caustic alkalies, lithium chloride, and a mixture of potassium nitrate and hydroxide at high temperatures corrode platinum appreciably, as do also alkali cyanides.

Many metals form low-melting alloys with platinum, and therefore such metals, either in the free state, as oxides or as easily reducible compounds, should never be heated in platinum vessels. Lead, bismuth, tin, cadmium, and antimony are among such metals. Mixtures of carbon and silica heated in platinum cause the latter to become brittle by absorption of carbon. Hypophosphites, phosphates with carbon, thiosulphates, and sulphides corrode platinum when heated with it, forming phosphide or sulphide.

Finely divided platinum, as platinum sponge or platinum black, which is obtained by reduction from its salts, has a marked absorptive power for gases, especially oxygen. One volume of platinum black absorbs several hundred volumes of oxygen, by which it becomes a powerful oxidizer; for example, it causes hydrogen to ignite, oxidizes sulphur dioxide to sulphuric acid, ammonia to nitric acid, etc.

Platinum is used chiefly for making chemical apparatus, as crucibles, dishes, etc., and in electrical apparatus; its salts are used as reagents in chemical operations, in photog-

raphy, and to give colors to ceramics. With oxygen it forms a monoxide, PtO, and a dioxide, PtO_2, which are reduced to the metal at a red heat. The platinous salts are brown, red, or colorless; the platinic salts have a yellow or brown color.

PLATINI CHLORIDUM.—*Platinic chloride*, E.; *Perchlorure de platine*, Fr.; *Platinchlorid*, G. $PtCl_4.5H_2O$. Molecular weight, 423.42.—It is prepared by dissolving 3 parts of platinum in a mixture of 16 parts of hydrochloric and 7 parts of nitric acid, evaporating the solution nearly to dryness, redissolving in hydrochloric acid, heating to expel the nitric acid, and evaporating at a moderate heat to dryness, when a red crystalline mass is left, which may be obtained from water in handsome red crystals containing 46 per cent. of platinum. When heated to 100° C., these lose $4H_2O = 16.9$ per cent., and turn brown. If the salt is permitted to crystallize in the presence of free hydrochloric acid, brownish-red needles are obtained which have the composition $PtCl_4.2HCl.6H_2O$, and contain 38 per cent. of platinum. This is the compound usually met with in commerce. Heated to above 110° C. it parts with hydrochloric acid and chlorine, and near 225° C. (437° F.) dark-brown platinous chloride is left. Platinum chloride dissolves readily in alcohol and water, yielding reddish-yellow liquids which precipitate the potassium and ammonium chlorides, forming K_2PtCl_6 and $(NH_4)_2PtCl_6$.

PLATINI ET SODII CHLORIDUM.—*Sodium platino-chloride*; *Sodium and platinum chloride.*—The double salt, $2NaCl.PtCl_4.6H_2O$, crystallizes in light-red prisms, and is freely soluble in water and alcohol. For medicinal purposes a preparation containing an excess of the sodium salt is used, made by dissolving 3 parts of platinic chloride and 5 parts of sodium chloride in water, and evaporating to dryness, stirring continually. It is an orange-yellow powder having a saline and metallic taste.

PLATINI IODIDUM.—*Platinic iodide.* PtI_4.—A solution of platinic chloride is mixed with a solution of an equivalent quantity of potassium iodide, the deep-red mixture nearly neuralized with potassium carbonate, and digested for an hour. The precipitate, after washing and drying, is a brown-black amorphous and tasteless powder, insoluble in water, but soluble in potassium carbonate and iodide with a pale-red color.

PLATINI ET POTASSII CYANIDUM.—*Potassium platino-cyanide.* $2KCN.Pt(CN)_2.3H_2O$.—It is best prepared, according to Meillet, by mixing rather concentrated solutions of 1 part of exsiccated platinic chloride and 2 parts of potassium cyanide, and heating the mixture until the precipitate is redissolved: ammonium carbonate and nitrogen are given off, and on cooling the double salt crystallizes. It forms long needles and prisms, having in different positions a yellow or bright-blue color, and when exposed to the air becoming opaque and rose-red. The salt is freely soluble in hot water, and its solution precipitates cupric salts greenish blue, mercurous nitrate bright blue, and ferrous salts bluish-white.

PLATINI ET BARII CYANIDUM.—*Platinum and barium cyanide; Barium platinocyanide.* $Ba(CN)_2.Pt(CN)_2.4H_2O$.—This salt occurs in large rhombic crystals, appearing green or yellow, according to the position in which it is viewed. It is used in preparing Röntgen fluoroscopes, because of its power to become luminous when Röntgen rays pass through it.

Action and Uses.—The action on the economy of the compounds of platinum was studied by Hoefer in 1841. The results of his investigation show that the chlorides of this metal are as poisonous as those of mercury and gold. A strong solution of platinum chloride applied to the skin produces itching followed by an eruption, but the double chloride of platinum and sodium has no such effect. Internally the chloride irritates the stomach and causes headache, even in small doses, while the double salt is not so irritating in its action. Both salts have been used in the treatment of syphilis, the chloride in the inveterate constitutional forms of the disease and the chloride of platinum and sodium in the primary stages. The dose of either preparation is from $\frac{1}{8}$ to 1 grain (0.008–0.06 Gm.), several times a day, in pill or mucilage.

PLUMBI ACETAS, *U. S., Br.*—Lead Acetate.

Plumbum aceticum, P. G.; *Saccharum saturni.—Sugar of lead*, E.; *Acétate de plomb, Sucre de saturne*, Fr.; *Essigsaures Bleioxyd, Bleiacetat, Bleizucker*, G.

Formula, $Pb(C_2H_3O_2)_2 + 3H_2O$. Molecular weight, 376.15.

Lead acetate should be kept in well-closed bottles, and be not less than 99.5 per cent. pure.—U. S.

Preparation.—No detailed methods are given in the pharmacopœias. The salt may be prepared by dissolving 1 part of lead oxide (litharge) in 2 parts of warm 30 per cent. acetic acid, filtering, and crystallizing.

The process described is frequently followed on a large scale. Sometimes, however, metallic lead is dissolved in acetic acid, which requires to be done in the presence of air, since the metal is unable to displace the hydrogen of the acid. Plates of lead are placed endwise in open vessels containing acetic acid, one-half of their length projecting above the liquid, and as fast as the metal under these conditions is oxidized by the oxygen of the air, it is dissolved, so that the formation of the salt in both cases is the result of the action between plumbic oxide and acetic acid, water being formed at the same time: $PbO + 2C_2H_4O_2$ yields $Pb(C_2H_3O_2)_2 + H_2O$. To obtain handsome and well-defined crystals the solution must have a very distinct acid reaction; if it is permitted to become faintly acid or neutral, a portion of the salt forms small granular crystals agglomerated into soft cauliflower-like masses, containing perhaps a basic lead compound.

Large quantities of lead acetate are now made from metallic lead by placing the same in granular form in large open stoneware cylinders and allowing strong acetic acid to fall upon it in drops from a cask provided with a glass outlet-tube and a multiple drip-cock attachment. During the operation, heat is developed as the acid slowly trickles over the metal, and under the influence of air the lead is gradually dissolved in the form of basic lead acetate. The solution is allowed to collect in the lower part of the cylinder, and is thence transferred to large receptacles, where it is exactly neutralized with acetic acid, and the solution of normal lead acetate then set aside to crystallize. Purified lead acetate for dispensing purposes is prepared in granular form by dissolving the large crystals in water, filtering and evaporating the solution with frequent stirring, so that small crystals may be produced. For uses in the arts large quantities of impure lead acetate are prepared from wood-vinegar, and vary in color from various shades of brown to pale red and white.

Properties.—Pure lead acetate crystallizes in colorless, glossy, transparent, or translucent prisms, which are often tabular and have an acetous odor and a sweet astringent and metallic taste. It is slightly efflorescent in the air, and on continued exposure is superficially converted into lead carbonate. When heated to 40° C. (104° F.) the salt loses its water of crystallization (14.25 per cent.). It fuses at 280° C. (536° F.) with the loss of acetic acid, and, when strongly heated, it is completely decomposed, with the evolution of carbon dioxide and acetone, and leaving a residue of finely divided metal mixed with oxide and carbonate. It also loses its water of crystallization over sulphuric acid and by the action of absolute alcohol, crystallizing from this liquid in an anhydrous condition; but when dissolved in hot 90–95 per cent. alcohol the salt crystallizes on cooling with $2H_2O$. It dissolves at 25° C. (77° F.) in 2 parts, and at the boiling-point in ½ part of water. The solution has a slight acid reaction, and if concentrated and mixed with strong alcohol, gradually separates a portion of the salt in crystals. It dissolves also in about 1 part of boiling and in 30 parts of cold alcohol, U. S. (29 parts P. G.), and is precipitated from this solution as a crystalline powder on the addition of ether. The aqueous solution of the salt has a slightly acid reaction, and yields a black precipitate with hydrogen sulphide test-solution, a yellow one with potassium iodide test-solution, and a white one with diluted sulphuric acid. On heating the salt in the flame of the blowpipe upon charcoal globules of metallic lead are obtained, surrounded by a reddish-yellow incrustation. The salt is decomposed by the mineral and many organic acids, acetic acid being liberated.

Tests.—Lead acetate should yield a clear solution with distilled water. A slight turbidity resulting from the presence of a little carbonate must disappear on the addition of a small quantity of acetic acid. Perfect solubility indicates the absence of sulphate and notable quantities of chloride. The aqueous solution, completely precipitated by hydrogen sulphide, should yield a filtrate which is not precipitated by ammonia and ammonium sulphide (zinc, etc.) or when evaporated to dryness, does not leave any residue (absence of salts of the alkali metals, and those of magnesium, calcium, zinc, and iron). Small quantities of copper would be indicated by the blue color of the filtrate obtained after precipitating the solution of the salt with an excess of ammonia. Potassium ferrocyanide should yield a white precipitate (absence of copper, iron, etc.), and on treating the salt with sulphuric acid in the presence of a crystal of ferrous sulphate a black color should not be produced (nitrate).—U. S. 1 Gm. should require 53.1 Cc. of

tenth-normal sulphuric acid to precipitate the lead completely.—Br. This corresponds to 99.87 per cent., each Cc. corresponding to 0.018808 Gm. of the salt.

Crude lead acetate is recognized in the P. G., which demands that a solution of the salt in 3 parts of water, although it may be opalescent, should yield a white (not a colored) precipitate with potassium ferrocyanide, thus showing the absence of iron and copper. The salt is usually contaminated with varying proportions of basic lead carbonate.

Action and Uses.—A solution of lead acetate applied to mucous membranes or to a broken surface of the skin constringes and blanches the area and forms a white coating of lead albuminate upon it. In medicinal doses it is a sedative astringent, and in overdose produces acute poisoning (see PLUMBUM), which has been followed in some instances by symptoms of chronic lead-poisoning. It is considered a valuable remedy by many practitioners in the treatment of serous diarrhœa and dysentery, especially in the subacute and chronic forms of these diseases. It is usually administered in pill form in combination with opium. As a styptic in internal hemorrhage it is of questionable utility except in those cases in which it comes in direct contact with the bleeding-point, as in hemorrhage from the stomach and intestine. In proportion of 1 to 8 grains (0.06–0.50 Gm.) to the ounce (30 Cc.) of water, it may be injected into the urethra in the treatment of gonorrhœal urethritis, and into the vagina for leucorrhœa. A solution of 1 to 2 grains (0.06–0.12 Gm.) to the ounce (30 Cc.) of distilled water is used as a collyrium in acute and chronic conjunctivitis. An alcoholic solution in the strength of ½ grain (0.03 Gm.) to the ounce (30 Cc.) is a soothing application to the dermatitis produced by poison ivy. The employment of lead acetate has practically been discontinued in the treatment of epilepsy, chorea, hysteria, aneurism, chronic bronchitis, and many other diseases in which it was formerly considered of value. The dose is from 1 to 3 grains (0.06–0.20 Gm.) every 3 to 6 hours.

PLUMBI CARBONAS, *Br.*—Lead Carbonate.

Cerussa, P. G.; *Plumbum carbonicum.*—*White lead, Basic lead carbonate*, E.; *Carbonate de plomb, Blanc de plomb, Céruse*, Fr.; *Bleiweiss, Bleicarbonat*, G.

Formula, $2PbCO_3.Pb(OH)_2 = Pb_3(CO_3)_2(OH)_2$. Molecular weight, 768.91.

Preparation.—When ammonium carbonate solution is added to a solution of a lead salt, normal lead carbonate, $PbCO_3$, is precipitated. Potassium or sodium carbonate precipitates a basic or oxycarbonate, the composition of which varies with the concentration and temperature. The normal carbonate as a pigment has less body than the basic salt which is obtained commercially by two methods.

One method, known as the *Dutch process*, is as follows: Cast sheets of lead are suspended in earthen pots containing a small quantity of vinegar or pyroligneous acid; a number of these pots are arranged in rows, alternating with layers of dung or spent tan, until a shed is filled, which is entirely covered with the same material. A warm and moist atmosphere, charged with carbon dioxide, is thus produced in the shed, favorable for the oxidation of the metal and its conversion by the acetic vapors into basic lead acetate, which is decomposed by the carbon dioxide, yielding white lead and neutral acetate. The latter again unites with a fresh portion of oxide, forming basic lead acetate, which is again acted upon by the carbon dioxide, and the process continues until in the course of a few weeks the lead is completely covered with a thick crust of white lead, which is detached, ground with water, and washed to remove lead acetate and dried. Various modifications of this process have been recommended and are in use, the most important one being that largely used in Austria, where the sheet lead is suspended in wooden boxes, vapors of acetic acid, moisture, and carbon dioxide being supplied in various ways; a number of such boxes are placed in a suitable room, where the temperature is slowly raised from about 25° to 50° C. (77°–122° F.), until after several weeks the conversion is completed.

The other method is known as *Thénard's process*, according to which a solution of lead subacetate is prepared in the usual way, and carbon dioxide passed through it, the filtrate from the precipitate being again used in the preparation of the lead solution. This process has been modified by Benson, so that levigated litharge is mixed with 1 or 2 per cent. of sugar of lead and sufficient water to form a thin paste, which, with frequent stirring, is exposed to the action of carbon dioxide until this ceases to be absorbed; the carbonate is washed with water.

Properties.—Commercial lead carbonate is in pulverulent masses or forms a non-gritty, heavy, white powder, which is not altered on exposure to air unless hydrogen sulphide be present, when it turns black. It is inodorous, and at first tasteless, but gradually develops a slight sweetish and metallic taste. It is insoluble in water and alcohol, but dissolves with effervescence in diluted acetic or nitric acid. The solutions yield with sulphuric acid a white, and with potassium iodide a yellow, precipitate. The white precipitates occasioned in the solution by sodium and potassium hydroxide are soluble in an excess of the precipitant. Heated to 155° C. (311° F.), lead carbonate parts with its water; near 180° C. (356° F.) it begins to lose carbon dioxide and turns yellow, and when heated before the blowpipe upon charcoal it yields globules of metallic lead, surrounded by a reddish-yellow incrustation.

Tests.—Lead carbonate may be adulterated with the sulphates of lead, barium, or calcium, which would be left behind as a white residue upon treatment with dilute nitric acid; only a trifling residue should be left. On adding to this solution an excess of caustic soda, the white precipitate of lead hydroxide at first formed should be completely dissolved (any insoluble portion would indicate the presence of calcium, barium, or strontium, whose hydroxides, contrary to that of lead, are insoluble in caustic alkali), and the alkaline solution should not be rendered permanently turbid on the addition of 1 drop of diluted sulphuric acid (indicating the absence of barium, lead sulphate being soluble in caustic alkali); but on precipitating the solution completely with sulphuric acid the filtrate should be colorless, and should not be precipitated or colored by potassium ferrocyanide (zinc, etc.) or by an excess of ammonia (copper, alumina, P. G.). The solution in diluted nitric acid on being completely precipitated by hydrogen sulphide should yield a filtrate that is not rendered turbid by sulphuric acid.

If 2 Gm. of the salt be dissolved in a mixture of 2 Cc. of nitric acid and 10 Cc. of water, it should not leave more than 0.02 Gm. of residue (limit of insoluble foreign salts). On completely precipitating the solution with hydrogen sulphide, the filtrate should not leave more than a trifling residue on evaporation (limit of salts of the alkalies, alkaline earths, or zinc). If 1 Gm. of the salt be strongly ignited in a porcelain crucible, it should leave a residue of lead oxide weighing not less than 0.85 Gm.

Composition.—White lead is an oxycarbonate, and has approximately the formula given above, in which case it will leave a residue of 86.2 per cent. upon being heated to redness. But the composition may vary from the presence of other oxycarbonates, and the residue left on ignition has been found as low as 83.7 and as high as 86.7 per cent.

A mixture of equal parts of white lead and barium sulphate is sold as *Venetian white; Hamburg white* and *Dutch white* consist of 1 part of white lead to 2 parts and 3 parts respectively of barium sulphate.

Action and Uses.—Lead carbonate is employed externally only. In powder it allays the local irritation due to erythema, erysipelas, intertrigo, and other cutaneous diseases. The official ointment or a thick cream, made by combining the drug with linseed oil, is a soothing application to scalds, superficial burns, and sunburn. As "flake white" it is sometimes associated with other drugs in the manufacture of face powders and cosmetics. In no form should it be applied to the skin for a long time, especially if there is a break in the cutaneous surface, for fear of producing poisoning. Because of its extensive employment in the arts, lead carbonate or white lead is responsible for most of the cases of chronic lead-poisoning and painters' colic.

PLUMBI IODIDUM, *U. S., Br.*—Lead Iodide.

Plumbum iodatum. Iodure de plomb, Fr.; *Jodblei*, G.

Formula, PbI_2. Molecular weight, 457.15.

The salt should be kept in well-stoppered bottles, protected from light, and should contain not less than 99 per cent. of pure salt.—U. S.

Preparation.—No official processes are given in the pharmacopœias. The salt may be prepared by double decomposition between cold or hot solutions of lead nitrate and potassium iodide, containing equal weights of these salts: $Pb(NO_3)_2 + 2KI = PbI_2 + 2KNO_3$. The precipitate of lead iodide is washed with water and dried at a gentle heat. Exactly equivalent quantities of the above salts should be employed, since excess of potassium iodide is a waste and causes loss of precipitate by dissolving a portion of it, and excess of lead nitrate may tend to the formation of a basic iodide. Boudet (1847)

ascertained that lead acetate can not be advantageously used in the preparation of the iodide inasmuch as double iodide of lead and potassium is invariably produced, and remains dissolved in the newly formed potassium acetate. The nitrate does not exert any similar influence; hence nearly the whole theoretical quantity of lead iodide is obtained.

Properties.—Lead iodide, if precipitated in the cold, is a bright-yellow powder, and if obtained from boiling solutions crystallizes in thin, shining, golden-yellow scales. It has the specific gravity 6.1, is inodorous, of a slight metallic taste, and when heated turns brick red or blackish brown, and, if air be excluded, fuses to a red-brown liquid and volatilizes, partly undecomposed, at a strong red heat; on cooling, it gradually acquires again its yellow color. When heated in contact with air, it melts, iodine is given off, and basic lead iodide remains, having an orange-yellow or amber-yellow color. It is permanent in a dry atmosphere, but when exposed to the light while moist is slowly decomposed, lead dioxide and carbonate being formed, besides free iodine. The U. S. Pharmacopœia gives its solubility in cold water (at 25° C.) as 1 in about 1300 parts, and 1 in about 200 parts of boiling water. These solutions are colorless and neutral to test-paper. The salt dissolves more readily in solutions of ammonium chloride, sodium thiosulphate, and of soluble iodides and alkali acetates, and is at least partly converted into double iodides. Alcohol dissolves very little of the salt, and, according to Vogel, boiling ether decomposes it, dissolving iodine and leaving pale-yellow oxyiodide.

Tests.—If 1 Gm. of the salt be triturated with 2 Gm. of ammonium chloride and 2 Cc. of water, a nearly white mixture will result. If this be transferred to a test-tube and heated on a water-bath for a few minutes, a clear and almost colorless solution should be formed (absence of chromate and other insoluble foreign salts). On cooling this solution a solid mass of nearly colorless, fine, silky crystals will be produced, and on adding water or diluted sulphuric acid to this mass, yellow lead iodide will be separated. If 1 Gm. of the salt be boiled for a few minutes with 20 Cc. of water, the mixture then cooled and filtered, the lead removed from the filtrate by hydrogen sulphide, a portion of the second filtrate, after boiling to expel hydrogen sulphide, and carefully neutralizing with ammonia water, should not be colored red by a drop of ferric chloride test-solution (absence of acetate). Another portion of this filtrate, if evaporated to dryness, should leave no residue (absence of soluble foreign salts). If 5 Cc. of water be heated to boiling with 0.1 Gm. of the salt, cooled and filtered into a test-tube, and to the filtrate there be added 5 Cc. of potassium hydroxide test-solution and about 0.2 Gm. of aluminum wire, and a pledget of purified cotton be inserted in the upper part of the tube, and its mouth covered with a piece of moistened red litmus-paper, no blue coloration of the paper should be discernible after heating the tube on a water-bath for 15 minutes (limit of nitrate).—U. S.

Action and Uses.—Lead iodide in the form of the official ointment is a stimulating application to indolent ulcers and sores. If used over a large area or for a long time over a small area, enough of the drug may be absorbed to cause symptoms of chronic poisoning. Internally it has been employed with doubtful utility in scrofulous and other swellings in doses of from ½ to 2 grains (0.03–0.12 Gm.).

PLUMBI NITRAS, *U. S.*—Lead Nitrate.

Plumbum nitricum—Azotate (Nitrate) de plomb, Fr.; *Salpetersaures Bleioxyd, Bleisalpeter*, G.

Formula, $Pb(NO_3)_2$. Molecular weight, 328.49.

It should contain not less than 99.5 per cent. of pure salt, and be kept in well-closed vessels.—U. S.

Preparation.—No official method is given, but it may be obtained by nearly neutralizing warm dilute nitric acid with lead oxide, and crystallizing in a cool place. If prepared from litharge containing copper, the resulting copper nitrate remains at first in the mother-liquor, but will contaminate the last crops of crystals, necessitating washing with water and recrystallization.

Properties.—Lead nitrate crystallizes on slow evaporation in colorless, transparent octahedrons, and in white nearly opaque crystals when hot solutions are cooled. It has the specific gravity 4.4, is not altered by exposure, and when heated decrepitates, fuses,

and gives off oxygen and nitrous vapors, leaving finally lead oxide. It is soluble in 1.85 parts of water at 25° C. (77° F.) and in 0.75 part of boiling water (U. S.). It is likewise soluble, though less freely, in weak alcoholic liquids, but is nearly insoluble in strong alcohol and in nitric acid. The salt is inodorous, possesses a sweetish astringent and somewhat metallic taste, and deflagrates slightly on being triturated with sulphur or thrown upon red-hot charcoal. The aqueous solution has an acid reaction upon blue litmus-paper, and shows the same reactions for lead, and should respond to the same tests for purity as given under PLUMBI ACETAS.

Action and Uses.—Lead nitrate in varying solution is a healing application to sore and cracked nipples, cracked lips, chapped hands, and other excoriations. The solution commonly used contains 10 grains (0.60 Gm.) of the salt to 1 ounce (30 Cc.) of water. This same solution is a useful deodorizing agent to correct the fetor arising from gangrenous sores and offensive discharges from the nose, ears, and vagina. Powdered lead nitrate is said to be an efficient remedy in the treatment of onychia maligna. Its application at first occasions severe pain unless a solution of cocaine is previously applied to the ulcers.

PLUMBI OXIDUM, *U. S., Br.*—Lead Oxide.

Lithargyrum, P. G.; *Plumbum oxydatum. Litharge*, E.; *Protoxide de plomb*, Fr.; *Bleioxyd, Bleiglätte*, G.

Formula, PbO. Molecular weight, 221.23.

It should contain not less than 96 per cent. of pure oxide, and be kept in well-closed vessels.—U. S.

Preparation.—Lead oxide is prepared by combining metallic lead with oxygen derived from the air. If heated to near a white heat, lead begins to volatilize, and in contact with the air burns with a bright-white flame to oxide, which was formerly known as *flowers of lead.* When merely heated to fusion, the metal oxidizes, forming a yellow amorphous powder known as *massicot*, but at a higher temperature the oxide melts and congeals in crystalline scales known as *litharge*, or *semi-vitrified lead oxide.* In this state it is obtained in several processes, such as that known as *cupellation*, in which the lead is oxidized, and the litharge, as it forms, removed by a blast, leaving behind any silver which may have been contained in the lead. An identical product is obtained by passing a current of air over molten lead heated to dull redness and constantly renewing the surface. Nearly all the litharge on the market is now obtained by the cupellation process.

Properties.—Litharge is a more or less crystalline powder which is composed of small scales varying in color between yellowish and pale brick red. When of a distinct yellow tint and glossy surface it has been called *argyritis, yellow* or *silver litharge* (*Silberglätte*, G.), while the red-tinted kind is sometimes known as *crysitis, red* or *gold litharge* (*Goldglätte*, G.). Its density varies between 9.25 and 9.5. It is inodorous and tasteless; in contact with the atmosphere it gradually combines with a little carbonic acid. When heated, it acquires a red-brown color. In the presence of even a small proportion of silica it congeals to a glass-like mass, and in the presence of charcoal it is reduced to metallic lead. It is soluble in dilute nitric acid and in hot acetic acid, the solutions showing with reagents the behavior of lead salts; slightly soluble in water, requiring according to Jorks 12,000 parts for solution, which acquires an alkaline reaction; also soluble in glycerin and in solutions of sugar and other carbohydrates, which on being digested with it acquire a brownish color and a caramel-like odor. In the presence of water it saponifies fats and fatty oils, forming glycerin and lead salts of the fatty acids (lead plaster). If the oxide has absorbed carbon dioxide through careless preservation, it causes trouble in the preparation of lead plaster and lead acetate. English litharge is the best, being free from iron and copper. In the arts litharge is used in the manufacture of flint glass, drying oils, and lead salts for glazing pottery.

Tests.—Lead oxide should be soluble in diluted nitric acid with but little effervescence (limit of carbonate), and without the development of the odor of nitrous acid, leaving not more than a trifling residue (absence of silicate, barium sulphate, etc.). If from the solution in diluted nitric acid the lead be precipitated by sulphuric acid, the filtrate, after the addition of an excess of ammonia-water, should not assume more than a slight bluish tint (limit of copper), nor yield more than traces of a reddish-yellow precipitate (limit of iron). If 5 Gm. of the oxide contained in a small flask be shaken

with 5 Cc. of water, then 20 Cc. of acetic acid added and the mixture boiled for a few minutes, and filtered, the insoluble residue, when well washed and dried, should not weigh more than 0.075 Gm. (absence of more than 1.5 per cent. of insoluble impurities). If to the mixed filtrate and washings obtained in the last test, hydrochloric acid be added in excess, the remainder of the lead removed from the filtrate by hydrogen sulphide, and the liquid filtered, the second filtrate should not yield a residue of more than 0.05 Gm. upon evaporation to dryness (limit of soluble impurities). When strongly heated in a porcelain crucible, the oxide should not lose more than 2 (1, P. G.) per cent. of its weight (limit of carbonate and of moisture).—U. S.

Uses.—Oxide of lead is seldom used alone. A mixture of oxide of lead with sweet oil has been applied to superficial burns, and ordinary white paint, containing litharge, linseed oil, and oil of turpentine, is a popular and excellent remedy for the same affection. Care should be taken not to leave it in contact with the broken skin. Gerhardt has proposed a mixture of oxide of lead and potassa as a caustic for condylomata and warts of the glans penis and vagina. It produces a blackish slough, but does not penetrate deeply.

Other Oxides.—PLUMBI OXIDUM RUBRUM.—*Minium*, P. G.; *Red lead*, E.; *Oxyde rouge de plomb*, Fr.; *Mennige*, G. Pb_3O_4 or $2PbO\text{-}PbO_2$.—On heating massicot to near 450° C. (840° F.) it gradually combines with more oxygen, and is converted into red lead; the conversion of the denser litharge into red lead is attended with greater difficulties. It is a bright orange-red, granular, crystalline powder, which, on being heated, becomes deeper red, purplish, and finally black, and has a density varying between 8.7 and 9.1. It is partly soluble in dilute nitric acid, leaving lead dioxide; at a red heat it is converted into litharge, oxygen being given off; and when heated upon charcoal metallic lead is produced. When mixed with about 20 per cent. of sugar and then treated with dilute nitric acid, it is wholly dissolved. When pure, it contains 90.66 per cent. of lead and 9.34 of oxygen. A variety of red lead less dense than the ordinary kind, and of a bright orange-red color, is used as a pigment under the name of *orange mineral* or *Paris red*.

PLUMBI DIOXIDUM.—*Lead dioxide* (*peroxide*), *Puce oxide of lead*, E.; *Peroxyde* (*Oxyde puce*) *de plomb*, Fr.; *Bleihyperoxid*, G.—This is left behind as an insoluble powder on treating red lead with diluted nitric acid, and is also produced from solution of lead salts by mixing them with an excess of solution of chlorinated lime or chlorinated soda. It is a dark-brown powder, which, on exposure to the light, slowly gives off oxygen, leaving red lead, and by heat is converted into oxygen and litharge. When triturated with one-eighth of its weight of sugar or with its own weight of oxalic acid, it is reduced to oxide or converted into carbonate. Its mixture with sulphur may be ignited by friction—a behavior which renders it useful in the manufacture of matches. Since it readily parts with one-half of its oxygen, it is a valuable reagent for strychnine and some other organic bodies, yielding colored oxidation-products. Its formula is PbO_2, and it contains 86.61 per cent. of lead and 13.39 per cent. of oxygen.

PLUMBUM.—Lead.

Plomb, Fr.; *Blei*, G.

Symbol, Pb. Atomic weight, 205.35. Bivalent or quadrivalent.

Lead has been known from the most remote period. It is found in the United States and many other countries, occasionally as oxide, more frequently as carbonate (*white lead ore*), or in combination with other acids. The most abundant lead ore is *galena*, a lead sulphide, PbS, which is frequently associated with the sulphides of zinc, iron, copper, and silver. The metal is obtained from the galena by roasting it, whereby a portion is oxidized to lead sulphate, while another portion parts with its sulphur, which escapes as sulphur dioxide, the metal being converted into oxide. The newly formed compounds react with the unaltered galena, forming lead, which fuses, and sulphur dioxide, which escapes. A considerable quantity of lead remains in the slag, which is used in a subsequent operation. The extraction of silver is effected by cupellation (see page 235), and the lead oxide is then reduced to the metallic state by heating it with charcoal.

Lead has a bluish-gray color and a bright metallic lustre. It is a soft metal, and when cooled slowly leaves a mark on being drawn over paper. Its specific gravity is 11.4; it is very malleable and ductile, but less tenacious than most other common metals; fuses at 325° C. (617° F.) and volatilizes at a white heat. On congealing, it expands slightly, but afterward contracts considerably, and under some circumstances it may be obtained crystallized in regular octahedrons. When exposed to a moist

atmosphere, it is superficially oxidized and becomes covered with a grayish layer. In contact with water and air or in the presence of a minute quantity of ammonia or of nitric acid, the metal is corroded and small quantities of it are held in solution. Sulphates prevent the lead from being dissolved, or, if dissolved, precipitate an insoluble sulphate. The effect of lead pipes on drinking-water is stated under AQUA (which see).

In addition to the three oxides described elsewhere, the existence of a suboxide, Pb_2O, has been assumed, but is doubted by many chemists. *Lead sesquioxide*, $Pb_2O_3 = PbO.PbO_2$, has been obtained as a yellow precipitate by adding chlorinated soda to an alkaline solution of lead, and more recently (1878) by H. Debray as a greenish-brown powder by heating lead peroxide to 350° C. (662° F.).

There are two series of *lead salts*, in one of which lead is contained in the acidulous radical, while in the other it constitutes the base. The former, called *plumbites* and *plumbates*, analogous to zincates and stannates, are formed when strong alkalies act on lead oxide and lead dioxide, respectively, the potassium compounds being K_2PbO_2 and K_2PbO_3. The alkali plumbates are colorless, decomposed by much water, and yield plumbates of the metals by acting upon metallic salts. The *plumbic salts* are white or colorless, unless colored by the acid; mostly insoluble in water, and then usually soluble in dilute nitric acid. The salts, which are soluble in water, have a sweet and metallic taste and an acid reaction to litmus, and their solutions yield white precipitates with carbonates, sulphates, phosphates, and chlorides, the last of which is slightly soluble in water, but less soluble in hydrochloric acid, while the precipitated lead sulphate is insoluble in water and dilute sulphuric and hydrochloric acids. Alkalies produce white precipitates of plumbic hydroxide, which is insoluble in ammonia, but soluble in potassa and soda. Potassium ferrocyanide yields a white precipitate. The precipitates by potassium chromate and potassium iodide are characterized by a bright-yellow color; the latter crystallizes from hot solutions in golden-colored scales. Hydrogen sulphide precipitates black lead sulphide, which is insoluble in dilute acids and in ammonium sulphide. Iron and zinc separate from the solutions of lead salts the lead in the metallic state, and by heating the salts with sodium carbonate upon charcoal before the blow-pipe, metallic globules of lead and a reddish-yellow incrustation of lead oxide are obtained.

Action and Uses.—Lead produces, when taken internally in poisonous doses in any of its soluble forms, a widespread gastro-enteritis and death from these intense inflammatory changes and the depressant effect exerted upon the central nervous system. The vomitus is white, owing to the formation of chloride of lead, and the stools are black from the formation of sulphide of lead. Vomiting is often a symptom of such poisoning, and constipation may be present instead of purging, owing to the astringent effect of the drug. The antidote to the soluble salts of lead is any soluble sulphate, such as Epsom or Glauber's salt, which also, if given freely, purge the patient of the poison. Chronic lead-poisoning is a very common condition and occurs in all walks of life. The poison finds its way into the body in a host of ways. In painters, as a result of the absorption of the drug while working with lead paint; in artisans who work in lead, in persons who eat cakes colored by chrome yellow, in others who eat preserved fruits kept in jars glazed with lead. A characteristic symptom is a blue line on the gums in those who are not careful in the cleansing of the mouth after meals. This is due to the formation of the sulphide of lead in the capillaries of the gums. Another very marked characteristic of chronic lead-poisoning is bilateral wrist-drop owing to the paralysis of the extensor muscles of the forearm. Still another is painters' colic, or *colica pictonum*, in which an agonizing, griping pain is felt above the navel. Lead-poisoning also causes a universal neuritis in some cases, producing symptoms like those of locomotor ataxia. More rarely chronic joint-changes take place like those of gout or rheumatoid arthritis, the so-called "plumbic gout." Still more rarely convulsions ensue as the result of saturnine encephalopathy. Often, however, these convulsions are really due to uræmia produced by the effect of the poison on the kidneys. Chronic lead-poisoning is to be treated by avoiding further exposure, by the use of potassium iodide to aid in the elimination of the drug, and by the use of electricity and strychnine to restore lost nerve power. Chronic lead-poisoning is usually due to the ingestion of the insoluble rather than the salts of lead.

UNOFFICIAL COMPOUNDS OF LEAD.

Plumbi Chloridum.—*Lead chloride*, E. ; *Chlorure de plomb*, Fr. ; *Bleichlorid, Chlorblei*, G. $PbCl_2$.—Obtained by precipitating lead acetate or nitrate solution with hydrochloric acid, washing and drying the precipitate. Colorless crystalline powder, or crystals, soluble in 140 parts of cold and 30 parts of boiling water. Basic lead chloride is sold as a pigment by the name of *Mineral-, Turner's, Veronese, Paris*, or *patent yellow*.

Plumbi Chromas.—*Lead chromate*, E. ; *Bleichromat, Chromsaures Blei*, G. $PbCrO_4$.—Obtained by interaction between lead acetate or nitrate and potassium chromate or dichromate. A heavy, beautiful yellow powder, insoluble in water and dilute acetic acid, easily soluble in caustic alkalies. It is sold in the market as a pigment usually under the name of *Chrome yellow, Paris yellow*, or *lemon-chrome*. *Basic lead chromate*, $PbCrO_4.PbO$, is obtained by treating chrome yellow with very dilute caustic soda or by boiling it with lime-water. It is a heavy, bright-red powder known as *Chrome red, Chrome orange*, or *American vermilion*. A mixture of chrome yellow and Prussian blue constitutes *Chrome green*.

Plumbi Tannas.—*Lead tannate*, E. ; *Bleitannat, Gerbsaures Blei*, G.—Obtained by dropping a solution of tannin into a solution of lead acetate, washing and drying the precipitate. It is at first nearly white, but gradually turns brown.

Action and Uses.—The chloride and tannate of lead have been used externally in ointment as a soothing application to ulcers and morbid growths. Lead chromate or chrome yellow has been responsible for many cases of chronic lead-poisoning when employed to give a rich yellow color to pastry.

PODOPHYLLUM, *U. S.*—Podophyllum ; May-apple.

Podophylli rhizoma, Br. ; *Mandrake-root, Vegetable Calomel*, E. ; *Fussblattwurzel*, G. ; *Rhizoma de Podophyllum*, Fr. ; *Podifillo*, It. ; *Podofilo*, Sp.

The dried rhizome of *Podophyllum peltatum* L. (*P. callicarpum* Raf.)—Fam. *Berberidaceæ*.

American mandrake is official in most pharmacopœias. The Belgian requires that it yield from 3 to 5 per cent. of podophyllin.

Origin.—Podophyllum, commonly known as *Umbrella-plant* or *Duck's foot*, grows abundantly throughout almost the whole of eastern and central North America, preferring a rather low, heavy, and clayey soil and open or partially open exposures. It is a perennial herb, growing from very long and much branched rhizomes, so as to form very large beds. It is a plant of very striking appearance. The aërial portion from the younger rhizomes consists of a slender stem about a foot high, terminating in a centrally peltate, smooth and shining leaf about 6 to 12 inches in diameter, nearly circular in outline, the margin coarsely and irregularly lobed and somewhat drooping, thus giving to the plant one of its popular names, Umbrella Plant. The stems from the older parts of the rhizome terminate in a single, recurved, beautifully waxy, white flower, about 2 inches broad, and 2 leaves, their stout petioles rising obliquely on the two sides, the blades somewhat more than semicircular, otherwise similar to those previously described, though a little larger. The fruit is a bright-yellow, soft and fleshy, very many seeded berry, which is somewhat sweet and edible. A few cases of poisoning, 2 of them fatal, have been reported from eating this fruit. Although the cases are thoroughly authenti-

FIG. 322.

Rhizome of *Podophyllum peltatum* L.

cated, they are not easily understood, since the fruit is ordinarily eaten freely without unpleasant results, under the names *Wild* or *Ground lemon, Indian, Hog*, or *Devil's apple*. In the rich alluvial lands of our central States, the rhizome is turned up by

the plough in the greatest abundance and is collected and marketed in great quantities and at small cost.

Description.—Of horizontal growth and indefinite length, occurring in irregular pieces; cylindraceous, lightly flattened from above, consisting of joints about 5 to 10 Cm. (2–4 In.) long, the internodes 2 to 8 Mm. ($\frac{1}{12}$–$\frac{1}{3}$ In.) thick, the nodes about twice as broad; yellowish brown to dark brown, the darker pieces usually longitudinally wrinkled, the lighter ones nearly smooth, the nodes marked above by broad cup-shaped scars and underneath by whitish, short stumps of the brittle roots; fracture short and sharp, whitish to pale brown, resinous in the best drug, marked by a loose circle of very short yellow wood-wedges surrounding a large pith; nearly inodorous; taste sweetish and bitter, becoming acrid.

The powder contains simple and compound starch-grains, the former from very minute up to 6 or 7 mikrons wide, the hilum from centric to very excentric, the rings obscure, and calcium oxalate crystals in rosettes of very irregular size, mostly 35 to 40 mikrons wide.

The thinner, dark-colored, much-wrinkled portions of mandrake rhizome are deficient in active constituent.

Constituents.—With a large amount of starch, small amounts of gum and fixed oil, and a very small amount of gallic acid, podophyllum yields $3\frac{1}{2}$ to 5 per cent. of a brownish-yellow resinous substance, soluble in alcohol but not in water, in which the activity resides. This resin is commonly denominated "Podophyllin" and is a mixed substance, for the composition and properties of which see RESINA PODOPHYLLI.

Pharmaceutical Preparations.—FLUIDEXTRACT OF PODOPHYLLUM, PILLS OF PODOPHYLLUM, BELLADONNA, AND CAPSICUM, RESIN OF PODOPHYLLUM, U. S. P.

Action and Uses.—Podophyllum is the slowest-acting official purge in the Pharmacopœia, requiring from 10 to 24 hours to produce its effect. In small doses it is a mild laxative, and in large amounts it produces copious, watery stools often attended with severe griping.

In overdose it causes vomiting, hypercatharsis, gastro-enteritis with bloody stools, general depression, and sometimes death. The experiments of Rutherford indicate that the drug distinctly excites the flow of bile, which renders it a useful cholagogue.

While it may be used in any case of constipation, it is of particular value in the constipation resulting from hepatic torpor and portal congestion, and is perhaps preferable to all other drugs except calomel. In the summer diarrhœas of children, when the passages consist almost entirely of water and have a peculiar mousy odor, the resin of podophyllum, in doses of from $\frac{1}{60}$ to $\frac{1}{50}$ grain (0.0010–0.0013 Gm.), repeated every few hours, will often cure when all other remedies have failed.

The Resina Podophylli, improperly called podophyllin, is the preparation usually employed when podophyllum is indicated. Its dose as a laxative is from $\frac{1}{20}$ to $\frac{1}{1}$ grain (0.003–0.006 Gm.); as a purge, from $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.032 Gm.). The drug in substance is given in from 5- to 10-grain (0.30–0.60 Gm.) doses as a laxative, 10 to 20 grains (0.60–1.30 Gm.) as a purge. The dose of the extract is about one-half that of the drug.

Other Species.—5 species of *Podophyllum* are recognized. Only 1 other than the above has been investigated pharmacologically, namely, *P. Emodi* Wall., of the East Indies, especially of the Himalayan region. This is a somewhat larger plant and produces a larger, orange-red or scarlet berry. The rhizome yields 2 or 3 times as much resin as the official article, but this resin has a different composition and is considered inferior.

POLYGONACEÆ.—The Smart-weed Family.

A family of 30 genera and nearly 700 species, of world-wide distribution and most diverse habits and properties. The economic importance of the family is considerable. Under the name *Buckwheat*, the seeds of *Fagopyrum Fagopyrum* (L.) Karsten (*Polygonum F.*—L.; *F. esculentum* Mœnch), ordinary *Buckwheat* or *Indian wheat*, *Crap*, *Heath*, or *Saracen's corn*, *Buchweitzen* (G.), *Sanasin* or *Blé noir* (Fr.), of *F. cymosum* Meissn., the *Chinese perennial buckwheat*, and of *F Tartaricum* (L.) Gærtn. (*Polygonum F.*—L.), the *Tartary* or *Rough buckwheat*, constitute an important source of flour. The fleshy fruits of several species of *Coccoloba*, of tropical America, are edible, as are the petioles of several species of *Rheum*, the well-known *Pie-plant*, and the leaves of *Rumex crispus* L. and of other species of *Rumex*. From a

medicinal point of view, the family is of considerable importance, yielding RHEUM and RUMEX, elsewhere considered. The prevailing property of the family is its astringency.

The root of *Rumex hymenosepalus* Torr. (*Cañaigre*) is an important tanning agent. This is a low-growing species, forming clumps or small beds in sandy soil through the southwestern United States and Mexico. The petioles are acid, and are sometimes used as a substitute for pie-plant. The fusiform, turnip-like roots are mostly about 15 Cm. (6 In.) long and a third as thick, when fresh, losing a third to a half of this thickness on drying. If dried entire, they are of a dark red-brown color, bearing a number of short transverse cracks, through which a light-brown inner layer can be seen. Internally they are of a bright reddish brown, with narrow wood-bundles and broad medullary rays. If first peeled, they dry with a number of sharp ridges separated by broad grooves. They contain about 25 per cent. of rheotannic acid, 18 of starch, about 1 of yellow resin, 20 of coloring-matter and sugar, and a trace of emodin.

Coccoloba Unifera L., the *Sea-* or *Tree-grape* or *Lobe-berry* of the West Indies, is similarly astringent, and an extract of its wood is somewhat known as *West Indian* or *Curaçoa Kino.*

The roots of many species of the large West American genus *Eriogonum* are highly astringent and furnish intestinal astringents to the aborigines and settlers.

The roots of many species of *Polygonum* (see *Bistorta*, sub GERANIUM) are similarly astringent. This genus is most noted, however, for the sharp acridity of the juices of a number of species, called on this account *Smart-weeds.* In medicine, the names *Polygonum*, *Water pepper*, and *Smart-weed* are commonly understood as applying to the fresh herbage of *P. hydropiper* L. It is a smooth annual, with weak stems, from 1 to 3 feet high, growing in and near water, in mud. The nodes are swollen and surrounded by cylindrical, shortly fringed sheaths. The leaves are lanceolate, more or less acuminate, ciliate, and pellucid-punctate, like the greenish, mostly 4-lobed calyx. The flowers are in panicled, drooping, mostly interrupted racemes and are greenish white, and usually 4-merons. The active principle is not understood, but has been called *polygonic acid.* It is destroyed by heating or drying. The plant contains 3 or 4 per cent. of tannin.

About 40 species of *Polygonum* are recorded as being medicinally employed. A number of species yield blue or yellow dyestuffs, and *P. tinctorium* Ait. is a source of Indigo in the Orient.

POPULUS CANDICANS.

Balm of Gilead Buds.

The buds of *Populus candicans* Ait. (*P. balsamifera candicans* A. Gray), gathered in late winter or early spring.

Origin.—The Balm of Gilead tree reaches a height of nearly 100 feet and a trunk diameter of 6 feet or more, abounding through eastern and central Canada and extending into the northern United States. The winter buds are very large and open in earliest spring, hence are very subject to injury from inclement weather and are specially protected by tough cartilaginous scales, heavily coated with oleoresin, the latter giving them their aromatic and medicinal properties.

FIG. 323.

Populus candicans buds (⅔ Nat.).

Description.—Solitary or 2 or 3 united by the bases; from 2 to 3.5 Cm. ($\frac{3}{5}$ to $1\frac{2}{5}$ In.) long by 6 to 9 Mm. ($\frac{1}{4}$ to $\frac{1}{3}$ In.) broad, ovate, long and sharply pointed, more or less flattened; surface exhibiting several large scales, dark brown, shining from the presence of a thick coat of soft and sticky resin; consisting of a series of thick, imbricated scales and enclosing one or more rudimentary catkins of rudimentary flowers, each subtended by a small fringed scale, and the whole held together by soft, sticky, yellowish-brown resin similar to that upon the surface; odor and taste pleasantly balsamic, the latter afterward a little acrid.

Constituents.—No examination of the constituents appears to have been made. The presence of volatile oil and resin are obvious. Black Poplar Buds contain an oil having the odor of chamomile, but that of the species under consideration is evidently quite distinct.

Action and Uses.—Populus candicans may be employed, like the other terebinthinates, as a stimulating expectorant, and in the form of ointment as an application to sluggish ulcers and sores.

POTASSA SULPHURATA, *Br.*—Sulphurated Potash.

Kalium sulfuratum, P. G.; *Hepar sulphuris.—Sulphurated potassa. Sulphuret of potassium, Liver of sulphur*, E.; *Sulfure de potasse, Foie de soufre*, Fr.; *Schwefelleber*, G.

A mixture of salts of potassium, of which the chief are potassium sulphides.

Origin.—The name "liver of sulphur" was introduced by Basilius Valentinus in the fifteenth century, but the process of melting together sulphur with an alkali was known already to Albertus Magnus in the thirteenth century, and the solubility of sulphur in alkalies to Geber in the eighth century. Spielmann (1766) recommended the preparation of liver of sulphur from 2 parts of potassium carbonate and 1 part of sulphur, in which proportions the ingredients are still employed.

Preparation.—The Br. P. directs sulphurated potash to be made by mixing potassium carbonate, previously dried, 10 ounces, and sulphur, 5 ounces, in a warm mortar, introducing the mixture into a crucible, which is heated, at first gradually, until effervescence has ceased, and finally to dull redness, so as to produce perfect fusion. The liquid contents of the crucible are poured out on a clean flagstone and quickly covered with an inverted porcelain basin, in order to prevent free access of air while solidifying. The solid product should, when cool, be broken into fragments and immediately enclosed in a green glass bottle furnished with an air-tight stopper.

On fusing sulphur with potassium carbonate the latter is decomposed, with the evolution of carbon dioxide, the sulphur uniting with the potassium to form a potassium polysulphide, a portion of which is oxidized by the oxygen of the carbonate, in excess over that contained in the carbon dioxide, to form potassium sulphate or thiosulphate; $4K_2CO_3 + 5S_2$ yields $K_2SO_4 + 3K_2S_3 + 4CO_2$, and $3K_2CO_3 + 4S_2$ yields $K_2S_2O_3 + 2K_2S_3 + 3CO_2$. But the degree of heat is likewise of importance, since at a high temperature the potassium thiosulphate is decomposed into pentasulphide and sulphate; $4K_2S_2O_3$ yields $K_2S_5 + 3K_2SO_4$. It is evident from this that products of very different composition are obtained by varying the proportion of the material; or, if this be used in the same relative proportions, by the injudicious application of heat, by which a part of the sulphur may be sublimed.

Properties and Tests.—Sulphurated potash, when recently made or well preserved in closed vessels, is in irregular fragments, breaking with a shallow conchoidal fracture and having a liver-brown color, which in contact with moisture changes to greenish yellow or brownish yellow. It has a slight odor of hydrogen sulphide, a bitter and acridly alkaline sulphurous taste, and an alkaline reaction to test-paper. It is partly deliquescent on exposure, and yields with water a brownish-yellow solution which has a strong odor of hydrogen sulphide, and evolves the latter freely on the addition of hydrochloric acid, sulphur being at the same time deposited. After boiling the hydrochloric acid solution until the hydrogen sulphide has been expelled, the liquid, freed from sulphur by filtration, will yield an abundant white crystalline precipitate with solution of tartaric acid (P. G.). About 50 per cent. of the sulphurated potash should be soluble in 90 per cent. alcohol (Br.).

When intended for internal use, the compound should be perfectly soluble in 2 parts of water. For external use an impurer article, *Kalium sulfuratum ad balneum*, is made like the above, with the exception that impure potassium carbonate (pearlash) is substituted for the purified.

If not protected from contact with air, sulphurated potash becomes green, and afterward gray, being partly converted into carbonate through the carbon dioxide of the air, and partly oxidized to thiosulphate, sulphite, and sulphate, sulphur being at the same time liberated.

Potassii Sulphidum.—*Potassium monosulphide.* K_2S.—Hydrogen sulphide gas is conducted into a solution of potassium hydroxide as long as it is absorbed, and an equal bulk of a like solution is added. The colorless liquid has a bitter taste and a strongly alkaline reaction, and on evaporation *in vacuo* yields colorless deliquescent quadrangular prisms, containing $5H_2O$, which are somewhat soluble in alcohol. The reactions taking place are: $KOH + H_2S = KSH + H_2O$ and $KSH + KOH = K_2S + H_2O$.

Besides the monosulphide and trisulphide, there are three others, namely, K_2S_2, K_2S_4, and K_2S_5. All except the monosulphide are yellow, and are oxidized when in contact with the air, forming potassium thiosulphate. They may be obtained by the action of sulphur on a solution of potassium hydrosulphide.

Potassii Sulphocarbonas.—*Potassium sulphocarbonate* or *thiocarbonate*, K_2CS_3.—On agitating a solution of potassium monosulphide with carbon disulphide the liquid acquires a yellow or red-brown color, according to its concentration and purity, and on careful evaporation at 30° C. (86° F.) yields orange-yellow deliquescent crystals of the hydrated salt, or a crystalline precipitate of the same salt on mixing the brown liquid with alcohol. It has a cooling, pungent, and somewhat sulphurous taste, and is sparingly soluble in alcohol. A solution containing also potassium carbonate, but sufficiently pure for destroying the *phylloxera* and other insects, is made by agitating potassium hydroxide solution with carbon disulphide as long as the latter is dissolved; and if alcohol be present, *potassium xanthogenate*, $K(C_2H_5)CS_2O$, is also formed. Both salts are slowly decomposed in the soil, with the liberation of carbon disulphide. Such a solution has been employed in Europe for the destruction of the phylloxera insect which infests grapevines.

Potassium Dithiocarbonate. K_2COS_2.—This is formed, as just stated, when carbon disulphide acts on hot caustic potash. It forms a reddish deliquescent salt, soluble in water and alcohol, and is employed in skin diseases as a 5 per cent. solution or ointment.

Action and Uses.—The disagreeable odor and taste of sulphurated potassa, and especially the doubt as to its merit in the host of diseases for which it has been recommended, account for its rare employment in internal medicine. Some of the diseases which it was thought to benefit were membranous croup, chronic rheumatism, gout, asthma, pulmonary tuberculosis, whooping-cough, and acute poisoning by lead, arsenic, and mercury. Externally, in lotions, baths, and ointments, it is employed with good effect in acne, psoriasis, scabies, and other skin eruptions. The strength of the lotion should be about 15 grains (1 Gm.) of the drug to the ounce (30 Cc.) of water, and of the bath, 15 grains (1 Gm.) to the gallon (4 L.). An ounce of ointment should contain about 30 grains of potassa sulphurata. If given internally, the dose is from 3 to 10 grains (0.20–0.60 Gm.).

POTASSII ACETAS, *U. S., Br.*—Potassium Acetate.

Kalium, s. Kali aceticum, Terra foliata tartari. Acetate of potash, E.; *Acétate de potasse*, Fr.; *Kaliumacetat, Essigsaures Kali*, G.

Formula, $KC_2H_3O_2$. Molecular weight, 97.44.

Potassium acetate should be kept in well-stoppered bottles and contain not less than 98 per cent. of pure salt.—U. S.

Preparation.—No method of preparation is given in the pharmacopœias. It may be obtained by almost neutralizing a solution of acetic acid with pure potassium carbonate or bicarbonate, filtering if necessary, and evaporating, first on a water-bath, then on a sand-bath, to complete dryness. Toward the end of the evaporation the mass must be stirred to prevent spurting. Acetic acid should be slightly in excess, since any excess of alkali would give rise to discoloration, which would also result if the temperature of the sand-bath were too high. With care, the powdery acetate may be fused without decomposition and obtained in masses on cooling. The salt should be bottled at once and the corks paraffined.

On adding potassium carbonate or bicarbonate to acetic acid effervescence of carbon dioxide takes place, and water and potassium acetate are formed; $K_2CO_3 + 2HC_2H_3O_2$ yields $2KC_2H_3O_2 + H_2O + CO_2$, and $KHCO_3 + HC_2H_3O_2 = KC_2H_3O_2 + H_2O + CO_2$.

Potassium bicarbonate is preferable in being nearly free from impurities and yielding at once a salt perfectly soluble in water. Potassium carbonate is less pure, but usually yields a clear solution with acetic acid, which, on being evaporated to dryness and again dissolved in water containing a little acetic acid, leaves some floccules of silica behind, from which it may be filtered and afterward again evaporated.

Potassium acetate may also be prepared from lead acetate by precipitating its solution with a slight excess of potassium carbonate, filtering, acidulating the filtrate with acetic acid, testing with hydrogen sulphide to insure its complete freedom from lead, and evaporating.

Properties.—Potassium acetate is a white salt forming a crystalline soft mass or a dry granular powder, or more frequently it is seen as a satiny, foliaceous, crystalline mass which melts to an oily liquid at about 292° C. (557.6° F.), and at a higher temperature evolves acetic acid, acetone, empyreumatic, and inflammable products (an alliaceous odor would indicate the presence of arsenic), and finally leaves a white residue

of potassium carbonate, which should be completely soluble in water. The salt is nearly inodorous, is free from acetous odor, has a warm and somewhat pungently saline taste, and is very deliquescent in the air. It dissolves at 25° C. (77° F.) in 0.40 part of water and in 2 parts of alcohol. The aqueous solution, saturated while boiling, contains 1 part of the salt to 0.125 part of water, and boils at 169° C. (336° F.) (Berzelius). Cold absolute alcohol dissolves one-third, and at the boiling temperature one-half, its weight of the salt. The alcoholic solution on the addition of ether gives a crystalline precipitate of the salt, and on passing carbon dioxide through it potassium carbonate is separated and acetic ether produced. The aqueous solution has a faintly alkaline reaction to litmus, but no effect on phenolphthalein, and disengages acetous vapors on the addition of sulphuric acid. The addition of sodium bitartrate test-solution to the concentrated aqueous solution causes a white precipitate of potassium bitartrate. With ferric chloride a dark-red color (ferric acetate) is produced, and, on boiling, a brown-red precipitate (ferric hydroxide). On triturating the salt with iodine it aquires an indigo-blue color, changing to brown on the addition of water.

Tests.—A solution of potassium acetate in distilled water slightly acidulated with acetic acid should not give a precipitate or a turbidity on the addition of an equal volume of hydrogen sulphide solution, when kept corked and warm for at least half an hour, either before or after making slightly alkaline with ammonia-water (absence of heavy metals). 5 Cc. of the aqueous solution (1 in 10) of the salt should not respond to the modified Gutzeit test for arsenic (see under ARSENI TRIOXIDUM).

If 1 Gm. of dry potassium acetate be thoroughly ignited, at red heat, and converted, the residue extracted with hot water and filtered, the filtrate should require for complete neutralization not less than 20.1 Cc. of half-normal sulphuric acid, methyl-orange being used as indicator.—U. S. Each Cc. of the acid solution represents 0.04872 Gm. of the acetate after it has been converted to carbonate, and 20.1 Cc. would show 97.93 per cent., instead of 98 as given above. This test is intended to prove the absence of sodium acetate and of more than 2 per cent. of moisture. The latter is more readily estimated by drying the salt at 120° C. (248° F.); considering the hygroscopic nature of the salt, 3 or 4 per cent. of moisture would seem to be admissible. The presence of notable quantities of sodium acetate is best determined by the intense yellow color imparted by the salt to a non-luminous flame. 4.9 Gm. of dry potassium acetate, evaporated to dryness with an excess of hydrochloric acid, leave a residue of KCl weighing 3.72 Gm., or, allowing for 2 per cent. of moisture, 3.645 Gm. The same weight of exsiccated sodium acetate leaves only 3.49 Gm., and of the crystallized sodium salt 2.104 Gm., NaCl. The U. S. P. (1900) has dropped the test for limit of chloride, while the Br. demands the absence of more than a trace.

Pharmaceutical Uses.—Potassium acetate, being unfit for dispensing in the dry state, is always prescribed in solution. For convenience in dispensing, the German Pharmacopœia recognizes—

Liquor Kalii Acetici, which contains one-third of its weight of the dry salt, and is prepared by neutralizing 100 parts of acetic acid, specific gravity 1.041, with 48 or 50 parts of potassium bicarbonate, expelling the carbon dioxide by heat, and diluting with sufficient water to obtain 147 parts. Its specific gravity is 1.176–1.180.

Action and Uses.—Potassium acetate, like the other alkaline salts of vegetable acids, is decomposed in the alimentary canal and absorbed into the blood as a carbonate, thereby increasing the normal alkalinity of that fluid and decreasing the normal acidity of the urine, which may be rendered distinctly alkaline if a sufficient quantity of the drug be given. The salt also increases the quantity of urine excreted. Because of these properties potassium acetate is employed in the alkaline treatment of acute rheumatism, and is held in esteem by some practitioners in the treatment of the so-called uric-acid diathesis and uric-acid gravel. It probably does good in these conditions by the thorough flushing the kidneys receive through the increase in the urinary flow, and by reducing the hyperacidity of the urine it relieves the irritability of the bladder. In the quantities that can be safely ingested the drug has no effect whatever toward the solution of calculi already formed. As a diuretic it may be given with advantage in dropsy due to acute desquamative nephritis and in other forms of renal and cardiac dropsy. It is a useful diaphoretic in acute febrile affections, especially in children. In doses of from ½ to 1 ounce (16–30 Gm.) it possesses purgative properties, for which it has been employed in catarrhal jaundice and in the jaundice of chronic malaria and hepatic torpor. At

one time it was supposed to purify the blood by aiding the oxidation of effete material. In psoriasis, eczema, and other cutaneous eruptions it may be given with benefit. The dose of potassium acetate as a diuretic is from 10 to 30 grains (0.60–2 Gm.) in a large quantity of water; as a purge, from ½ to 1 ounce (16–30 Gm.).

POTASSII BICARBONAS, *U. S.*, *Br.*—Potassium Bicarbonate.

Kalium bicarbonicum, P. G.; *Kali carbonicum acidulum.—Bicarbonate of potash, Potassium hydrogen carbonate*, E.; *Bicarbonate de potasse*, Fr.; *Kaliumbicarbonat, Doppeltkohlensaures Kali*, G.

Formula, $KHCO_3$. Molecular weight, 99.41.

The salt should be kept in well-stoppered bottles and contain not less than 99 per cent. of pure bicarbonate.—U. S.

Preparation.—This salt was first prepared by Cartheuser (1757) from potash and ammonium carbonate. Cavendish originated the process which is still used, acting with carbon dioxide upon a solution of the carbonate. The salt is best prepared on a large scale, and the essential feature of any method is the conversion of the very soluble normal carbonate, K_2CO_3, into the less soluble acid carbonate by the action of carbon dioxide; thus, $K_2CO_3 + CO_2 + H_2O = 2KHCO_3$. The completion of the change to bicarbonate is determined by adding to a portion of the solution mercuric chloride solution, which should give no red precipitate, or magnesium sulphate solution, which should give no precipitate (carbonate would give a red precipitate in the first case and a white one in the second). After 24 hours' standing in a cool place the crystals are filtered and washed with ice water and dried at 25° C. (77° F.) in an atmosphere of carbon dioxide. Potassium bicarbonate is manufactured to some extent from potassium chloride by the Solvay process described under SODII CARBONAS, but trimethylamine is used instead of ammonia, since the chloride of the former produced in the process is more soluble than the ammonium chloride, and thus permits of a greater concentration of the solution and larger yield of the potassium bicarbonate. The reaction is: $KCl + N(CH_3)_3 + H_2O + CO_2 = KHCO_3 + N(CH_3)_3HCl$. Another method of manufacture consists in saturating with carbon dioxide the caustic potash solution obtained by electrolyzing potassium chloride (see under POTASSIUM HYDROXIDE).

Properties.—Potassium bicarbonate crystallizes in transparent, colorless, monoclinic prisms, which are permanent in the air, inodorous, and have a saline and slightly alkaline, but not a caustic taste. At 100° C. (212° F.) it begins to lose CO_2 slowly, but the conversion to carbonate is not complete until 350° C. (662° F.) is reached, whereby 30.97 per cent. of the weight is lost. The salt is very sparingly soluble in alcohol, and at 25° C. (77° F.) dissolves in 3 (U. S.) (4, Br., P. G.) parts of water, or in 1.9 parts at 50° C. (122° F.) (U. S.). According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 23.23 parts, at 20° C. (68° F.) 26.91 parts, and at 60° C. (140° F.) 41.35 parts of the salt; the solution of the pure salt has at first a neutral reaction to litmus-paper and phenolphthalein, but soon becomes feebly alkaline by partial conversion of the salt into carbonate, effervesces briskly on the addition of acids, yields with an excess of tartaric acid a white crystalline precipitate of potassium bitartrate, and loses carbon dioxide slowly when evaporated *in vacuo*, and rapidly when heated to the boiling-point, leaving carbonate in solution. 5 Gm. of the salt exposed to a low red heat leave 3.45 Gm. of a white residue consisting of potassium carbonate.

14 parts of citric and 15 parts of tartaric acid are neutralized by 20 parts of potassium bicarbonate. A less pure potassium bicarbonate in a pulverulent state is met with in commerce under the name of *sal aëratus*, but much sold as such is sodium bicarbonate.

Tests.—The presence of potassium carbonate causes the bicarbonate to become moist on exposure, and its solution in cold water to yield a white precipitate with magnesium sulphate and a yellow or brick-red one with corrosive sublimate; the latter reagent produces a white precipitate with pure potassium bicarbonate. If to 1 Gm. of the salt, dissolved in 20 Cc. of water at or below 15° C. (59° F.) without agitation, 0.2 Cc. of normal hydrochloric acid and 2 drops of phenolphthalein test-solution be added, a red tint should not appear immediately (limit of carbonate). The aqueous solution of the salt, slightly acidulated with hydrochloric acid, should not give a precipitate or coloration when treated with hydrogen sulphide solution as described under POTASSIUM

Carbonate (absence of heavy metals). To neutralize 1 Gm. of potassium bicarbonate should require not less than 9.96 Cc. (10 Cc., Br. P. and P. G.) of normal sulphuric acid (corresponding to 99 per cent. of the pure salt), methyl-orange being used as indicator.—U. S. Each Cc. of normal acid is equivalent to 0.09941 Gm. of the salt. When heated to redness, the residue should be 69 per cent. of the weight of the salt (Br. P. and P. G.), which should not undergo temporary charring (P. G.). The U. S. P. of 1900 has omitted tests for limit of iron and chloride, while the Br. P. and P. G. give tests for these and sulphate, and in addition the Br. P. has tests for calcium, magnesium, sulphides, and nitrates. The latter seems to be a case of excessive refinement.

Metallic salts, if present as impurities, remain behind on dissolving the salt in water, or are indicated by producing a precipitate on the addition of hydrogen sulphide. Sodium salts present as impurities will impart an intense yellow color to a non-luminous flame. The complete solubility of the salt in 4 parts of cold water excludes notable quantities of sodium bicarbonate. Potassium bicarbonate represents 47 per cent. of K_2O, 44 per cent. of CO_2, and 9 per cent. of H_2O.

Action and Uses.—Potassium bicarbonate acts like the acetate and citrate in increasing the excretion of urine and reducing its acidity. Because of this action it relieves the pain and irritability of the bladder caused by a too acid urine. Its value in the gouty and uric-acid diathesis depends more upon the increased flow of urine produced by the drug than upon any specific action attributed to it in preventing the formation and deposition of uric acid or urates in the tissues. As an antacid it is beneficial in relieving the pain and eructations due to hyperacidity of the stomach contents, but it has been largely replaced by sodium bicarbonate in this condition.

Potassium bicarbonate frequently relieves jaundice, especially that due to a catarrhal condition of the mucous membrane of the bile-ducts and duodenum. Added to expectorant mixtures, it increases the bronchial secretion and renders it more fluid.

From potassium bicarbonate are made the liquor potassii citratis and neutral mixture, the latter by adding enough potassium bicarbonate to lemon-juice to neutralize it. The dose of potassium bicarbonate is from 5 to 40 grains (0.3–2.6 Gm.), but as much as 2 drachms (4 Gm.) may be given, well diluted with water.

POTASSII BITARTRAS, *U. S.*—Potassium Bitartrate.

Potassii tartras acidus, Br.; *Tartarus depuratus*, P. G.; *Cremor tartari, Kalium-bitartaricum.—Acid tartrate of potash, Cream of tartar*, E.; *Bitartrate de potasse, Crème de tartre, Pierre de vin*, Fr.; *Weinstein*, G.

Formula, $KHC_4H_4O_6$. Molecular weight, 186.78.

Potassium bitartrate should contain at least 99 per cent. of the pure salt.—U. S.

Origin.—Acid potassium tartrate is contained in many acidulous fruits, but is collected altogether from the juice of the grape, in which it becomes insoluble after fermentation, and is deposited in the casks in crystalline crusts. These form the *crude tartar* or *argol*, and consist of potassium bitartrate, with calcium tartrate, coloring and extractive matters, and yeast and other vegetable fragments. *Red argol* is deposited from red wines, and has a brownish color; *white argol*, obtained from white wines, is gray or brownish white. Crude tartar is not used medicinally, and little is collected in the United States; but the importation of it has increased from 6,965,015 pounds in 1876 to nearly 28,000,000 pounds in 1895, and nearly 23,500,000 pounds in 1897, the latter being valued at about $1,900,000. The quantity of crude tartar obtained from American wines is rapidly increasing.

Purification.—Crude tartar is boiled with water, much of the coloring-matter precipitated by the addition of clay, the liquid filtered through animal charcoal or otherwise clarified, and crystallized. The operation has to be repeated several times. The amount of calcium tartrate contained in crude tartar varies between about 5 and 15 per cent. Although this salt is insoluble in water, it dissolves to some extent (more in hot than in cold) solutions of tartrates; hence it can not be completely removed from cream of tartar by simple recrystallization. However, the crystals forming on the side of the crystallizing-vats contain less of this impurity than the crusts deposited at the bottom, and by careful management the amount may be reduced to about 3 per cent. or less.

To obtain potassium bitartrate free from calcium salt, finely powdered cream of tartar is macerated for 24 hours with 8 or 10 per cent. of hydrochloric acid, previously diluted with water; or it is dissolved in boiling water, the same amount of hydrochloric acid added, and the solution continually stirred while it cools. The mother-liquor is drained off, the crystalline powder washed with cold water, and dried. A considerable proportion of potassium bitartrate remains in the mother-liquor, and may be utilized in the preparation of tartaric acid by neutralizing it with lime, when calcium tartrate is deposited.

At the present time large quantities of cream of tartar are obtained in a high state of purity and in the form of fine powder, by what is termed the precipitation method. The lees or acid residues of wine-casks are partially neutralized with sodium carbonate and brought into solution in water, which solution is then allowed to percolate through soda-ash contained in stone cylinders. The solution of potassium and sodium tartrate thus obtained is allowed to crystallize for the purpose of purification, after which the slightly colored crystals are redissolved in water and decomposed by addition of acetic acid, as a result of which acid potassium tartrate, almost absolutely pure, is precipitated in powder-form, while sodium acetate remains in solution.

Properties.—When a hot solution of potassium bitartrate is rapidly cooled, the salt separates in very small crystals, which float on the liquid, and from this behavior it has received the name *cream of tartar*. The larger crystals, which are deposited, were formerly distinguished as *crystalli tartari*. They are rhombic prisms, and when pure are transparent, but as usually seen are more or less opaque from the presence of calcium tartrate. But in this form it is rarely kept in the shops, where it is almost exclusively employed in the form of powder. This is white, somewhat gritty, not altered on exposure, inodorous, and has a pleasant acidulous taste and distinct acid reaction. Potassium bitartrate requires at 25° C. (77° F.) 200 (U. S.), 192 (P. G.) parts, and at 100° C. (212° F.) 16.7 (U. S.), 20 (P. G.) parts of water for solution; it is freely soluble, with the formation of neutral salts, in ammonium and potassium hydroxide solutions, and in solution of alkali carbonates, with the evolution of carbon dioxide. It is insoluble in alcohol, is more soluble in dilute hydrochloric acid than in water, and is precipitated from this solution by alcohol; the solutions in dilute sulphuric and nitric acids, however, when mixed with alcohol, deposit potassium sulphate and nitrate. The solutions in alkaline liquids again deposit the salt on being sufficiently acidulated with hydrochloric, acetic, or other acid. In the aqueous solution of the salt, rendered neutral by potassium or sodium hydroxide test-solution, silver nitrate test-solution produces a white precipitate which, on boiling, becomes black by the separation of metallic silver. If, before boiling, sufficient ammonia-water be added to dissolve the white precipitate, the metal will, on boiling, form a mirror on the sides of the test-tube. When heated in a crucible it evolves inflammable gas and the odor of burning sugar, and leaves a black residue known as *black flux*, which is a mixture of potassium carbonate and charcoal; the latter is finally consumed on continuing the ignition with free access of air, leaving potassium carbonate or *white flux*. These fluxes are often made by deflagration of intimate mixtures of 2 parts of cream of tartar with potassium nitrate, using 1 part of the latter for the black and 4 parts for obtaining the white flux. On subjecting potassium bitartrate to destructive distillation, carbon dioxide, carbonic oxide, and various hydrocarbons are obtained in the gaseous state; also an aqueous liquid containing much acetic acid, a sublimate of pyrotartaric acid, various tarry products, and in the retort potassium carbonate.

Tests.—When potassium bitartrate is treated with a hot solution of potassium hydroxide whatever remains undissolved is impurity. In this way only the coarser adulterations, such as *terra alba*, sand, etc., or calcium tartrate if present as impurity to a considerable extent, can be detected. Cream of tartar has been adulterated with gypsum, chalk, alum, amylaceous substances (stale bread, etc.). These substances are best detected by treating 0.5 Gm. of the powder with 3 Cc. of ammonia-water, wherein it should be completely soluble. The residue left by ammonia will acquire a blue color on the addition of iodine if starch is present; cold dilute hydrochloric acid added to the residue will leave terra alba, starch, and some gypsum undissolved, and produce effervescence if chalk is present.

If 1 Gm. of the salt be well triturated with about 1 Gm. of potassium carbonate and 0.5 Gm. of potassium nitrate, and the mixture heated gradually to dull redness in a porcelain crucible, and, upon cooling, the resulting mass be treated with a slight excess of

diluted hydrochloric acid and filtered, the filtrate should not yield a gelatinous precipitate upon being made slightly alkaline with potassium hydroxide test-solution, soluble in excess of the reagent (absence of alum). If the precipitate be insoluble, it is collected and, after thoroughly washing with hot distilled water and dissolving in hot dilute nitric acid, no yellow precipitate should appear upon the addition of an excess of ammonium molybdate test-solution (absence of phosphates).

Chlorides and sulphates are most conveniently detected in the aqueous solution of cream of tartar, which, after addition of a few drops of nitric acid, should not be precipitated by barium nitrate (sulphates) or silver nitrate (chlorides). The aqueous solution (1 in 20) of the salt, slightly acidulated with hydrochloric acid, to which an equal volume of hydrogen sulphide solution is added, should not give a precipitate or coloration when kept closed in a warm place for at least half an hour, either before or after rendering slightly alkaline with ammonia-water (absence of lead, arsenic, etc.). No odor of ammonia should be evolved on heating the salt with a slight excess of potassium or sodium hydroxide test-solution. If 1 Gm. of potassium bitartrate be thoroughly ignited at a red heat, and the residue extracted with hot water and filtered, the filtrate should require for complete neutralization not less than 10.60 Cc. of half-normal sulphuric acid solution, methyl-orange being used as an indicator.—U. S. Each Cc. of the acid corresponds to 0.09339 Gm. of the salt and 10.60 Cc. corresponds to 0.9899 Gm., or 98.99 per cent. of pure salt. The German Pharmacopœia permits the presence of traces of chloride and of not more than 0.25 per cent. of calcium tartrate. For the detection of the latter it has adopted the test proposed by Biltz: 1 Gm. of the salt is repeatedly agitated and macerated for half an hour with 5 Cc. of 30 per cent. acetic acid; then dilute with 25 Cc. of distilled water, and to the clear decanted liquid add 8 drops of ammonium oxalate test-solution, when it should not become cloudy in less than 1 minute (P. G.). The diluted acetic acid (P. G.) is nearly identical with the acetic acid (U. S.). In the above test with 8 drops of ammonium oxalate solution a turbidity beginning after ½, 1, or 2 minutes indicates respectively $\frac{1}{3}$, $\frac{1}{4}$, or $\frac{1}{6}$ per cent. of calcium tartrate. This test has been omitted from the U. S. P. of 1900. The British demands that 1 Gm. of the salt shall require at least 5.2 Cc. of normal sodium hydroxide solution for neutralization, corresponding to 95.55 per cent., each Cc. of the acid corresponding to 0.18375 Gm. of the salt (Br. molecular weight = 183.75). This result seems contradictory to the further requirement of the Br. that the total amount of impurities should not exceed 2.5 per cent. of the dried salt.

Tartarus Boraxatus, P. G. *Cremor tartari solubilis, Kalium tartaricum boraxatum, Borax tartarisata.—Boro-tartrate of potassium and sodium*, E.; *Tartro-borate de potasse et de soude*, Fr.; *Boraxweinstein*, G.—2 parts of borax are dissolved in 15 parts of distilled water and digested with 5 parts of cream of tartar. When entirely dissolved, the filtered liquid is evaporated with constant stirring, the resulting residue dried in thin layers, and while still warm reduced to powder and preserved in well-corked bottles. —P. G. It is a white, amorphous, deliquescent powder of an agreeably acidulous taste and acid reaction. It is soluble in its own weight of cold and less than half its weight of boiling water, insoluble in alcohol, and when heated is decomposed, leaving a residue of borax, potassium carbonate, and charcoal. The aqueous solution of the salt is not altered by acetic acid or by a small quantity of diluted sulphuric acid, but after the addition of tartaric acid a crystalline precipitate is produced. Moistened with sulphuric acid, the salt imparts a green color to the flame of alcohol. A 10 per cent. aqueous solution should not be altered by ammonium sulphide (metals), should not evolve ammonia on being warmed with potassa, should not be precipitated by ammonium oxalate (calcium), and after the addition of a few drops of nitric acid it should not be precipitated by barium nitrate, and should merely become opalescent with silver nitrate.

Potassii Tartroboras.—*Potassium boro-tartrate*, E.; *Tartrate borico-potassique, Crême de tartre soluble, Tartre boraté*, Fr.; *Borsäureweinstein*, G.—4 parts of cream of tartar, 1 of boric acid, and 10 of water are heated together until dissolved; the solution is evaporated to dryness and the residue powdered.—Fr. Cod. It forms a white inodorous powder or may be obtained in thin transparent scales, has an acidulous taste, is not deliquescent, and dissolves in 2 parts of cold water. When long kept, it becomes less soluble in water, but its solubility is restored on treating it with boiling water.

Action and Uses.—Unlike the other potassium salts of vegetable acids, potassium bitartrate does not render the urine neutral or alkaline; on the contrary, it has a tendency to increase its acidity, and may be employed to neutralize or acidify an alkaline urine.

It resembles the above-mentioned salts, however, in that it produces diuresis, and is employed as a valuable diuretic in dropsy due to acute or chronic nephritis. In the latter disease it is administered in combination with jalap or senna or dissolved in infusion of juniper-berries (1 ounce (30 Gm.) of salt to 1 pint (480 Cc.) of infusion). In acute renal inflammation it should be used without the juniper. In large doses it exercises a laxative influence, and is occasionally combined with sulphur for this effect in the treatment of hemorrhoids. In household medicine it is frequently used to "cool the blood" in mild febrile attacks and skin diseases, and to allay thirst in summer. Added to sweetened water it makes a pleasant, acidulous, refrigerant drink.

The dose of the drug as a diuretic is from ½ to 2 drachms (2–8 Gm.), largely diluted with water; as a laxative, from ½ to 1 ounce (16–30 Gm.).

POTASSII BROMIDUM, *U. S.*, *Br.*—Potassium Bromide.

Kalium bromatum, P. G.; *Bromure de potassium*, Fr.; *Bromkalium, Kaliumbromid*, G.

Formula, KBr. Molecular weight, 118.22.

Potassium bromide should contain not less than 97 per cent. of pure salt.—U. S.

Preparation.—This salt, like many others, is best made on a large scale. One method consists in decomposing a solution of ferrous bromide (obtained by the action of bromine on iron under water) with potassium carbonate, heating the mixture, filtering, evaporating the filtrate, and crystallizing. The reaction is: $FeBr_2 + K_2CO_3 = FeCO_3 + 2KBr$, insoluble ferrous carbonate being precipitated. The latter is very bulky, but by boiling for some time it is converted into a denser ferric hydroxide, which is more readily washed out with water than the carbonate. The process followed by large manufacturers is to add bromine to a solution of potassium hydroxide until the liquid remains colored, evaporate it to dryness, and expose the saline residue, mixed with charcoal, in small portions at a time, to red heat in an iron crucible; the fused mass is treated with water, the resulting solution filtered and set aside to crystallize. When bromine and potassa are brought together, potassium bromide and bromate are formed; thus, $6KOH + 6Br = 5KBr + KBrO_3 + 3H_2O$; by heating the mixed salts with charcoal all bromate is reduced to bromide; thus, $KBrO_3 + 3C = KBr + 3CO$.

Properties.—Pure potassium bromide crystallizes in colorless cubes which are neutral to test-paper. It is met with in commerce in the form of a granular crystalline powder or of cubical crystals, which are white and glossy, and, having been obtained from an alkaline solution, have a slight alkaline reaction. It is permanent in the air, inodorous, has a pungent, saline taste, and when heated decrepitates, melts at 700° C. (1200° F.), and on cooling congeals again to a transparent mass; at a bright-red or at a white heat it is slowly volatilized without decomposition, communicating a violet color to the flame. It is soluble at 25° C. (77° F.) in about 1.5 (2, Br., P. G.) parts of water and in 180 parts of alcohol; in less than 1 part of boiling water, and in 16 parts of boiling alcohol; also soluble in 4 parts of glycerin.—U. S. The aqueous solution yields a white crystalline precipitate on the addition of tartaric acid or of a saturated solution of sodium bitartrate, and on the cautious addition drop by drop of chlorine-water diluted with an equal volume of water liberates bromine, which dissolves in chloroform or carbon disulphide with a reddish-yellow or brown-yellow color; this color should be free from any violet tint (absence of iodide). 1 Gm. of the powdered and dried salt, when completely precipitated by silver nitrate, yields, if perfectly pure, 1.579 Gm. of dry silver bromide. The precipitate is insoluble in nitric acid and in a moderate excess of ammonia-water.

Tests.—If 1 Gm. of the salt be dissolved in 10 Cc. of water and 0.1 Cc. (2 drops) of tenth-normal sulphuric acid be added, no color should be produced by the subsequent addition of a drop of phenolphthalein test-solution, even after heating (limit of alkali). If diluted sulphuric acid be dropped upon crushed crystals of the salt, and the mixture be shaken with 1 Cc. of chloroform, the latter should not assume a pink color (absence of bromate).—U. S. This test depends on the fact that bromic acid acts on hydrobromic acid liberating bromine: $5HBr + HBrO_3 = 3H_2O + 3Br_2$. 10 Cc. of the aqueous solution (1 in 20) should not be rendered turbid by an equal volume of hydrogen sulphide test-solution (absence of metals), P. G.; nor, when acidulated with hydrochloric acid, by 1 Cc. of potassium sulphate test-solution (barium), U. S., P. G.; nor by 1 Cc. of

barium chloride test-solution (sulphate), P. G.; nor be colored blue by 0.5 Cc. of potassium ferrocyanide test-solution after acidifying (iron), P. G. The Br. P. demands the absence of calcium, magnesium, sodium, ammonium, cyanide, thiocyanate, besides heavy metals, and allows only the slightest reactions for chlorides, iodides, and sulphates. The aqueous solution (1 in 20) of the salt, slightly acidulated with hydrochloric acid and mixed with an equal volume of hydrogen sulphide solution, should not give a precipitate or coloration after standing corked in a warm place for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals). If 0.3 Gm. of the well-dried salt be dissolved in about 50 Cc. of water, and 2 or 3 drops of potassium chromate test-solution be added, it should require not less than 24.6 Cc., nor more than 25.85 Cc. (not less than 25.11 Cc., nor more than 25.62 Cc., Br.; 25.4 Cc., P. G.) of tenth-normal silver nitrate solution to produce a permanent red color. —U. S. 0.3 Gm. of pure potassium bromide would require 25.38 Cc. of the volumetric solution, while 0.3 Gm. of potassium chloride would require 40.51 Cc.; hence 1 per cent. of chloride is represented by each 0.1513 Cc. of tenth-normal silver solution used in excess of 25.38 Cc. for 0.3 Gm. of the salt; therefore 0.47 Cc. (25.85–25.38 Cc.) excess of silver nitrate solution allowed in titration represents 3.1 per cent. of potassium chloride, assuming this to be the impurity present. If the quantity of silver solution used falls below that theoretically required, it is due to the presence of impurities which do not react with the silver nitrate, or to iodides. As the U. S. P. does not allow the presence of iodide, the lower figure, 24.6 Cc. of silver nitrate solution limits the amount of impurities having no action on it, and corresponds to 96.92 per cent. of bromide. The Br. P. places the limit of chloride at 1.6 per cent., and the P. G. restricts the impurity of chloride to 1.46 per cent. A very delicate test for chloride is the following: To a solution of the salt are added potassium dichromate and sulphuric acid, and the mixture distilled; the distillate will contain chlorochromic anhydride, CrO_2Cl_2, and after neutralization with ammonia will have a yellow color and show the reaction of chromates.

Action and Uses.—The chief influence of potassium bromide, which may be taken as a type of all the bromides which are employed in medicine, is exercised upon the nervous system. Upon the brain it acts as a sedative, its dominant effect being exercised upon that portion of the cerebral cortex which controls voluntary movements. In large doses it also acts as a sedative to the intellectual centres of the brain in the anterior convolutions, and massive doses, or large doses, frequently repeated, probably depress the perceptive centres in the posterior convolutions. Upon the motor pathways of the spinal cord it exercises little effect when given in medicinal amount, but upon the sensory portions of the spinal cord it is distinctly sedative in its influence. Medicinal doses probably have no effect upon the peripheral sensory nerves. It is eliminated from the body in all the secretions, but escapes chiefly through the kidneys. Its elimination is very slow, and for this reason, when administered day after day, it rapidly accumulates in the body, and produces more and more marked effects. The therapeutic deduction to be drawn from this fact is that many patients who require large doses at the beginning of its employment may, after several days, be kept thoroughly under its influence by doses which are not more than half as large as those which were first administered. Upon other portions of the body the bromide of potassium exercises comparatively little effect which can be used advantageously in medicine. When taken for a considerable period of time, particularly if the doses are large, it is very prone to produce acne of the face and back, which eruption progressively increases, both as to its distribution and severity, if the drug is continued, until a large number of well-developed pustules may be present. Associated with this acne the patient is found to be heavy and stupid, and often somnolent, his mental processes being so slow that a considerable length of time is required for him to grasp ideas or to express his thoughts.

The great diminution in reflex activity produced by the action of the drug upon the sensory portions of the nervous system results in a number of conditions which become more and more noteworthy as the use of the drug is continued. Digestion becomes impaired because the benumbing of the sensory nervous apparatus of the stomach results in a lack of recognition on its part of the presence of food, and a consequent failure to promptly secrete an adequate quantity of gastric juice. Constipation develops for similar reasons. The disorder of the digestion and the constipation are also in part due to the depressant influence which is exercised by the potash itself, and it is important to remember when large doses of the bromide of potassium are used that many of the

marked symptoms presented by the patient depend upon the action of the potassium rather than upon the bromine which is associated with it, and for the effects of which the combination has been employed. A few cases of epilepsy have been reported in which, because of idiosyncrasy to the drug, a condition of mental excitement has developed instead of mental sedation, the degree of excitement being so marked that the patient was insane for the time being. These cases are, however, so rare that they are curiosities in medicine. Those physicians who have employed the bromides in large doses and for long periods of time are agreed that the pustular acne, to which reference has already been made, may be diminished in its severity, or prevented from appearing to some extent by careful attention to the condition of the patient's bowels, holding that in many instances the eruption is in part due to the absorption of toxic matter from the alimentary canal. It is also the habit of these physicians to prescribe small doses of Fowler's solution of arsenic during the time that the bromide is being used, not only for its tonic influence, but to exercise a beneficial influence upon the skin.

Bromide of potassium is employed in medicine solely for its influence upon those portions of the nervous system which have already been named. In many instances it is a symptomatic remedy; that is to say, it is of value for the purpose of relieving symptoms which may be annoying, without any expectation that it will relieve the underlying disease. Thus, in epilepsy, the bromide of potassium is a standard palliative. In this malady it does good by depressing or quieting the motor area of the cerebral cortex, so that its disordered cells will not send out convulsive impulses. It probably does good in this disease, too, by its sedative influence upon the sensory portions of the system whereby excitation of the motor cortex of the brain is prevented by reason of the fact that the drug depresses the sensory pathways in the spinal cord, and so prevents peripheral impulses from reaching the central nervous system. When used in epilepsy it must be given in large enough doses to produce distinct physiological effects. In the majority of instances the best results which can be obtained from its use consist in the diminution in the frequency and severity of the fits. Occasionally, if all other conditions in and about the patient are favorable, it may diminish the frequency of the attacks to so great an extent as to produce a virtual cure, but these cases are, unfortunately, in the minority. Care must be taken that the drug is not used so long and in such full doses as to add its depressant effects to the mental deterioration which sometimes develops in epileptics. Its administration, therefore, must be cautious and carefully watched. Next to its employment in epilepsy, it has its greatest field of usefulness in the control of various manifestations of nervous excitation, varying from the mental distress and nervous irritability of overwrought men and women to the manifestations of fully developed hysteria. Here, again, it relieves the symptoms without curing the underlying cause of the condition. In infantile convulsions it is a most useful drug because of the physiological action already described. Under these circumstances, it may be given either by the mouth or by the rectum, according to the condition of the patient's stomach. In tetanus and strychnine-poisoning it does good by quieting the sensory portions of the spinal cord. One or two drachms are required in cases of this kind, and it may be necessary to repeat the dose several times. Certain forms of neuralgia, dependent upon irritability of the nervous system, may also be benefited by its use, particularly if it is combined with citrate of caffeine and one of the coal-tar products, this combination being the basis of most of the popular headache remedies of the day.

In persistent vomiting, due to irritability of the vomiting centre in the medulla, the bromide of potassium is a sovereign remedy. As a rule, it must be given by the rectum, as the stomach is not retentive enough to permit its absorption before it is vomited. In delirium tremens it is often used in full doses for its sedative effect, particularly if it is combined with chloral. Among the other uses of the bromide may be mentioned its employment in cases of hyperchlorhydria, in which condition it does good by diminishing the reflex activity of the nervous supply of the stomach. It is also of value in cases of sexual excitement or nymphomania, in irritability of the bladder, and in certain forms of nervous dysmenorrhœa. Certain physicians are in the habit of employing it, in moderate doses, for the relief of cardiac palpitation affecting neurotic persons or those who use tobacco to excess.

The dose of bromide of potassium varies from 5 to 60 grains (0.3–4 Gm.). For children the dose varies from 2 to 20 grains (0.05–1.3 Gm.).

POTASSII CARBONAS, *U. S., Br.*—Potassium Carbonate.

Kalium carbonicum, P. G.; *Potassii carbonas purus, Sal tartari.—Carbonate of potash, Salt of tartar*, E.; *Carbonate de potasse*, Fr.; *Kaliumcarbonat, Kohlensaures Kali*, G.

Formula, K_2CO_3. Molecular weight, 137.27.

Potassium carbonate should be kept in well-stoppered bottles and contain, when thoroughly dried, at least 98 per cent. of pure salt.—U. S.

Origin and Preparation.—Potassium carbonate is contained in many mineral waters, and is met with in the animal economy chiefly after the administration of potassium citrate or tartrate. Plants take their inorganic constituents from the soil, and when incinerated leave them behind as *ashes*. The ash of most plants contains potassium, sodium, calcium, and magnesium in combination with chlorine, carbonic, sulphuric, phosphoric, and silicic acids, usually ferric oxide, and occasionally some other elements. As a rule, plants grown near the seashore yield an ash rich in sodium, and those grown inland an ash in which potassium salts predominate. Succulent plants or parts of plants generally yield a larger percentage of ash (calculated for the exsiccated substance) than dry or woody parts. The amount of ash and its constituents necessarily varies to a certain extent, being influenced by the nature of the soil, the age of the plant, and by various other causes; the composition of the ash and of its soluble portion must therefore vary for the same species.

For a long time this article was chiefly obtained in those countries, as in some parts of Europe and North America, where wood is cheap or where its transportation to more remunerative markets is too costly, by burning the wood and lixiviating the ashes. The solution is obtained as concentrated as possible by passing the weaker liquids through fresh portions of ash, afterward evaporated and heated in iron vessels, so that on cooling it will solidify to a hard mass; this constitutes the *crude potash* of the market. This crude potash is of a more or less deep-brown, reddish-brown, or bluish color, due to organic impurities, and to iron, copper, or manganese; it is deliquescent on exposure and has a very caustic taste. It is not recognized by any of the pharmacopœias.

Large quantities of carbonate of potash are at present prepared from the ash obtained from the residue of the beet-sugar manufacture, which contains about one-third its weight of this salt, and is freed from other potassium and sodium salts by allowing these to crystallize from concentrated solutions at different temperatures. On washing the fleece of sheep with water, evaporating the solution, and igniting the residue, an ash is obtained containing but a small percentage of sodium salts and a larger proportion of potassium chloride and sulphate. The potassium salts obtained in these processes, notably in the former one in large quantities, also the potassium salts from the Stassfurt mines, are by suitable processes converted into potassium sulphate, and this salt into carbonate by a process similar to that of Leblanc for soda (see SODII CARBONAS), by heating the sulphate with lime and charcoal, whereby potassium carbonate and an insoluble calcium oxysulphide are formed.

Various methods of obtaining potassium carbonate from other sources have been recommended, and to some extent are used. E. Meyer (1857) proposed to ignite an intimate mixture of 10 parts of *feldspar* (aluminum and potassium silicate) with from 14 to 18 parts of lime, to boil the mass with water under pressure, and to evaporate the solution, at the same time conducting the products of combustion over the liquid, in order to convert the caustic potassa into carbonate and to precipitate the alumina which was in solution.

Another method recently applied consists in bringing together potassium chloride, crystallized magnesium carbonate, $MgCO_3.3H_2O$ (see MAGNESII CARBONAS), in water, and passing into the mixture carbon dioxide under pressure, when a double carbonate is formed, $KHMg(CO_3)_2 + 4H_2O$, which is difficultly soluble in water and even in dilute acids. By heating this salt with water to 120° C. (248° F.) it is decomposed, potassium carbonate going into solution.

Potassium carbonate from wood-ashes, at the present time, scarcely makes up one-half of the total production, and the supply from this source is becoming less each year.

When crude potash (*black salts*) is heated in a reverberatory furnace, organic impurities are burned out and a mass is obtained which, when cold, has a bluish-white color and is known as *Pearlash*. This is official in the P. G. as Kalium Carbonicum Crudum

(Potasche), and is required to contain for the anhydrous salt 90 per cent. of potassium carbonate, and 1 Gm. should require at least 13 Cc. of normal hydrochloric acid for neutralization.

It is a tedious matter to prepare pure potassium carbonate from pearlash, as the carbonate does not crystallize well and is very soluble in water, which facts render it almost impossible to get rid of all impurities. A pure salt can be obtained more expeditiously in an indirect way. When an organic salt of potassium is ignited, the residue left contains potassium carbonate. Cream of tartar, being the most common salt available for this purpose, was formerly more extensively employed than at present for preparing pure potassium carbonate; hence the name *salt of tartar*, which is, however, in the United States usually employed as a synonym for *purified* potassium carbonate. In making carbonate from potassium bitartrate, the latter is usually mixed with saltpeter, which should be entirely free from chloride, and then deflagrated by throwing the mixture in small portions into a red-hot crucible, when the potassium of both the bitartrate and nitrate is left behind as carbonate. In this way, *black* and *white flux* are prepared, of which the latter usually contains potassium nitrite. By exhausting the black flux with water and evaporating the solution a very pure potassium carbonate is obtained.

Pearlash may be considerably purified by extracting it with an equal weight of cold water, by which most of the less soluble impurities remain behind, and evaporating the solution to dryness. By converting the carbonate thus obtained into bicarbonate the latter salt may be obtained nearly chemically pure, and when heated to redness will give off water and carbon dioxide, and leave an equally pure carbonate; $2KHCO_3$ yields $K_2CO_3 + H_2O + CO_2$. In these operations only silver or clean iron vessels should be employed, for reasons explained under POTASSIUM HYDROXIDE.

Properties.—Potassium carbonate in its pure state is a white inodorous salt, sometimes crystalline, but usually in the form of a granular powder, which has a strong alkaline reaction and a strongly alkaline but scarcely a caustic taste, and is deliquescent in the air, forming a colorless or yellowish liquid of an oily appearance (*Oleum tartari per deliquium*). It is soluble in 0.91 part of cold water and in two-thirds its weight of boiling water, and from its concentrated solution may with some difficulty be obtained in transparent crystals containing 16.36 per cent. of water. It is insoluble in alcohol, dissolves in dilute acids with effervescence, and has the chemical behavior of potassium salts. A fragment of the salt attached to the loop of a platinum wire should impart a pure violet color to a non-luminous flame. A solution of the salt in a slight excess of diluted hydrochloric acid will give a yellow precipitate with platinic chloride test-solution, a white crystalline precipitate with a saturated solution of tartaric acid, and a yellow one with sodium cobalt nitrite solution. The salt when heated to 130° C. (266° F.) loses all the water it may have retained or absorbed (about 16 per cent., Br.); this exsiccated salt melts at a bright-red heat, and slowly volatilizes at a white heat.

Tests.—The aqueous solution (1 in 20), slightly acidulated with hydrochloric acid and mixed with an equal volume of hydrogen sulphide solution, should not give a precipitate or coloration after standing corked in a warm place for at least ½ hour, either before or after adding ammonia-water to slight alkalinity (absence of metallic impurities). If 5 Cc. of the aqueous solution be carefully mixed with an equal volume of concentrated sulphuric acid, and after cooling, 3 Cc. of ferrous sulphate test-solution be poured upon it so as to form a separate layer, no brown color should appear at the line of contact (absence of nitrate). No residue should be left on dissolving 1 Gm. of the salt in 20 Cc. of water (absence of earthy impurities). 20 Cc. of a solution of the salt (1 in 20) acidulated with hydrochloric acid should not be colored blue by 0.5 Cc. of potassium ferrocyanide test-solution (iron).—P. G. The 1900 U. S. P. has dropped the tests for thiosulphate, sulphate, sulphide, cyanide, and limit of chloride, for which see U. S. P., 1890, and the preceding edition of this book. The Br. P. and P. G. still retain tests for these impurities. 1 Gm. of the salt, weighed after thoroughly drying at 130° C. (266° F.), dissolved in about 50 Cc. of water, should require not less than 14.28 Cc. of normal sulphuric acid for neuralization, with methyl-orange as indicator. —U. S. 1 Cc. of the acid represents 0.068635 Gm. of the salt, hence 14.28 Cc. of the acid corresponds to 98 per cent. of pure salt in the dried specimen. According to the P. G., 1 Gm. of the salt, not dried, should require not less than 13.84 Cc. of normal acid, corresponding to 95 per cent. According to the Br., 1 Gm. should require at least 11.9 Cc. of normal sulphuric acid for neutralization, corresponding to 82 (81.64) per

cent. of anhydrous carbonate. Before applying the volumetric test the absence of notable quantities of sodium carbonate should be proved.

Liquor Kali Carbonici.—11 parts of pure potassium carbonate are dissolved in 20 parts of distilled water; the solution has the specific gravity 1.330 to 1.334, and 3 parts of it should contain 1 part of potassium carbonate.—P. G.

Potassii Percarbonas.—*Potassium percarbonate.* $K_2C_2O_6$.—This salt is obtained by passing an electric current through a saturated solution of potassium carbonate at —10° C. (14° F.). When dry, it is colorless and stable; but when moist, it has a bluish color and decomposes. Cold water decomposes it slowly, but when heated the action is more rapid: $K_2C_2O_6 + H_2O = 2KHCO_3 + O$. It is a good oxidizing agent, decolorizing indigo, etc. With dilute acids hydrogen peroxide is formed. It has been proposed to use the salt to bleach cotton-wool, silk, hair, wool, and feathers.

Action and Uses.—Potassium carbonate may be given for the same purposes as potassium bicarbonate (which see), but is rarely employed, because it is more apt to produce irritation of the stomach than is the latter drug. In concentrated solution it exercises a decided corrosive influence upon mucous membranes with which it comes in contact, and has produced death when taken into the stomach. The antidotes to it are vegetable acids and fixed oils. In the form of lotion, bath, and ointment it is used in some cutaneous diseases. The lotion should contain from 1 to 2 drachms (4–8 Cc.) of potassium carbonate to the pint (480 Cc.) of water, and the ointment 10 to 40 grains (0.6–2.60 Gm.) to the ounce (30 Cc.). The dose of potassium carbonate is from 10 to 30 grains (0.60–2 Gm.), well diluted in water.

POTASSII CHLORAS, *U. S., Br.*—Potassium Chlorate.

Kalium chloricum, P. G.; *Kali oxymuriaticum, Kali muriaticum oxygenatum.—Chlorate of potash*, E.; *Chlorate de potasse*, Fr.; *Kaliumchlorat, Chlorsaures Kali*, G.

Formula, $KClO_3$. Molecular weight, 121.68.

Potassium chlorate should be kept in glass-stoppered bottles and contain not less than 99 per cent. of pure salt. Great caution should be observed in handling it, as dangerous explosions are liable to occur when it is mixed with organic matter (cork, tannic acid, sugar, etc.) or with sulphur, antimony sulphide, phosphorus, or other easily oxidizable substances, and the mixture subjected to heat, or trituration, or concussion.—U. S.

Preparation.—At present potassium chlorate is largely made by a process similar to that given in the British Pharmacopœia, which consists in passing chlorine gas into water holding lime, or preferably magnesia, in suspension, by which means chloride and hypochlorite of the respective metals are formed. The latter salt is decomposed by heat into chlorate and chloride, and upon treating the solution with potassium chloride a reaction sets in, by which potassium chlorate and calcium or magnesium chloride are formed, the latter salts remaining in solution, while the potassium chlorate crystallizes out. Magnesia is preferred to lime, as potassium chlorate is less soluble in solution of magnesium chloride than of calcium chloride. The reactions involved may be expressed as follows: $2Ca(OH)_2 + Cl_4 = Ca(ClO)_2 + CaCl_2 + 2H_2O$; $3Ca(ClO)_2 = Ca(ClO_3)_2 + 2CaCl_2$; $Ca(ClO_3)_2 + 2KCl = 2KClO_3 + CaCl_2$.

Large quantities of the salt are produced both in this country and in Europe by a process which consists in passing an electric current through a heated solution of potassium chloride, whereby chlorine collects around one pole (the positive) and potassium hydroxide around the other. The solution of potassium hydroxide by a process of circulation is carried to the compartment of the next cell containing the positive pole, and so on, by which it comes in contact with chlorine and forms chlorate, which continually crystallizes out. The change is most simply expressed thus: $2Cl + H_2O = 2HCl + O$; $KOH + HCl = KCl + H_2O$; $KCl + 3O = KClO_3$.

The salt is also manufactured by boiling together in solution chlorinated lime and potassium chloride: $KCl + 3CaOCl_2 = KClO_3 + 3CaCl_2$. On cooling, the chlorate crystallizes out.

Potassium chlorate seems to have been known to Glauber (1657); it was described by Higgins (1786) as a kind of saltpeter, and was recognized by Berthollet (1786) as the compound of a hitherto unknown acid.

Properties.—Potassium chlorate crystallizes in colorless shining plates or in short monoclinic prisms. It is inodorous, has a cooling, saline taste, and neutral reaction, is

permanent in the air, melts without decomposition at 334° C. (633.2° F.), gives off oxygen above 352° C. (665.6° F.); at the same time it forms potassium perchlorate, and at a higher temperature, above 400° C. (752° F.), parts with all its oxygen (39.2 per cent. of its weight), leaving 60.8 per cent. of potassium chloride having the properties described below. It requires, at 25° C. (77° F.), 16 U. S., 16 Br., P. G., parts of water for solution, or 1.7 U. S., 3 Br., 2 P. G., parts of boiling water.—U. S.

Ammonium nitrate increases, but ammonium chloride and acetate decrease the solubility in water (Pearson, 1869). The salt is slightly soluble in diluted alcohol, but is insoluble in absolute alcohol. As ordinarily met with in commerce, the salt contains traces of calcium chloride, from which it is freed by dissolving it in 2 or 3 times its weight of hot distilled water, and stirring the solution while cooling; it will then be obtained in small crystals, which, after draining and washing with cold water, are pure. The saturated aqueous solution of the salt yields with tartaric acid a white precipitate of potassium acid tartrate, and with platinic chloride solution a copious yellow precipitate is produced. When strong sulphuric acid is added to potassium chlorate, *chlorine dioxide*, ClO_2, is formed: this is a yellow heavy gas, which, in the presence of combustible matter or by a slight elevation of temperature, is decomposed with a powerful explosion into oxygen and chlorine. On adding hydrochloric acid to potassium chlorate a deep-yellow, dangerously explosive gas, the *euchlorine* of Davy, is produced; it is a mixture of chlorine and chlorine dioxide.

Tests.—The aqueous solution, containing 5 (Br. P., P. G.) per cent. of potassium chlorate, should not be precipitated by barium chloride (sulphate), silver nitrate (chloride), or ammonium oxalate (calcium salt). The U. S. P., 1900, has omitted these three tests as the impurities are innocuous, and with a limit of purity of 99 per cent. may be disregarded. If 1 Gm. of the salt, 5 Cc. of water, 5 Cc. of potassium hydroxide test-solution, and about 0.2 Gm. of aluminum wire, contained in a 40 Cc. test-tube, into the upper part of which is inserted a pledget of purified cotton, be heated on a water-bath for 15 minutes, no blue coloration should be imparted to moistened red litmus-paper placed over the mouth of the tube (limit of nitrates and nitrites). The aqueous solution (1 in 20) of the salt should not become discolored upon adding ammonium sulphide test-solution (absence of heavy metals).

Action and Uses.—The chlorate of potassium is a drug which has a very limited range of usefulness. At one time it was largely employed with the idea that by its administration the body might be provided with an additional quantity of oxygen over and above that taken from the air by the lungs. We now know that the quantity of oxygen which can be obtained from any dose of chlorate of potassium which is safe to administer is too small to be of any use, and we also know that chlorate of potassium does not part with its oxygen until it is heated to a temperature far higher than that of the human body. Increasing experience has also taught us that, next to the cyanide of potassium, it is one of the most poisonous of the potash salts which are used in medicine, not only exercising a destructive action upon the blood and producing methæmoglobin, but also by its depressant action upon the nervous system and by its irritant effect upon the kidneys. It is also capable of producing widespread fatty degeneration if taken in poisonous doses. In a number of cases its use in very large doses has resulted in death. In all probability its administration to patients whose kidneys are impaired by disease has in the past hastened dissolution, particularly as some practitioners have given it internally in large doses in the treatment of diphtheria with the idea that it would favorably affect the diseased mucous membrane of the pharynx or provide more oxygen to the tissues.

The drug escapes from the body by all the secretions, and particularly in the saliva. Because of its elimination through the salivary glands it exercises a continual influence upon the oral mucous membrane, and in cases in which the kidneys and stomach are healthy it may be given in small doses internally in the treatment of aphthous stomatitis with advantage. It is also used as a gargle, in the strength of from 2 to 10 grains (0.1–0.60 Gm.) to the ounce (30 Cc.), in cases of simple and follicular pharyngitis. Certain English practitioners have also advised its internal use in women who have a tendency to abort. How it can do good under these circumstances it is difficult to understand.

The dose of chlorate of potassium for internal use is 2 to 10 grains (0.1–0.60 Gm.).

POTASSII CITRAS, *U. S., Br.*—Potassium Citrate.

Kalium citricum.—Citrate of potash, E.; *Citrate de potasse,* Fr.; *Kaliumcitrat, Citronsaures Kali,* G.

Formula, $K_3C_6H_5O_7 + H_2O$ or $C_3H_4(OH)(COOK)_3 + H_2O$, U. S.; $C_3H_4(OH)(COOK)_3$, Br. Molecular weight, 322.08.

Potassium citrate should be kept in well-stoppered bottles and contain not less than 99 per cent. of pure salt.—U. S.

Preparation.—The pharmacopœias give no formula for preparing this salt. It may be prepared by neutralizing a solution of citric acid with potassium carbonate, or bicarbonate, and evaporating the solution to dryness, with constant stirring, so as to obtain the salt in small granules. The finished product retains a little over 5.5 per cent. of water, but should be free from impurities; the commercial article is frequently acid, showing imperfect saturation. As the salt is deliquescent, it must be well protected against air. The reaction taking place is: $3KHCO_3 + H_3C_6H_5O_7.H_2O = K_3C_6H_5O_7 + 3CO_2 + 4H_2O$. On evaporating the clear solution the heat should not be permitted to rise high enough to burn the salt. When dry, it may be triturated in a warm mortar; and may thus be rendered uniformly pulverulent.

Properties.—Potassium citrate is a white granular inodorous powder having an alkaline reaction to litmus-paper, but no effect on phenolphthalein, and a saline, cooling (feebly acid, Br.) taste. It is deliquescent on exposure, dissolves in 0.5 part of water at 25° C. (77° F.) (U. S.), and is more freely soluble in boiling water. It is insoluble in absolute alcohol, and forms with dilute alcohol a solution upon which a stronger alcohol floats. Its solution gives a white crystalline precipitate with a saturated solution of sodium bitartrate, but it remains clear on the addition of calcium chloride till it is boiled, when a white precipitate of calcium citrate takes place, which is readily soluble in acetic acid. From its concentrated solution it may be procured in transparent needles which have the above composition and contain $H_2O = 5.55$ per cent. This water of crystallization is not completely expelled until the heat is raised to about 200° C. (392° F.), a portion being retained by the salt as prepared by the above process. At about 230° C. (446° F.) the salt begins to turn brown, and at a higher temperature is completely decomposed, inflammable vapors having a very pungent, acid odor being given off, while potassium carbonate remains behind mixed with charcoal, which latter is with difficulty completely consumed by continued heating. The salt, heated with strong sulphuric acid, yields a brown liquid, gives off an inflammable gas (carbonic oxide), and evolves the odor of acetic acid. If 1 Gm. of potassium citrate be thoroughly ignited at red heat, and the residue extracted repeatedly with hot water, the filtrate on cooling should require for complete neutralization not less than 18.4 Cc. of half-normal hydrochloric acid, methyl-orange being used as indicator. This corresponds to 98.77 per cent. of pure salt. Each Cc. of the acid represents 0.05368 Gm. of the salt. This test recognizes a salt containing 5.55 per cent. or less of water, while the Br. P. requires the anhydrous salt, of which 1 Gm. heated to redness until gases cease to be evolved, leaves an alkaline residue requiring for exact neutralization at least 9.7 Cc. of normal solution of sulphuric acid, corresponding to 98.33 per cent. of anhydrous salt.

Tests.—The aqueous solution of the salt should not be colored red by a drop of phenolphthalein test solution nor effervesce on the addition of acetic acid (absence of carbonate) or produce with it a crystalline precipitate (absence of tartrate). The aqueous solution (1 in 20), slightly acidulated with acetic acid, should not give a precipitate with hydrogen sulphide, neither before nor after addition of ammonia-water, after standing corked in a warm place for at least half an hour (absence of heavy metals).

Action and Uses.—Potassium citrate is an efficient refrigerant, diaphoretic, and diuretic in acute febrile attacks, especially in children. Its efficiency in fever may be enhanced by the adding to its solution spirit of nitrous ether and small doses of aconite. Under its influence highly acid and irritating urine becomes neutral or alkaline and bland. The official solution of the drug (Liquor Potassii Citratis) is a convenient substitute for the old neutral mixture made from lemon-juice and potassium bicarbonate or carbonate, but it lacks the pleasant taste of the latter preparation. Potassium citrate is given in the dose of from 5 to 30 grains (0.3–2 Gm.), the liquor potassii citratis, in the dose of from 2 to 8 drachms (8–30 Cc.).

POTASSII CITRAS EFFERVESCENS, *U. S.*—Effervescent Potassium Citrate.

Preparation.—Potassium citrate, 200 Gm.; citric acid, in uneffloresced crystals, 162 Gm.; sodium bicarbonate, dried and powdered, 477 Gm.; tartaric acid, dried and powdered, 252 Gm. Dry the potassium citrate on a water-bath until it ceases to lose weight; powder and mix it intimately with the citric and tartaric acids, then thoroughly incorporate the sodium bicarbonate. Place the mixture on a plate of glass or in a suitable dish, in an oven heated between 93° and 104° C. (199.4° and 219.2° F.). When the mixture, by the aid of careful manipulation with a wooden spatula, has acquired a moist consistence, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep it in well-stoppered bottles. The yield is about 1000 Gm.—U. S.

When the salt is dissolved in water, the sodium bicarbonate is decomposed by the free acids, causing effervescence by the escape of carbon dioxide, and the formation of sodium citrate and sodium tartrate. 1 part of tartaric acid decomposes 1.12 parts, and 1 part of citric acid decomposes 1.203 parts of sodium bicarbonate. Hence the quantity of the respective acids in the formula will decompose 477 Gm. of the bicarbonate, which is the weight given in the official formula. Upon solution of the effervescent salt in water, the carbonic acid present renders the taste agreeably acidulous and refreshing. The temperature prescribed by the pharmacopœia must not be exceeded, to avoid fusion and subsequent decomposition, which would color the mixture and develop a disagreeable, bitterish taste.

Action and Uses.—This preparation affords a convenient and pleasant means of administering potassium citrate. It is given in doses of from 1 to 2 drachms (4–8 Gm.) in water, to be drunk while effervescing.

POTASSII CYANIDUM, *U. S.*—Potassium Cyanide.

Kalium cyanatum, Cyanuretum potassicum s. kalicum.—Cyanure de potassium, Fr.; *Kaliumcyanid, Cyankalium*, G.

Formula, KCN. Molecular weight, 64.7.

The salt should be kept in well-stoppered bottles and should contain not less than 95 per cent. of pure potassium cyanide.—U. S. It has been dropped from the Br. (1898).

Preparation.—Potassium cyanide of the purity required by the U. S. Pharmacopœia is best prepared by generating hydrocyanic acid from 2 parts of potassium ferrocyanide with the requisite quantity of sulphuric acid, and conducting the gas into a solution of 1 part of potassium hydroxide in 5 or 6 parts of strong alcohol; the bulky crystalline precipitate is drained upon a funnel, washed with strong alcohol, and dried between bibulous paper at a moderate heat.

Another process for obtaining pure potassium cyanide consists in heating dry potassium ferrocyanide to low redness, excluding the air until the residue has cooled. Nitrogen is liberated and escapes, and the potassium cyanide remains mixed with carbide of iron; $K_4Fe(CN)_6$ yields $4KCN + FeC_2 + N_2$. Air is excluded to prevent oxidation of cyanide to cyanate. The cold mass is extracted with hot 60 per cent. alcohol, and the solution evaporated, when pure cyanide is obtained. The mass can also be extracted with hot water, but on evaporating this solution some cyanide is decomposed into ammonia and potassium formate and a less pure product results: $KCN + 2H_2O = HCOOK + NH_3$.

F. and E. Rogers (1834) devised a process which is extensively used on a large scale. It consists in heating desiccated potassium ferrocyanide (8 parts) with potassium carbonate (3 parts) to redness, until the mass ceases to effervesce, and pouring out the upper white layer, which is free from the black residue of iron, on a slab. The reaction is explained by the equation, $2K_4Fe(CN)_6 + 2K_2CO_3 = 10KCN + 2KCNO + Fe_2 + 2CO_2$, showing that, besides cyanide, potassium cyanate is also formed, carbon dioxide is evolved, and iron is separated in the metallic state: the cyanate may be removed by means of alcohol or carbon disulphide. Both salts must be well dried before they are

mixed, otherwise considerable ammonia is given off; and if the carbonate is contaminated with sulphate, the fused mass will contain a corresponding amount of potassium sulphide. A portion of the product remains in the crucible with the iron; but if it is dissolved with water, it becomes contaminated again with potassium ferrocyanide, which may be regenerated by digestion with sulphide of iron and crystallization to free it from potassium sulphide. The commercial cyanide prepared thus is usually very impure, containing hydroxide, carbonate, cyanate, and formate of potassium, sometimes as much as half the weight of the product. It is known in commerce as *Liebig's cyanide.*

A very pure cyanide is now made by fusing together anhydrous potassium ferrocyanide and metallic potassium and filtering the molten mass through porous clay. The reaction is: $K_4Fe(CN)_6 + K_2 = 6KCN + Fe$. For commercial purposes a mixed cyanide of potassium and sodium is produced by the same method, except that in place of metallic potassium the less expensive sodium is used.

Properties.—Thus prepared, potassium cyanide is a white granular powder consisting of minute transparent cubes, or after melting at a dull-red heat it forms on cooling a white, opaque crystalline mass. When perfectly dry, it is inodorous; but when moist, it is decomposed by the carbon dioxide of the atmosphere and has the odor of hydrocyanic acid. It has an alkaline and bitter taste, reacts strongly alkaline upon test-papers, is deliquescent on exposure, and is freely soluble in water, but is nearly insoluble in absolute alcohol. 80 parts of boiling 90 per cent. alcohol dissolve 1 part of the cyanide; weaker alcohol dissolves it in larger proportion. The aqueous solution dissolves iron, zinc, copper, and nickel, with the evolution of hydrogen, and, in the presence of oxygen, also silver and gold. The solution yields with a saturated solution of sodium bitartrate a white crystalline precipitate, and with sodium cobaltic nitrite test-solution a copious yellow precipitate is produced. The aqueous solution is decomposed on exposure to the air, absorbs carbon dioxide, becomes brown, and deposits a dark-brown precipitate; on boiling, it is partly decomposed, yielding ammonia and potassium formate. The salt fused in contact with the air is partly oxidized to cyanate, and if fused with sulphur yields potassium sulphocyanate.

Impure potassium cyanide, as obtained by the first process, and which is extensively used in the arts, has similar properties, but is in white, opaque pieces. When dissolved in water the cyanate contained in it is gradually decomposed, with the formation of potassium and ammonium carbonates; $2KCNO + 4H_2O$ yields $K_2CO_3 + (NH_4)_2CO_3$.

Tests.—The impurities likely to be present in medicinal potassium cyanide are carbonate and chloride. A solution of the salt in 20 parts of water should not effervesce with hydrochloric acid or should disengage merely isolated gas-bubbles (limit of carbonate). After the acid has been added in slight excess, a drop of ferric chloride test-solution should produce neither a blue (absence of ferrocyanide) nor a red color (sulphocyanate). A few drops of the aqueous solution give with silver nitrate test-solution a white precipitate, which is soluble in an excess of the solution of potassium cyanide, also in ammonia-water, and in concentrated nitric acid (distinction from silver chloride). If 5 Cc. of the solution be shaken with a few drops of ferrous sulphate test-solution and ferric chloride test-solution, and a slight excess of hydrochloric acid then added, a precipitate of Prussian blue will be produced. On heating to redness a mixture of 1 part of the salt with 3 parts of ammonium carbonate, dissolving the residue in water, and acidulating with nitric acid, the solution should give no (or only a faint) turbidity with silver nitrate (chloride). The U. S. Pharmacopœia (1900) has dropped this test. If 1 Gm. of the salt be dissolved in distilled water to the volume of 100 Cc., then 64.7 Cc. of this solution mixed with 5 Cc. of ammonia-water and 3 drops of potassium iodide test-solution should require not less than 47.5 Cc. of tenth-normal silver nitrate solution before the appearance of a permanent precipitate (each Cc. of the silver solution indicating 2 per cent. of pure potassium cyanide).—U. S. In the titration, silver cyanide, which is at first formed, remains dissolved in the remaining unconverted alkali cyanide. As soon as exactly one-half of the hydrocyanic acid has been converted into silver cyanide, as shown by the equation, $2KCN + AgNO_3 = AgCN.KCN + KNO_3$, the solution becomes cloudy by the precipitation of silver iodide, which is insoluble in the ammonia-water. Potassium iodide solution thus acts as an indicator to show when exactly half of the cyanide has been titrated, which is taken as the end-point. Hence, from the equation, it follows that 1 molecule of $AgNO_3$ is equivalent to 2 molecules of KCN (molecular weight, 64.7), or 1 Cc. of tenth-normal solution of silver nitrate is equivalent to 0.01294 Gm. of KCN,

which is 2 per cent. of 0.647 Gm. of the alkali cyanide contained in the 64.7 Cc. of solution taken for the assay. Owing to the frequency with which sodium cyanide is found in potassium cyanide, the titration method does not give the true amount of potassium salt, since it does not distinguish between cyanides of potassium and sodium, but it does give the true amount of hydrocyanic acid which is in combination. If the salt contains only potassium cyanide besides other foreign substances, 95 per cent. of KCN required by the U. S. P. would represent 39.4 per cent. of HCN. It is immaterial if the salt contains sodium cyanide as far as its efficiency is concerned, as a mixed cyanide containing 39.4 per cent. HCN has the same efficiency as potassium cyanide alone containing 95 per cent. KCN. The Cc. of tenth-normal silver solution used multiplied by 0.00537 gives the weight of HCN in the amount of salt titrated, whether the latter be pure KCN or a mixtura of KCN and NaCN.

Potassium cyanide is used extensively in the arts in electroplating with gold, silver, and nickel, in photography, in extracting gold and silver from ores and fine residues or "tailings."

Action and Uses.—Potassium cyanide possesses an identical physiological action with hydrocyanic acid, for which it may be substituted (see ACIDUM HYDROCYANICUM DILUTUM). It has the advantage over dilute hydrocyanic acid in being more stable and uniform in strength. Overdoses are as rapidly lethal as those of the latter drug. In addition to its internal use a solution containing 2 to 4 grains (0.10–0.25 Gm.) of the drug to the ounce (30 Cc.) of water has been employed as a sedative application for the relief of headache and neuralgia. To remove the stain of silver nitrate from the skin, muslin, linen, etc., a solution of potassium cyanide, 5 to 10 grains (0.3–0.60 Gm.) to the ounce (30 Cc.) of water, is serviceable. A more efficient solution for this purpose contains 2½ drachms (10 Gm.) of potassium cyanide, 15 grains (1 Gm.) of iodine in 3 ounces (90 Cc.) of water. Potassium cyanide is given in the dose of from $\frac{1}{12}$ to $\frac{1}{8}$ grain (0.005–0.008 Gm.).

POTASSII DICHROMAS, *U. S., Br.*—Potassium Dichromate.

Potassii bichromas, U. S., 1890; *Kalium dichromicum*, P. G.—*Bichromate of potash, Red chromate of potassium*, E.; *Bichromate de potasse*, Fr.; *Kaliumdichromat, Doppeltchromsaures Kali*, G.

Formula, $K_2Cr_2O_7$. Molecular weight, 292.28.

Potassium dichromate should contain not less than 99 per cent. of the pure salt.—U. S.

Origin.—The metal *chromium* was discovered by Vauquelin in 1797 in a Siberian mineral which is composed of lead chromate, but it is more abundantly found as *chrome iron ore*, which is a compound of chromic and ferrous oxides, $FeO.Cr_2O_3$. It is met with in several localities in the United States, in Russia, and in Sweden, and is used in preparing the dichromate.

Preparation.—The finely ground chrome-iron ore, mixed with potassium carbonate and calcium hydroxide or carbonate, is roasted in a reverberatory furnace, which causes the separation of all iron in the form of ferric oxide and the production of potassium chromate from the newly formed chromic acid; lime or chalk is added simply to prevent fusion of the mixture. The following equation explains the reaction: $2FeOCr_2O_3 + 4K_2CO_3 + 7O = Fe_2O_3 + 4K_2CrO_4 + 4CO_2$. After the roasting or oxidation has been completed the mass is lixiviated with water, which dissolves the yellow potassium chromate; the latter salt, upon addition of sulphuric acid, yields potassium dichromate and sulphate, the two salts being separated by crystallization: $2K_2CrO_4 + H_2SO_4 = K_2Cr_2O_7 + K_2SO_4 + H_2O$. In order to explain the constitution of dichromates it must be assumed that chromic anhydride is capable of forming two acids, namely, $CrO_3 + H_2O = H_2CrO_4$, chromic acid, and $2CrO_3 + H_2O = H_2Cr_2O_7$, dichromic acid.

Properties.—Potassium dichromate crystallizes in large orange-red transparent triclinic prisms or 4-sided plates, which are inodorous and are not altered on exposure. The salt melts below a red heat to a transparent dark brown-red liquid, which, on cooling, crystallizes and finally falls into a crystalline powder. At a white heat the salt is decomposed into oxygen gas, green chromic oxide, and yellow potassium chromate. The dichromate is insoluble in alcohol; it is soluble in water, 1 part of the salt requiring

at 0°	10°	20°	40°	60°	80°	100° C.
20.14	11.81	7.65	3.43	1.98	1.37	0.98 parts of water (Kremers).

The U. S. and P. G. give the solubility in water at 25° C. (77° F.) as 1 in 9 and as 1 in 1.5 parts of boiling water. The solution has an orange-red color, an acid reaction, and a bitter, styptic, metallic taste, and is deoxidized, with the formation of chromic oxide or chromic salts, on the addition of hydrogen sulphide, sulphurous acid, or of sulphuric acid and alcohol, or other organic matters. Heated with hydrochloric acid, chlorine is given off. The solution yields a pale-yellow precipitate with barium chloride, a yellow one with lead acetate, and a purplish-red one with silver nitrate, the three precipitates being soluble in nitric acid. With a cold saturated solution of sodium bitartrate a white crystalline precipitate of potassium bitartrate is produced, and sodium cobaltic nitrite produces a copious yellow precipitate.

Tests.—As met with in commerce, the salt is usually pure. Its solution in 100 parts of water should not be precipitated on the addition of excess of potassium carbonate (absence of calcium salt), and after having been acidulated with nitric acid should not be disturbed by barium chloride (absence of sulphates) or by silver nitrate (chlorides).

Composition and Uses.—The salt is free from water, and represents 31.86 per cent. of K_2O and 68.14 per cent. of CrO_3; it may be regarded as a compound of chromic anhydride with potassium chromate $= K_2CrO_4.CrO_3$, or as the neutral salt of *dichromic acid*, $H_2Cr_2O_7$, which is not known in the uncombined state. The chief use for the salt is as an oxidizer when mixed with sulphuric or acetic acid in chemical industries, particularly in the oxidation of anthracene to anthraquinone, from which alizarine is manufactured. Large quantities are also used for rapid tanning, which has been introduced in late years. It is used also in certain kinds of electric cells.

Action and Uses.—Potassium dichromate is a caustic like chromic acid, possessing, however, a milder action than the latter drug. A saturated aqueous solution affords a useful application for the removal of warts and syphilitic vegetations. Weaker solutions, containing 2 to 5 grains (0.10–0.30 Gm.) to the ounce (30 Cc.) of a mixture of glycerin and water, has been applied with asserted good results as an astringent in ulcerated sore throat. In large quantity potassium dichromate is a violent corrosive poison, producing severe abdominal pain, vomiting, purging, frequent bloody stools, general depression, coma, and death. Poisoning from the drug should be treated with lime-water, emetics, demulcent drinks, opium for the pain and gastro-enteritis, and stimulants like strychnine hypodermically for the depression. Its internal administration in secondary syphilis, progressive spinal paralysis, and other diseases is no longer in favor.

Potassii Chromas.—*Potassium chromate, Yellow or neutral chromate of potassium.* K_2CrO_4. Molecular weight, 192.94.—It is obtained by adding potassium carbonate to a hot solution of the dichromate as long as effervescence is observed; the solution changes in color to yellow, and yields on evaporation 6-sided lemon-yellow crystals, which may be fused without decomposition and dissolve in less than 2 parts of water, the solution having an alkaline reaction. It is employed as a reagent.

POTASSII ET SODII TARTRAS, *U. S.*—Potassium and Sodium Tartrate.

Soda tartarata, Br.; *Sodæ et potassæ tartras, Sodæ potassio-tartras, Tartarus natronatus*, P. G.; *Natro-kali tartaricum, Sal polychrestum Seignetti, Rochelle Salt, Tartrated soda*, E.; *Sel de Seignette, Soude tartarisée*, Fr.; *Seignettesalz*, G.

Formula, $KNaC_4H_4O_6 + 4H_2O$. Molecular weight, 280.18.

Potassium and sodium tartrate should contain not less than 99 per cent. of the pure salt.—U. S.

Preparation.—This double salt was first obtained in 1672 by Pierre Seignette, an apothecary of Rochelle, in France, and was sold as a secret remedy. But in 1731 the process for obtaining it was communicated by Boulduc to the French Academy, and by C. J. Geoffroy to Sloane, of London. It may be prepared by exactly neutralizing a solution of sodium carbonate with potassium bitartrate, boiling to drive out carbon dioxide, neutralizing again with the one or the other constituent if necessary, filtering, and evaporating to crystallization. The reaction is: $2KHC_4H_4O_6 + Na_2CO_3.10H_2O = 2KNaC_4H_4O_6 + CO_2 + 11H_2O$, a double tartrate being formed. 16 parts of potassium bitartrate require $12\frac{1}{6}$ parts of crystallized sodium carbonate if both are chemically pure. Owing to the presence of calcium tartrate in the one, and the loss of water of crystallization in the other, the proportions required must vary somewhat with different samples of the commercial salts; but there is no difficulty in rendering the solution exactly neutral

if the above directions are followed. It is advisable to keep the neutralized mixture for some time at a temperature of about 60° C. (140° F.), when much of the calcium tartrate will be deposited, and may be removed by filtration. Large and well-formed crystals are obtained if the solution is very slowly evaporated.

Properties.—Potassium and sodium tartrate crystallizes in large, perfectly transparent, inodorous, 6- or 8-sided prisms, or more frequently half-prisms, of the right rhombic order. If crystallized from a solution containing calcium tartrate, they are white and more or less opaque. In our commerce the salt is most generally met with in the state of white powder. It has a mild saline, faintly bitterish and cooling taste, is slightly efflorescent in dry air, and dissolves at 25° C. (77° F.) in 1.2 parts of water, and in less than 1 part of boiling, but is nearly insoluble in alcohol.—U. S. The salt melts in its water of crystallization when carefully heated to about 75° C. (167° F.), and after cooling remains liquid and soft for some time. By the heat of the water-bath it loses 19 per cent. of water of crystallization, and at 130° C. (266° F.), or, according to Fresenius, near 215° C. (419° F.), altogether 25.5 per cent. At a higher heat it is decomposed, gives off inflammable gases which have the odor of burning sugar, and leaves charcoal, mixed with the potassium and sodium carbonates, and imparts to a non-luminous flame a yellow color, appearing red when viewed through a blue glass. The concentrated aqueous solution yields, on the addition of hydrochloric or acetic acid, a crystalline precipitate of cream of tartar; with barium chloride, a white precipitate soluble in nitric acid; and with silver nitrate, a white precipitate turning black on boiling. The aqueous solution is feebly alkaline to litmus paper, but does not affect phenolphthalein.

Tests.—The solution in 20 parts of distilled water should be clear, of neutral reaction to test-paper, and should produce no precipitate or turbidity with ammonium oxalate (calcium salt) or with hydrogen sulphide (metals); and when acidulated with nitric acid and filtered from the precipitated acid potassium tartrate, the clear solution should not be affected by barium chloride (sulphate). The U. S. P., 1900, omits the tests for calcium, and for chloride and sulphate, but the P. G. demands the absence of these. Although ammonia is not likely to be present in a salt having the above properties, the U. S. and P. G. direct testing for it with caustic alkali. The aqueous solution (1 in 20) of the salt, slightly acidulated with hydrochloric acid, when mixed with an equal volume of hydrogen sulphide test-solution, should not give a precipitate or coloration, after standing corked in a warm place for at least half an hour, either before or after adding ammonia-water to slight alkalinity (absence of heavy metals). If 1 Gm. of potassium and sodium tartrate be thoroughly ignited at red heat, and the residue extracted repeatedly with hot distilled water, the united filtrates should require for complete neutralization not less than 14.1 Cc. of half-normal hydrochloric acid solution, methyl-orange being used as indicator.—U. S. Each Cc. of the acid represents 0.070045 Gm. of the salt, hence 14.1 Cc. represent 0.9876 Gm., which is 98.76 per cent. The Br. permits a salt of 98.05 per cent., 1 Gm. when titrated requiring at least 7 Cc. of normal acid.

Ammonii et Potassii Tartras. *Tartarus solubilis ammoniatus.—Potassium and ammonium tartrate*, E.; *Tartrate de potasse et d'ammoniaque*, Fr.; *Weinsaures Ammoniak-Kali*, G. $KNH_4C_4H_4O_6$.—It is prepared by diffusing 1 part of cream of tartar in 2½ or 3 parts of boiling water, adding ammonium carbonate as long as effervescence takes place, filtering, and crystallizing. It is well to render the solution alkaline by the addition of a little ammonia-water. The double salt crystallizes in transparent prisms having a pungent and cooling saline taste and becoming opaque on exposure from loss of ammonia. It is soluble in about 2 parts of cold and less than its own weight of hot water.

Action and Uses.—Rochelle salt, in doses of from 2 to 4 drachms (8–16 Gm.), is a mild laxative, more readily borne by the stomach than most salines. In larger quantity (1 ounce (30 Gm.) or more) it is an active hydragogue purge. It is the purgative constituent of Seidlitz powder (Pulvis Effervescens Compositus).

In small doses, frequently repeated, it does not purge, but is absorbed, probably as a carbonate, and renders the urine alkaline.

POTASSII FERROCYANIDUM, *U. S.*—Potassium Ferrocyanide.

Potassæ prussias flava, Kalium ferrocyanatum, Kalium borussicum.—Yellow prussiate of potash, E.; *Prussiate jaune de potasse, Ferrocyanure de potassium*, Fr.; *Ferrocyankalium, Blutlaugensalz*, G.

Formula, $K_4Fe(CN)_6 + 3H_2O$. Molecular weight, 419.62.

Potassium ferrocyanide should contain not less than 99 per cent. of the pure salt, and be kept in well-closed bottles.—U. S.

Preparation.—This salt was discovered by Macquer (1752) in boiling Prussian blue with potassium hydroxide. The iron contained in it was for a long time supposed to be an impurity, even after Berthollet (1787) had shown it to be one of its essential constituents. Yellow prussiate of potash, as it is commercially called, possesses no medicinal properties, but is the source of official hydrocyanic acid and other cyanides; when pure the salt is not poisonous. It is made by heating, in iron vessels, with constant stirring, a mixture of potassium carbonate, metallic iron, and scraps of horn, leather, or other nitrogen-containing substances. The fused mass, known as "melt," is, after cooling, leached with water, and the solution decanted and crystallized; the insoluble residue consists of iron, charcoal, ferrous sulphide, calcium phosphate, and silica.

While formerly the salt was made almost exclusively by this process, the source of the salt at the present time is the exhausted mass of ferric hydroxide which is used to purify illuminating-gas. Cyanogen compounds, as well as others, are absorbed by the iron hydroxide, by which, among other products, ferrocyanides are formed. By suitable chemical treatment the latter are converted into the potassium salt.

Properties.—Potassium ferrocyanide crystallizes from water in large inodorous, lemon-yellow, 4-sided tables or prisms, which are translucent and rather soft and friable, and, being crystallized on a cord, usually cohere in columnar masses. It has the specific gravity 1.83, a sweetish and saline taste, and dissolves with a yellow color in 4 parts of water at 25° C. (77° F.) and in 2 parts of hot water, the salt being precipitated from this solution by alcohol in pale-yellow pearly scales. The salt is permanent at a low temperature, but near 60° C. (140° F.) it begins to lose water of crystallization, of which it contains 12.8 per cent., and it becomes anhydrous at 100° C. (212° F.), leaving a white friable mass which melts below red heat, and at a higher temperature is decomposed into nitrogen and a mixture of potassium cyanide and carbide of iron. Exposed to light in the presence of moisture, it is slowly decomposed, with the formation of Prussian blue. Its solution has a neutral reaction and produces a dark-blue precipitate with ferric salts, a bluish-white precipitate (becoming dark-blue in contact with air) with ferrous salts; a brown-red precipitate with salts of copper; and white precipitates with lead acetate and mercuric chloride; also a white crystalline precipitate with a saturated solution of sodium bitartrate. Heated with dilute sulphuric acid, hydrocyanic acid is given off. Alkalies fail to precipitate the iron from its solution, but on fusing the salt with potassium carbonate, potassium cyanide is formed and metallic iron is separated.

Tests.—The concentrated solution of the salt should not effervesce on the addition of sulphuric acid (absence of carbonate). The precipitate produced in the aqueous solution, acidulated with nitric acid, by silver nitrate test-solution should be of a pure white color, without a tinge of red (absence of ferricyanide).—U. S. The tests for limit of chloride and sulphate have been dropped from the 1900 Pharmacopœia.

Pharmaceutical Uses.—Potassium ferrocyanide is used in the preparation of dilute hydrocyanic acid, of cyanides, ferrocyanides, and of the following salts:

Derivative Products.—Potassium Ferricyanide or Ferridcyanide. *Red prussiate of potash.* $K_6Fe_2(CN)_{12}$ or $K_3Fe(CN)_6$.—On passing chlorine gas into a cold solution of potassium ferrocyanide the liquid changes in color from yellow to red. When it ceases to produce a blue precipitate or color with ferric chloride, it is concentrated and the crystals purified by recrystallization. The salt is in dark-red transparent prisms, has a saline and slightly astringent taste, and dissolves in about 4 parts of cold water. On exposure to light the solution is readily altered, ferrocyanide being again produced, when it will yield a blue precipitate with ferric salt. The salt in its fresh solution is employed as a test, precipitating dark blue with ferrous, red brown with mercurous, brownish yellow with cupric, and orange colored with argentic salts. It yields no precipitates with ferric, mercuric, or plumbic salts.

Potassium Sulphocyanate (Sulphocyanide).—*Sulfocyanure de potassium*, Fr.; *Kaliumsulfocyanat, Rhodankalium*, G. Formula, KSCN. Molecular weight, 96.53.—It is prepared by melting together 17 parts of potassium carbonate, 32 parts of sulphur, and 46 parts of

anhydrous potassium ferrocyanide, and heating to low redness; the cold mass is treated with boiling alcohol. The salt crystallizes in colorless, 4-sided, striated prisms, which are inodorous, have a pungent and saline taste, are deliquescent on exposure, and dissolve readily in water and in alcohol. A solution of the salt is used as a test for ferric salts, with which it gives a blood-red color which is not discharged by hydrochloric acid (difference from acetates and formates), but disappears on the addition of corrosive sublimate (difference from meconates).

Sodium Nitroprusside. $Na_2Fe(CN)_5NO.2H_2O$.—It is prepared by digesting 1 part of potassium ferrocyanide with 2 parts of nitric acid and 2 parts of water until the liquid ceases to produce a blue precipitate with iron salts. On cooling, potassium nitrate crystallizes, and the mother-liquor after neutralization with sodium carbonate yields colorless crystals of potassium nitrate and red ones of sodium nitroprusside; the latter are recrystallized from water. The salt forms ruby-colored rhombic prisms which are permanent in the air and dissolve in 2½ parts of cold water, the solution being decomposed by light. A fragment of the salt heated with an oxygenated volatile oil darkens the latter, often producing a characteristic color; this reaction is prevented by oil of turpentine. In alkaline solution it is a delicate test for sulphides, producing with them a violet or blue color.

Action and Uses.—Potassium ferrocyanide is not used in internal medicine, except as a chemical antidote to poisoning by copper sulphate. Except in its impure commercial state it can be ingested in large quantity without producing any effect, either beneficial or deleterious, upon the economy.

POTASSII HYDROXIDUM, *U. S.*—Potassium Hydroxide.

Potassa, U. S., 1890.—*Potassa caustica*, Br.; *Kali causticum fusum*, P. G.; *Potassii (Potassæ) hydras, Kali hydricum fusum, Lapis causticus chirurgorum.*—*Caustic potash, Potassa, Potassium hydrate*, E.; *Potasse caustique, Potasse fondue, Pierre à cautère*, Fr.; *Kaliumhydroxyd, Ætzkali*, G.

Formula, KOH. Molecular weight, 55.74.

Potassium hydroxide should contain not less than 85 per cent. of pure potassium hydroxide and not more than 2 per cent. of foreign inorganic substances other than water. It should be kept in well-stoppered bottles of hard glass.—U. S.

Preparation.—The substance usually employed in pharmacy and the arts is obtained by the action of slaked lime on potassium carbonate, as described under Liquor Potassii Hydroxidi: $K_2CO_3 + Ca(OH)_2 = CaCO_3 + 2KOH$. The solution is evaporated rapidly in a clean silver or iron basin until the water is driven off and the potassium hydroxide remains in quiet fusion, when it is poured into iron or silver cylindrical molds to harden. The purity of the product depends upon the quality of the potassium carbonate used, and if made from the bicarbonate it is of much better quality. It is known in commerce as *potassa by lime*, and should contain not more than 5 to 6 per cent. of water, but it sometimes contains as much as 20 to 25 per cent. It is not advisable to try to drive off all the water by heating, as the iron or silver vessel is then attacked by the alkali. It should be preserved in glass-stoppered bottles of hard glass, with a layer of paraffin around the stopper to keep out moisture. White glass is attacked by the hydroxide, but green bottles serve very well for preserving it.

For chemical operations a purer article is often required, which may be obtained in several ways. *Potassa by baryta* is prepared by exactly precipitating a hot solution of crystallized barium hydroxide with a concentrated solution of potassium sulphate, filtering off the precipitate, and quickly evaporating as above: $Ba(OH)_2 + K_2SO_4 = BaSO_4 + 2KOH$. This method yields very pure potassium hydroxide.

Potassa by alcohol is prepared by dissolving 1 part of ordinary potassium hydroxide in 4 parts of 95 per cent. alcohol. After several days an aqueous layer collects at the bottom of the vessel containing the impurities, such as carbonate, chloride, sulphate of potassium, etc., while the alcoholic solution of pure potassium hydroxide stands above it, which may be drawn off and evaporated.

The purest potassium hydroxide is obtained by adding pure metallic potassium in small pieces to distilled water in a silver basin and evaporating as above: $K + H_2O = KOH + H$. Potassium hydroxide obtained by these three methods is much more expensive than potassium hydroxide by lime.

In recent years large quantities of caustic potash are made electrolytically from potassium chloride. When a strong electric current is passed through a solution of the

chloride in a suitable vessel, the chloride is decomposed into chlorine, which is collected at the positive electrode and used for making bleaching-powder, and potassium, which combines with water to form the hydroxide and accumulates at the negative electrode. The solution of potassium hydroxide is drawn off and utilized as such or evaporated.

Molten potassium chloride is also decomposed by the electric current, giving chlorine and metallic potassium, which is converted in the apparatus into solid potassium hydroxide by a jet of steam (*Elect. World and Eng.*, April 5, 1902).

Properties.—Caustic potash is either pulverulent or in irregular pieces of crystalline texture; more generally it is in dry white cylindrical pieces, which break readily with a crystalline and somewhat translucent fracture. It is inodorous or has a faint odor of lye; its taste is strongly caustic and acridly alkaline. It dissolves at 25° C. (77° F.) in 0.4 part of water and in 2 parts of alcohol, and is much more soluble in both liquids at the boiling temperature (U. S.); the taste and reactions of these solutions are strongly alkaline. The alcoholic solution is yellowish, and on keeping turns brown because of the aldehyde in the alcohol being converted into aldehyde resin. Alcohol which has been distilled several times from lime will remain colorless a long time when caustic potash is dissolved in it, being free from aldehyde. Potassium hydroxide is but slightly soluble in ether. On exposure to the air it rapidly absorbs moisture, liquefies, and combines with carbon dioxide. When heated to about 530° C. (986° F.) it fuses to a colorless oily liquid, and in a strong red heat it slowly volatilizes, forming white acrid vapors.

Tests.—The aqueous solution (1 in 20) should be perfectly clear and colorless (absence of organic matter). After acidulation with hydrochloric acid it yields a bright-yellow precipitate with platinic chloride test-solution. A concentrated aqueous solution (1 in 10), when dropped into tartaric acid test-solution, produces at first a white crystalline precipitate, which redissolves when the alkali is added in excess. The aqueous solution (1 in 20), slightly acidulated with hydrochloric acid, and mixed with an equal volume of hydrogen sulphide test-solution, should not give a precipitate or coloration after standing corked in a warm place for at least ½ hour, either before or after addition of ammonia to slight alkalinity (absence of heavy metals). On adding an excess of diluted sulphuric acid to 10 Cc. of a 10 per cent. aqueous solution of potassium hydroxide, no distinct effervescence should occur (limit of carbonate). The tests for absence of calcium and for limits of chloride, sulphate, silicate, and nitrate have been dropped from the 1900 Pharmacopœia, since these impurities are innocuous and the use of potassium hydroxide is more technical than medicinal. The P. G. retains the tests for the above impurities, but the Br. P. has a test for only silica and other insoluble matter in alcohol in addition to the hydrogen sulphide test for heavy metals. To test for sodium, dissolve 0.56 Gm. of potassium hydroxide in 5 Cc. of water, add a few drops of phenolphthalein test-solution, and then from a burette sufficient tartaric acid test-solution (3 Gm. in 20 Cc.) to neutralize the solution accurately. Next add another volume of the tartaric acid test-solution equal to that first used, and then sufficient absolute alcohol to precipitate completely the potassium bitartrate formed. Separate the precipitate by filtration and wash it with a little alcohol. The filtrate should not require more than 2 Cc. of tenth-normal potassium hydroxide solution to restore the red color (absence of more than 1.5 per cent. of sodium hydroxide). About 1 Gm. of the hydroxide, accurately weighed in a stoppered bottle, is dissolved in about 50 Cc. of water and titrated with normal sulphuric acid, using methyl-orange as indicator; multiply the number of Cc. of acid consumed by 5.574, and divide the product by the weight of hydroxide taken; the quotient, which must not be less than 85, is the per cent. of pure potassium hydroxide present.—U. S. Each Cc. of normal acid represents 0.05574 Gm. of KOH. The last test is not strictly accurate unless the total absence of sodium hydroxide is ascertained. The Br. P. and P. G. require 90 per cent. purity.

An impure potassium hydroxide of a deep-gray or greenish color is sometimes met with. It is unfit for medicinal purposes, and may be purified by treating it with alcohol, which dissolves the alkali, and evaporating this solution to dryness.

Potassa cum Calce. *Potassa with lime, Vienna caustic,* E.; *Caustique (Poudre) de Vienne,* Fr.; *Wiener Aetzpulver,* G.—This preparation is a grayish-white powder of a strongly caustic taste and alkaline reaction, obtained by rubbing together equal parts of caustic potash and lime in a warm mortar. When exposed to the air, it absorbs moisture and carbon dioxide. Treated with diluted nitric or hydrochloric acid, it dis-

solves completely with slight effervescence, and yields a solution in which both potassium and calcium are indicated by reagents.

CAUSTICUM CUM POTASSA ET CALCE, Fr. Cod., is a stronger preparation, known in France as *caustique de Filhos*, and made by fusing 100 parts of caustic potash, adding thereto 10 parts of powdered burned lime, and pouring the mass into lead tubes of suitable size to harden.

Action and Uses.—Potassium hydroxide is a violent, deeply penetrating caustic. It destroys the tissues for a considerable area around the point of application by abstracting water from them and decomposing nitrogenous compounds. Its application is attended by severe burning pain, and for this reason its use as a cauterant is greatly restricted. Taken in poisonous quantity it produces an alkaline taste in the mouth, intense burning pain in the fauces, œsophagus, stomach, and intestines; vomiting, usually of blood, purging, overwhelming oppression, sometimes convulsions, delirium, and death. If death does not occur promptly the patient may ultimately succumb to œdema of the larynx, widespread gastro-intestinal lesions, or to stricture of the œsophagus. The antidotes are vinegar, lemon-juice, or some other dilute acids or fixed oils. Potassium hydroxide may be used as a cauterant to growths, fungous granulations, and superficial cancers. When used, the skin surrounding its point of application should be protected by wax, suet, oils, or a piece of adhesive plaster with a hole in it large enough to admit the growth, to prevent extensive destruction of adjacent healthy tissue. When the caustic has acted sufficiently, it should be washed off with water, vinegar, or other dilute acid. In solution (Liquor Potassii Hydroxidi) it may be administered to correct the pain and discomfort due to gastric hyperacidity.

It is not as good a remedy as the alkaline carbonates or citrates to render the urine alkaline and allay irritability of the bladder due to highly acid urine. It is mildly diuretic. The dose of the liquor potassii hydroxidi is from 10 to 60 minims (0.6–4 Cc.).

POTASSII HYPOPHOSPHIS, *U. S.*—Potassium Hypophosphite.

Kalium hypophosphorosum.—Hypophosphite de potasse, Fr.; *Kaliumhypophosphit, Unterphosphorigsaures Kali*, G.

Formula, KH_2PO_2. Molecular weight, 103.39.

Potassium hypophosphite should be kept in well-closed bottles and contain 98 per cent. of pure salt. Caution should be observed in handling, as explosion is liable to occur when triturated or heated with nitrates, chlorates, or other oxidizing agents.—U. S.

Preparation.—This salt may be prepared in a manner similar to that by which CALCIUM HYPOPHOSPHITE (which see) is obtained. When a solution of potassium hydroxide is boiled with phosphorus, potassium hypophosphite is produced, which is freed from alkali by passing carbon dioxide into the solution, evaporating, and dissolving the hypophosphite by alcohol. It is also yielded by the double decomposition of calcium hypophosphite and potassium carbonate, when calcium carbonate is precipitated and potassium hypophosphite remains in solution; $Ca(H_2PO_2)_2 + K_2CO_3$ yields $CaCO_3 + 2KH_2PO_2$.

Properties.—It may be obtained in hexagonal tabular crystals, but, being extremely deliquescent on exposure, it is usually seen in white, opaque, crystalline masses or as a white granular powder. It is inodorous, has a pungent, saline, and bitterish taste, and a neutral or faintly acid reaction. It dissolves in 0.5 part of water and in 7 parts of alcohol at 25° C. (77° F.), in 0.3 part of boiling water and in 3.6 parts of boiling alcohol, insoluble in ether.—U. S. Heated to redness when not in contact with air or in a long test-tube, it evolves easily inflammable hydrogen phosphide, burning with a white (bright-yellow, U. S.) flame. According to Remmelsberg (1872), the gas given off consists of hydrogen and hydrogen phosphide, and the residue of potassium pyrophosphate and metaphosphate. Heated in the air, the salt burns with a yellow flame, and when evaporated with nitric acid or triturated or heated with oxidizing agents it detonates violently. When boiled with potassium hydroxide, hydrogen is given off; phosphite and, after the solution becomes more concentrated, phosphate of potassium are formed. The solution yields with a saturated solution of sodium bitartrate a white crystalline precipitate of cream of tartar, and with silver nitrate a white precipitate which rapidly turns brown and black, separating metallic silver; acidulated with hydrochloric acid, and gradually added to a solution of corrosive sublimate, it causes a white precipitate consisting of calomel, and on further addition a black precipitate of metallic mercury.

Tests.—The aqueous solution of the salt (1 in 20) should not effervesce on the addition of an acid (absence of carbonate).—U. S. The aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, should not show the presence of heavy metals when treated with an equal volume of hydrogen sulphide solution, and kept corked in a warm place for at least ½ hour, neither before nor after addition of ammonia-water. 5 Cc. of a 10 per cent. solution, when evaporated to dryness on a water-bath with 3 Cc. of nitric acid in 10 Cc. of water, should not respond to the modified Gutzeit's test for arsenic (see under ARSENI TRIOXIDUM).

The U. S. P. (1900) has dropped the volumetric estimation of this salt by permanganate solution. This method is defective, as are the other titration methods, and the only accurate estimation is by the gravimetric method (see under CALCII HYPOPHOSPHIS). The tests for chloride, sulphate, and phosphate have also been omitted.

Action and Uses.—Potassium hypophosphite is used for the same purposes and in the same dose as CALCII HYPOPHOSPHIS (which see).

POTASSII IODIDUM, *U. S., Br.*—Potassium Iodide.

Kalium jodatum, P. G.; *Kali hydroiodicum, Iodure de potassium*, Fr.; *Jodkalium*, G.

Formula, KI. Molecular weight, 164.76.

Potassium iodide should be kept in well-stoppered bottles and contain not less than 99 per cent. of pure salt.—U. S.

Preparation.—No detailed methods are given in the U. S., Br. P., or P. G. This salt is prepared by methods exactly like those given under POTASSII BROMIDUM (which see). When iodine is added to a solution of potassium hydroxide, potassium iodide and iodate are formed: $6KOH + 6I = 5KI + KIO_3 + 3H_2O$. After evaporation the mass is mixed with charcoal, dried, and heated to redness, whereby the iodate is reduced to iodide.

The salt may also be obtained by interaction between ferrous iodide and potassium carbonate as described under POTASSIUM BROMIDE. A source for large quantities of potassium iodide is cuprous iodide, which is manufactured as a by-product from sodium iodate obtained from the mother liquors of Chille saltpeter (see IODINE). The copper iodide is suspended in water acidified with hydrochloric acid, and decomposed by hydrogen sulphide, forming insoluble copper sulphide and hydriodic acid. The latter is neutralized with potassium carbonate and evaporated to crystallization.

Nearly all the potassium iodide consumed here is now manufactured in the United States.

Properties.—Potassium iodide is in colorless transparent or translucent or white cubes of a neutral or scarcely perceptible alkaline reaction upon litmus-paper. Potassium iodide has a peculiar, faint, iodine-like odor, a pungent, saline, afterward bitterish taste, melts below a red heat, and congeals on cooling to a pearly mass. On melting the salt in contact with air a trace of iodate is formed, a little iodine given off, and the mass acquires an alkaline reaction (Petterson, 1870); at a bright-red heat the salt is slowly volatilized. It is permanent in the air, but in a damp atmosphere or when of an alkaline reaction is somewhat deliquescent. It is freely soluble in water, requiring, at ordinary temperature, 0.75 part and 0.5 part of boiling water. It is also soluble in alcohol, requiring 12 parts (U. S.) at 25° C. (77° F.) and 6 parts of boiling alcohol; also soluble in 2.5 parts of glycerin. Rapid solution of the salt in water produces a marked fall in temperature. The aqueous solution yields with tartaric acid or with sodium bitartrate a white crystalline precipitate of potassium bitartrate, and with a few drops of chlorine water liberates iodine, which is recognized by the blue color it imparts to starch-paste or by the violet color of its solution in chloroform or carbon disulphide. On exposure to sunlight solutions of potassium iodide acquire a yellow or brownish color from the liberation of iodine. The experiments of Papasogli (1881) prove that sunlight, both diffused and direct, does not decompose pure potassium iodide or its mixture with iodate; but carbonic anhydride liberates from the mixture a small quantity of iodine, while at low temperatures it has no effect upon either one of the pure salts, yet at high temperatures separates hydriodic acid in solutions of the pure iodide. Strong mineral acids, such as concentrated nitric and sulphuric, liberate iodine from the dry salt or its solution. Ferric salts, platinum chloride, nitrous acid, chlorine, and bromine also liberate iodine in solutions of the iodide. A mixture of the salt with ammonium chloride

becomes moist and brown on exposure, and when heated is decomposed, potassium chloride and iodide being left. In concentrated solution 1 molecule of potassium iodide dissolves 2 atoms of iodine, forming $KI.I_2$, which is decomposed on dilution with water, precipitating a portion of the iodine. If the molecular weight of the salt is dissolved in about 30 times its weight of water, the solution takes up 1 atomic weight of iodine. These solutions are completely decolorized when agitated with ether, chloroform, or carbon disulphide; but if the solution has been made with alcohol instead of water, carbon disulphide fails to extract the iodine, although this element is removed by the solvent mentioned from the simple tincture of iodine (Jörgensen, 1870). These facts, it seems, point to the existence of compounds of 1 atom of potassium with 1, 2, and 3 atoms of iodine.

Tests.—If impurities other than bromide and chloride are present, the large cubical crystals will usually be the purest; for the following tests it is therefore advisable to triturate together crystals of different size. A little of the powdered salt taken up with the loop of a platinum wire and held in a non-luminous flame should at once impart a violet color to the latter (absence of sodium salt).—P. G. No residue should be left when 1 Gm. of the salt is dissolved in 2 Cc. of diluted alcohol of specific gravity 0.928 (absence of less soluble salts). If 1 Gm. of the salt be dissolved in 10 Cc. of water and 0.1 Cc. (2 drops) of tenth-normal sulphuric acid solution be added, no color should be produced by the subsequent addition of a drop of phenolphthalein test-solution, even after heating (limit of alkali). This test shows the absence of more than 0.07 per cent. of carbonate. The aqueous solution (1 in 20) slightly acidulated with hydrochloric acid should not be colored or precipitated by the addition of an equal volume of hydrogen sulphide test-solution, after standing corked in a warm place for at least ½ hour, either before or after addition of ammonia-water to slight alkalinity (absence of arsenic, lead, copper, etc.). 10 Cc. of a 5 per cent. solution, when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate test-solution (absence of barium). If 1 Gm. of the salt, 5 Cc. of water, 5 Cc. of potassium hydroxide test-solution, and about 0.2 Gm. of aluminum wire be heated for 15 minutes on a water-bath in a tube containing a pledget of purified cotton in the upper portion and covered with a moistened piece of red litmus-paper, no blue coloration of the paper should be visible (limit of nitrate or nitrite). No blue color should be communicated to 20 Cc. of the aqueous solution (1 in 20) by 0.5 Cc. (10 drops) of potassium ferrocyanide test-solution (absence of iron).—P. G. If to 0.5 Gm. of the salt dissolved in 10 Cc. of previously boiled and cooled distilled water, 2 drops of diluted sulphuric acid (free from sulphurous and nitrous acids) be added, no distinct yellow color should appear within ½ minute (limit of iodate). Cyanide may be present from using impure potassium carbonate or impure iodine; its presence is determined by adding to a solution of the iodide a little ferrous sulphate, a drop of solution of ferric chloride or sulphate, and a slight excess of solution of sodium hydroxide. On warming the mixture and acidulating it with hydrochloric acid a blue color (of Prussian blue) should not be produced. 0.2 Gm. of the salt dissolved in 2 Cc. of ammonia-water, and then agitated with 13 Cc. of tenth-normal solution of silver nitrate, should yield a filtrate which on being acidulated with nitric acid should not become more than slightly turbid nor should any darkening appear within 10 minutes (limit of chlorides or bromides and absence of thiosulphate), U. S.; or should not become so turbid within 10 minutes as to lose its pellucidity.—P. G. This test proves the absence of more than about 1 per cent. of chloride and bromide. Silver iodide is also slightly soluble in (about 3000 parts of) ammonia-water. If 0.5 Gm. of the well-dried salt be dissolved in 10 Cc. of distilled water with 3 drops of potassium chromate test-solution as indicator, it should require not more than 30.8 Cc. nor less than 30 Cc. of tenth-normal silver nitrate solution to produce a permanent red color (corresponding to at least 99 per cent. of pure salt).—U. S. The theoretical quantity of silver solution required for 0.5 Gm. of pure potassium iodide is 30.35 Cc. Each 0.372 Cc. of silver solution consumed in excess of the theoretical quantity represents 1 per cent. of potassium chloride, assuming this to be the impurity present. Hence an excess of 0.47 Cc. of silver solution allowed by the U. S. P. represents 1.2 per cent. of KCl in the salt. The lower limit, 30 Cc., is less than the theoretical quantity of silver solution, which may be due to impurities having no action on silver, and represents 98.51 per cent. of KI. 1 Cc. of the silver solution = 0.016476 Gm. of KI. According to the Br. P., 1 Gm. should require not less

than 59.5 Cc. nor more than 61.9 Cc. of tenth-normal solution of silver nitrate for titration. The theoretical quantity for the pure salt is 60.7 Cc. (British atomic weights); assuming the absence of chloride, the lower limit, 59.5 Cc., corresponds to 98 per cent. of KI, thus allowing 2 per cent. impurity other than chloride. This seems inconsistent with the demands of purity given in the Br. The upper limit of 61.9 Cc., assuming that the excess over the theoretical amount is due to chloride, allows 1.86 per cent. of chloride, which again is inconsistent with the demands in the tests for purity.

The results of the volumetric assay are subject to misinterpretation unless the operator is experienced, inasmuch as the method is based upon the assumed presence of alkali chloride, omitting the possibility of other haloid salts being present. Accurate estimation of the iodide as well as the bromide is best done by gravimetric methods, for which standard works on chemistry should be consulted.

Potassium carbonate, sulphate, iodate, nitrate, and cyanide are insoluble in strong alcohol, which dissolves only small quantities of potassium bromide and chloride. An adulteration of the iodide with more than mere traces of the last two salts may be detected by treating the iodide with 18 times its weight of warm alcohol, and, after cooling, testing the undissolved portion. These admixtures may be estimated from the silver precipitate, which from 10 grains of pure potassium iodide weighs 14.15 grains (or 1.415 Gm. from 1 Gm. of the salt), from the same quantity of bromide, 15.8 grains, from chloride 19.2 grains, and from cyanide 20.57 grains. Moreover, the last three may be extracted from the former by ammonia, and, after acidulating this solution with nitric acid, collected, and weighed separately; or, instead of dissolving it in water, the salt to be tested may be dissolved in ammonia-water, when, on the addition of silver nitrate, only silver iodide will be thrown down.

Action and Uses.—Iodide of potassium exercises a powerful influence upon nutritional and metabolic processes in the body. The somewhat indefinite term "alterative" is often applied to its activities. Potassium iodide is rapidly absorbed and rapidly eliminated, escaping from the body by all the secretions, but chiefly through the kidneys and salivary glands. Although the greater portion of it escapes in the first 24 hours, some of it remains in the body for days after the last dose has been taken; and if the administration of it has been continued for a long period, a considerable quantity accumulates in the body. For this reason larger doses are needed at first than later on, in the treatment of such diseases as syphilis, chronic rheumatism, and other conditions, in which full doses are often required. Small quantities slightly raise the blood-pressure, but full doses distinctly lower it, particularly if the pressure be high because of arteriosclerosis. It does not always act as a diuretic, but in certain cases of heart disease and renal disease it greatly increases the urinary flow. It is employed in medicine chiefly for the purpose of treating syphilis, particularly when this disease has advanced toward the end of its second stage or is entering upon its tertiary manifestations. It is also of value in the early portion of the second stage of the disease, but at this time does not give the results which can be obtained by the administration of the various preparations of mercury. In the treatment of syphilis with the iodide of potassium very much larger doses are used than are commonly given for other diseases. Cases are on record in which as much as 800 or 1000 grains have been taken in 24 hours, the patient arriving at these quantities at the end of a considerable period of time during which ascending doses have been given. It is customary to start with 5 to 10 drops of a saturated solution (1 grain to the drop) 3 times a day after meals, and to add 1 drop to each dose each day. The drug should be continued for a long period of time, not less than from 1 to 2 years, if there are manifestations of syphilis present. Indeed, it is often advantageous, in order to prevent the development of parasyphilitic conditions in later life, to continue the iodide of potassium in moderate doses, alternating with protoiodide of mercury, for 3 years.

Iodide of potassium is the best drug that we have for combating the advances of parasyphilitic conditions of the nervous system which develop years after the primary infection, but it is to be distinctly understood that the drug cannot cure those lesions of the nervous system which have resulted in sclerotic changes. The most it can do is to arrest the progress of degenerative processes, and so prevent any increase in the severity of the symptoms. When very active manifestations of syphilitic disease appear in the nervous system, the protoiodide of mercury is often the better drug, since mercury is a more rapidly acting syphilitic remedy than is iodide of potassium. Many specialists in

the treatment of syphilis use the protoiodide of mercury for several months, then employ the iodide of potassium for several months, and then return once more to the mercurial.

The second valuable employment of iodide of potassium is in the treatment of chronic metallic poisoning, particularly that which is due to lead, arsenic, or mercury. Under these circumstances it forms double soluble salts with the metals in the tissues and aids in their elimination. It is also of value in chronic articular and muscular rheumatism, but it is of little or no value in acute or inflammatory rheumatism, although in the later stages of this disease it may aid materially in causing absorption of the inflammatory exudates which have been produced by the acute stage. In all forms of chronic rheumatism it often acts best if combined with wine of colchicum root. Iodide of potassium also has a reputation of being of value in the treatment of certain forms of asthma and in catarrh of the stomach and bowels of the subacute type. It should not be used in bronchitis if the bronchial secretion is very profuse and liquid. For that practically incurable condition—pulmonary emphysema—iodide of potassium has been largely employed, but any relief that comes to the patient from its use is probably due to its effect upon the associated chronic bronchitis or its influence upon the heart, blood-vessels, and kidneys. The drug has also been used in the treatment of hepatic cirrhosis with asserted advantage.

A very useful employment of iodide of potassium is in the treatment of arteriosclerosis, whether this change in the vascular system be due to advancing years, syphilis, gout, metallic poisoning, or any of the other causes which are known to be provocative of this condition. Iodide of potassium is also advantageous in some cases of pleural and abdominal effusion for the purpose of aiding in the disappearance of the liquid.

When iodide of potassium is taken in full dose, particularly if the person is susceptible to its effects, it not rarely causes coryza, so that the patient seems to be suffering from a severe cold in the head. In other instances, with or without these symptoms, acne develops on the face, back, and chest, and, occasionally, those who have an idiosyncrasy to the drug have various aberrant rashes break out, varying in severity from that of a mild dermatitis to petechiæ, bullæ, or blebs. A few cases have been reported in which œdema of the glottis has followed its employment.

The manner in which iodide of potassium does good in all the conditions which have been named is not understood. It undoubtedly exercises an influence upon nutrition, but what these influences are our knowledge of physiology and pathology is not sufficient to give us light upon the subject.

As the taste of iodide of potassium is exceedingly disagreeable to many persons, it is best to order it in saturated solution, and to prescribe compound syrup of sarsaparilla in another bottle. The patient then places the required number of drops of the solution of iodide of potassium at each dose in a dessertspoonful or a tablespoonful of the compound syrup with the hope that the sarsaparilla may cover its taste. Other physicians administer the iodide with fluidextract of licorice, in milk, or in junket, the latter method of administration being very popular. The iodide, as a rule, should be given 1 hour after meals rather than immediately after. It should not be taken on an empty stomach when its systemic influence is desired. If the patient is unable to carry a solution of the drug because of its bulk, it may be put up in capsules or tablets, and each dose followed by a draught of milk or water, for the purpose of diluting the drug after it enters the stomach, otherwise it may produce gastric irritation.

For all conditions in which iodide of potassium has been suggested and recommended, save syphilis, the ordinary dose is from 5 to 20 grains (0.30–1.30 Gm.).

POTASSII NITRAS, *U. S.*, *Br.*—Potassium Nitrate.

Kalium nitricum, P. G.; *Potassæ nitras, Nitrum depuratum, Sal petræ, Sal nitri.*—*Nitrate of potash, Nitre, Saltpetre*, E.; *Azotate (Nitrate) de potasse, Nitre prismatique, Salpêtre*, Fr.; *Kaliumnitrat, Salpetersaures Kali, Salpeter, Kalisalpeter*, G.

Formula, KNO_3. Molecular weight, 100.43.

Potassium nitrate should contain not less than 99 per cent. of the pure salt.—U. S.

Origin and Preparation.—Nitrum of the Romans was alkali carbonate, that of sodium being chiefly thus designated. Saltpetre was known to Geber in the eighth century, and in the Latin translations of his writings is called sal petræ and sal petrosum. Subsequently it was distinguished as sal nitrum or sal nitri, until at the close of the sixteenth century it was called nitrum. (See Sodii Carbonas.) Fused by itself or with

the addition of a small quantity of sulphur, it was formerly used as *sal prunelle* or *nitrum tabulatum*. Saltpetre is produced near the surface of the earth wherever nitrogenous organic substances are undergoing decomposition in the presence of air, moisture, and potassium compounds. It is present in considerable quantities in the calcareous soil near dwellings of some parts of India. This soil becomes impregnated with urine, and after it has been exhausted of its soluble salts soon generates them again, the decomposition being hastened by the hot and moist climate. In several parts of Europe nitrates are formed in a precisely analogous manner, either by collecting the urine of domestic animals in ditches which have been previously filled with a porous calcareous earth, or by mixing in the so-called *saltpetre-beds* animal and vegetable substances with wood-ashes and marl or other material containing lime, and forming this mixture into mounds which are occasionally moistened with drainings from the dung-pit, until after two or three years the salt accumulates in the outer layer of the heap, which is then removed, lixiviated with water, and left in contact with wood-ashes in order to decompose the calcium and magnesium nitrates which are usually present. In India, which furnishes the greater part of the nitre, the process of exhausting the earth is very similar, except that it is usually packed upon wood-ashes and the whole lixiviated. The real cause of the formation of nitrates from nitrogenous matter is a nitrifying bacillus or ferment, *Bacillus nitrificans*. By the action of this germ the ammonia formed by the decay of organic matter is oxidized, first to nitrous, then to nitric acid, which, in contact with the alkalies in the soil, forms nitrates.

In the Mammoth Cave of Kentucky, and in other localities of the United States, saltpetre has occasionally been procured, and it may be obtained in variable quantities from most soils where vegetable and animal materials have been decaying, and from which it is taken up by the plants growing there, some of which are very rich in this salt. A. Boutin (1874) ascertained that *Amarantus melancholicus ruber* contains 16, and *Am. atropurpureus* even 22.77, per cent. of potassium nitrate, calculated for the dry herb. The same salt crystallizes in some old extracts.

At present potassium nitrate is made almost exclusively from potassium chloride of the Stassfurt mines by a process of mutual decomposition effected with native sodium nitrate (Chile saltpetre), advantage being taken of the lesser solubility of the newly formed sodium chloride in hot water to rid the solution of this impurity upon concentration by boiling. The potassium nitrate subsequently crystallizes out, and is further purified by recrystallization. On cooling the solutions the crystallization of the nitre is usually disturbed by frequent stirring in order better to drain off the mother-liquor, in which most of the foreign salts remain dissolved.

Most of the saltpetre used in the United States is purified here from the foreign crude article, of which more than 10,300,000 pounds were imported during the year 1900.

Potassium nitrate is to be had both in the form of large crystals and as a fine granular powder; the latter is preferred for pharmaceutical purposes, and is largely obtained from manufacturers of gunpowder, who require a pure article for their purposes.

The name saltpetre, or nitre, is used almost exclusively in commerce for this salt, and when fused and cast into round molds it is sold under the name *sal prunelle*.

Properties.—Potassium nitrate crystallizes in colorless, transparent, 6-sided, striated prisms of the rhombic system, which frequently have cavities in the interior filled with mother-liquor, so that on trituration they yield a damp powder. It is often kept in the granulated state, and is then a white crystalline powder. When heated to 353° C. (667.4° F.), it fuses to a colorless liquid, and congeals again on cooling to a radiating crystalline mass; in the presence of even a small proportion of sodium chloride the radiating arrangement is less distinct, at least in the centre of the mass, or entirely wanting. At a higher temperature it gives off oxygen, and afterward oxygen and nitrogen, being gradually converted into potassium nitrite and oxide; on the addition of sulphuric acid this residue gives off nitrous vapors. Potassium nitrate is neutral to test-paper, inodorous, has a pungently saline and cooling taste, and dissolves in water with a marked diminution of temperature. 1 part of the salt dissolves

at 0°	15°	30°	40°	50°	60°	80°	100°	114.1° C.	
in 7.25	3.85	2.25	1.563	1.163	0.901	0.582	0.405	0.306	parts of water,

the boiling-point of the most concentrated solution being 114.1° C. (237.4° F.). The salt is insoluble in absolute and sparingly soluble in diluted alcohol. It is permanent in

the air, but, according to Mulder (1864), absorbs a considerable amount of water when kept in a confined atmosphere saturated with moisture. When thrown upon red-hot coal it deflagrates. Warmed with sulphuric acid and copper it evolves red nitrous vapors; its aqueous solution gives a white crystalline precipitate of cream of tartar on the addition of a concentrated solution of tartaric acid or of sodium bitartrate, and if acidulated with hydrochloric acid yields a yellow precipitate with platinum chloride.

Tests.—The aqueous solution of the salt (1 in 20) should have a neutral reaction, and should not be affected by hydrogen sulphide or ammonium sulphide (absence of metals), barium chloride (absence of sulphate), silver nitrate (chloride), ammonium carbonate (calcium salt), or, after the addition of ammonium carbonate, by ammonium phosphate (magnesium salt). The U. S. P. (1900) has omitted all of these tests except that with hydrogen sulphide, but the Br. P. and P. G. still retain them. On mixing the powdered salt or its concentrated solution with alcohol, and igniting the latter, the flame should have a violet but not a yellow color (sodium salt). The aqueous solution (1 in 20) of the salt, slightly acidulated with hydrochloric acid, when mixed with an equal volume of hydrogen sulphide solution, should not give a precipitate or coloration, after standing corked in a warm place for at least half an hour, neither before nor after adding ammonia-water to alkalinity (absence of heavy metals). If a small crystal of ferrous sulphate or a drop of diphenylamine test-solution be mixed with the aqueous solution (1 in 20) and concentrated sulphuric acid be poured in, so as to form a separate layer, a dark-brown or a deep-blue color, respectively, will appear at the line of contact (nitrate). If to 10 Cc. of the aqueous solution (1 in 20) of the salt 1 Cc. of chloroform be added, then chlorine-water, diluted with an equal volume of water, drop by drop, with agitation, the chloroform should be free from any violet tint (iodine). No yellow color should appear when 0.1 Gm. of the dry salt is sprinkled upon 1 Cc. of pure concentrated sulphuric acid (absence of chlorate and perchlorate). On mixing 1 Gm. of the dry salt with 1 Gm. of sulphuric acid, evaporating to dryness, and igniting, the residue consists of potassium sulphate, and should weigh 0.86 Gm. In the presence of sodium nitrate the weight is less. The salt is an excellent oxidizing agent, as it parts easily with its oxygen at elevated temperature; with charcoal, sulphur, sugar, etc., it forms highly combustible or explosive mixtures.

Action and Uses.—In small doses potassium nitrate is diuretic and diaphoretic. Larger doses produce purgation and cardiac sedation, and if given over a long period of time cause irritation of the stomach, a slow weak pulse, and general depression. Poisonous quantities (½ ounce (16 Gm.) or more) produce severe gastro-enteritis, vomiting and purging of blood, suppression of urine, decided circulatory and respiratory depression, convulsions, and occasionally death, which may, however, occur suddenly unattended by any painful symptoms. At autopsy the stomach and intestines are found to be injected, the blood of a lighter color than normal, and the kidneys in a state of acute inflammation. There is no known chemical antidote to potassium nitrate, and poisoning is to be treated by removing the drug from the stomach and administering oils or mucilages, stimulants, and opium for the pain. Potassium nitrate is inferior as a diuretic to the harmless vegetable potassium salts, which have replaced it in the treatment of dropsy, rheumatism, and fevers. In spasmodic asthma, inhalation of the fumes of burning potassium nitrate allays the spasm and renders the breathing freer and less stridulous. For this purpose the Chartæ Potassii Nitratis are used, either by being rolled into cigarettes and smoked by the asthmatic or a piece of the paper is burned in a pan and the fumes inhaled. Impregnation of the paper with compound tincture of benzoin or tincture of belladonna in addition to the nitre enhances its efficiency. In the combustion of the drug potassium and ammonium nitrites, pyridine, and other bodies are formed, and to these the antispasmodic properties are ascribed. Nitre is sometimes used by packers to preserve meats. It is given in the dose of from 5 to 30 grains (0.3–2 Gm.).

POTASSII PERMANGANAS, *U. S.*, *Br.*—Potassium Permanganate.

Kalium permanganicum, P. G.; *Potassæ permanganas, Kali hypermanganicum crystallizatum.—Permanganate of potash*, E.; *Permanganate de potasse*, Fr.; *Kaliumpermanganat, Uebermangansaures Kali, Chamæleon*, G.

Formula, $KMnO_4$. Molecular weight, 156.98.

Potassium permanganate should be kept in glass-stoppered bottles protected from

light, and should not be triturated nor combined in solution with organic or readily oxidizable substances. It should contain not less than 99 per cent. of the pure salt.—U. S.

Preparation.—No method is given in the pharmacopœias. As stated under MANGANUM, a number of oxides of manganese exist, the lower ones being basic, while the higher ones, as MnO_3 and Mn_2O_7, are acidic, forming manganic and permanganic acids, respectively, H_2MnO_4 and $HMnO_4$. Manganic acid, however, does not exist in the free state, but only in its salts, the manganates, which are green. When oxygen is added to any of the lower oxides or their compounds in the presence of an alkali, manganate is formed, or if in acid solution, permanganic acid is obtained. Manganates are very unstable and easily form permanganates when their solutions are diluted and heated or acidified. In the manufacture of potassium permanganate the first step is the production of potassium manganate, by heating to semifusion at a dull-red heat an intimate mixture of manganese dioxide, caustic potash, and potassium chlorate, when the following reaction occurs: $3MnO_2 + 6KOH + KClO_3 = 3K_2MnO_4 + KCl + 3H_2O$. The green fused mass is then treated twice with boiling water, whereby the potassium manganate is converted into permanganate—$3K_2MnO_4 + 2H_2O = 2KMnO_4 + MnO_2 + 4KOH$—manganese dioxide being again precipitated and potassium hydroxide remaining in solution with the permanganate. The presence of potassium hydroxide in the liquid prevents a full yield of permanganate by holding a portion of the manganate in solution without change; a stream of carbon dioxide is therefore passed into the liquid to neutralize the potassium hydroxide and thus allow all the manganate to be converted into permanganate and dioxide; in place of carbon dioxide, diluted sulphuric acid is sometimes used for the same purpose. Finally, after decantation and filtration through asbestos, the solution is concentrated and set aside to crystallize. As potassium permanganate is readily decomposed by organic matter, all dust and dirt must be excluded during the last steps of the process, and filtration must not be performed through organic filters, as paper or muslin. The first crop or two of crystals are usually pure; subsequently they become mixed with potassium chloride and sulphate, and require to be purified by recrystallization. Finally, the other salts accumulate in the mother-liquors to such an extent that crystals of pure permanganate can no longer be obtained, and the liquids are advantageously used for disinfecting, bleaching, or other purposes.

The approximate quantities to be used in the above fusion are 5 parts of caustic potash, 4 parts of good (90 per cent. or over) manganese dioxide, and 3½ parts of potassium chlorate, the latter furnishing oxygen to the manganese dioxide. On account of the change of color from the green manganate to the purple permanganate, the former was formerly known as chameleon mineral.

Properties.—Potassium permanganate is in dark-purple or deep violet-red, nearly black, slender monoclinic prisms, which have a greenish or bluish metallic luster, do not react upon litmus-paper, are permanent in the air and without odor, and have a sweet, astringent taste. A small quantity of it imparts to a large quantity of water a rich purple tint, which is destroyed by organic matter and deoxidizing agents. Alcohol, acetone, acetic acid, oxalic acid, glycerin, tartaric acid, citric acid, sugar, gum, tannin, quinine, aniline, gelatin, and many other organic compounds are more or less readily oxidized in the cold or on boiling. It dissolves at 25° C. (77° F.) in 15 (20, Br.) parts of water and in 3 parts of boiling water. The solution of the pure salt may be boiled without being decomposed, but in the presence of much potassium hydroxide it acquires a green color from the formation of manganate, oxygen being given off at the same time; $2KMnO_4 + 2KOH$ yields $2K_2MnO_4 + H_2O + O$. A diluted solution of potassium hydroxide exerts no reducing action except in the presence of organic matter. The solution of permanganate is decolorized by hydrogen sulphide, carbon disulphide, thiosulphates, sulphites, phosphorus, hypophosphites, iodine, iodides, and many other inorganic oxidizable substances, as well as by organic compounds; the brown oxide which is precipitated yields with diluted sulphuric acid a colorless or reddish solution. When heated to redness, the salt parts with a portion of its oxygen and leaves a black residue of an alkaline reaction, from which water extracts potassium hydroxide. When thrown upon red-hot charcoal it deflagrates, and upon being triturated with sulphur or other inflammable bodies the mixture is decomposed with detonation. On mixing its solution in a closed vessel with glycerin, syrup, or other liquids containing organic matter a similar decomposition, accompanied by explosions, will take place. A warm concentrated solution of it, mixed with silver nitrate and allowed to cool, deposits large crystals of

silver permanganate, which require over 100 parts of water for solution and are decomposed on being boiled with water. The stains produced by potassium permanganate in mortars and other utensils may be speedily removed by a strong solution of oxalic acid.

Tests.—The solution of the salt in much water should have a rose color, without a tinge of green (absence of manganate). If 0.5 Gm. of the salt be boiled with 20 Cc. of water and 4 Cc. of alcohol until it is completely decomposed, and the liquid then filtered, the clear, colorless filtrate will serve for the following tests: 5 Cc. of the filtrate, acidulated with nitric acid, should not be rendered more than very slightly turbid by the addition of barium chloride test-solution (limit of sulphate). In another portion of 5 Cc., acidulated with nitric acid, silver nitrate test-solution should produce no precipitate or cloudiness (absence of chloride). If to another portion of 5 Cc. of the filtrate 1 drop of diphenylamine test-solution be added, and then 1 Cc. of pure concentrated sulphuric acid be poured in, so as to form a layer beneath, no blue color should appear at the line of contact (absence of nitrate). If 0.1 Gm. of the salt be dissolved in 100 Cc. of hot distilled water, to which 1 Cc. of pure sulphuric acid had previously been added, the solution should require for complete decoloration not less than 31.5 Cc. of tenth-normal oxalic acid solution.—U. S.

The official test with oxalic acid depends upon the following reaction: $2KMnO_4 + 5H_2C_2O_4.2H_2O + 3H_2SO_4 = 10CO_2 + K_2SO_4 + 2MnSO_4 + 13H_2O$; which shows that 313.96 parts of potassium permanganate are capable of oxidizing 625.5 parts of crystallized oxalic acid. As each Cc. of tenth-normal oxalic acid solution contains 0.006255 Gm. of the acid, it will require 0.0031396 Gm. of potassium permanganate for oxidation: the 31.5 Cc. required by the Pharmacopœia test will correspond to 0.0989 Gm. (0.0031396×31.5) of $KMnO_4$, which is equivalent to 98.9 per cent.

According to the Br. P., 1 Gm. of the salt should require 31.2 Cc. of normal oxalic acid for titration, corresponding to 97.89 per cent. of $KMnO_4$. 1 Cc. of the oxalic acid solution represents 0.031374 Gm. of the salt (Br. P. atomic weights).

Acidum Permanganas.—*Permanganic acid.* $HMnO_4$.—This acid may be obtained in pure form by electrolyzing a solution of potassium permanganate between poles separated by a porous cup. Caustic potash accumulates at one pole and permanganic acid at the other. The acid solution is deep purple in color and stable. Pure salts of the various metals can be obtained from it.

Condy's Fluid.—A disinfecting liquid obtained by dissolving 53 parts of potassium permanganate and 333 parts of crystallized aluminum sulphate in 777 parts of hot water. On cooling, potash alum crystallizes out, which is separated from the liquid. The latter hence consists of a solution of sulphate and permanganate of aluminum.

Action and Uses.—When brought in contact with organic matter potassium permanganate is decomposed with the liberation of oxygen, and because of this oxidizing power it is an efficient antiseptic and deodorant. Applied locally in solution it destroys the fetor arising from gangrenous ulcers and wounds, hospital gangrene, cancer, especially of the uterus, abscesses, caries, ozena, sore throat of diphtheria and scarlet fever, etc. The solution used should be from 20 to 60 grains (1.30–4 Gm.) to the pint (480 Cc.): the weaker in the form of lotion, gargle, or applied on a swab to mucous membranes; the stronger as a wash for ulcers, wounds, etc. Solutions varying in strength from 1 : 5000 to 1 : 500 are valuable injections in leucorrhœa and gonorrhœal urethritis. 1 grain (0.05 Cc.) to the ounce (30 Cc.) of water affords a useful deodorizing and palliative irrigation in ozena and fetid otorrhœa. The drug in substance or in saturated solution may be used as a mild caustic. It is popular with some surgeons as a disinfectant for the hands prior to operation. The hands, after thorough scrubbing with soap and water, are dipped into a saturated solution of potassium permanganate, then into a saturated solution of oxalic acid to decolorize them, and finally washed in sterile water. The brown stain made by the salt on the skin or fabric can be removed by oxalic acid. Owing to its oxidizing power it is asserted to be an efficient antidote to snake venom, if placed on the wound before the poison is absorbed or injected hypodermically around the point at which the poison entered. It is also considered a good chemical antidote in poisoning from phosphorus and vegetable alkaloids, particularly morphine, but it renders inert only that part of the poison which has not been absorbed. The quantity used should be about one and a half times the amount of poison ingested. It was first advocated by Ringer in 1882 as an emmenagogue, given in the dose of from 1 to 2 grains (0.05–

0.10 Gm.), 3 times a day, in amenorrhœa, due to exposure to cold or other transient causes, but it is less efficacious than manganese binoxide. Potassium permanganate has been employed internally in dyspepsia, flatulence, obesity, lithæmia, diphtheria, and other diseases, but owing to its rapid decomposition in the stomach it is probably of service only in the first two states mentioned, acting in these by oxidation as a destroyer of the abnormal products present in the stomach. When used in solution it should be dissolved in distilled water, and it should never be mixed in a mortar with any organic substance, as it will explode. It is given in the dose of from 1 to 2 grains (0.05–0.10 Gm.), in tablets or in pills, made with resin, cerate, kaolin, or soft paraffin.

POTASSII SULPHAS, *U. S.*, *Br.*—Potassium Sulphate.

Kalium sulfuricum, P. G.; *Potassæ sulphas, Arcanum duplicatum, Tartarus vitriolatus, Sal polychrestum Glaseri.—Sulphate of potash*, E.; *Sulfate de potasse*, Fr.; *Kaliumsulfat, Schwefelsaures Kali*, G.

Formula, K_2SO_4. Molecular weight, 173.07.

It should contain not less than 99 per cent. of pure salt.—U. S.

Origin.—This salt is present in sea water and in various mineral waters, in the ashes of many plants, in many salt-beds, and in the lava of different volcanoes. It is obtained as a secondary product in many chemical processes, such as the preparation of iodine from kelp, of nitric acid from potassium nitrate, of hydrochloric acid from potassium chloride, and in the purification of potash, etc. It appears to have been prepared in the fourteenth century from the saline residue left in the preparation of nitric acid, and to have been used medicinally by Paracelsus in the sixteenth century. Glaser (1663) prepared it by adding sulphur to melted salpeter.

Preparation.—In the manufacture of the products of the Stassfurt mines potassium sulphate is obtained by decomposing potassium chloride with a hot concentrated solution of *schoenite* (magnesium and potassium sulphates), and separating the newly formed sulphate from the double chloride of potassium and magnesium, which is formed at the same time, before the latter can crystallize. In Kalusz, Galicia, the salt is prepared from *kainite*, a mixture of magnesium and potassium sulphate and chloride, and granulating the newly formed potassium sulphate.

In the laboratory the pure salt may easily be prepared by neutralizing sulphuric acid with caustic potash, evaporating, and crystallizing: $2KOH + H_2SO_4 = K_2SO_4 + 2H_2O$.

Properties.—Potassium sulphate crystallizes in transparent, colorless, and hard 6-sided rhombic prisms or pyramids, or combinations of the two forms. It is permanent in the air, inodorous, has a somewhat sharp and saline, bitterish taste, is neutral to test-paper, has the specific gravity 2.65, and yields a white powder. The salt dissolves at 25° C. (77° F.) in about 9 parts of water and in 4 parts of boiling water (U. S.). It is insoluble in alcohol, but dissolves in about 500 parts of diluted alcohol. The aqueous solution, acidulated with hydrochloric acid, gives with barium chloride a white (sulphate), with platinic chloride a yellow (potassium), and with saturated solution of sodium bitartrate a white (potassium) crystalline precipitate. When heated, it decrepitates strongly, melts at a bright-red heat without decomposition, and at a white heat volatilizes slowly in white non-alkaline vapors, leaving a residue which on cooling is crystalline and has an alkaline reaction; when mixed with an excess of ammonium chloride and ignited it leaves potassium chloride. It imparts a purple color to flame.

Tests.—The aqueous solution (1 in 20) of the salt slightly acidulated with hydrochloric acid, when mixed with an equal volume of hydrogen sulphide solution, should not yield a precipitate or coloration, after standing corked in a warm place for at least half an hour, either before or after addition of ammonia-water to slight alkalinity (absence of metals). 5 Cc. of the solution (1 in 10) should not respond to the modified Gutzeit's test for arsenic given under Arseni Trioxidum.—U. S. The solution should not be precipitated by ammonium carbonate or oxalate (calcium, etc.) nor by silver nitrate (chloride). The solution, mixed with an equal volume of sulphuric acid, should not give a brown or black color on the addition of ferrous sulphate (nitrate). The U. S. P. (1900) omits tests for calcium, chloride and nitrate, the absence of which is demanded by the Br. P. Held in a non-luminous flame it should impart at once a

violet color (absence of sodium). 1 Gm. of potassium sulphate, when completely precipitated by barium chloride, yields 1.338 Gm. of dry barium sulphate.

Action and Uses.—Potassium sulphate, in doses of from ½ to 1 drachm (2–4 Gm.), acts as a gentle aperient, and in larger doses, 2 to 4 drachms (8–16 Gm.), it slowly produces purgation, often with colicky pains in the abdomen. It is not a safe drug to be used in large quantity, as fatal results have followed the administration of from 1½ to 2 ounces (45–60 Gm.). When employed it should be diluted with a large quantity of water. Potassium bisulphate is also a purgative, but it is more powerful and irritating than the sulphate.

Allied Salt.—Potassii Bisulphas. $KHSO_4$. Molecular weight, 135.21.—Potassium bisulphate or acid sulphate is the saline mass remaining in the retort on preparing nitric acid from potassium nitrate and sulphuric acid, and may be obtained in needle-shaped prisms by dissolving it in less than its own weight of boiling water and cooling. The crystals are colorless and transparent, have a strongly acid taste, and acid reaction to litmus, are fusible when heated, congealing on cooling to a translucent mass, and at a higher heat are decomposed with evolution of oxygen and sulphur dioxide, neutral potassium sulphate being left. The salt dissolves without change in 2 parts of cold water, but when dissolved in a large quantity of hot water neutral sulphate crystallizes on cooling, the liquid containing sulphuric acid. A like decomposition into neutral sulphate and acid is occasioned by alcohol.

POTASSII TARTRAS, *Br.*—Potassium Tartrate.

Kalium tartaricum, P. G.; *Potassæ tartras; Tartarus solubilis.—Tartrate of potash, Soluble tartar*, E.; *Tartrate de potasse, Tartre soluble, Sel végétale*, Fr.; *Kaliumtartrat, Neutrales weinsaures Kali*, G.

Formula, $K_2C_4H_4O_6$. Molecular weight, 224.64. The formula given in the Br. P. is $K_2C_4H_4O_6.H_2O$, containing 1 molecule of water of crystallization, but, according to F. B. Power, this is an error, and the formula should be $(K_2C_4H_4O_6)_2.H_2O$. Hager (*Handbuch*, 1902), on the other hand, states that neither the crystals nor the powder contain any water of crystallization, but they absorb moisture from the air and become damp. The Fr. Cod. recognizes the anhydrous salt.

Preparation.—This salt appears to have been known in the sixteenth century. Boerhaave (1742) prepared it by neutralizing cream of tartar with salt of tartar, and named it *tartarus tartarisatus*. That a solution of the same salt is obtained on neutralizing cream of tartar with lime was shown by Rouelle and Marggraf (1770). It is obtained in the first part of the process for making Tartaric Acid (which see), but it is usually prepared by Boerhaave's process, or preferably with potassium bicarbonate, using 25 parts of this salt, 47 parts of pure potassium bitartrate, and about 100 parts of boiling water. The neutral or faintly alkaline solution is concentrated until a pellicle forms and set aside to crystallize; the crystals are drained and dried. The mother-liquor is further concentrated, and when it begins to yield colored crystals may be decomposed by hydrochloric acid to obtain the remaining salt as bitartrate. The yield of crystallized potassium tartrate is about 55 or 56 parts.

If the potassium bitartrate is contaminated with calcium tartrate, this salt may be decomposed by prolonged boiling with potassium carbonate, calcium carbonate being deposited. Calcium tartrate is soluble in a solution of potassium tartrate, and, unless decomposed as stated, is best removed by evaporating the solution to dryness, granulating the salt, and treating it with twice its weight of *cold* water, when most of the calcium tartrate will be left undissolved.

Properties.—Potassium tartrate crystallizes in 4- or 6-sided colorless and transparent crystals of the monoclinic system, which in the presence of calcium tartrate are white and rather opaque. It is more frequently met with as a granular or fine white powder, is inodorous, has a saline, bitterish taste, is without action on litmus-paper, and may be heated to 100° C. (212° F.) without losing in weight; but near 220° C. (428° F.) about 5.5 per cent. of acetone and other volatile products are formed, the residue containing potassium carbonate; above this temperature the salt becomes colored, melts, gives off inflammable vapors having the odor of burning sugar, and leaves a black residue having an alkaline reaction and effervescing strongly with acids. Heated with sulphuric acid, it forms a black, tarry fluid, evolving inflammable gas and the odor of burning sugar. It requires 240 parts of boiling alcohol for solution, and is nearly insoluble in cold alcohol.

1 part of water dissolves 1.3 parts of the salt at 17.5° C. (63.5° F.) and 2.8 parts at 100° C. Tests for tartrate and impurities are the same as given under POTASSII ET SODII TARTRAS. A 5 per cent. solution of the salt acidulated with nitric acid should at most become opalescent on the addition of silver nitrate (chloride).—P. G. The Br. P. requires that 1 Gm. of the salt, converted to carbonate by heating to redness, be neutralized by 8.4 Cc. of normal sulphuric acid when titrated, corresponding to 98.08 per cent. for the formula $(K_2C_4H_4O_6)_2.H_2O$ or 101.83 per cent. for the Br. P. formula. Evidently the formula suggested by Power is better, and, as he states, 8.5 Cc. of normal acid is a better requirement than 8.4 Cc., the former volume corresponding to 99.25 per cent. of the salt, which would be in accord with the demand of the Br. P. that only the slightest reactions with the tests for calcium, magnesium, sodium, chlorides, or sulphates should be afforded by the salt.

Action and Uses.—Potassium tartrate is a mild refrigerant diuretic in small doses and a laxative in large quantity. As a diuretic it differs from the bitartrate in that it renders the urine alkaline. Its purgative action is not as efficient as that of magnesium or sodium sulphate, but it may be used when a mild, aperient effect is desired. Combined with senna, gamboge, or scammony it lessens the griping produced by these drugs. Potassium tartrate is given in the dose of from ½ to 1 drachm (2–4 Gm.) as a diuretic, and from ½ to 1 ounce (16–30 Gm.) as a purgative.

POTASSIUM.—Potassium.

Potassium, Fr.; *Kalium*, G.

Symbol, K. Atomic weight, 38.86.

Potassium is a member of the family of alkali metals, which have been referred to under CÆSIUM and LITHIUM (which see). It occurs widely distributed in nature, as may be seen by referring to the various official salts, but the one great deposit of potassium compounds which are available for commercial purposes is the Stassfurt mine in Germany, where potassium exists as chloride and sulphate, usually in combination with magnesium chloride and sulphate. These minerals are known as carnallite, kainite, silvite, schönite (see under MAGNESIUM), and are of great value in the manufacture of potassium salts and of fertilizers. These salts occur in layers overlying enormous beds of rock-salt, all of which were deposited in remote times from sea water. The source of the potassium salts originally was the feldspars, micas, etc., which suffered decomposition by weathering processes, and yielded the potassium compounds (silicate) to rain waters and rivers, and through the latter to the sea. (See under KAOLIN.)

Preparation.—The metal was first isolated in 1807 by Sir Humphrey Davy, by electrolyzing molten caustic potash, and much is obtained at the present day by electrolyzing molten potassium chloride (see POTASSII HYDROXIDUM). The oldest method of preparing it commercially consists in heating a mixture of potassium carbonate and carbon, for example, charred cream of tartar, to strong redness, when carbonic oxide is produced and the metal distils over: $K_2CO_3 + 2C = 2K + 3CO$. Other methods consist in heating caustic potash or potassium sulphide with aluminum, magnesium, iron, iron carbide or carbon; thus, $2KOH + 2Mg = 2K + 2MgO + 2H$ and $K_2S + Fe = 2K + FeS$.

Properties.—Potassium is of silver-gray color, of a strong metallic luster, harder than sodium, but softer than lead, fuses at 62.5° C. (144.5° F.), is brittle at the freezing-point of water, and at a red heat volatilizes, forming green vapors. Its density is 0.865 and its atomicity univalent. It has a great affinity for oxygen, and when thrown upon water decomposes this liquid, melts, and burns with a purple flame. It must be preserved under petroleum naphtha, which is free from oxygen. There are three oxides of potassium known—the *monoxide*, K_2O, *dioxide*, K_2O_2, and *tetroxide*, K_2O_4, of which only the former is of importance on account of the uses in medicine and the arts to which its combinations with water and acids are put.

Potassium Salts.—Potassium hydroxide is a very strong base, and completely neutralizes the strongest acids. The salts are colorless unless the acid has a distinct color, and are neutral to test-paper, except those with weak acids, which have a distinct alkaline reaction. They are mostly readily soluble in water, and in such solutions, if not too dilute, are precipitated in a gelatinous condition by hydrofluosilicic acid, and in a crystalline form by tartaric acid, acid sodium tartrate, sodium cobaltic nitrite, platinic chloride, and

sodium picrate. The last three precipitates are yellow, the others white. When heated before the blowpipe, the potassium salts impart a purplish tinge to the flame, which is masked by the presence of a small quantity of sodium salt. The yellow color of the latter is absorbed by looking at the flame through blue glass, and the potassium flame becomes then visible.

UNOFFICIAL POTASSIUM COMPOUNDS.

Potassii Bisulphis.—*Potassium bisulphite.* $KHSO_3$.—It is prepared by passing into a concentrated solution of potassium carbonate an excess of sulphur dioxide and adding strong alcohol. The salt crystallizes in white needles, has a sulphurous taste and neutral reaction to test-paper, and on exposure slowly evolves sulphur dioxide. On passing sulphurous acid gas into a warm saturated solution of potassium carbonate the liquid finally becomes greenish, and on cooling deposits hard, glossy, tabular crystals of *potassium pyrosulphite*, $K_2(SO_2)_2O$, which have a saline taste, and on heating give off sulphur and sulphur dioxide, leaving potassium sulphate. Potassium bisulphite or sulphite given in the quantity of from 2 to 4 drachms (8–16 Gm.) in 24 hours exercises a mild, diuretic effect. They possess some power to control fermentation in the intestinal canal, but are now rarely employed for this purpose.

Potassii Bromas.—*Potassium bromate*, E. ; *Bromate de potasse*, Fr. ; *Kaliumbromat Bromsaures Kali*, G. $KBrO_3$.—This salt is formed when bromine is added to hot caustic potash, along with potassium bromide (see the latter). The bromate is separated from the bromide by crystallization, being less soluble than the latter. It forms colorless cubes or tablets, soluble in 15 parts of cold and 2 parts of hot water. Like potassium chlorate it forms dangerous mixtures with combustible substances, such as sulphur, sugar, etc., on account of its oxidizing powers. Silver bromate is difficultly soluble, while silver chlorate is easily soluble. It is used for analytical purposes because it liberates bromine in an acidified solution of potassium bromide: $5KBr + KBrO_3 + 3H_2SO_4 = 3H_2O + 3K_2SO_4 + 3Br_2$. A mixture of the two salts in the proportion given by the equation and diluted to decinormal strength is known as Koppeschaar's Solution, and is employed in titrating phenol, producing tribromphenol.

Potassii Cantharidas.—*Potassium cantharidate.* $C_{10}H_{14}K_2O_6.2H_2O$.—If cantharidin be heated with twice its weight of potassium hydroxide and 100 parts of water in a flask on a water-bath, a clear solution of potassium cantharidate will be obtained; the solution is usually diluted by the gradual addition of warm water to such an extent that each Cc. shall contain 0.0002 Gm. of cantharidin. The salt may be obtained in crystals having the above composition and soluble in 25 parts of water; the addition of acids to the aqueous solution causes the separation of cantharidin, not cantharidic acid, which latter has never been obtained in a free state. Potassium cantharidate was first recommended by Liebreich in 1891 for hypodermic injection in the treatment of certain forms of tuberculosis. The average dose for adults is 1 to 1.5 Cc. of a solution of the salt representing 0.0002 to 0.0003 Gm. ($\frac{1}{324}$–$\frac{1}{216}$ grain) of cantharidin.

Potassii Chloridum, *s. Kalium chloridum* (*chloratum*), *Sal digestivum Sylvii.*—*Potassium chloride*, E. ; *Chlorure de potassium*, *Sel digestif*, Fr. ; *Kaliumchlorid*, G. Formula, KCl.—It is obtained in large quantities at Stassfurt from *carnallite*, a double chloride of potassium and magnesium, and forms white or colorless, inodorous cubes or quadrangular prisms which have a saline taste resembling that of table-salt, and which are fusible without decomposition. The salt dissolves in 3 parts of cold and a little less than 2 parts of hot water, and is slightly soluble in alcohol, but is insoluble in absolute alcohol. Its aqueous solution should have a neutral reaction, and should be free from impurities when tested as directed under the official salts. It should not be confounded with potassium chlorate nor with chlorinated potassa. It is largely employed in the manufacture of other potassium compounds.

Potassii Glycerophosphas.—*Potassium glycerophosphate*, $C_3H_7O_3.PO_3K_2$.—This salt is very hygroscopic, with an alkaline reaction, becoming dry only after long heating to 140° to 150° C. (284°–302° F.). It also occurs in the market as a 50 per cent. aqueous solution. It is used for the same purposes and in small doses as the calcium salt.

Potassii Iodas.—*Potassium iodate*, E. ; *Iodate de potasse*, Fr. ; *Kaliumjodat*, *Jodsaures Kali*, G. KIO_3.—This salt is left behind on treating the product of the reaction of iodine upon potassa with alcohol; or it may be prepared, according to L. Henry (1870), by diffusing 127 parts of iodine in cold water, passing chlorine into it until iodine chloride, ICl, has been formed, and dissolved in water, adding 122.5 parts of potassium chlorate and heating, when chlorine gas will be evolved, and potassium iodate crystallizes on cooling; $ICl + KClO_3$ yields $KIO_3 + Cl_2$. The salt crystallizes in translucent or milk-white cubes, dissolves in 13 parts of cold and in 3.1 parts of boiling water, and is more freely soluble in solution of potassium iodide and insoluble in alcohol. When heated, the salt fuses, and at a high temperature parts with its oxygen, leaving potassium iodide. It detonates, but less violently than the chlorate, when thrown upon burning coal. On the addition of arsenous acid or stannous chloride the solution separates iodine; if not too diluted, its solution yields white granular precipitates with salts of barium, lead, and silver.

Potassii Osmas.—*Potassium osmate.* $K_2OsO_4.2H_2O$.—This salt is preferred by many to pure osmic acid (see page 48). It is prepared by adding potassium hydroxide to an alcoholic solution of osmium tetroxide; the liquid assumes a beautiful red color; and if concentrated, the potassium osmate will separate as a crystalline powder. Slow evaporation of dilute solutions produces deep garnet-red crystals of octahedral shape, which are readily soluble in water, of a sweetish, astringent taste, and permanent in dry air; in moist air the salt deliquesces and is decomposed; hence solutions of the salt are not very stable. Potassium osmate is generally used hypodermically in the form of a 1 per cent. solution; internally it may be given in pill-form, in doses of 0.001 to 0.0015 Gm. ($\frac{1}{65}$—$\frac{1}{45}$ grain).

Potassii Perchloras.—*Potassium perchlorate.* $KClO_4$.—To obtain it, potassium chlorate is carefully heated until it melts and just begins to evolve oxygen, and is kept at this temperature until gas is no longer given off, and a portion of the residue, on being tested with strong hydrochloric acid, acquires only a faint-yellow color. The saline mass is dissolved in water and freed from chloride by recrystallization. Potassium perchlorate is in colorless rhombic crystals which have a slight saline taste, and when heated to about 400° C. (752° F.) is decomposed into oxygen gas and potassium chloride. It is insoluble in alcohol, and dissolves in 5½ parts of boiling water, but requires at 15° C. (49° F.) 65 parts, and at 10° C. (50° F.) 88 parts, of water for solution. This salt is employed in preparing *perchloric acid*, for which Bullock (1865) devised the following process: Potassium perchlorate is distilled with twice its weight of sulphuric acid mixed with $\frac{1}{10}$ part of water. The distillate, containing perchloric, sulphuric, and a little hydrochloric acid and chlorine, is carefully treated with lead carbonate until the sulphuric acid has been completely precipitated. The liquid is filtered, freed from lead by hydrogen sulphide, filtered again, and boiled until it attains a specific gravity of about 1.6, when by distillation it may be obtained of the density 1.693. It is a colorless, oily, very acid liquid, containing 72 per cent. of $HClO_4$, boiling at 203° C., and not affected by sunlight or by sulphurous or hydrochloric acid, but readily decomposed by iodine and bromine. The acid is monobasic, forms mostly deliquescent salts, which are also soluble in alcohol, and when added to not too dilute solutions of potassium salts produces precipitates of potassium perchlorate. This salt is said not to possess the irritating and poisonous properties of potassium chlorate. It has been proposed as an antiperiodic in malaria, but is never used as such.

Potassii Persulphas.—*Potassium persulphate*, E.; *Kaliumpersulfat*, G.; *Anthion.* $K_2S_2O_8$.—A salt of persulphuric acid, obtained by electrolysis of a solution of potassium bisulphate. It forms colorless prisms soluble in 50 parts of water. It oxidizes sodium thiosulphate to sulphate, hence is used in photography.

Potassii Picras.—*Potassium picrate*, E.; *Kaliumpikrat*, *Pikrinsaures Kalium*, G. $C_6H_2(NO_2)_3OK$.—This is obtained by neutralizing a hot solution of 20 parts of picric acid with 7 parts of potassium carbonate and crystallizing in a cool place. It forms small yellow crystals or a powder, soluble in 230 parts of cold and 15 parts of boiling water, and nearly insoluble in alcohol. The salt is bitter and explodes by pressure, a blow, or by heating. It should be kept in a bottle with a cork and not a glass stopper, to avoid friction.

Potassii Sozoiodolas.—*Potassium sozoiodolate.* $C_6H_2I_2(OH)SO_3K + 2H_2O$.—A colorless salt soluble in 84 parts of water and 200 parts of alcohol. Used as a 3 per cent. dusting-powder with talcum or in ointments (3 per cent.) in skin diseases.

Potassii Sulphis.—*Potassium sulphite*, E.; *Sulfite de potasse*, Fr.; *Kaliumsulfit*, *Schwefligsaures Kali*, G. $K_2SO_3.2H_2O$.—On passing sulphur dioxide into a solution of potassium carbonate until the carbon dioxide has been expelled, and adding an equal weight of potassium carbonate, the sulphite, having the above composition, will crystallize on evaporation. It forms octahedral crystals, which are inodorous or of a slight sulphurous odor, somewhat deliquescent, dissolve freely in water, sparingly in alcohol, show an alkaline reaction to test-paper, and have a bitter saline and sulphurous taste. On exposure to the air it is oxidized and gradually converted into sulphate; it should therefore be preserved in well-stoppered bottles. On adding sulphuric or hydrochloric acid to its solution the odor of burning sulphur is given off, but no turbidity from liberated sulphur is produced (difference from thiosulphate). The commercial salt is usually in the form of white opaque crystalline fragments or powder, obtained by evaporating the aqueous solution. For tests and titration, see Sodii Sulphis. For action and uses, see Potassii Bisulphis.

Potassii Telluras.—*Potassium tellurate.* K_2TeO_4.—This compound and the corresponding sodium salt, Na_2TeO_4, are prepared by neutralizing an aqueous solution of pure crystallized telluric acid with potassium and sodium hydroxide, respectively, evaporating the solution to dryness, and washing the residue with alcohol. Both salts occur as a white crystalline powder, readily soluble in water, but insoluble in alcohol; a 2 per cent. aqueous solution should not at once yield a black precipitate upon addition of stannous chloride solution, showing absence of tellurious acid. The alkaline tellurates have been recommended as antihydrotics in daily doses of 0.05 Gm. (about $\frac{4}{5}$ grain), to be given at bedtime; they have been used with effect in arresting the night-sweats of phthisis, but cause an intense garlicky odor of the breath, which is but slightly modified by peppermint.

PRIMULACEÆ.—The Primrose Family.

A family of 28 genera and about 350 species, distributed throughout almost the entire globe, but especially abundant in the north-temperate zone. Their economic importance is almost wholly in the direction of ornamentation, some of our most pleasing household flowers, primroses, cyclamens, etc., pertaining to this family. Medicinally, many species are interesting because of the presence in them of saponin and other bitter principles, or of salicylates.

Primula, Primrose, Cowslip, Lady's-keys, Culverkeys, Herb Peter, Palsywort (E.); *Primel, Schlüsselblume* (G.); *Primavire* (Fr.); *Primavera* (Sp.), is the plant *Primula officinalis* Jacq. (*P. vulgaris* Hill). The part mostly used is the rhizome and roots, under the name *Radix arthritica* or *Radix paralysans*. The plant is an acaulescent perennial of Europe and northern Asia, very commonly cultivated in gardens, and blooming in early spring. The subterranean portion consists of a short, upright, brownish, and scaly root-stock, beset with a number of fleshy roots, and containing a thick mealy bark and a yellowish meditullium. The flowers are pendulous upon short or elongated scapes in umbels of 10 or 12; the calyx is 12 Mm. ($\frac{1}{2}$ In.) or more long, pentangular, tubular, somewhat inflated, acutely lobed, and pale yellowish; the corolla is about 25 Mm. (1 In.) long, funnel-shaped, 5-lobed, the lobes obcordate, of a lemon-yellow color, and has in the throat 5 saffron-colored spots. The corolla alone is sometimes collected for the drug (*flores primulæ*). It has when fresh a honey-like odor and a sweetish taste, and on drying usually acquires a dark-greenish color. The fresh root has a slight sweetish odor and a sweetish, afterward bitterish and acrid taste. The odor of the root and flowers appears to be due to a small quantity of a butyraceous volatile oil. The *primulin* of Hünefeld is considered by Gmelin to be identical with mannit. The acrid principle is either saponin or closely related to it; Saladin (1830) regarded it as identical with cyclamin.

Nearly a dozen other species of *Primula* agree with *P. officinalis* in properties and, for the most part, in uses. *P. obconica* Hance is a well-known irritant poison, the symptoms being those of saponin-poisoning, and is used in the treatment of eczema and other skin diseases.

Two or three species of *Androsace* are similarly used.

Cyclamen, *Sow-*, *Swine-*, or *Ground-bread* or *Bleeding-nun* (E.); *Erdbrod, Schweinbrod, Erdscheibe* (G.); *Pain de porceau, Arthanite* (Fr.); *Pan de puerco* (Sp.) is the tuber of *Cyclamen Europœum* L. The plant is a perennial herb of Europe, well known in cultivation. Its leaves are all radical, roundish, cordate, long-petioled, purple underneath, white-blotched above. The scapes bear solitary, large, nodding, pink flowers, the perianth segments strongly reflexed. The pyriform or spindle-shaped tubers of *Lathyrus tuberosus* L., which are of the size of a walnut, are said to be occasionally substituted for those of cyclamen; they have a mucilaginous taste. The tuber is 25 to 50 Mm. (1–2 In.) thick, flattish circular or depressed globose, dark brown externally, internally white, mealy, with a rather thin bark, and with narrow and short fibro-vascular bundles arranged in irregular circles. In the fresh state it has a burning, acrid taste; after drying, this is milder. The important constituent is the saponin-like body *cyclamin* or *arthanitin*, $C_{20}H_{24}O_{10}$. It is white, amorphous, or in minute crystals, of a bitter and acrid taste, soluble in carbon disulphide, chloroform, alcohol, and water, and insoluble in ether and fixed and volatile oils. Its aqueous solution foams like soap-water, is precipitated by tannin, and when boiled with dilute acids yields glucose and resinous *cyclamiretin*.

Most species of the genus have been more or less employed similarly. Similar properties are said to pertain to various species of *Lysimachia* or *Loosestrife*, especially *L. nummularia* L., the *Creeping loosestrife, Moneywort, Herb tuppence, Wandering-Jennie or -sailor, Pfenningkraut* (G.), *Monnayère* (Fr.), a creeping perennial of Europe, naturalized in the United States, bearing opposite, short-petioled, smooth, rotund, finely punctate leaves, and large, solitary, axillary, bright-yellow, 5-merous flowers.

Anagallis, *Pimpernel, Poor-man's weather-glass, Shepherd's sundial, Red chickweed, Bird's-eye, Waywort* (E.); *Rothe Miere, Gauchheil, Collmarkraut* G.; *Mouron rouge* (Fr.), is the herb *Anagallis arvensis* L., of Europe, and introduced as a weed into many countries. It is a slender, prostrate, spreading annual, with opposite, sessile, oval-ovate, black-dotted leaves, from 5 to 20 Mm. ($\frac{1}{5}$–$\frac{4}{5}$ In.) long, and small scarlet flowers, with crimson centre, on very slender peduncles. The habit of the flowers of opening only in sunshine has given the names "weather-glass," "sun-dial," etc. The herb has an acrid taste, due evidently to the presence of saponin. It has gained some repute in the treatment of rheumatism.

PRUNUM, *U. S., Br.*—Prune.

Pflaume, Zwetsche, G.; *Pruneau noir*, Fr. Cod.; *Ciruela*, Sp.; *Ameixas Passadas*, Port.

The partially dried ripe fruit of *Prunus domestica* L. (Fam. *Rosaceæ*).

The prune is official in most pharmacopœias, some of which, as the British, specify that produced by the *variety Juliana* DC., of the above-named species.

Origin.—The prune tree is a native of southwestern Asia and is now cultivated in all temperate regions. The annual consumption of the fruit as a food is enormous, the

California product now taking precedence of all others as to extent of production. This product is less acid and less highly flavored than the French or European Prune, although larger and finer looking. For this reason it is probably inferior as a laxative, containing a smaller amount of the fruit-salts.

So well known a food-fruit requires no description. The stone with its contained seed should, of course, be removed before using.

Constituents.—The pulp of the prune contains from 35 to 40 per cent. of uncrystallizable sugar in the sweeter varieties, about half as much in the fresh fruit, together with pectin, albumin, and 2 or 3 per cent. of malic and tartaric acids, chiefly the former, partly free and partly combined, mostly with potassium.

The seed contains amygdalin and yields prussic acid, like the bitter almond.

Pharmaceutical Preparation.—Confection of Senna, U. S. P.

Action and Uses.—Prunes are nutritious and laxative, but eaten in excess may produce flatulence and griping. Stewed with sugar and water they form a good article of diet to be taken in habitual constipation. The addition of a small quantity of senna increases their efficiency without affecting their agreeable taste. The presence of prunes in confection of senna and similar preparations lessens the griping of the more powerful ingredients.

PRUNUS VIRGINIANA, *U. S.*—Wild-cherry Bark.

Pruni Virginianæ cortex, Br.—*Rum*, *Whiskey*, or *Cabinet cherry*, E.; *Wildkirschenrinde*, *Amerikanischer Zierstrauch*, G.; *Écorce de cerisier de Virginie*, Fr.; *Corteza de cerezo*, Sp.

The dried bark of *Prunus serotina* Ehrhardt (*Cerasus s.* Lois.; *Prunus Virginiana* Mill.—Fam. *Rosaceæ*), collected in the autumn.

Wild Cherry is official only in the United States and British pharmacopœias. The U. S. P. states that the bark of the very large and of the very small stems is to be rejected. The B. P. does not mention this, and, in fact, specifically refers, in its description, to old and thick bark. The superiority of the young, thin bark has been fully proved.

Fig. 324.

Wild cherry (¾ Nat.).

Fig. 325.

Choke cherry (¾ Nat.).

Origin.—The wild cherry is a small or medium-sized tree, growing in fence-rows, along the borders of forests and in similar exposed or partly exposed situations, through-

out eastern and central North America. Its wood is hard, dark red and handsome, and highly valued in cabinet work. The foliage and inflorescence characters are here illustrated. The small black or black-purple fruit occurs in pendulous racemes. It varies greatly in edible qualities, being sweet, acidulous, and somewhat bitter, but little astringent when ripe. One case of fatal poisoning is recorded from the decomposition of the seeds, with formation of prussic acid, due to impaction of a large quantity of the stones in the intestine. Cattle are frequently killed, apparently by prussic-acid poisoning, after eating the leaves which have been wilted by the sun, although they eat the fresh leaves with impunity. This plant should not be confounded with *P. Virginiana* L. (*Cerasus V.* Lois.; *P. obovata* Bigel.), the Choke cherry, which is commonly only a large shrub, with coarser foliage, and larger, mostly red fruit, which is exceedingly astringent, even when ripe.

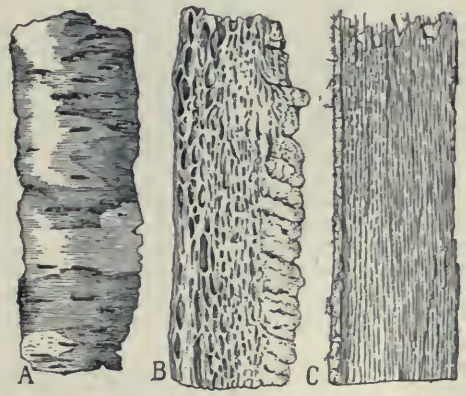
The bark, upon collection, is usually deprived of the periderm, the green phelloderm layer being thus exposed.

Description.—In curved pieces or irregular fragments, 2 to 4 Mm. ($\frac{1}{12}$–$\frac{1}{6}$ In.) thick, the outer surface green or greenish-brown, smooth and somewhat glossy, marked with shallow, transverse, light-colored furrows, the inner surface rusty-brown, either shortly and finely reticulate-striate, or finely and deeply reticulate-pitted by the separation of the tissues in drying; fracture short, granular or rough, the outer layer green, the inner brown, the intermediate purplish; odor characteristic, that from the water-macerated bark strongly resembling that of bitter almonds, as does the taste, which is also somewhat astringent.

The amount of ash should be between 4 and 5 per cent.

The powder exhibits calcium oxalate crystals in various forms, chiefly in rosettes, which are mostly about 17 mikrons broad and which in the bark are contained in cells arranged in regular rows. A few short and thick bast-cells, with somewhat similar stone-cells, occur and starch-grains from 3 to 5 mikrons broad are abundant.

FIG. 326.



Wild-cherry bark: A, outer surface (Nat.); B, inner surface (× 2); C, Choke-cherry bark, inner surface (× 2).

The powder of Choke-cherry bark contains numerous long, slender bast-fibres.

Constituents.—The important constituent of wild-cherry bark is a glucoside very similar to, if not identical with, amygdalin, or perhaps more nearly like laurocerasin, in connection with an enzyme, by the action of which, in presence of water, hydrocyanic acid is freed. For a discussion of this subject, see AMYGDALA AMARA. The yield of hydrocyanic acid is extremely variable, ranging from about 0.03 per cent. in old trunk-bark to about 0.25 per cent. in fresh root-bark. The yield is less in the spring than in the autumn, less in thicker bark, and decreases as the dried bark is kept on hand. There is from 2.5 to 4.5 per cent. of tannin, this also most abundant in the autumn. A small amount of a fluorescent bitter glucoside has been extracted in the form of white crystals.

Pharmaceutical Preparations.—FERRATED WINE OF WILD CHERRY, WINE OF WILD CHERRY, N. F.; FLUIDEXTRACT OF WILD CHERRY, SYRUP OF WILD CHERRY, U. S. P.

Action and Uses.—Owing to the bitter principle contained, wild-cherry bark is a stomachic and bitter tonic useful in gastric atony and general debility. The quantity of hydrocyanic acid which it generates with water is so small that the drug must be given in large quantity to act as a sedative to the bronchial and laryngeal mucous membranes, and even then this effect is so fleeting as to make it of doubtful value. In very large doses wild cherry bark distinctly decreases the rate of the pulse. In quantity much too small to be of benefit it has been employed as a circulatory sedative in the hectic fever of tuberculosis and in cardiac palpitation arising from anæmia, chlorosis, dyspepsia, and nervous disorders.

As a tonic wild cherry is used in the form of the infusion, the dose of which is from ½ to 1 fluidounce (16–30 Cc.), and of the fluidextract in from 30- to 60-minim (2–4 Cc.)

doses. The syrup of wild cherry in the dose of from 1 to 4 drachms (4–16 Cc.) is a pleasant vehicle for other drugs.

Allied Products.—Reference has already been made under Amygdala Amara to the existence in the seeds of the *Drupaceæ* and *Pomaceæ* of Amygdalin or a similar glucoside. The leaves of the cherry, peach, plum, and related plants also contain these substances, with resulting similar properties, and a number of them have been thus employed.

Laurocerasi Folia (*Cherry laurel leaves, Cherry bay leaves,* E.; *Kirschlorbeerblatter,* G.; *Laurier-cerise, Lauroceraso,* Fr.; *Laurel cerezo,* Sp.) are the leaves of *P. Lauro-cerasus* L. (*Cerasus L.* Lois.; *Laurocerasus vulgaris* Car.; *L. officinalis* Roem.). The drug is official in the British Pharmacopœia, which requires the use of the fresh leaves. These leaves are derived from a large evergreen shrub or small tree of southwestern Asia, now largely naturalized in southern Europe. The leaves are about 15 Cm. (6 In.) long, oblong to obovate, narrowed toward each end, the margins sharply serrate and somewhat revolute, the texture thick and coriaceous, the surface smooth and somewhat shining, dark green above, pale underneath, where 1 or 2 rather large depressed glands are found beside the midrib, close to the base. They emit a bitter-almond odor when bruised. The leaves contain 1.3 per cent. of crystallizable, bitter, *laurocerasin* ($C_{40}H_{67}NO_{30}$), which is probably a compound of amygdalin ($C_{20}H_{27}NO_{11}$), amygdalic acid ($C_{20}H_{28}O_{13}$), and $6H_2O$. It is decomposed by "emulsin" into hydrocyanic acid, benzaldehyde (C_6H_5COH), and sugar, but much more slowly than amygdalin, and with only half the yield of HCN. The delay may be due to a preliminary setting free of amygdalin before the fermentation proceeds. The distillate of bruised fresh leaves has yielded 0.12 per cent. of hydrocyanic acid and 0.5 per cent. of benzaldehyde (oil of bitter almonds), some of this latter probably existing already formed in the leaves. The spring leaves are said to give the largest yield. The other constituents are sugar, tannin, fatty or waxy matter, and crystalline *phyllic acid* which is insoluble in water, and soluble in alcohol or ether, and is also found in the leaves of apple, peach, almond, and maple.

Persica or Peach leaves (*Pfirsich,* G.; *Pêcher,* Fr.; *Durazno, Melocoton,* Sp.) is the leaves of *Persica vulgaris* DC. (*Amygdalus Persica* L.). This tree is indigenous to southwestern Asia and is the well-known peach of cultivation. The leaves of cultivation vary extremely in size and are lanceolate, acuminate, finely serrate, glabrous but rugose-wrinkled, and rather thin. They possess the same odor and taste as the other products of this class already considered. They contain about 3 per cent. of amygdalin and yield, like the others, hydrocyanic acid and oil of bitter almond.

PULSATILLA.—Pulsatilla.

Pasque-flower, Easter-flower, Dane's blood, E.; *Küchenschelle, Pulsatille,* G.; *Anemone, Pulsatille, Coquelourd,* Fr.; *Pulsatila,* Sp.; *Anemola,* Port.

The dried herb of *Anemone Pulsatilla* L. (*Pulsatilla vulgaris* Mill.; *P. Pulsatilla* Lyons) or of *A. pratensis* L. (*P. pratensis* Mill.—Fam. *Ranunculaceæ*), collected soon after commencing to flower, carefully preserved, and kept not longer than one year.

The recognition of *Pulsatilla,* Adans., as a genus distinct from *Anemone,* is perhaps judicious, but the terminology of Engler and Prantl is followed in the U. S. P., to preserve uniformity. Pulsatilla is not official in any other of the more important pharmacopœias. The Portuguese prefers *A. nemorosa* L. (*Anemola dos bosques*).

Origin.—Low, delicate, and beautiful perennial herbs, of early spring, the herbage quickly perishing, growing in dry, partially open, and grassy situations throughout most of Europe, and extending into northern Asia; also cultivated for ornament. The second named is rather more abundant southward, the first named northward. Collecting is usually carelessly performed, resulting in the presence of much grass in the drug. Pulsatilla should be dried in the shade. It loses its properties rather rapidly after being dried.

Description.—Silky-villous; leaves radical, long-petioled, the petioles usually purplish, the blades twice or thrice deeply 3-parted or pinnately cleft, the lobes linear and acute; flowers long-peduncled, subtended by a pinnately parted involucre of 3 sessile leaves; calyx of (usually 5 or 6) large, dull-purple, hairy sepals; petals obsolete; stamens numerous; pistils several, becoming in fruit long, plumose-tailed akenes; inodorous and very acrid.

Constituents.—Besides tannin and ordinary plant constituents, Pulsatilla contains a colorless or yellowish acrid volatile oil, the active principle of which is a peculiar crystalline camphor, which is extracted by ether or chloroform and possesses vesicating properties. This is slowly, or rapidly in the presence of water, decomposed into anemonin and iso-anemonic acid. *Anemonin* ($C_{10}H_8O_4$) occurs in colorless, odorless, neutral, friable

crystals, soluble in chloroform, nearly insoluble in ether and water, exceedingly acrid when fused. *Iso-anemonic acid* ($C_{15}H_{14}O_7$) is a white, crystalline, tasteless powder, dissolving in alkalies with a yellow color, insoluble in most common solvents.

Fig. 327.

Anemone Pulsatilla (½ Nat.).

Action and Uses.—It is probable that no drug in the materia medica has been employed in so many different diseases, or has had ascribed to it so divers and conflicting virtues as pulsatilla.

"According to Galen the anemones are endowed with acrid, drawing, cleansing, and opening virtues. When chewed anemone excites a secretion of mucus, its juice cleanses the brain and nostrils and lessens or removes opacities of the cornea. It purifies ulcers, cures lepra and pityriasis, is emmenagogue and galactogogue. Neither Dioscorides, Pliny, nor the Arabians added anything to this enumeration, and the drug seems to have been almost forgotten until the close of the eighteenth century." Since then it has been recommended at different times in the treatment of cataract, paralysis, rheumatism, melancholia, syphilis, dysmenorrhœa, and a host of other morbid conditions.

The bruised fresh fruit and anemonin irritate the skin and may produce vesication. Taken internally it produces a sense of burning in the mouth and fauces and may cause inflammation of the stomach and intestines. In poisonous doses it causes death preceded by cardiac and respiratory depression and convulsions. The dose of the powdered drug is from 2 to 5 grains (0.10–0.30 Gm.); of the extract, ½ to 3 grains (0.025–0.20 Gm.); and of anemonin, ⅛ to ½ grain (0.008–0.025 Gm.).

Allied Drugs.—*Anemone hirsutissima* (Pursh.) (*Clematis h.* Pursh.; *Anemone Nuttalliana* DC.; *A. patens N.*—A. Gray; *Pulsatilla hirsutissima* Britton) is the *American pulsatilla* or *Pasque flower, Easter flower, April fool, Badger-weed, Hartshorn plant, Prairie anemone,* or *P. crocus,* of northwestern North America. It has been found to have the same constituents as Pulsatilla, is used in the same way, and was formerly included in the official definition. It closely resembles Pulsatilla. The genus *Anemone,* L., in the broad sense here considered, comprises about 100 species, many of which have been found to possess similar constituents and properties and a number of which are similarly employed, especially the following: *A. nemorosa* L., the *Wind flower* or *Wood crowfoot, Weisser Waldhahnenfuss* (G.), *A. de bois* or *A. sylvie* (Fr.), common throughout Europe; and its American representative, *A. quinquefolia* L.; *A. coronaria* L., of the Levant; *A. sylvestris* L. and *A. ranunculoides* L., of northern Europe and Asia, and used in Siberia. (See also Ranunculaceæ.)

PULVERES.—Powders.

Poudres, Fr.; *Pulver,* G.

Preparation.—All solid drugs may be reduced to powder, but the means by which pulverization is effected must vary very considerably according to the nature of the drug. The large majority of crystallized chemical compounds are readily powdered by *trituration* in a porcelain or Wedgewood mortar; many of those which are insoluble or sparingly soluble in alcohol may be powdered by *precipitating* them from their concentrated solution by pouring it slowly and with continual agitation into alcohol. Compounds which are insoluble in water may frequently be obtained in a more or less fine powder, which is either amorphous or crystalline, by means of double decomposition and *precipitation.* Soluble compounds may also be powdered by evaporating their solution, and, as it thickens, by stirring it continually, so as to disturb crystallization or prevent the compound from

separating as a solid mass. This process is termed *granulation*, and is equally applicable to fusible substances, which, after having been liquefied by heat, are stirred or triturated while they are cooling and congealing. Volatile compounds and elements (calomel, sulphur, etc.) may be finely powdered by *sublimation*, and by suddenly condensing their hot vapors in a large chamber with a current of air, or, if insoluble in water, with a current of steam.

In several of these processes the powder is not obtained of uniform fineness, and then requires to be *sifted*, or the finer particles are separated from the coarser by means of *elutriation*, which process consists in diffusing the powder in water and decanting from the heavy sediment. The fine powder, which remains longest in suspension, is then permitted to subside, and, after withdrawing the liquid, dried. It is evident that only those substances are adapted to this treatment which are heavier than water, and which are entirely insoluble therein; elutriation is usually preceded by *levigation*, which is simply a process of trituration in the presence of sufficient moisture to render the mass soft. The operation is performed either in a mortar or upon a slab by the aid of a muller.

Drugs which are composed of vegetable tissue or which consist of exudations cannot, as a rule, be reduced to powder by these means. In these cases *contusion* is required, and this is the method most frequently employed. The substance is placed in a rather deep mortar, and broken by perpendicular strokes with the flattened surface of a heavy pestle. The process is called *bruising* if the substance is to be broken merely into a coarse powder. If the drug contains a certain amount of oil or resin, the heat produced by the pounding will often render the material more or less soft or adhesive. This result is best prevented by exposing the drug to a low temperature and powdering in the cold, when it will retain its pulverulent condition at ordinary temperatures, or, if it conglomerates, it may be rubbed into powder by slight trituration. Mortars made of iron or brass are best adapted for preparing powders by contusion. Some tough materials are conveniently reduced to powder by *rasping*.

Most of the vegetable powders are, however, prepared on a large scale at the drug-mills by *grinding*, the grinding surface being a bed of hard stone upon which either iron balls or millstones are made to revolve. A draught is thereby created which carries the fine powder up to a certain height, and if this alone is collected it is called a *dusted powder*. Oily seeds and similar material cannot profitably be powdered in this manner, because by the pressure and heat created by the grinding the oil rises to the surface and agglutinates a part of the powder. Such material is best ground, or rather cut, between horizontal millstones suitably prepared for the purpose. A number of drug-mills which may be worked by hand have been constructed, and serve a good purpose for the use of the pharmacist in preparing the coarser kind of powders, but none have been made which could be used with advantage for finely powdering moderate quantities.

Whether contusion or grinding is resorted to, the drugs to be powdered should be deprived of the moisture remaining in them by exposing them in a drying-room to a temperature of about 50° C. (122° F.). Drugs, however, which owe their virtues to volatile oil, and which should be powdered in the air-dry condition or on a small scale, are conveniently dried over burnt lime. The different tissues of plants are not reduced to powder with equal facility; the fibro-vascular bundles and the bast-fibres are usually more refractory than parenchyma-tissue, and more or less of the former generally remains behind as a coarse powder. When the powder is intended to be exhausted by percolation or otherwise, the coarse particles are utilized with the fine powder; but in case the latter be intended for dispensing, the coarser portion is removed by a sieve. The fine powder which may be sifted off from time to time during the process of powdering should be carefully mixed to ensure uniformity in composition. The fibrous portion of vegetable drugs is usually less active than the remainder, and if in such a case the whole of it be rejected, the resulting powder must necessarily be stronger than the crude drug from which it has been prepared; thus, if the bark of ipecacuanha-root be separated from the wood and powdered by itself, such powdered ipecacuanha will possess an activity about 20 per cent. greater than the root itself.

Fineness of Powders.—The United States Pharmacopœia designates five degrees of fineness—namely, *very fine*, when passed through a sieve of eighty or more meshes to the linear inch; *fine*, when passed through one of sixty meshes; *moderately fine*, through one of fifty meshes; *moderately coarse*, through one of forty meshes; and *coarse*, if passed

through a sieve of twenty meshes to the linear inch. The fineness of powders is often conveniently described as being No. 20, etc., indicating that it has been passed through a sieve of that size.

Compound Powders.—Since nearly all solid drugs may be obtained and kept in the state of powder, the pharmacopœias give special directions only for those powders which are composed of two or more ingredients. In preparing these it is generally advisable to reduce each substance separately to powder; the powders are then weighed out and mixed in a mortar, or are passed repeatedly through a suitable sieve. Some special observations will be made in connection with several official powders.

Mixtures of powdered charcoal or powdered rhubarb with calcined magnesia are likely to cake when made in a mortar with anything like pressure of the pestle; uniformity of mixture is readily obtained by stirring gently together and then passing repeatedly through a bolting-cloth sieve.

Dispensing of Powders.—In the majority of cases when powders are prescribed the ingredients are such as are kept on hand pulverized or in such a condition that they may be easily powdered by trituration in a mortar. The latter ingredients are then weighed out first, and rubbed fine before the powders are added. As in the case of pills, small quantities of toxic remedies are best triturated with some sugar of milk before mixing them with the other powders, so as to ensure more uniform distribution. Should soft substances, such as extracts or liquids, as volatile oils, be directed, they are triturated with the sugar which usually is a constituent of magistral powders until reduced to powder, when the other articles are added and well mixed. In most cases, perhaps, it will be of advantage not to use finely powdered sugar, but to employ sugar in small lumps, which, while being rubbed to powder in the presence of the other ingredients, will tend to cause their still greater subdivision through the prolonged attrition. There are, however, occasional exceptions to the procedure as described, for in consequence of the elevation of temperature produced by the trituration chemical processes are likely to be induced which would interfere with the stability of the powder; such instances are the mixing of oxidizing agents like potassium chlorate with vegetable substances, which under the pressure of the pestle would cause an explosion; or the mixing of salts, which in the presence of a little moisture would result in liquefaction, as in triturating together lead acetate and zinc sulphate. Compound powders of this nature ought invariably to be made by powdering the constituents separately in a mortar; if necessary, they should then be well dried, and finally mixed upon smooth paper with the aid of a spatula, without exerting any friction. Powders intended for external application by "dusting" should be dispensed in an impalpable condition if possible, and for this purpose are best passed through a bolting-cloth sieve of 110 to 130 meshes to the inch.

Powders are rarely prescribed in bulk, except when intended for external use; in nearly all cases they are divided by the pharmacist, each dose being dispensed in a separate paper. Deliquescent and volatile powders should be dispensed in parchment, paraffined, or waxed paper.

Size of capsule.	No.	00.	0.	1.	2.	3.	4.	5.
Bismuth subnitrate	Grs.	20	14	10	8	6	4	2
Cinchonidine sulphate	Grs.	8	6	4	3	2	1½	¾
Dover's powder	Grs.	12	8	6	4	3	2	1
Powdered aloes	Grs.	10	7	5	4	3	2	1
Powdered rhubarb	Grs.	12	8	6	4	3	2	1
Quinine sulphate	Grs.	8	6	4	3	2	1½	¾
Salicin	Grs.	10	7	5	4	3	2	1
Salicylic acid	Grs.	8	6	4	3	2	1½	¾

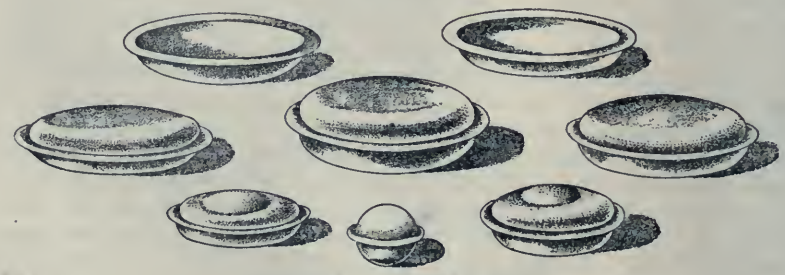
Administration.—Powders are generally taken suspended in water or in a liquid flavored with syrup or some pleasant aromatic. The nauseous taste, however, will not always thus be disguised, and physicians frequently direct the powder to be enclosed in gelatin capsules or in wafers. The filling of definite quantities of a powder into capsules is rather troublesome, on account of the small orifice of the latter, and special

forms of apparatus have been devised to facilitate the operation. The Ihrig Capsule Filler, for sale by Emanuel & Ihrig, Pittsburg, Pa., is one of the best devices ever suggested for filling powders into capsules. Manufacturers of gelatin capsules suggest the table on p. 1263 as a guide for approximate capacity of empty capsules, which will enable pharmacists to make suitable selection without much trouble, bearing in mind, however, that the capacity varies according to the degree of compression exerted in filling.

The use of wafers is not so much in vogue in this country as in Europe, but they are in many respects preferable to capsules; less compression of the material is necessary, and the envelope, made of rice-flour, is more readily distintegrated in the stomach. Sometimes small square or circular sheets of wafer-paper are ordered, and the patient is directed to enclose each dose as wanted; this is done by dipping the wafer into cold water, whereby it is rendered flaccid; it is then laid over a spoon, the powder placed in the centre, and, the edges having been folded over, it is swallowed with a draught of water.

The small round wafers known as cachets are intended to be filled and sealed by pharmacists. Various appliances have been proposed, of which that extensively used in Europe in connection with Mohrstadt's cachets is decidedly the most desirable, as it is simple in construction and quickly operated; the device is sold in this country by J. M. Grosvenor & Co., of Boston, as the "Konseal" filling and closing apparatus. The use of the word "konseal" in place of cachets or wafers does not strike one as particularly appropriate, and is to be regretted. The "konseals," or cachets, are concave disks made of rice-flour and water; they are of convenient form, perfectly digestible, keep permanently for years, and are prepared in six sizes, shown in Fig. 328, varying in capacity from 1 to 10 or 20 grains of dry powder.

Fig. 328.



"Konseals" or rice-flower cachets.

When powders are to be dispensed in wafers it will, of course, be necessary first to make the required number of divisions on paper, either by weighing or measuring with the eye; in Europe a graduated glass tube with hard-rubber piston is said to be used for the same purpose.

Preservation.—When perfectly free from moisture, vegetable powders may be preserved in hermetically sealed vessels; but since they attract moisture on occasional exposure, it is much better to keep them in a dry place enclosed in vessels which will admit the air, but exclude the light. As a rule, such powders will be found to keep well in good paper boxes unless they contain volatile oil.

PULVIS ACETANILIDI COMPOSITUS, *U. S.*—Compound Acetanilide Powder.

Poudre d'acétanilide composée, Fr.; *Zusammengesetztes Antifebrinpulver*, G.

Preparation.—Acetanilide, 70 Gm.; caffeine, 10 Gm.; sodium bicarbonate, 20 Gm. Reduce the ingredients separately to a fine powder and mix them thoroughly.—U. S.

To prepare an ounce of this powder, use 336 grains of acetanilide, 48 grains of caffeine, and 96 grains of sodium bicarbonate.

Compound acetanilide powder is one of the new preparations of the Pharmacopœia. It should be kept in well-stoppered bottles in a dry place. When mixed with water, partial solution takes place, the resulting mixture being alkaline to test-paper.

Uses.—For the uses of this powder, see Acetanilidum. The dose is from 2 to 10 grains (0.10–0.60 Gm.).

PULVIS AMYGDALÆ COMPOSITUS, *Br.*—Compound Powder of Almonds.

Confectio amygdalæ, Conserva amygdalarum.—Confection of Almond, E.; *Conserve d'amandes*, Fr.; *Mandelconserve*, G.

Preparation.—Take of sweet almonds 8 ounces; refined sugar, in powder, 4 ounces; gum-acacia, in powder, 1 ounce. Steep the almonds in warm water until their skins can be easily removed, and when blanched dry them thoroughly with a soft cloth and rub them lightly in a mortar to a smooth consistence. Mix the gum and the sugar, and, adding them to the pulp gradually, rub the whole to a coarse powder. Keep it in a lightly covered jar.—Br.

Uses.—The compound powder of almonds is convenient for preparing almond mixture when mixed with water in the proportion of Gm. 500 in Gm. 75 (2½ ounces to a pint).

PULVIS ANTIMONIALIS, *Br.*—Antimonial Powder.

Pulvis antimonii compositus, Pulvis Jacobi.—James' powder, E.; *Poudre antimoniale de James*, Fr.; *Jamesches Antimonpulver*, G.

Preparation.—Oxide of antimony, 1 ounce; calcium phosphate, 2 ounces. Mix them intimately.—Br.

Antimonial powder is intended as a simplified substitute for a nostrum which has enjoyed considerable reputation in Great Britain and elsewhere for more than a hundred years. Another formula, formerly recognized as yielding a good substitute, requires the ignition of a mixture consisting of 1 part of antimonous sulphide and 2 parts of horn shavings by throwing this in small quantities into a red-hot crucible, powdering the product, and keeping again for some time at a red heat.

A somewhat similar preparation is known here as *Tyson's antimonial powder*, of which two kinds are sometimes employed. One, designated as No. 1, consists of antimonous oxide, 10 parts, and calcium phosphate, 90 parts. No. 2 is made by triturating antimonous oxide, 10 parts, and potassium sulphate, 45 parts, into a fine powder, and adding 45 parts of calcium phosphate.

Uses.—This powder depends for its virtue upon the antimony oxide contained. In doses of from 3 to 10 grains (0.20–0.60 Gm.) it is diaphoretic, and in larger quantity emetic and purgative.

PULVIS AROMATICUS, *U. S.*—Aromatic Powder.

Pulvis cinnamomi compositus, Br.; *Compound powder of cinnamon*, E.; *Poudres des épices, P. des aromates, Poudre aromatique*, Fr.; *Gewürzpulver, Aromatisches Pulver*, G.

Preparation.—Saigon cinnamon, in No. 60 powder, 35 Gm.; ginger, in No. 60 powder, 35 Gm.; cardamom, deprived of the capsules and crushed, 15 Gm.; nutmeg, in No. 20 powder, 15 Gm.; to make 100 Gm. Rub the cardamom and nutmeg with a portion of the cinnamon until reduced to a fine powder, then add the remainder of the cinnamon and the ginger, and rub them together until they are thoroughly mixed.—U. S.

To prepare 4 avoirdupois ounces of aromatic powder use 613 grains each of Saigon cinnamon and ginger and 262 grains each of cardamom and nutmeg.

Grated as finely as possible, the nutmeg is gradually added, with constant trituration, to the crushed cardamom-seed and a portion of the powdered cinnamon, and afterward mixed with the remaining powders. The British Pharmacopœia omits the nutmeg, and directs powdered cinnamon, cardamom, and ginger, of each 1 ounce, to be thoroughly mixed.

Uses.—Aromatic powder given internally may be used alone as a warm stimulating carminative in flatulence, colic or diarrhœa, but it is generally employed as an adjuvant to other drugs to increase their absorption or to correct griping. It may be made into an excellent cataplasm to be applied to the abdomen for the purpose of allaying nausea and colic. When thus employed sufficient of the powder should be enclosed in a flannel or thin muslin bag, and moistened with warm whiskey or vinegar. A better formula than this for a spice poultice or plaster contains equal parts of powdered cinnamon, cloves, allspice, and nutmeg, to which may be added a small quantity of black pepper to produce a more powerful effect. Aromatic powder is given in the dose of from 5 to 15 grains (0.30–1 Gm.).

PULVIS CATECHU COMPOSITUS, *Br.*—Compound Powder of Catechu.

Poudre de cashcuttie composée, Fr.; *Zusammengesetztes Katechupulver*, G.

Preparation.—Take of catechu, in powder, 4 ounces; kino, in powder, rhatany-root, in powder, each 2 ounces; cinnamon-bark, in powder, nutmeg, in powder, each 1 ounce. Mix them.—Br.

Uses.—This powder is a useful astringent in serous diarrhœa. Its administration when the stools contain much mucus should be preceded by a purge. The dose is from 10 to 60 grains (0.60–4 Gm.).

PULVIS CRETÆ AROMATICUS, *Br.*—Aromatic Powder of Chalk.

Confectio aromatica, Lond.—*Poudre de craie aromatique*, Fr.; *Gewürztes Kreidepulver*, G.

Preparation.—Take of cinnamon-bark, in powder, 4 ounces; nutmeg, in powder, 3 ounces; cloves, in powder, 1½ ounces; cardamom-seeds, in powder, 1 ounce; refined sugar, in powder, 25 ounces; prepared chalk, 11 ounces. Mix.—Br.

Uses.—This powder combines the carminative properties of the aromatics with the astringent and antacid effect of the chalk, and may be employed in diarrhœa associated with hyperacidity of the dejecta. There is no good reason for having a fixed formula like this one. The choice of the ingredients and their doses had better be left to the discretion of the prescriber. The dose is from 30 to 60 grains (2–4 Gm.).

PULVIS CRETÆ AROMATICUS CUM OPIO, *Br.*—Aromatic Powder of Chalk and Opium.

Poudre de craie opiacée, Fr.; *Kreidepulver mit Opium*, G.

Preparation.—Take of aromatic powder of chalk, 9¾ ounces; opium, in powder, ¼ ounce. Mix.—Br.

Uses.—The addition of 1 grain of opium to each 40 grains of aromatic chalk powder increases the efficiency of the last-named preparation, particularly when pain is present. The dose is from 10 to 20 grains (0.60–1.30 Gm.).

PULVIS CRETÆ COMPOSITUS, *U. S.*—Compound Chalk Powder.

Poudre de craie composée, Fr.; *Kreidepulver mit Gummi*, G.

Preparation.—Prepared chalk, 30 Gm.; acacia, in fine powder, 20 Gm.; sugar, in fine powder, 50 Gm.; to make 100 Gm. Mix them intimately.—U. S.

Uses.—This powder has been introduced with the view of preparing from it the official chalk mixture as wanted. It should always be made with prepared chalk as directed in the official formula, and not with precipitated calcium carbonate, as has been done at times. Dose, from 20 to 60 grains (1.30–4 Gm.).

PULVIS EFFERVESCENS COMPOSITUS, *U. S.*—Compound Effervescing Powder.

Pulvis sodæ tartaratæ effervescens—Effervescent tartarated soda powder, Br.; *Poudre gazogène laxative*, Fr. Cod.; *Pulvis aërophorus laxans*, P. G.; *Pulveres effervescentes aperientes; Pulvis aërophorus Seydlitzensis.—Aperient effervescing powders, Seidlitz powders* E.; *Poudre gazifère purgative, Poudre de Sedlitz*, Fr.; *Abführendes Brausepulver, Seidlitzpulver*, G.

Preparation.—Sodium bicarbonate, in fine powder, 31 Gm.; potassium and sodium tartrate, in fine powder, 93 Gm.; tartaric acid, in fine powder, 27 Gm. Mix the sodium bicarbonate intimately with the potassium and sodium tartrate, divide the mixture into 12 equal parts, and wrap each part in a separate blue paper. Then divide the tartaric acid into 12 equal parts, and wrap each part in a separate white paper. Keep the powders in well-closed containers, in a dry place.—U. S.

The alkaline powder is usually put into a blue paper, each containing of sodium bicarbonate 2.58 Gm. (U. S., Br.) (2.5 Gm., P. G.; 2.0 Gm., Fr. Cod.), and of potassium and sodium tartrate 7.75 Gm. (U. S., Br.) (7.5 Gm., P. G.; 6 Gm., Fr. Cod). The

tartaric acid is wrapped in white paper, and weighs 2.25 Gm. (U. S.) (2.46 Gm., Br.; 2.0 Gm., Fr. Cod., P. G.). On mixing the solutions of the contents of the two papers, Mr. Wm. Gilmour (1881) observed the formation of potassium bitartrate even in the presence of insufficient tartaric acid for producing neutral sodium tartrate; this effect is due to the liberated carbonic acid.

The mixture of Rochelle salt and sodium bicarbonate is known commercially as Seidlitz mixture: owing to its variable composition, as sold in the market, it is best prepared by the pharmacist himself by mixing 1 part of sodium bicarbonate with 3 parts of Rochelle salt. The small wooden measures intended for dividing the saline mixture and acid are, as a rule, unreliable, and moreover the quantity of powder that can be compressed into these measures varies considerably with the condition of the atmosphere; hence the requisite quantities should be weighed for each paper, being 160 grains of Seidlitz mixture and 35 grains of tartaric acid.

Action and Uses.—This powder presents a pleasant form in which to administer Rochelle salt The reaction between the tartaric acid and the sodium bicarbonate results in the formation of sodium tartrate and carbonic acid. The sodium tartrate enhances the cathartic effect of the preparation, and acts as a mild, refrigerant diuretic, while the carbonic acid gas is a stimulant to the stomach and creates an agreeable sense of coolness in the abdomen. Seidlitz powder is an efficient saline laxative in the early stage of febrile states and to relieve nausea, headache, and constipation or diarrhœa produced by excessive indulgence in food or alcohol. By E. E. Montgomery it is considered the purgative of choice after abdominal operations.

The contents of the white paper should be dissolved in about 2 fluidounces of water, and of the blue paper in about 4 fluidounces of water; the two solutions are then mixed and drunk during effervescence. As much as two sets of powders may be taken if a full purgative effect is desired.

In sick stomach, when the solution of the whole powder cannot be retained, the two powders should be divided into fourths, and a fourth added to a fourth dissolved in a half wineglassful of water, and taken every 15 minutes until an entire powder is ingested. This will often quiet the stomach and produce purgation.

Allied Preparations.—PULVERES EFFERVESCENTES, U. S., 1870; *Pulvis aërophorus anglicus*, P. G.—*Effervescing powders, Soda powders*, E.; *Poudre gazeuse, P. gazogène, P. aërophore, P. de Seltz*, Fr.; *Englisches Brausepulver*, G.—Take of sodium bicarbonate, in fine powder, 360 grains; tartaric acid, in fine powder, 300 grains. Divide each of the powders into 12 equal parts, and keep the parts, severally, of the bicarbonate and of the acid in separate papers of different colors.

PULVIS AEROPHORUS; BRAUSEPULVER (P. G.) is composed of 13 parts of sodium bicarbonate, 12 parts of tartaric acid, and 25 parts of white sugar. Each substance is finely powdered and well dried before the three are mixed, when the powder may be kept unaltered in well-closed vessels. But if these are opened, and from the deposition of moisture decomposition begins to take place, the change proceeds more rapidly in a closed than in an open vessel should the latter be kept in a dry and airy place. The powder keeps much better if granulated as described above. Either form of powder may serve as a vehicle for the convenient and pleasant administration of other medicines, such as salts of iron, quinine, etc., which should not be mixed with the sodium bicarbonate alone.

PULVIS ELATERINI COMPOSITUS, *Br.*—Compound Powder of Elaterin.

Preparation.—Take of elaterin, 5 grains; sugar of milk, 195 grains. Rub them together in a mortar until they are reduced to a fine powder and intimately mixed.—Br.

Uses.—This powder is one-fourth the strength of the Triturati Elaterini (U. S. P.), and is given in the dose of from ½ to 5 grains (0.03–0.30 Gm.). (See ELATERINUM.).

PULVIS GLYCYRRHIZÆ COMPOSITUS, *U. S., Br.*—Compound Powder of Glycyrrhiza (Licorice).

Pulvis liquiritiæ compositus, P. G.; *P. pectoralis Kurellæ.—Poudre pectorale, Poudre de réglisse composée*, Fr.; *Brustpulver*, G.

Preparation.—Senna, in No. 80 powder, 180 Gm.; glycyrrhiza, in No. 80 powder, 236 Gm.; washed sulphur, 80 Gm.; oil of fennel, 4 Gm.; sugar, in fine powder, 500 Gm.; to make 1000 Gm. Rub them together until they are thoroughly mixed.—U. S.

To prepare 1 pound of compound licorice powder use 2 avoirdupois ounces and 385 grains of powdered senna, 3 avoirdupois ounces and 340 grains of powdered glycyrrhiza, 1 avoirdupois ounce and 123 grains of washed sulphur, 30 minims of oil of fennel, and 8 avoirdupois ounces of sugar.

Powdered senna, 2 parts; powdered licorice-root, 2 parts; powdered fennel, 1 part; washed sulphur, 1 part; powdered sugar, 6 parts.—P. G., Br.

The first formula has been adapted from that of the German Pharmacopœia, and is practically identical with it and with that of the British Pharmacopœia. The powder is of a greenish-yellow color.

The present U. S. P. formula, like that of 1890, differs from those of Europe in the use of oil of fennel in place of the fruit, and the increase of powdered licorice-root accordingly; the quantity of oil is based on the assumption that prime fennel will yield 5 per cent. of volatile oil. We regard the change as a very desirable one, since the whole powder can readily be passed through a No. 80 sieve, and will not assume a disagreeable odor by age, which sometimes occurs when it is made with powdered fennel.

Uses.—This is a mild and efficient laxative powder, given in the dose of from ½ to 2 drachms (2–8 Gm.). It is frequently employed for the relief of constipation during pregnancy.

PULVIS IPECACUANHÆ ET OPII, *U. S.*—Powder of Ipecac and Opium.

Pulvis ipecacuanhæ compositus, Br.; *Pulvis d'ipecacuanha opiacée*, Fr. Cod.; *Pulvis ipecacuanhæ opiatus*, P. G—*Compound powder of ipecacuanha, Dover's powder*, E.; *Poudre de Dover*, Fr.; *Doversches Pulver*, G.

Preparation.—Ipecac, in No. 60 powder, 10 Gm.; powdered opium, 10 Gm.; sugar of milk, in No. 30 powder, 80 Gm.; to make 100 Gm. Rub them together into a very fine powder.—U. S.

To prepare 4 avoirdupois ounces of Dover's powder use 175 grains each of powdered ipecac and powdered opium, and 1400 grains of sugar of milk.

Ipecacuanha root, in powder, and opium, in powder, of each ½ ounce; potassium sulphate, in powder, 4 ounces. Mix.—Br.

In the U. S. P. formula the milk-sugar is directed to be used in a rather coarse powder; the fragments of the crystals, being very hard, serve to grind the vegetable powders still finer during the necessarily prolonged trituration. The German Pharmacopœia orders the same ingredients in the same proportions as given above, but directs all three to be separately very finely powdered, and then to be intimately mixed. Both powders are of a pale-brown color and have the odor of opium, somewhat modified by that of ipecac; they differ but slightly in taste, that of the Br. P. being somewhat saline in addition to the bitter and nauseous taste of the other ingredients, which predominates in the powder prepared by the above formula. The Dover's powder of the French Codex is nearly the same as that originally used by Dr. Dover; it is composed of potassium sulphate and nitrate, each 40 parts, and dry opium and ipecacuanha, each 10 parts, the whole to be made into a homogeneous powder.

Action and Uses.—Dover's powder is anodyne and diaphoretic, and is employed with particularly good effect in the forming stages of acute inflammations, such as coryza, laryngitis, pleurisy, bronchitis, pneumonia, etc. Its sedative properties are available in many painful conditions. It may be used to check diarrhœa from transient causes or from such diseases as typhoid fever, tuberculosis, and dysentery. To obtain its full diaphoretic effect it should be administered in one dose of from 10 to 20 grains (0.6–1.30 Gm.), preceded by a hot general bath or mustard pediluvium and followed by hot drinks and the use of warm bed-clothing. As an anodyne the dose of Dover's powder is from 3 to 5 grains (0.20–0.30 Gm.), repeated every 3 or 4 hours.

PULVIS JALAPÆ COMPOSITUS, *U. S., Br.*—Compound Powder of Jalap.

Pulvis purgans, Pulvis jalapæ tartaratus, Pulvis catharticus.—Poudre de jalap composée, Fr.; *Jalapenpulver mit Weinstein*, G.

Preparation.—Take of jalap, in No. 60 powder, 35 Gm.; potassium bitartrate, in fine powder, 65 Gm.; to make 100 Gm. Rub them together until they are thoroughly mixed.—U. S.

Take of jalap, in powder, 5 ounces; acid potassium tartrate, 9 ounces; ginger, in powder, 1 ounce. Mix.—Br.

Uses.—Compound jalap powder is a rather powerful hydragogue cathartic, and is of value in renal or cardiac dropsy in the dose of from 10 to 40 grains (0.60–2.60 Gm.). (See JALAP.)

PULVIS KINO COMPOSITUS, *Br.*—Compound Powder of Kino.

Pulvis kino cum opio.—Poudre de kino opiacée, Fr.; *Kinopulver mit Opium*, G.

Preparation.—Take of kino, in powder, $3\frac{3}{4}$ ounces; opium, in powder, $\frac{1}{4}$ ounce; cinnamon-bark, in powder, 1 ounce. Mix.—Br.

Uses.—This is an astringent and sedative powder which may be used in diarrhœa. Its employment should be preceded by a purge if the alvine discharges contain much mucus. The dose is from 5 to 20 grains (0.30–1.30 Gm.).

PULVIS MORPHINÆ COMPOSITUS, *U. S.*—Compound Powder of Morphine.

Pulvis camphoræ compositus Tully.—Tully's powder, E.; *Poudre de Tully*, Fr.; *Tullysches Pulver, G.*

Preparation.—Morphine sulphate, 1.5 Gm.; camphor, 32 Gm.; glycyrrhiza, in No. 60 powder, 33 Gm.; precipitated calcium carbonate, 33.5 Gm.; alcohol a sufficient quantity. Rub the camphor with a little alcohol, and afterward with the glycyrrhiza and precipitated calcium carbonate, until a uniform powder is produced. Then rub the morphine sulphate with this powder, gradually added, until the whole is thoroughly mixed.—U. S.

This formula originated with Dr. William Tully, of New Haven, Conn. The powder should be very carefully prepared, so that the morphine salt may be uniformly incorporated with the other ingredients. Owing to the volatilization of camphor, it is best to prepare the powder in a small quantity only, and to preserve it in a well-stoppered bottle kept in a cool place. Each grain of the mixed powders contains about $\frac{1}{60}$ grain of morphine sulphate and practically $\frac{1}{8}$ grain of camphor.

Uses.—This powder was introduced by Dr. Tully as a substitute for Dover's powder, but it is certainly less efficient. The dose is from 5 to 10 grains (0.30–0.60 Gm.).

PULVIS OPII COMPOSITUS, *Br.*—Compound Powder of Opium.

Poudre d'opium composée, Fr.; *Zusammengesetztes Opiumpulver*, G.

Preparation.—Take of opium, in powder, $1\frac{1}{2}$ ounces; black pepper, in powder, 2 ounces; ginger, in powder, 5 ounces; caraway-fruit, in powder, 6 ounces; tragacanth, in powder, $\frac{1}{2}$ ounce. Mix.—Br.

This powder contains 10 per cent. of powdered opium.

Uses.—Compound opium powder contains the ingredients, in a dry state, of the confection of opium, and may be used for the same purposes. Dose, 2 to 5 grains (0.12–0.30 Gm.).

PULVIS RHEI COMPOSITUS, *U. S., Br.*—Compound Powder of Rhubarb.

Pulvis magnesiæ cum rheo, P. G.; *P. infantum, s. P. antacidus.—Magnesia and rhubarb, Gregory's powder*, E.; *Poudre de rhubarbe composée*, Fr.; *Kinderpulver*, G.

Preparation.—Take of rhubarb, in No. 60 powder, 25 Gm.; magnesium oxide, 65 Gm.; ginger, in No. 60 powder, 10 Gm.; to make 100 Gm. Rub them together until they are thoroughly mixed.—U. S.

To prepare 4 avoirdupois ounces of compound rhubarb powder use 1 avoirdupois ounce of powdered rhubarb, 2 avoirdupois ounces and 263 grains of calcined magnesia, and 175 grains of powdered ginger.

The official magnesia being the light or bulky variety, it will be found very difficult to mix the powders uniformly if they are put into the mortar promiscuously; the better plan is to mix the rhubarb and ginger, and incorporate the magnesia in small quantities, gradually added, finally passing the whole mixture through a bolting-cloth sieve.

The British Pharmacopœia has adopted Dr. Gregory's formula: Powdered rhubarb, 2 ounces; light magnesia, 6 ounces; powdered ginger, 1 ounce; the mixed powder is to be passed through a fine sieve. Mr. Gilmour (1881) observed that in order to render this powder readily miscible with water the rhubarb and ginger should first be triturated with about 5 per cent. of magnesium carbonate, and the calcined magnesia afterward added.

The formula of the German Pharmacopœia is as follows: Magnesium carbonate, 50 parts; oil-sugar of fennel (1 drop of oil of fennel to 2 Gm. of sugar), 35 parts; powdered rhubarb, 15 parts. Mix.

These powders, when freshly prepared, have a yellowish color, but on keeping gradually assume a reddish tint from the absorption of moisture and the reaction of the magnesia with the constituents of rhubarb; in the presence of water or of alcohol they become deep red.

Action and Uses.—This is a fairly good laxative preparation to be given in cases of acid dyspepsia and diarrhœa with acid stools, particularly in children. The after-constipating effect of the rhubarb detracts from the value of the powder in cases of ordinary constipation. The dose is from 10 to 60 grains (0.60–4 Gm.).

PULVIS SCAMMONII COMPOSITUS, *Br.*—Compound Powder of Scammony.

Preparation.—Scammony resin, in powder, 4 ounces; jalap, in powder, 3 ounces; ginger, in powder, 1 ounce. Mix.—Br.

Action and Uses.—The effect obtained from the combination of drugs so similar in their action as scammony and jalap does not warrant their employment as the only active ingredients of a purgative powder. The modifying action of the ginger is too slight to be of much real value. The dose is from 10 to 20 grains (0.60–1.30 Gm.).

PULVIS TRAGACANTHÆ COMPOSITUS, *Br.*—Compound Powder of Tragacanth.

Preparation.—Take of tragacanth, in powder, gum-arabic, in powder, starch, in powder, each 1 ounce; refined sugar, in powder, 3 ounces. Rub them well together.—Br. It is a white powder, having a sweet mucilaginous taste.

PULVIS GUMMOSUS (P. G.) is used for similar purposes, but has the following composition: Powdered gum-acacia, 50 parts; powdered licorice-root, 30 parts; powdered sugar, 20 parts. It is a yellowish-white powder, having the odor of licorice-root and a sweet, mucilaginous taste.

Action and Uses.—This powder is a useful agent with which to suspend heavy, insoluble powders in liquid mixtures. It may also be used as a demulcent and as a pill excipient.

PYRETHRI FLORES.—Insect Flowers; Insect Powder; Pulvis Insecticidus.

The half-expanded flower-heads of *Chrysanthemum roseum* Web. et Mohr (*Pyrethrum carneum* M. B.) and *C. Marschallii* Aschers. (*Pyrethrum roseum* M. B.), these two yielding the *Blue, Persian,* or *Caucasian insect powder* (*Persische Bertramblüthen, Pyrethrè de Caucase, Chamomile de Perse*), and of *C. cinerariifolium* (Trev.) Bocc. (*Pyrethrum c.* Trev.), this yielding the *White* or *Dalmatian Insect Powder.* (Fam. *Compositæ.*)

Origin.—The insect powders were long exported to us without any information as to their botanical source, but were finally traced to the above-named plants, slender, hardy perennials, very similar to our common daisy, natives of western Asia, where they are cultivated upon a vast scale, great secrecy being maintained as to the methods of cultivation and production. The plants have now been successfully introduced to cultivation in various other countries, and the industry has attained commercial importance in California and northern Africa. Experiments in New York State show that they can withstand the winter and yield an active product, but the trials were purely experimental. Although the plant withstands drouth well, irrigation is found necessary upon the arid plains of California. The yield does not reach commercial importance until the plants

are 3 years old, and they remain at their best for 2 or 3 years. Statements differ as to the relative quality of the flowers before beginning to expand, but it is certain that it deteriorates rapidly after the seed begins to form, and the half-open stage is generally recognized as the most economical for collection. The plants are cut off near the ground and the heads torn off by a sort of combing machine. Statements conflict as to whether they should be dried in the sun or in the shade. By the former method they lose a portion of their volatile oil, but it is claimed that they are then equally active. The probability is that they are then not quite so good. Upon the other hand, the delay attendant upon the slow process of shade-drying exposes them to some danger of deterioration. A similar question exists as to the best method of preserving the powder. While it appears, on general principles, that it should be preserved in tight containers, claims have been made that the powder was equally active after being loosely preserved for a number of years, and even after being entirely deprived of odorous constituents by prolonged heating. Upon the other hand, we have to consider that insects are destroyed by burning the powder in the room which contains them, provided the volatile substances driven off can reach them.

Description.—*Dalmatian Flowers.*—Stem none, or very short; head subglobose, usually a little broader than long, 6 to 12 Mm. (¼–½ In.) in diameter, with irregularly projecting rays; involucral scales light grayish brown or greenish, erect, in 2 or 3 series, lanceolate, obtusish, very finely hairy, the middle portion much thicker and darker; rays in a single series, erect, or the outer more or less recurved, yellowish or brownish white, their length varying with the degree of development; disk yellow, flat, concave or slightly convex, the flowers very small and numerous, the ovaries sharply 5-winged; receptacle nearly flat, or the centre somewhat elevated, naked.

Persian Flowers are similar in form, but usually a little larger, the involucre very dark purple or blackish, its scales narrower and thicker, the rays purple, the ovary 10-ribbed, the receptacle strongly convex.

The Dalmatian powder should have a greenish-yellow color, an odor somewhat resembling tea, and an aromatic and slightly bitter taste. It contains 8 to 10 per cent. of moisture and yields 6.5 to 7 per cent. of ash, almost wholly soluble in hydrochloric acid. The finer the powder, the more efficient its action. The Persian is similar, but somewhat darker, or grayish yellow.

Substitutes and Adulterants.—Absolutely pure insect powder is difficult to obtain. Sophistication begins with the use of the mature or even old heads, and this is to be determined in the powder only by finding the tissues of the seed in various stages of development and by the yield of fat. Next in importance is the use of the stems. The regular practice in the exporting countries was to grind in the stems in the proportion of one-third of the whole. Although we now import the heads entire, great quantities of the stems are still used in this way. The following simple method of assay will serve to detect adulterations readily: Macerate 8 Gm. of insect powder for an hour with 80 Gm. of ether, shaking the mixture frequently. Then decant or draw off 50 Gm., add 1 Cc. of water, and shake thoroughly. Filter, and wash the filter well with ether, transferring filtrate and washings to a tared flask, and distil. Finally, weigh the soft residue. Half-opened buds yield 6 to 7 per cent. of extract, and unexpanded buds from 7.5 to 9.5 per cent. The ethereal extract of pure flowers is of a golden-yellow, dark-yellow, or brownish-yellow color, while that of the stem has a dirty-green tint. Stem adulteration is also detected by microscopical examination, the powder exhibiting numerous large particles of glistening wood-fibre and sclerenchymatic tissue and large hairs sharpened at both ends. Quassia, Quillaja, Fustic, and Chrome-yellow are said to be used, and all increase the ash-percentage, pure insect powder yielding about 7 per cent. of ash. The last named, like Aloes and Curcuma, impart a suspiciously bright-yellow color. Hungarian daisies and other flower-heads have been used, but there is little advantage in the operation from a pecuniary standpoint, because of their expensive nature.

Constituents.—Statements upon this point are very contradictory. It is well established that there is an amount of volatile oil ranging from 0.5 per cent. down to a trace, according to quality, the Persian having apparently the most, and the amount decreasing as the flowers mature; also 4 per cent. (in the Persian) to 7 per cent. (in the Dalmatian) of 2 resins, one soluble in ether, the other, present in more than double the amount of the first, soluble in alcohol. The presence and amount of fatty matter will depend upon the development of the oily seeds. The properties were first supposed to

reside in the volatile oil, but are now known to be retained after this is driven off. It is now generally assumed that they reside in the acid resin, but this idea is apparently negatived by the fact that this can be neutralized without affecting the activity, and that cold water, which does not extract the resin, promptly acquires the toxicity of the powder. The decoction and the alcoholic tincture are equally effective. The presence of a crystalline alkaloid has been asserted, and denied by others. The family relationship of the plant is opposed to the alkaloidal idea. Thoms has reported a glucoside, which is to be expected, but it could scarcely be expected to destroy insects by the burning of the powder. Several analysts have reported a volatile acid. We must conclude, therefore, that the activity of insect powder has not yet been located.

Action and Uses.—Insect-powder, although not poisonous to man, acts as a powerful lethal agent to insects and vermin that infest the bodies of man and animals, and to such as are to be found in bed-clothing, around kitchens, and other parts of the house.

The usual method of application is to sprinkle the powder in such places as are frequented by the insects, and, in the case of man and animals, to apply it to the surface of the body. An infusion or tincture of the powder is not as efficacious as the drug itself. The fumes of the burning powder are also destructive to insects, and when used in this manner small cones or pastilles are made of the powder, added to some gum, and potassium nitrate.

Allied Species.—The genus *Chrysanthemum*, L., contains nearly 150 species, but only a few of them, and these in the section *Pyrethrum*, are known to possess insecticidal properties. Others, possessing the aromatic, bitter properties of the family, will be considered under COMPOSITÆ.

PYRETHRUM, *U. S.*—Pellitory.

Pyrethri radix, Br., P. A.; *Radix pyrethri romani. Pellitory-root, Pellitory of Spain, Spanish chamomile, Longwort*, E.; *Römische Bertramwurzel*, G.; *Pyrèthre officinal*, Fr. Cod.; *P. vrai, Salivaire*, Fr.; *Peritre*, Sp.; *Salivaria*, Port.

The dried root of *Anacyclus Pyrethrum* (L.) DC. (*Anthemis P.* L.; *Matricaria P.* Baill.—Fam. *Compositæ*).

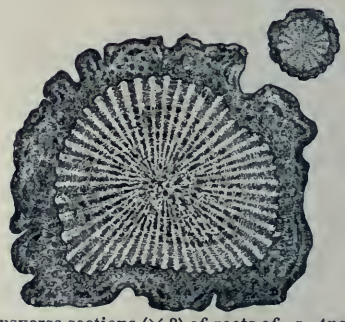
Pyrethrum is official in most pharmacopœias, several of which specify the root of *A. officinarum* Hayne (*German pellitory*, E.; *Zahnwurzel, Speichelwurzel*, G.; *Pyrèthre commun*, Fr.).

Origin.—From a weak perennial herb, resembling the chamomile, but with the ray-florets broadly oval and purplish underneath. It is a native of northwestern Africa and is occasionally cultivated as a garden flower. It is collected in the autumn. Our drug is imported mostly by way of Italy and France, and large quantities are exported to India by way of Egypt.

FIG. 329.

Roman Pyrethrum root (Nat.).

FIG. 330.



Transverse sections (× 3) of roots of—*a*, *Anacyclus Pyrethrum* DC.; *b*, *Anacyclus officinarum* Hayne.

Description.—From 5 to 12 Cm. (2–5 In.) long and 1 to 2 Cm. ($\frac{2}{5}$–$\frac{4}{5}$ In.) thick, nearly straight and unbranched, cylindraceous, tapering or slightly fusiform, bearing a few tough, hair-like, yellowish rootlets, and in the centre of the crown usually a tuft of cottony or silky, whitish, fibrous tissue; externally deep brown, or slightly grayish brown, inconspicuously annular near the crown, very roughly wrinkled and pitted, harsh to the touch; fracture short and sharp; bark thick, the inner layer brown, containing about 3 circles of dark-red resin-cells, the outer layer dark brown; wood yellow brown, finely radiate, containing 4 or more circles of resin-cells; inodorous, pungent, and acrid, producing a prompt and strong sialagogue effect. It should yield from 5 to 6 per cent. of ash.

Constituents.—Pyrethrum contains a brown acrid resin, containing *pelletorin*, which is soluble in alcohol, not in water (*Dunstan* and *Garnett*); 2 potassa-soluble acrid fixed oils, one brown, the other yellow, and the alkaloid *pyrethrine*, which, under the action of alcoholic solution of potassium hydroxide, decomposes into *piperidine* (see PIPER) and pyrethric acid, resembling piperic acid. There is also considerable inulin, a little tannin, volatile oil, and gum. The drug yields about 5 per cent. of washed ether-extract, consisting of resin and fat, which has gone under the name "pyrethreis."

Pharmaceutical Preparation.—TINCTURE OF PYRETHRUM, U. S. P.

Action and Uses.—When chewed, pellitory has an acrid taste, produces a pricking sensation in the mouth and fauces, and increases the secretion of saliva. Applied to the skin, it irritates and distinctly reddens it. Its sialagogue effect has been employed for the relief of headache, neuralgia, and other pains in the head and face. Its stimulating property has been found of value in atonic states of the tongue or pharynx, and in relaxation of the uvula. For these several conditions the root is used as a masticatory in the quantity of from ½ to 1 drachm (2–4 Gm.), or in the form of a decoction or tincture as a gargle.

Little is known of the general physiological action of pellitory, but in a child of 3½ years 50 minims of the tincture produced severe gastro-enteritis, a rapid, weak pulse, and convulsions. The child recovered.

German Pyrethrum or *Pellitory Root*, or *Pyrèthre allemande*, is the root of *A. officinarum* Hayne, cultivated in Germany, its nativity unknown. In foliage and habit it closely resembles the Roman, but the disk of the flower-head is flattish. The root is very long and slender (only about $\frac{1}{8}$ to ¼ In. thick), brown gray externally and dingy white internally. The bark is rather thick and contains 1 circle of rather large resin-cells. The meditullium consists of slender brownish wood-wedges and whitish medullary rays which contain no resin-cells. It is otherwise very similar to the Roman, but comes to market with a considerable portion of the stem adhering. This should be removed before using.

PYRIDINA.—Pyridine.

Pyridinum.—Pyridine, Fr.; *Pyridin*, G.

Formula, C_5H_5N. Molecular weight, 78.48.

Occurrence.—Pyridine occurs in the products resulting from the dry distillation of nitrogenous organic matter, and with its homologues is found in tobacco-smoke, coal-tar, naphtha, etc. Commercially it is produced by refining crude bone oil by treatment with sulphuric acid and subsequent decomposition with sodium hydroxide. The mixture of liberated bases is subjected to fractional distillation, and the distillate, freed from aniline by means of oxidizing agents, is again fractionated. Pyridine has been prepared synthetically by the action of phosphorus pentoxide on amyl nitrate, by reduction of azoamidonaphthalene in alcoholic solution by means of stannous chloride, and also by passing a mixture of hydrocyanic acid and acetylene through a red-hot tube.

Properties.—Pure pyridine is a colorless, limpid, volatile liquid, possessing a peculiar empyreumatic odor and a sharp burning taste. Its specific gravity at 15° C. (59° F.) is 0.98; its boiling-point 117° C. (242.6° F.). It is miscible with water, alcohol, ether, chloroform, and fixed oils in all proportions, but is precipitated from its aqueous solutions by the fixed alkali hydroxides. A glass rod dipped into pyridine, when brought in contact with hydrochloric acid vapor, produces white fumes, as in the case of ammonia. Pyridine has strong basic properties, and combines with acids by addition to form salts, which are crystallizable, hygroscopic, and readily soluble in water. With water the base unites to form a hydrate, $C_5H_5N + 3HO$, which boils at 93°C. (199.4° F.). Pyridine precipitates solutions of ferric, chromic, and aluminum salts as hydroxides, and has the peculiar property of forming crystallizable double salts with salts of the metals, particularly the chlorides of zinc, cadmium, copper, and mercury. Nascent hydrogen converts pyridine into piperidine.

Action and Uses.—Pyridine somewhat resembles coniine in its action; it is, however, less powerful. In toxic doses it profoundly depresses motor centres and nerves, producing marked muscular relaxation, cyanosis, and death from paralysis of the respiratory centre and nerves supplying the respiratory muscles. It is employed in medicine almost solely as a remedy to relax the spasm of bronchial asthma, and is administered by inhalation in the dose of from 5 to 10 drops (0.30–0.60 Cc.).

PYROGALLOL, *U. S.*—Pyrogallol.

Pyrogallolum, P. G.; *Acidum pyrogallicum.—Pyrogallic acid, Trihydroxybenzene*, E.; *Acide pyrogallique*, Fr.; *Pyrogallol, Pyrogallussäure*, G.

Formula, $C_6H_3(OH)_3$. Molecular weight, 125.10.

A triatomic phenol obtained chiefly from gallic acid by careful heating of the same. It should be kept in dark amber-colored vials.—U. S.

Pyrogallol was first obtained by Scheele in 1786 upon heating gallic acid, and was by him considered pure gallic acid. Gmelin pointed out the difference between the two substances, and Pelouze first showed that gallic acid when heated splits up into pyrogallol and carbon dioxide.

Preparation.—When gallic acid is heated with two or three times its weight of water for about ½ hour at a temperature between 200° and 210° C. (392° and 410° F.), under pressure in a suitable boiler, in such a manner that the liberated carbon dioxide can escape, a somewhat colored solution of pyrogallol is obtained; this is boiled with animal charcoal, filtered, and evaporated; when cool a scarcely colored crystalline mass is obtained, which is still further purified by sublimation. Or pyrogallol may be obtained by the direct sublimation of gallic acid (previously dried at 100° C.—212° F.) in an oil-bath at 200° or 210° C. (392° or 410° F.); in this case the yield is rarely more than 25 or 30 per cent., while by the first process nearly the whole theoretical yield (about 75 per cent.) is obtained.

Properties and Tests.—Pyrogallol occurs as light, white, shining laminæ or fine needles, odorless, and having a bitter taste; on exposure to air and light they acquire a gray or darker tint. It is soluble at 25° C. (77° F.) in 1.6 parts of water and in 1 part of alcohol; very soluble in boiling water and in boiling alcohol; also soluble in 1.1 parts of ether. When heated to 132° C. (269.6° F.), pyrogallol melts, and may be sublimed unchanged. Heated rapidly to 250° C. (482° F.), it is converted into the black amorphous *metagallic* acid, which is insoluble in water and has a bitter taste. When ignited, it is consumed, leaving no residue. The aqueous solution, which is at first neutral and colorless, gradually acquires, by exposure to the air, a brown color and an acid reaction due to absorption of oxygen. The same change takes place very rapidly if the solution contains a caustic alkali. The aqueous solution (1 in 10) of pyrogallol reduces solutions of the salts of silver, gold, and mercury even in the cold. When freshly prepared, 1 Cc. of the aqueous solution (1 in 20) is colored brownish red by a few drops of ferric chloride test-solution, and this color is changed to a deep bluish black on the addition of 1 or 2 drops of ammonia-water. A bluish-black color is also produced in the aqueous solution of pyrogallol by freshly prepared ferrous sulphate test-solution.—U. S. The aqueous solution is turned brown by nitrous acid. If lime-water be shaken with pyrogallol, the former assumes a purple color, which soon changes to brown and black, the mixture becoming turbid at the same time.

Pyrogallol heated with phthalic anhydride to 200° C. (392° F.) yields *gallein*, a dyestuff soluble in potassium hydroxide to a blue non-fluorescent solution, and in ammonia with a violet color.

Action and Uses.—The symptoms produced by poisonous doses of pyrogallol are those of a violent, irritant, depressing poison. These symptoms may follow its administration by the mouth or its absorption in large quantity from the surface of the skin. In several cases it has occasioned death, preceded by vomiting and purging, severe abdominal pain, acceleration of the pulse, depression of temperature, cyanosis of the lips, convulsions, and coma. The urine in these cases was dark in hue, and contained albumin and methæmoglobin, the blood was chocolate colored, and the red corpuscles disorganized.

Changes in the liver, almost identical with those caused by phosphorus, have been found in animals poisoned by pyrogallol. Pyrogallol is employed almost exclusively in dermatological practice, and is considered by some a specific in psoriasis. Asserted good results have followed its employment in lupus, leprosy, epithelioma, and parasitic skin diseases. It may be applied in solution or ointment of the strength of 5 to 15 per cent.

The solvents employed are water, alcohol, ether, or collodion, the last possessing the advantage of preventing staining of the linen. The dark-brown stain of the skin caused by the drug will gradually fade, but that of the clothing is indelible.

Concentrated solutions or ointments should not be applied over a large area, for fear of absorption of a poisonous quantity.

Derivative Compounds.—GALLACETOPHENONE.—*Gallactophenone, Trioxyacetophenone, Alizarin-yellow C.* $C_6H_2.(OH)_3C_2H_3O$.—This is a derivative of pyrogallol, in which a hydrogen atom has been displaced by the acetyl group, C_2H_3O. It is formed when a mixture of 1 part of pyrogallol and 1½ parts each of zinc chloride and glacial acetic acid is heated for a short time to 145° to 150° C. (293°–302° F.); upon adding water to the fusion while still hot, gallacetophenone separates, and may be purified by crystallization from boiling water. Thus obtained, it is a crystalline powder of dirty-flesh color and faintly acid or neutral reaction. Gallacetophenone requires 600 parts of cold water for solution, but is readily soluble in hot water, alcohol, or ether, and in all proportions in glycerin; it melts at 170° C. (338° F.). It is readily soluble in alkaline solutions, yielding yellow solutions. The aqueous solution yields a greenish-black precipitate with ferric chloride, and a lemon-yellow lake with aluminium hydroxide.

EUGALLOL.—*Monacetylpyrogallol*, E.; *Pyrogallolmaoacetat*, G. $C_6H_3(OH)_2CH_3CO_2$.—A brownish-yellow transparent syrupy mass, easily soluble in water and acetone. Used as an ointment in 33 per cent. solution in acetone. Applied externally in psoriasis and other skin diseases.

LENIGALLOL.—*Triacetylpyrogallol*, E.; *Pyrogalloltriacetat*, G. $C_6H_3(CH_3CO_2)_3$.—Prepared by boiling 10 parts of pyrogallol, 1 part of sodium acetate, and 25 parts of acetic anhydride for 2 hours, crystallizing the product and washing it with water. A white crystalline powder, insoluble in water, and melting at 165° C. (329° F.). Applied in the form of 0.5 to 5 per cent. ointment in acute eczema, and about 50 per cent. ointment in psoriasis.

SALIGALLOL.—*Pyrogalloldisalicylate.* $C_6H_3(OH)(C_7H_5O_3)_2$.—A resinous solid, insoluble in water, soluble in 2 parts of acetone and 15 parts of chloroform. It is used as a 33 per cent. solution in acetone, similar to lenigallol.

PHLOROGLUCOL.—*Phloroglucin.* $C_6H_3(OH)_3$.—It is an isomer of pyrogallol, and occurs naturally in many plants, and may be obtained by fusing quercetin, maclurin, catechin, or scoparin with potassium hydroxide. It is prepared commercially by fusing 1 part of resorcin with 6 parts of sodium hydroxide until the mass is of a chocolate-brown color, dissolving the mass in water, decomposing it with an excess of sulphuric acid, filtering, and extracting the phloroglucol from the filtrate by means of ether. The residue from the ether solution is purified by sublimation. From water it crystallizes with 2 molecules of water of crystallization, as colorless rhombic plates, having a sweet taste, and which lose their water of crystallization below 100° C. (212° F.). Phloroglucol melts at 210° C. (410° F.) if heated slowly, and at 217° C. (422.6° F.) if heated rapidly (Hartley, Dobbie, Lauder, *J. C. S.*, 1902, p. 930). At higher temperatures it is sublimable. It is readily soluble in water, alcohol, and ether. It is precipitable with basic lead acetate solution, and is colored deep violet with solution of ferric chloride. It is a strong reducing agent, reducing Fehling's solution and ammoniacal silver nitrate solution. With vanillin and hydrochloric acid it yields a bright-red compound. A freshly-cut piece of pine moistened with a 1½ per cent. solution of phloroglucol and then with dilute hydrochloric acid, develops an intense red color. Potassium nitrite added to a solution of phloroglucol and aniline nitrate gradually produces a vermillion-red precipitate.

PYROXYLINUM, *U. S., Br.*—Pyroxylin.

Collodion cotton, Colloxylin, Soluble gun-cotton, E.; *Fulmicoton soluble*, Fr.; *Kollodiumwolle*, G.

A product obtained by the action of nitric and sulphuric acids on cotton, and consisting chiefly of cellulose dinitrate, $C_6H_8(ONO_2)_2O_3$. It should be kept in cartons, protected from the light.—U. S.

Preparation.—The present U. S. Pharmacopœia does not give a process of manufacture. In the 1890 edition the following formula was given, which has been found to yield very satisfactory results: Purified cotton, 100 Gm.; nitric acid, 1400 Cc.; sulphuric acid, 2200 Cc.; alcohol, ether, water, each a sufficient quantity. Mix the acids gradually in a glass or porcelain vessel and, when the temperature of the mixture has fallen to 32° C. (90° F.), add the purified cotton. By means of a glass rod imbue it thoroughly with the acids, and allow it to macerate, until a sample of it, taken out, thoroughly washed with a large quantity of water, and subsequently with alcohol, and pressed, is found to be soluble in a mixture of 1 volume of alcohol and 3 volumes of ether. Then remove the cotton from the acids, transfer it to a larger vessel, and wash it, first, with cold water until the washings cease to have an acid taste, and then with boiling water, until they cease to redden blue litmus-paper. Finally, drain the pyroxylin on filtering-paper, and dry it in small, detached pellets, by means of a water- or steam-bath, at a temperature not exceeding 60° C. (140° F.).

Take of cotton 1 ounce; sulphuric acid, nitric acid, each 5 fluidounces. Mix the acids in a porcelain mortar, immerse the cotton in the mixture, and stir it for 3 minutes with a glass rod until it is thoroughly wetted by the acids. Transfer the cotton to a vessel containing water, stir it well with a glass rod, decant the liquid, pour more water upon the mass, agitate again, and repeat the affusion, agitation, and decantation until the washing ceases to give a precipitate with barium chloride. Drain the product on filtering-paper and dry in a water-bath.—Br.

The French Codex has a similar formula, but somewhat different proportions: It directs the maceration of 55 parts of well-dried cotton in a mixture of 1000 parts sulphuric acid specific gravity 1.84 and 500 parts nitric acid specific gravity 1.42, which has been cooled to 30° C. (86° F.). The German Pharmacopœia directs a mixture of 1000 parts of crude sulphuric acid specific gravity 1.830 and 400 parts of crude nitric acid specific gravity 1.380; when cooled to 20° C. (68° F.), 55 parts of purified cotton are to be macerated in the mixture for 24 hours at a temperature of 15° to 20° C. (59°–68° F.).

Properties and Tests.—Pyroxylin occurs as a yellowish-white, matted mass of filaments, resembling raw cotton in appearance, harsh to the touch; exceedingly inflammable, burning, when unconfined, very rapidly with a luminous flame; less explosive than cellulose trinitrate. Slowly but completely soluble in 25 parts of a mixture of 3 volumes of ether and 1 volume of alcohol. Soluble in acetone and in glacial acetic acid, and precipitated from these solutions on addition of water. It should leave no weighable residue of mineral impurities when ignited. When kept in well-closed bottles and exposed to the light, it is decomposed with the evolution of nitrous vapors, a carbonaceous mass being deposited.—U. S.

A large number of formulas for preparing collodion cotton have been published, many with the nitric acid replaced by a nitrate, and the sulphuric acid correspondingly increased in quantity. Such mixtures may be made to yield as good results as the mixture of the two acids, but, owing to the separation of crystalline sulphates, it is more difficult to imbue the cotton thoroughly and uniformly with the mixture.

In making collodion cotton it is essential that due attention be paid to the strength of the acids, or, if a nitrate is used, to its freedom from chloride; likewise, that the temperature be permitted to fall as indicated before the cotton, which should be free from fat, is introduced, and the cotton be thoroughly imbued with the acid mixture. If introduced at too high a temperature, other insoluble compounds will be produced or the cotton will dissolve and portions not moistened with the liquid will not be acted on, and likewise remain insoluble. Small portions of the cotton may from time to time be examined, thoroughly washed with water, afterward with alcohol, pressed, and then examined as to their solubility in a mixture of ether and alcohol. When these are found to be soluble, the cotton is withdrawn or the whole mixture added to a large bulk of water, the cotton washed with water until free from acid taste, then pressed to free it from water, steeped in alcohol, and again pressed, after which it may be dried by exposure at a moderate temperature. The yield is usually about 140 per cent.

Composition.—Pelouze (1838) obtained explosive compounds by treating cotton, hemp, and paper with strong nitric acid. In 1846 Schoenbein announced the discovery of gun-cotton, and in the same year Otto published a process for preparing it by maceration in fuming nitric acid. In 1848 Maynard employed collodion. That gun-cotton is a nitrated compound of cellulose, and that the weight of the product is greater than that of the cotton employed, was recognized at an early day. At one time the theory was advanced that by the action of nitric acid on cotton one, two, or more hydrogen atoms in the cellulose are displaced by the group NO_2, and thus nitro-compounds formed, to which the name of mono-, di-, tri-, nitro-cellulose, etc., was given. Later investigations have proven that true nitric acid esters are formed, in which one, two, or more hydroxyl groups have been displaced by a corresponding number of groups of the nitric acid radical. The terms cellulose, mono-, di-, tri-, penta-nitrate, etc., are now used to designate the different compounds. All cellulose nitrates give up nitric acid when treated with alkalies, and concentrated sulphuric acid displaces the nitric acid almost completely, even in the cold. The nitrates are also converted back into cellulose by the action of reducing agents, such as ferrous acetate, potassium hydrosulphide, or a solution of stannous chloride in caustic soda. The same change occurs when cellulose nitrate is boiled with ferrous sulphate and hydrochloric acid, the whole of the nitrogen escaping as nitric oxide if air be excluded,

according to the following equation: $2C_6H_7(NO_3)_3O_2 + 18HCl + 18FeSO_4 = 2C_6H_{10}O_5 + 6NO + 6H_2O + 3Fe_2Cl_6 + 6Fe_2(SO_4)_3$. This plan may be used as a ready means of determining the amount of nitration of pyroxylin (Eder). In Germany the name "pyroxylin," which in England and this country is used to designate the soluble nitrates employed in the manufacture of collodion, is restricted to the insoluble and explosive variety better known as gun-cotton, and which is probably a penta- or hexa-nitrate; the name "colloxylin" is there given to the soluble varieties. When the mixture of nitric and sulphuric acids as directed in the official formula is allowed to act on cotton, one or more cellulose nitrates may be formed, dependent upon the temperature employed, the strength of the acids, and the length of time of immersion; the presence of sulphuric acid simply facilitates the elimination of water, which invariably accompanies the formation of ethers. The cotton is apparently not altered in structure and appearance, the staple remaining intact. Official collodion cotton is probably a mixture of cellulose dinitrate and trinitrate ($C_6H_8(NO_3)_2O_3$) and ($C_6H_7(NO_3)_3O_2$), both of which are soluble in a mixture of alcohol and ether.

Similar nitrated compounds are also obtained from other carbohydrates; thus starch yields with concentrated nitric acid a transparent jelly of xyloidin, $C_6H_9(NO_2)O_5$, and a similar change is produced in paper by dipping it into strong nitric acid and afterward washing with water.

Preservation.—When collodion cotton, particularly in the moist state, is kept in well-stoppered bottles, it undergoes decomposition, frequently accompanied with the evolution of nitrous vapors or with ignition and explosion. It is best preserved in a dry atmosphere and enclosed in vessels which permit the free access of air, but should never be compressed tightly.

Pharmaceutical Preparations.—COLLODION.—U. S. P.

Uses.—Pyroxylin is employed in pharmacy in the preparation of collodion and in the arts in the manufacture of transparent varnishes.

Q.

QUASSIA, *U. S.*—Quassia.

Quassiæ lignum, Br.; *Lignum quassiæ*, P. G.; *Jamaica quassia, Quassia-wood, Bitter-wood, Bitter ash*, E.; *Quassiaholz, Fliegenholz*, G.; *Quassie amer, Bois amer*, Fr. Cod.; *Quassie de la Jamaique*, Fr.; *Quassia della Giammaica*, It.; *Quassia amarga*, Sp., Port.; *Pau Quassia*, Port.

The wood of *Picrasma excelsa* (Swz.) Planch. (*Quassia e.* Swz.; *Q. polygama* Lindsay; *Picræna e.* Lindl.; *Simaruba e.* DC.) or of *Quassia amara* L. (Fam. *Simarubaceæ*).

Quassia is official in all pharmacopœias, though most of them do not specify the first-named variety. Those which do, for the most part, employ the synonym "*Picræna.*" Many specify instead the second-named, or Surinam variety. The Portuguese permits the use of both, while others expressly forbid the use of the Jamaica variety.

Origin.—Jamaica Quassia is derived from a small or medium-sized tree of the West Indies, said to resemble an ash tree, whence the name "Bitter Ash." It was originally introduced as a substitute for the older drug, Surinam Quassia, and was later adopted in place of it. The Surinam species is scarcely more than a very large shrub.

Description.—Jamaica Quassia. Occurring in various forms, usually in chips, raspings, or billets, yellowish white or pale yellow, and of rather coarse texture; odor slight; taste intensely bitter; medullary rays containing tetragonal prisms or small, arrow-shaped crystals of calcium oxalate. Billets of Jamaica quassia are usually 12.5 Cm. or more in diameter; in tangential section the medullary rays are mostly 3 to 5 rows of cells in width.

Surinam Quassia. Occurring usually in billets not exceeding 7.5 Cm. in diameter; the wood is heavier, harder, and more deeply colored than that of Jamaica quassia, and the medullary rays in tangential section are mostly 1 or 2 rows of cells in width.

The powder shows irregular calcium oxalate crystals, 8 to 15 mikrons long. In view of the definition, the bark should not be present in the powder, whereas it usually is so in the Surinam variety, large stone-cells being then visible. The ash is frequently stated to be 7 or 8 per cent., but is in reality only half this amount. The Swiss Pharmacopœia mentions that ferric chloride should deepen the color of the aqueous infusion, but cause no precipitate, thus alluding to the absence of tannin.

Constituents.—Although Jamaica Quassia is said to contain traces of a yellowish alkaloid, giving a fine blue fluorescence with acidulated alcohol, the important bitter principle is a neutral, crystalline substance, commonly known as *Quassiin*, but determined by Massute to be a mixture of two crystalline bodies, which he denominated *α-* and *β-picrasmin*. "Quassiin" is extracted by neutralizing the aqueous infusion with soda, precipitating with tannin and decomposing the precipitate with lead oxide or lime. It is commonly said to exist to the extent of only 0.05 to 0.15 per cent., but really exists in much larger amount, Wiggers says 0.75 per cent. This discrepancy is probably due to the fact that it is difficult to procure in a pure state, and that the purification processes involve considerable loss. Quassiin crystallizes in needles or prisms, and is soluble in alcohol and chloroform and in 1200 parts of cold water. Its bitterness is most intense. The *α*-picrasmin ($C_{35}H_{46}O_{10}$) melts at 204° C. (399.2° F.), the *β*-picrasmin ($C_{36}H_{48}O_{10}$) at 209° to 212° C. (408.2°–413.6° F.). The bitter principle of Surinam Quassia is closely related and of similar action, but is not identical.

Pharmaceutical Preparations.—Extract of Quassia, Fluidextract of Quassia, Tincture of Quassia, U. S. P.

Action and Uses.—Quassia is a bitter tonic, employed with much benefit in dyspepsia due to an atonic condition of the gastric mucous membrane. As a stimulant to the appetite in anorexia following the acute fevers it ranks with gentian and cinchona. Large doses are apt to produce vomiting, and its prolonged use, even in moderate medicinal quantity, may result in gastric derangement. An infusion made by adding ½ to 1 ounce (16–30 Gm.) of quassia to 1 pint (480 Cc.) of hot water is an efficient

remedy to be used as an enema for the removal of thread- or seat-worms (Oxyuris vermicularis). The rectum should be thoroughly emptied by an injection of soap and water prior to the employment of the quassia infusion. Quassia may be given in powder in the dose of from 5 to 30 grains (0.30–2 Gm.), but either the tincture in from ½ to 1 drachm (2–4 Cc.) doses, or 10 to 30 minims (0.60–2 Cc.) of the fluidextract, or 1 to 3 grains (0.06–0.20 Gm.) of the extract are preferred. An infusion is often employed by the laity. Since quassia is devoid of tannin it may be added to tonic preparations containing iron salts without producing a bluish-black precipitate. Quassin, in ¼- to ½-grain (0.015–0.03 Gm.) doses, may be substituted for the crude drug.

Allied Drugs.—The barks of both Quassias are somewhat used separately. That of Jamaica Quassia is dark gray to blackish gray, furrowed and warty, yellowish white on the inner surface, and 4 to 8 Mm. (⅙–½ In.) thick. The fracture of the outer layer is smooth, that of the inner tough and fibrous. It is bitter like the wood. Its constituents have not been investigated. That of Surinam Quassia is lighter in color, nearly smooth without, more nearly white on the inner surface, very brittle, and only about ⅕ or ¼ as thick.

The wood of *P. quassioides* (Buch.-Ham.) Benn. (*Nima q.* Buch.-Ham.) is used in an exactly similar way in India. It is a much larger tree than either of the American Quassias, its bark dark brown, reticulate-fissured, and transversely scarred. The wood is light yellow, the medullary rays exhibiting from 1 to 5 rows of cells on tangential section. It will thus be seen that this variety bears a remarkably close similarity to the official. Dymock and Warden found in it a trace of alkaloid, a bitter, resin-like, fluorescing principle, and another bitter crystalline resinous body, as well as a crystalline substance apparently identical with Quassiin.

P. ailantoides (Bunge) Planch. is a Japanese species, there known as "*nigaki*," meaning *Bitter-wood*. The bark is in this case the more bitter part and is described as being very thin, gray, and somewhat shining, the wood yellow. The bark was found to contain a principle very similar to Quassiin.

An African Quassia has been reported as coming from the Congo region, which it is said can scarcely be distinguished from Surinam Quassia, and which yields a principle apparently identical with Quassiin.

Under the name *Iron-wood* or *Ostrya* (also called *Lever-wood* and *Hop hornbeam*), the heart-wood and the bark of *Ostrya Virginiana* (Mill.) W. (*Carpinus V.* Mill.; *O. Virginica* W.), elsewhere considered, are used as Quassia-substitutes.

Samadera.—In the Philippines and in the East Indies the wood of *Samadera Indica* Gærtn. (called "Manungal" in the Tagala dialect) is used as a Quassia-substitute. The seeds are also bitter and yield a fixed oil.

QUERCUS, *U. S.*—White Oak.

Cortex quercus, P. G.—*Stone oak*, E.; *Eichenrinde*, G.; *Écorce de chêne*, Fr.; *Corteccia di Quercia*, It.; *Corteza de Encina*, Sp.; *Casca de Carvalho*, Port.

The dried bark of *Quercus alba* L. (Fam. *Cupuliferæ*), collected from trunks or branches 10 to 25 years of age, and deprived of the periderm.

Quercus, or Oak Bark, is official in nearly all pharmacopœias. Owing to the uniformity with which the barks of different oaks possesses strongly astringent properties, different species are named in different countries, chiefly according to convenience of supply. Thus many pharmacopœias name *Q. Robur* L., *Q. pedunculata* Ehrh., and *Q. sessiliflora* Martyn, the last two quoted by some as De Candolle's varieties of *Q. Robur*, which is the *British* or *English oak*, or *European white oak* (*Steineiche, Sommereiche*, G.; *Chêne blanc*, Fr.). The Russian Pharmacopœia requires that oak bark contain about 15 per cent. of tannin.

Of the many species of oak found abundantly in America, the bark of *Q. alba* is preferred because of its pure astringency, uncomplicated by any specially troublesome coloring- or other matters. The tree, which is sometimes very large, is abundant throughout eastern and central North America, and is represented further west by closely related and similar species. It yields the highly prized American oak timber.

It is generally believed that neither very old nor very young bark is equal to that from medium-sized trunks and large branches; though in Europe that from smaller branches or stems is preferred, so that the bark usually occurs in quills. The bark is collected in early spring, after first scraping off the rough, silvery- or ashy-gray corky layer.

Description.—In nearly flat pieces, 3 to 10 Mm. ($\frac{1}{8}$–$\frac{2}{5}$ In.) thick, of a rough and splintery appearance and loose texture, harsh to the touch, pale brown throughout, or becoming of a pinkish brown upon exposure, the inner surface very coarsely short-striate; fracture tough, coarsely splintery; odor faint, tan-like; taste strongly astringent; not tinging the saliva yellow when chewed.

It usually occurs as an irregularly coarse, splintery-fibrous powder.

FIG. 331.

Quercus alba ($\frac{1}{4}$ Nat.).

FIG. 332.

Quercus alba (Nat.).

Constituents.—The important constituents of White Oak bark are about 7 per cent. of *quercitannic acid* and a variable amount of *oak-red*. This quercitannic acid is yellowish brown, amorphous, yields a brown precipitate with lead acetate, and was found by Stenhouse (1862) to yield sugar when boiled with dilute sulphuric acid. But, according to J. Löwe (1881), this tannin is not a glucoside; it is separated anhydrous ($C_{28}H_{24}O_{12}$) by saturating its solution with sodium chloride; it is almost insoluble in ether, but dissolves readily in acetic ether; it gives yellowish-white precipitates with gelatin, albumen, tartar emetic, and the alkaloids, and when heated with dilute acids under pressure yields *oak-red* ($C_{28}H_{22}O_{11}$). Quercitannic differs from gallotannic acid in not being convertible into either gallic or pyrogallic acid. The infusion of oak-bark yields to ether a little gallic and ellagic acids. The great value of oak-bark for tanning purposes is due to the presence in it of various substances which have the property of "filling" the leather, but which are unimportant from a medicinal point of view. Pectin, resin, wax, fat, lævulin, and the sugar quercit have been found. There is also a very slight amount of an unstudied bitter principle.

Pharmaceutical Preparation.—FLUIDEXTRACT OF QUERCUS, U. S. P.

Action and Uses.—Quercus owes its virtue to the contained tannic acid. Although rarely given internally, its astringent property may be of service in diarrhœa or hæmoptysis. Infusions of the strength of $\frac{1}{2}$ to 1 ounce (16–30 Gm.) to the pint (480 Cc.) of water are used as vaginal irrigations in leucorrhœa due to chronic endometritis, simple or gonorrhœal vaginitis, as astringent rectal injections in hemorrhoids and prolapsus ani, and as a gargle in subacute and chronic inflammations of the tonsils and pharynx. The dose of the fluidextract is from 10 to 60 minims (0.60–4 Cc.).

Allied Products.—Under this head a large number of products must be referred to. They are divisible into two series, one allied merely by composition, and properties or uses, the other through botanical relationship as well. The latter will be first considered.

Quercus, Sps.—The genus *Quercus*, L., comprises more than 200 species, distributed widely through the northern hemisphere. Its products are noted for their astringency. They constitute two series, that represented chiefly by GALLA and ACIDUM TANNICUM being characterized by the presence of gallo-tannic and gallic acids, that represented by the barks by the presence of quercitannic acid. The oak-barks differ among themselves chiefly in the amount of tannin and in the amount and kind of coloring-matter. The tannic acids of the different species appear to be identical as to their own properties, but since they yield different phlobaphenes or coloring-matters, it appears that this cannot be the case. The largest yield of tannin recorded is said to be about 22 per cent., from the bark of *Q. incana* Roxb., of India.

European white oak bark, referred to above, occurs in quills, the bark being about 2 Mm. ($\frac{1}{12}$ In.) thick; the outer surface is gray or brown gray, glossy, and smooth or somewhat fissured; the inner surface is cinnamon colored and somewhat rigid. The bark breaks with a smooth, and in the inner layer with a fibrous, fracture, and in odor and taste resembles the preceding.

Yellow oak bark, also called *Dyers'* or *Quercitron oak*, and incorrectly though commonly in pharmacy known as "Black oak," is the bark of *Q. velutina* Lam. (*Q. tinctoria* Bartr.; *Q. coccinia tinctoria* A. Gray), common in eastern North America. This bark was formerly official, and is largely employed in the arts under the name of *quercitron-bark*. It resembles that of the white oak, but the suberous layer, which is generally removed, is of a blackish-brown color, and the inner bark of a deep reddish brown with a yellowish tint. Like the preceding, it is usually kept as a coarse powder; when masticated it tinges the saliva bright brownish yellow, due to the presence of *quercitrin*, which has been met with in many plants. This is deposited from the decoction of black oak bark on cooling, forms when pure a yellow crystalline, inodorous, and nearly tasteless powder, which is sparingly soluble in hot and nearly insoluble in cold water, dissolves in about 5 parts of alcohol, slightly in ether, is colored dark green by ferric chloride, and dissolved in alkalies becomes dark brown on exposure. Its formula is $C_{33}H_{30}O_{17}$ ($C_{36}H_{38}O_{20}$, Liebermann, 1879). Treated with acids, it splits into the crystalline unfermentable sugar *isodulcit*, $C_6H_{14}O_6$, and into *quercetin*, $C_{27}H_{18}O_{12}$ ($C_{24}H_{16}O_{11}$, Liebermann); the latter is likewise yellow and crystalline, is found ready formed in a number of plants, is colored dark green by ferric chloride, precipitated brick red by lead acetate, sublimable by alkalies, resolved into phloroglucin and *quercetic acid*, $C_{15}H_{10}O_7$, and with fusing potassa yields protocatechuic acid.

This is said to be the species which yields the peculiar galls often called *Oak-plums*.

A great many oak-barks have been examined as to their tannin and coloring-matters, especially by Trimble, but the results are of interest rather to tanners and dyers than in medicine. The astringent properties are not confined to the bark. Under the name *Vallonea* (*Valonia, Acorn-cups*, E.; *Walonen, Knoppern*, G.; *Valloné, Velanédé, Gallon*, Fr.) the scaly involucres of the fruits of various species are employed in tanning. *Oriental valonia* consist of the cups of *Q. vallonea* Klotschy and of several allied species or varieties of *Q. Ægilops* L., indigenous to southeastern Europe and the Levant. They are about 2.5 Cm. (1 In.) or more broad, have thick spreading or recurved scales, and possess a strongly astringent taste. *Hungarian valonia* constitute a combination of cup and gall, being the cups of *Q. robur* L., rendered irregular in shape, and more or less winged, by the excrescences produced by the sting of *Cynips quercis calycis*. The cups of our indigenous species are likewise astringent.

Acorns themselves are astringent, often very strongly so, notwithstanding that the kernels of *Q. alba* and some others are edible, and are used as a coffee-substitute under the name of *Acorn-coffee*. Among other things they contain much starch, protein, fat, and sugar.

Fagaceæ (*Cupuliferæ*).—This family, of which the oaks are the most important representatives, is noted for its abundance of tannin. CASTANEA and GALLA are separately discussed. The bark and leaves of the several species of Beech (*Fagus*) are quite rich in tannin. The nuts of the American beech are edible and excellent. They are said by La Wall to contain upward of 25 per cent. of albuminoids, 30 of fat (double this amount in some selected specimens), and 3.5 of starch, but no sugar.

Other Tannin-yielding Families worthy of note are the following: *Myricaceæ* and *Salicaceæ*—the barks of *Salix* and *Myrica* having been elsewhere discussed. That of *M. Nagi* Thunb. (*M. rubra* Sict. et Zucc.), of India, is there used for tanning and contains 11 to 14 per cent. of tannin. The barks of *Alnus* and other *Betulaceæ* have been referred to under BETULA. In tropical America the barks of many *Melastomaceæ* (especially species of *Tibouchina*, in the Andes) and of many *Malpighiaceæ* are used for tanning. That of *Malpighia glabra* L. is largely used in Mexico under the name of *Nance bark*. It contains 26 per cent. of tannin.

The *Leguminosæ* are especially rich in tannin. Although this statement applies to all divisions of the family, it is especially true of the *Mimosaceæ* and to a less extent of the *Cæsalpiniaceæ*. The bark of the root, and to a lesser extent other parts, of the large shrub or small tree *Cercis Canadensis* L. (*Siliquastrum C.*—Medic.; *S. cordatum* Moench), the

American Judas tree, Salad tree or *Red bud* (*Bouton rouge, Gainier*, Fr.), as well as of the related species *C. Siliquastrum* L. (*Siliquastrum Arbor-Judas* Medic.), the *European Judas tree*, is rich in tannin and is considerably astringent. The barks of many species of *Acacia* are valuable for tanning purposes. In India, *A. Arabica* Willd. yields the much-used *Babul bark*. The pods of this species contain 22 per cent. of tannin and are commercial under the names *Neb-neb* and *Bablah*, and their extract under that of *Akakia*. *Wattle bark* is an Australian product, the *Golden wattle* yielded by *A. pycnantha* Benth., the *Black wattle* by *A. decurrens* Willd. *Algarobilla* is the fruit of *Cæsalpinia brevifolia* Benth. The wood and bark of many species of *Mimosa*, as well as of the closely related genus *Calliandra*, are used in various countries as astringents. That of *C. Houstoni* Benth. is known in Mexico as *Pambotano*. Maiden has listed 10 species of the related genus *Albizzia*, which are used in Australia. In tropical America the barks of various species of *Pithecolobium* are so used. *Cortex adstringens brasiliensis*, which was used in Europe during the first half of the present century, is obtained from *Stryphnodendron polyphyllum* Mart., a tree known in Brazil as *barbatimao* or *barbimao*. The bark is covered with a thick fissured blackish red-brown cork, has a light-brown bast-layer readily separating in bands, possesses a strongly astringent and somewhat mucilaginous taste, and contains about 30 per cent. of tannin, which yields with ferric salts a blackish gray-green precipitate. *Divi-divi*, an Indian product, is the pods of *Cæsalpinia coriaria* Willd. (*Libidibia c.* Schlecht). They contain more than 50 per cent. of tannin. A closely related product is *Tari* or *Teri*, the pods of *C. digyna* Rottl. One-third of their weight consists of tannin suitable for tanning purposes.

The *Dilleniaceæ* is another family rich in tannin. In the Philippines, the wood of *Tetracera macrophylla* Vall. is largely used for hæmoptysis and locally for sore throat, under the Tagala name *Malakatimon*.

The bark of *Odina Wodier* Roxb. (Fam. *Anacardiaceæ*) is abundant and widely distributed in India, and there used for tanning, also as a medicinal astringent. It is used also for rough cordage, and to yield a golden or pale-brown tint in silk-dyeing.

Those interested in this subject will find it useful to refer to *Agricult. Ledger*, 1902, No. 1, which is a pamphlet of 56 pages, devoted to *Indian tanning materials*.

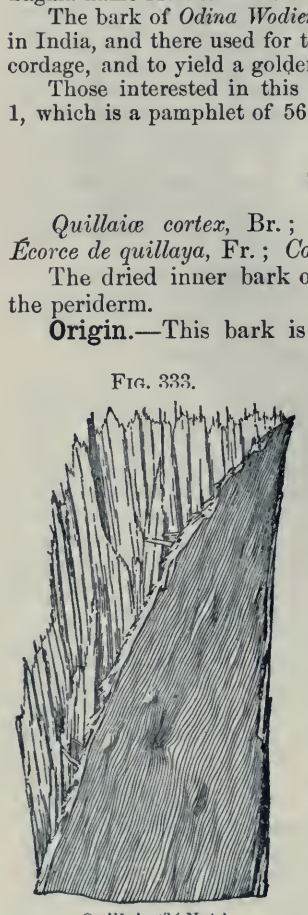
QUILLAJA, *U. S.*—Quillaja.

Quillaiæ cortex, Br.; *Cortex Quillaiæ*, P. G.—*Soap-bark*, E.; *Seifenrinde*, G.; *Écorce de quillaya*, Fr.; *Corteza de quillaya, Quillaya*, Sp.

The dried inner bark of *Quillaja Saponaria* Molina (Fam. *Rosaceæ*), deprived of the periderm.

Origin.—This bark is collected from a very large tree growing in and near the coast region of central and northern Chile. The bark is imported in bales, packed under hydraulic pressure.

Fig. 333.



Quillaja (¾ Nat.).

Description.—In large, flat pieces, 3 to 8 Mm. (⅛–⅓ In.) thick; outer surface brownish white, often with larger or smaller patches of the dark-brown outer layer adhering, otherwise smoothish or lightly striate; inner surface pale yellowish or whitish, nearly smooth, or often with longitudinally elongated blister-like elevations; fracture tough and strongly splintery, the laminæ oblique to each other; transverse section checkered with pale-brownish bast-fibers imbedded in the white tissue; inodorous, but the powder highly sternutatory; taste persistently acrid.

The infusion foams like soap-water.

Constituents.—The active portion of soap-bark consists of about 9 per cent. of an amorphous substance commonly denominated "saponin," but which is in reality a mixture of two glucosidal bodies better known as *quillajic acid* and *quillajasapotoxin*. Kobert recommends the extraction and separation of these two saponin bodies in the following manner: A decoction of quillaja bark is filtered and concentrated, then saturated with ammonium sulphate, boiled for some minutes, and again filtered. The resulting precipitate contains the quillajic acid and the coloring-matter of the bark, while the colorless filtrate will contain the quillajasapotoxin. In order to recover the quillajic acid, the precipitate is expressed and treated repeatedly with boiling alcohol, the alcoholic solutions are united and filtered, and to the clear fil-

trate, when cool, ether is finally added, which precipitates the acid in the form of a white, flocculent mass. The quillajasapotoxin is obtained from the colorless filtrate above mentioned by concentrating the same, adding an excess of alcohol, removing the newly separated ammonium sulphate, filtering, and adding ether, which precipitates the sapotoxin in the form of a white powder. In place of the above method, the two bodies may be separated by means of neutral and basic lead acetates, but the latter process is more laborious (see separate article on SAPONINS). Soap-bark is noted for its large content of crystals, chiefly of calcium sulphate, partly of calcium oxalate.

Quillajic acid, $C_{19}H_{30}O_{10}$, is a weak amorphous acid, forming also amorphous salts. It is readily soluble in water, solutions of caustic, and carbonated alkalies, and in alcohol and methyl alcohol, but very difficultly soluble in chloroform and insoluble in ether. Its aqueous solution foams considerably when shaken, and changes the color of blue litmus-paper to red, and that of congo red to blue. Quillajic acid is precipitated by both neutral and basic lead acetate, differing in this respect from the other saponin body met with in soap-bark. After boiling with diluted mineral acids it yields dextrose, but it is not affected by ptyalin, pancreatin, and diastase. It is strongly sternutatory and has an acrid taste, but, according to Kobert, does not possess these properties if it has been purified by acetylization or been treated with barium hydroxide.

Quillajasapotoxin, $C_{17}H_{26}O_{10}$, frequently designated simply as *sapotoxin*, occurs as an amorphous neutral substance, soluble in water, warm diluted alcohol, and solutions of caustic and carbonated alkalies, but difficultly soluble in alcohol, and almost insoluble in chloroform; somewhat soluble in a mixture of 1 part of absolute alcohol and 4 parts of chloroform. It is insoluble in ether and difficultly soluble in methyl and amyl alcohol. Its aqueous solution foams strongly when agitated, and prevents sedimentation of finely divided matter added thereto. Quillajasapotoxin has a somewhat mild taste, which soon becomes acrid and burning, and is intensely irritating and sternutatory. It is not affected by neutral lead acetate, but is precipitated by the basic acetate. It is decidedly toxic and exercises a solvent effect on red blood-corpuscles.

Pharmaceutical Preparations.—FLUIDEXTRACT OF QUILLAJA, TINCTURE OF QUILLAJA, U. S. P.

Action and Uses.—Quillaja has been recommended as a substitute for senega in subacute and chronic bronchitis. It is stimulating to the bronchial mucous membrane, and relieves cough by causing dislodgement of tenacious mucus from the walls of the bronchi. The bark in powder produces sneezing, and has been used as a snuff with asserted good results in chronic rhinitis. In infusions of varying strength it is employed as a detergent in place of soap to cleanse the scalp when it is affected with ulcers or eruptions.

Allied Products.—In the Philippines the bark of *Entada scandens* (L.) Benth. (*Mimosa s.*—L.) is employed under the name *Gogo*, and in Java under the name *Gandoo*, for the same purposes as soap-bark, its constituents being evidently very similar. The seeds of this plant constitute one of the several products known as *Sea bean* or *Faba marina*.

The number of drugs and other active vegetable substances, many of them used as fish poisons, which contain acrid, sternutatory, and poisonous substances foaming with water, and to which the name saponin has been applied, is large, and very many of them have been referred to in this work, especially in our articles on CARYOPHYLLACEÆ and other families.

QUINIDINÆ SULPHAS.—Quinidine Sulphate.

Sulfate de quinidine basique, Fr. Cod.; *Chinidinum (Conchininum) sulfuricum.*—*Sulphate of conquinine*, E.; *Sulfate de quinidine*, Fr.; *Schwefelsaures Chinidin, Conchininsulfat*, G.

Formula, $(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 2H_2O$. Molecular weight, 776.75.

The neutral sulphate of an alkaloid obtained from the bark of several species of cinchona. Quinidine sulphate should be kept in well-stoppered bottles in a dark place.

Preparation.—The mother-liquors from the recrystallization of quinine sulphate yield on concentration a crop of crystals consisting chiefly of this salt, which is purified by treatment with animal charcoal and by recrystallizing it. On adding to the mother-liquors a considerable excess of ammonia, cinchonine will be precipitated and quinidine dissolved; the solution deposits the alkaloid quinidine, together with impurities, on the

addition of soda. The alkaloid may then be dissolved in dilute sulphuric acid, and the salt purified by recrystallization. Since quinidine enters the mother-liquors containing the amorphous alkaloids, and is precipitated with chinoidine, it may be prepared from the latter, according to Hesse (1868), by exhausting it with ether, converting the dissolved alkaloids into sulphates, precipitating quinine and cinchonidine with Rochelle salt, purifying the filtrate with animal charcoal, and precipitating the quinidine with potassium iodide; the alkaloid is then liberated by ammonia, combined with sulphuric acid, and the salt crystallized.[1]

Quinidine is an isomer of quinine, which it closely resembles in the fluorescence of its solutions, and in the thalleioquin reaction, as well as in its physiological properties. It is, however, distinguished from QUININE (which see) in being dextrogyre ([a]. = + 236.77° in 97 per cent. alcohol, Hesse). It crystallizes from boiling water as non-efflorescent permanent plates with 1½ molecules of water, from ether as rhombohedra, and from alcohol with 2½ molecules of water as lustrous monoclinic prisms or needles, which are efflorescent, but do not lose all their water of crystallization under 120° C. (248° F.). It melts at 168° C. (334.4° F.). Quinidine is soluble in 2000 parts of water at 15° C. (59° F.), in 750 parts of boiling water, in 22 parts of ether at 20° C. (68° F.), and readily soluble in hot chloroform and amyl alcohol.

Properties.—Quinidine sulphate crystallizes in white, silky needles which resemble those of the quinine salt, but are less matted and do not effloresce on exposure even when heated to 80° C. (176° F.); when heated to 120° C. (248° F.) they part with their water of crystallization (4.6 per cent.), and on ignition are entirely consumed. The solution in dilute sulphuric acid shows the blue fluorescence of quinine solutions, and strikes an emerald-green color on the successive addition of chlorine-water and ammonia, and a red color in the successive addition of chlorine-water, potassium ferrocyanide, and ammonia. The salt has also, like the corresponding quinine salt, a very bitter taste and a neutral reaction. It dissolves at 10° C. (50° F.) in 108 parts (Hesse), at 15° C. (59° F.) in 110 parts (Fr. Cod.), and at the boiling-point in 10 parts of water; at 15° C. (59° F.) also soluble in 8 parts of alcohol and 19.5 parts of chloroform, and in 10 parts of boiling chloroform. It is very soluble in boiling alcohol and nearly insoluble in ether.

FIG. 334.

Quinidine Sulphate with KSCy: microscopic crystals.

The chloroform solution on evaporation leaves the salt in an amorphous state, and on exposure to diffused daylight gradually acquires a green color, but the alkaloid is not perceptibly affected thereby (Hesse, 1879). The aqueous solution yields with barium chloride a white precipitate which is insoluble in hydrochloric acid; with potassium ferrocyanide golden-yellow prisms or a yellow crystalline precipitate; and with potassium iodide from neutral solution, a white, and from acid solution a reddish-yellow, crystalline precipitate. Potassio-cadmic-iodide (Marme's reagent) added to dilute solutions of quinidine yields tufts of microscopic crystals which are markedly different from those of the other quinine alkaloids (Vreven). When a drop of the solution is mixed with a drop of solution of potassium sulphocyanate, the microscope reveals groups of radiating feathery crystals; this quinidine sulphocyanate requires 1477 parts of water for solution.

Tests.—When heated on platinum-foil the salt should burn without leaving any residue. The thalleioquin test may be applied as follows: On treating 10 Cc. of an aqueous solution (about 1 in 1600) of the salt with 2 drops of bromine-water, and then with an excess of ammonia-water, the liquid will acquire an emerald-green color. With proper adjustments of the reagents, more dilute solutions will show a paler tint, while more concentrated ones will acquire a deeper color or deposit a green precipitate. De Vrij's (1878) test is applied as follows: A cold saturated, aqueous solution of the salt yields a white precipitate with potassium iodide test-solution (difference from quinine sulphate); dissolved in 50 Gm. of hot water, and 0.5 Gm. potassium iodide added, a

[1] The alkaloid *quinidine* was first isolated as a pure base by Van Heijningen (1848). In the literature antedating 1877 much confusion exists as to the name for this alkaloid. The term quinidine of the present day is synonymous with the β-quinine of Heijningen (1849), the β-quinidine of Kerner (1862), and Hesse's (1874) conchinine, as well as chinotin, cinchotin, conquinine, pitayin, and crystallized chinoidin.

sandy crystalline precipitate must fall, and after some hours the mother-liquor, on being tested with ammonia, should not produce an appreciable precipitate. Quinidine sulphate should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of readily carbonizable organic impurities) nor produce a red color with nitric acid (difference from morphine). If a small quantity of ammonia-water be added to 3 Cc. of an aqueous solution of the salt saturated at 15° C. (59° F.), a white precipitate (quinidine) will be produced, which requires more than 30 Cc. of ammonia or more than thirty times its weight of ether to dissolve it (absence of more than small proportions of other cinchona alkaloids). 0.5 Gm. should dissolve clear in 10 Gm. of chloroform.

Action and Uses.—The sulphate and other salts of quinidine may be substituted for those of quinine. They are less powerful than the quinine salts, and must be administered in larger quantity. The antiperiodic dose of the sulphate is from 10 to 60 grains (0.60–4 Gm.).

Allied Salts.—QUINIDINÆ BISULPHAS, *Acid quinidine sulphate*, $C_{20}H_{24}N_2O_2.H_2SO_4 + 4H_2O$. It is obtained by dissolving the sulphate in sufficient diluted sulphuric acid and evaporating. It forms long colorless prisms of an asbestos-like appearance, soluble in 8.7 parts of water at 10° C. (50° F.) and losing 14.57 per cent. of water at 120° C. (248° F.).

QUINIDINÆ HYDRIODIDUM, *Quinidine hydriodide*, $C_{20}H_{24}N_2O_2HI$. It is obtained by double decomposition of neutral solutions of quinidine sulphate and potassium iodide as a white crystalline powder, or from warm and somewhat diluted solutions in colorless scaly prisms. It is slightly soluble in alcohol and in hot water, and requires at 10° C. (50° F.) 1270 parts of water for solution. The salt is anhydrous and contains 28.09 per cent. of iodine.

QUINIDINÆ HYDRIODIDUM ACIDUM, *Acid quinidine hydriodide*, $C_{20}H_{24}N_2O_2(HI)_2 + 3H_2O$. It is prepared like the preceding salt, using, however, a warm acidulated solution of quinidine sulphate. It forms an orange-colored crystalline powder or glossy golden-yellow prisms, turns brown yellow at 120° C. (248° F.) from loss of water, which is absorbed again on exposure to moist air, and is soluble in 90 parts of cold water, and more freely soluble in alcohol and in hot water. The salt contains 8.5 per cent. of water and 43.77 per cent. of iodine.

QUINIDINÆ HYDROCHLORIDUM, *Quinidine hydrochloride*, $C_{20}H_{24}N_2O_2.HCl + H_2O$. It is prepared by dissolving 10 parts of quinidine in about 200 parts of water and 4.5 parts of 25 per cent. hydrochloric acid and crystallizing the salt. It forms asbestos-like fibres, which are soluble in about 50 parts of water at 15° C. (59° F.), readily soluble in alcohol, but almost insoluble in ether.

QUININA.—*U. S.*—Quinine.

Chininum.—Quinine, Fr.; *Chinin*, G.

Formula, $C_{20}H_{24}N_2O_2 + 3H_2O$. Molecular weight, 375.46.

An alkaloid obtained from the bark of various species of Cinchona. Quinine should be kept in well-stoppered bottles in a dark place.—U. S.

Preparation.—On precipitating a solution of quinine sulphate in acidulated water with an alkali, a curdy, amorphous, white precipitate is obtained, consisting of the anhydrous alkaloid, which if kept under the liquid is gradually changed to the crystalline hydrate of the above formula. It requires to be washed with distilled water and dried at a low temperature. The same hydrate may also be obtained from the solution of the alkaloid in diluted alcohol by crystallizing at a low temperature, while at 30° C. (86° F.) silky needles of anhydrous quinine are separated (Hesse). On concentrating a solution of quinine in ammonia-water the hydrate crystallizes. The precipitation of quinine should be effected without heat, and only a slight excess of ammonia should be used to prevent loss of the alkaloid.

Properties.—Quinine occurs as a white, flaky, or micro-crystalline powder, odorless, having a bitter taste, and slightly efflorescent in dry air. Quinine, when freshly crystallized, should contain 3 molecules of water of crystallization. When heated, it fuses at 57° C. (134.6° F.), and loses 2 molecules of water of crystallization at 100° C. (212° F.), and the third molecule at 125° C. (257° F.); at ordinary temperatures the loss is gradual. Quinine free from water is soluble in 1750 parts of water, 0.6 part of alcohol, 4.5 parts of ether, 1.9 parts of chloroform, 158 parts of glycerin, 120 parts of benzene, 3450 parts of a solution of potassium hydroxide (1 in 20), and in 1810 parts of ammonia-water at 25° C. (77° F.). It is soluble in 810 parts of water at 80° C. (176° F.). Quinine containing 3 molecules of water is soluble in 1550 parts of water, 0.6 part of alcohol, 1.3 parts of ether, 1.6 parts of chloroform, 212 parts of glycerin, 166 parts of benzene, 3450 parts of a solution of potassium hydroxide (1 in 20), and in 1810

parts of ammonia-water at 25° C. (77° F.). It is soluble in 775 parts of water at 80° C. (176° F.). When rendered anhydrous by heating to constant weight at 125° C. (257° F.), its melting-point is 174.9° C. (346.8° F.). It is lævogyrate, and is alkaline to moistened litmus-paper. If to 1 Cc. of an aqueous solution of quinine (1 in 100), containing just sufficient diluted sulphuric acid to effect complete solution, there be added 2 Cc. of bromine test-solution, followed by 1 Cc. of ammonia water, the liquid should acquire an emerald-green color (thalleioquin). If 0.7 Gm. of quinine be dissolved in a mixture of 15 Cc. of acetic acid, 6 Cc. of alcohol, and 0.5 Cc. of sulphuric acid, the solution heated to boiling, and 7 Cc. of a saturated solution of iodine in alcohol be added slowly, bronze or olive-green crystals of quinine iodo-sulphate will separate on gradually cooling the solution. These crystals are insoluble in cold water. If 0.2 Gm. of quinine be dissolved in 1 Cc. of diluted sulphuric acid, the solution diluted with distilled water to 20 Cc. and neutralized with ammonia-water, and 1 drop of solution of hydrogen dioxide and 1 drop of copper sulphate test-solution be added, and the liquid boiled, an intensely red color should appear, which slowly changes to a blue, and finally to a green color. (Quinine and quinidine alone respond to this test.)—U. S.

Quinine is a strong base, neutralizes the strongest acids, forming crystallizable salts, which, if soluble, have an intensely bitter taste, and displaces ammonia from its salts on being heated with their solutions. The crystals are alkaline to litmus and turmeric, but not to phenolphthalein. Its salts of 2 molecules of base and 1 of acid are neutral to Brazil wood, cochineal, and logwood, but strongly alkaline to methyl orange. The bisulphate is neutral to the latter indicator. The acidulated solutions show a vivid blue fluorescence, which disappears on the addition of hydrochloric, hydriodic, and sulphocyanic acids and of thiosulphates. The fluorescence is also prevented in dilute solutions by the presence of acetphenetidin, which latter may also cause a blue color to appear, instead of green, in the thalleioquin test.

Solutions of the alkaloids, as such, in neutral solvents, exposed to sunlight develop a brown color and lose their alkaloidal character through the formation of *quiniretin* (Flückiger). Quinine, on treatment with permanganate, chromic acid, nitric acid, etc., yields various oxidation products, according to conditions—formic acid HCO_2H, quitonine $C_{19}H_{22}N_2O_4$, cincholeupone $C_9H_{17}NO_2$, cincholeuponic acid, quinic acid, and cinchomeronic acid $C_5H_3N(COOH)_2$ being among the products. When fused with potassium hydroxide, quinine yields methoxyquinoline, $C_9H_6N(OCH_3)$. Quinine is considered to be a derivative of hydro-diquinoline.

Quinine heated with glycerin to about 190° C. (374° F.) is converted into the isomeric base *quinicine*, which was discovered by Pasteur (1853), and may be obtained from most acid quinine salts by heating them to about 130° C. (266° F.). Quinicine is amorphous (difference from quinine and cinchonidine), dextrogyre, difficultly soluble in water, readily soluble in alcohol, and forms with acids crystallizable salts which are colored green by chlorine-water and ammonia, and yield with hypochlorites white precipitates which are turned green by ammonia.

Tests.—Quinine should not impart more than a faintly yellowish tint to sulphuric acid (limit of really carbonizable organic impurities), nor produce a red color with nitric acid (difference from morphine). 1 Gm. of quinine should dissolve completely in a slightly warmed mixture of 6 Cc. of absolute alcohol and 3 Cc. of ether, which solution should remain clear on cooling (absence of cinchonine and cinchonidine). Quinine should not lose more than 14.3 per cent. of water on heating to 125° C. (257° F.) (absence of an excess of water). When heated with 2 Cc. of potassium hydroxide test-solution, no ammonia should be evolved (absence of ammonium salts). Dissolve 2 Gm. of quinine, which has previously been dried at 50° C. (122° F.) for two hours in a porcelain dish, in 20 Cc. of alcohol. Add 2 drops of hematoxylin test-solution, neutralize exactly with sulphuric acid, and evaporate to dryness on a water-bath. Complete the test by following the directions given on page 1296, under QUININÆ SULPHAS (Test for Other Cinchona Alkaloids, Section II.).—U. S.

Action and Uses.—Quinine and its salts possess a very bitter taste, and are capable, in concentrated form, of causing gastric irritation, and on elimination, some irritation of the bladder. When taken in full medicinal dose it causes a sense of fullness in the head and dizziness, ringing in the ears, some impairment of hearing, and even disorders of taste and smell. In those who are very susceptible to its effects it may cause blindness, and those who suffer from middle-ear disease may be made completely deaf by its use. In small medicinal doses it acts as a bitter tonic upon the gastric mucous

membrane and as a feeble nervous stimulant or tonic. Upon the blood in medicinal doses it produces in health no changes whatever, but in very large doses it probably prevents the out-wandering of white blood cells, known as diapedesis. If taken for any considerable period of time, it increases the number of red blood corpuscles. Its effect upon respiration is very slight. Upon body temperature it exercises no influence in health, and is a feeble antipyretic in disease, except in malarial fever, when it has a specific influence upon the malarial parasite. The drug is entirely absorbed by the stomach, and if it enters the intestine is precipitated by the alkaline juices of that part of the alimentary canal, although after precipitation it is possible that small quantities are slowly absorbed. Quinine escapes chiefly through the kidneys, but a large part of it is oxidized and destroyed by the tissues of the body. It diminishes tissue waste.

When poisonous doses are taken it not only produces the symptoms already named, but also deep coma, superficial breathing, a slow pulse, and absolute loss of hearing and sight. Very few cases of serious poisoning from its use have, however, been reported. On the other hand, few drugs are so frequently followed by untoward effects when taken by susceptible individuals. In addition to the symptoms named which sometimes follow a medicinal dose, it not rarely produces various forms of skin eruption, most commonly of the nature of erythema or urticaria. Occasionally, vesicles and petechiæ are present. Many of the disagreeable symptoms which are felt in the head can be avoided, when large doses are necessary, by the simultaneous administration of 10 or 20 grains of bromide of sodium with 15 minims of the fluidextract of ergot. Occasionally, in old cases of chronic malarial cachexia, the use of quinine seems to produce hemiglobinuria. Strangury due to irritation of the neck of the bladder is sometimes caused by its use.

Quinine is used in medicine for three chief purposes: First, and most important, for its anti-malarial influence, which it exercises by virtue of its power over the malarial parasite, which it destroys in so small a proportion of blood as 1 to 20,000. When used to combat malarial infection, it may be employed as a preventive and as a cure. Patients exposed to malarial infection should take from 3 to 5 grains daily to prevent the development of the disease. In patients who have already become infected, the method of its administration depends somewhat upon the type of the parasite. When it is due to the presence of the tertian or quartan parasite, the quinine may be given in soluble form—that is, in freshly made pill, capsule, or solution—every hour for 3 or 4 hours before the expected paroxysm. If the drug is preceded by calomel, so that the liver is rendered active at the time of its absorption, it is very much more efficacious than if the liver is torpid. Ordinarily, doses of from 5 to 20 grains, given at the intervals named, are quite sufficient. Smaller doses are required if the patient will keep to his bed than if he persists in moving about. Certain practitioners prefer to administer the quinine not several hours before the paroxysm, with the object of aborting the oncoming attack, but during or a short time before the paroxysm, in order that the drug may destroy the parasite when sporulation occurs during the attack of chill and fever, since by this means the young parasites are killed before they can attack other red cells. If a patient suffering from a malarial paroxysm is seen, therefore, as late as the sweating stage, the administration of full doses of quinine will do much toward preventing a subsequent attack. It is of great importance to remember that the introduction of quinine into a stomach which is atonic and torpid will not be followed by good results, since the drug will not be absorbed with sufficient rapidity to enter the blood and destroy the parasite. The calomel treatment already advised is, therefore, necessary in most cases, and the absorption of quinine can be hurried by giving a hot drink with it, or by administering to the patient a few drops of hydrochloric acid, which will aid in its solution and absorption. In bilious remittent fever which is due to the æstivo-autumnal parasite, the condition of the stomach and liver is usually so grave that active treatment must be devoted to these two organs, and quinine can do little good unless they are fit to aid in its entrance into the blood. Under these circumstances the drug should be given in hourly doses, in larger quantities than are necessary in the infection by tertian and quartan parasites. In severe cases of æstivo-autumnal infection, when the infection is pernicious in character, it may be advisable to give the quinine intravenously, employing a vein in the leg for the injection, so that the drug will not go to the heart in a concentrated form, under which circumstances it is a depressant to this viscus. 10 to 15 grains is as much as should be given in this manner at a single dose. The injection is prepared by dissolving 15 grains of quinine hydrochloride with 15 grains of sodium chloride in an ounce and a half of sterile, distilled water or in normal salt solution. In certain forms

of severe neuralgia depending upon malarial infection quinine is a very valuable remedy. Its use in typhoid and other fevers as an antipyretic is practically valueless, since large doses are prone to disorder the stomach, and small doses cannot exercise any effect upon the fever. Further than this, the fever is bound to run its course whether quinine is given or not. Although the drug was employed quite largely at one time as an antipyretic in non-malarial diseases, this use of it has become almost obsolete, because of the introduction of the more powerful coal-tar antipyretics, and because of its innate feebleness.

As a bitter tonic during convalescence from any one of the acute infectious diseases, in the dose of from 1 to 5 grains, twice or thrice a day, it is a valuable drug.

Among the other uses of quinine may be mentioned its employment to overcome uterine inertia in feeble women; but for this purpose a cup of strong coffee, a hypodermic injection of strychnine, or the internal use of the fluidextract of kola or coca is much more advantageous. It has been claimed by obstetricians of experience that the use of quinine in labor predisposes the patient to postpartum hemorrhage. The idea that it is capable of causing abortion when given in medicinal dose is incorrect, unless perchance the patient is one who is prone to abort.

Quinine, in moderate dose, is a useful "support" to the general system in the pneumonia of children and during mental or physical strain in adults. It also has a reputation of being of value as a prophylactic against the infection which causes whooping-cough. Under these circumstances it is much more efficacious if taken into the mouth in solution or if sprayed into the pharynx than if swallowed in pill form. In the strength of 1 : 3000 quinine may be injected into the colon in cases of amœbic dysentery, as it is capable of destroying the Amœba coli.

Administration.—The best salt of quinine for ordinary uses is the hydrochloride, because it is very soluble. Next, in this advantage, is the hydrobromide, while the most insoluble are the sulphate and tannate, both of which salts have a lower alkaloidal strength. The bisulphate is also frequently employed.

Because of its bitter taste quinine is commonly given in pill or capsule. It ought not to be used in compressed tablets or in the form of old pills, since these are difficult of solution, and often pass into the bowel before being dissolved, and thereby the patient loses the full medicinal effect of the doses given. In the administration of quinine to children it may be mixed with chocolate and licorice, and the tannate of quinine may be employed because its insolubility renders it less bitter than the more soluble forms. When quinine is to be used in suppositories, the best salt to employ is the hydrochloride.

UNOFFICIAL SALTS OF QUININE.

Quininæ Acetas. *Quinine acetate.* $C_{20}H_{24}N_2O_2.HC_2H_3O_2$.—Quinine acetate crystallizes in long white needles, and is soluble in about 600 parts of water at 15° C. (59° F.), in 20 parts of hot water, and in 7 parts of alcohol. It contains 84.38 per cent. of quinine and 15.62 per cent. of acetic acid. When crystallized from a solution containing excess of acetic acid the neutral quinine acetate $C_{20}H_{24}N_2O_2.2(HC_2H_3O_2).3H_2O$ is obtained, which contains 65.06 per cent. of quinine.

Quininæ Arsenas. *Quinine arsenate.* $2(C_{20}H_{24}N_2O_2).H_3AsO_4 + 8H_2O$.—This salt is obtained by precipitating a solution of 10 parts of quinine hydrochloride, dissolved in 200 parts of warm water, with a solution of 3.9 parts of sodium arsenate dissolved in 100 parts of water. The precipitate is washed with cold water and recrystallized from hot water. It occurs as long white prisms, difficultly soluble in cold water, readily soluble in hot water. It contains 69.39 per cent. of quinine and 12.30 per cent. of arsenic acid. It is given in the dose of from 1 to 3 grains (0.06–0.20 Gm.).

Quininæ Arsenis. *Quinine arsenite.* $3(C_{20}H_{24}N_2O_2).H_3AsO_3 + 4H_2O$.—The salt is prepared by boiling 5 parts of silver arsenite and 11.3 parts of quinine hydrochloride with 100 parts of 70 per cent. alcohol, under a reflux condenser, until the transposition is complete, filtering, and crystallizing the salt from the clear filtrate. Silky white needles, sparingly soluble in cold water, soluble in about 150 parts of boiling water, in 15 parts of cold and 6 parts of boiling alcohol, in 8 parts of chloroform, in 25 parts of ether, and in 20 parts of benzene. The salt contains 83.08 per cent. of quinine and 8.45 per cent. of arsenous acid.

Quininæ Benzoas. *Quinine benzoate.* $C_{20}H_{24}N_2O_2.C_7H_6O_2$.—This salt is obtained by dissolving 3 parts of benzoic acid and 8 parts of quinine (anhydrous) in hot alcohol and crystallizing. It forms small prisms containing 72.65 per cent. of quinine and 27.35 per cent. of benzoic acid. It requires 373 parts of water at 10° C. (50° F.) for solution.

Quininæ Boras. *Quinine borate.* $C_{20}H_{24}N_2O_2.BO_3H_3$.—It is prepared by evaporating a mixture of 10 parts of anhydrous quinine and 1.91 parts of boric acid with 20 parts of water and pulverizing the dry residue. It contains 83.95 per cent. of quinine and 16.05 per cent. of boric acid.

Quininæ Bromas. *Quinine bromate.* $C_{20}H_{24}N_2O_2.HBrO_3$.—It is prepared by C. A. Cameron (1882) either by neutralizing quinine with bromic acid or by precipitating barium bromate with quinine sulphate. It forms asbestos-like masses consisting of long needles, dissolves in 250 parts of cold water, freely in warm water, in diluted acids, and in alcohol; it is not decomposed at a moderate heat, but detonates in contact with strong sulphuric acid.

Quininæ Camphoras. *Quinine camphorate.* $2(C_{20}H_{24}N_2O_2).C_{10}H_{16}O_4$.—The salt is obtained by evaporating and crystallizing an alcoholic solution of 10 parts of camphoric acid and 32.4 parts of anhydrous quinine. A white powder, insoluble in water, but soluble in alcohol. It contains 76.41 per cent. of quinine.

Quininæ Carbolas. *Quinine carbolate, Quinine phenate.* $C_{20}H_{24}N_2O_2.C_6H_6O$.—The salt is obtained by dissolving 34.4 parts of quinine (anhydrous) in 100 parts of alcohol and adding 10 parts of crystallized carbolic acid and crystallizing. Delicate white needle-shaped crystals, soluble in 400 parts of water, in 80 parts of alcohol, and contain 77.52 per cent. of quinine.

Quininæ Carbonas. *Quinine carbonate.* $C_{20}H_{24}N_2O_2.H_2CO_3 + H_2O$.—Freshly precipitated quinine is suspended in water and a current of washed carbonic acid gas passed through the mixture until all the quinine is dissolved, and the solution allowed to evaporate and crystallize. Fine needle-shaped crystals, soluble in water and alcohol, and effervesce with acids. It is apt to decompose on keeping. The salt contains 80.2 per cent. of quinine.

Quininæ Chloras. *Quinine chlorate.* $C_{20}H_{24}N_2O_2.HClO_3 + 1\frac{3}{4}H_2O$.—This salt is prepared by allowing molecular quantities of quinine sulphate and barium chlorate to react upon each other in hot aqueous solution and crystallizing the filtered liquid. White crystalline needles or tufts, sparingly soluble in cold water, soluble in hot water, and emit chlorine on addition of hydrochloric acid. It contains 73.66 per cent. of quinine.

Quininæ Chlorhydrophosphas. *Quinine chlorhydrophosphate.* $C_{20}H_{24}N_2O_2.HCl\text{-}2[H_3PO_4] + 3H_2O$.—This salt is obtained in a crystalline form by dissolving 35 parts of quinine hydrochloride in a mixture of 70 parts of phosphoric acid (25 per cent.) and 9 parts of hydrochloric acid (12.5 per cent.) and allowing the salt to crystallize upon spontaneous evaporation of the liquid. The crystals are soluble in 2 parts of water, have an acid reaction, and contain 53.08 per cent. of quinine, 5.96 per cent. of hydrochloric acid, 32.1 per cent. of phosphoric acid, and 8.84 per cent. of water.

Quininæ Chlorhydrosulphas. *Quinine chlorhydrosulphate.* $[C_{20}H_{24}N_2O_2]_2H_2SO_4\text{-}2HCl + 3H_2O$.—This salt is prepared by dissolving 10 parts of quinine sulphate in 3.3 parts of hydrochloric acid (25 per cent.) and letting the solution crystallize by spontaneous evaporation of the liquid. Colorless crystals, soluble in 1 part of water, and giving reactions for chloride and sulphate with test reagents. It contains 74.24 per cent. of quinine, 11.22 per cent. of sulphuric acid, and 8.54 per cent. of hydrochloric acid.

Quininæ Chromas. *Quinine chromate.* $C_{20}H_{24}N_2O_2.H_2CrO_4 + 2H_2O$.—The salt may be prepared by dissolving 4 parts of quinine hydrochloride in 100 parts of warm water and precipitating it with a solution of 1 part of neutral potassium chromate dissolved in 15 parts of water. The precipitate is washed free from chloride and recrystallized from hot dilute alcohol. Yellow crystalline needles, soluble in 2433 parts of water at 12° C. (53.6° F.), in 2000 parts at 16° C. (60.8° F.), and 160 parts of boiling water.

Quininæ Citras. *Quinine citrate.* $(C_{20}H_{24}N_2O_2)_2.C_6H_8O_7 + 7H_2O$.—The salt may be prepared by adding 3.086 parts of quinine (anhydrous) to a boiling solution of 1 part of crystallized citric acid in 100 parts of water and heating, a clear solution is obtained, which is then filtered and allowed to cool and crystallize. Quinine citrate occurs as white crystalline needles, which are soluble in 900 parts of cold water, in 30 parts of boiling water, in 3 parts of boiling alcohol, and 45 of cold alcohol. Quinine citrate contains 67.08 per cent. of quinine.

Quininæ Ferrocyanidum. *Quinine ferrocyanide.* $C_{20}H_{24}N_2O_2.Fe(CN)_6H_4 + 2H_2O$.—This salt may be prepared by mixing alcoholic solutions of 10 parts of quinine (anhydrous) and 6.66 parts of hydroferrocyanic acid and allowing the salt to crystallize. It occurs as yellow crystalline needles, having a bitter taste. The salt is difficultly soluble in water, but readily soluble in hot alcohol. It contains 56.25 per cent. of quinine.

Quininæ Glycerophosphas. *Quinine glycerophosphate.* $[C_{20}H_{24}N_2O_2]_2PO_4H_2(C_3H_5O_2) + 4H_2O$.—This salt may be obtained by neutralizing quinine with the necessary equivalent of glycerophosphoric acid and crystallizing the product. It may also be prepared by adding a solution of 34.8 parts of quinine hydrochloride in 1000 parts of water to a solution of 10 parts of calcium glycerophosphate. The precipitate is washed and crystallized. Odorless white crystalline needles, having a bitter taste, and are soluble in about 200 parts of boiling water, in 100 parts of cold water, and readily soluble in hot alcohol and glycerin. The crystals melt at 154° C. (309.2° F.), and contain 72.36 per cent. of quinine. For other

QUININE GLYCEROPHOSPHATES, see Proc. A. P. A. 46, p. 1056. This salt is used as a tonic in nervous exhaustion in the dose of from 2 to 5 grains (0.12–0.30 Gm.).

Quininæ Hydriodidum. *Quinine hydriodide.* $C_{20}H_{24}N_2O_2.HI$.—This salt may be prepared by precipitating a solution of 10 parts of quinine hydrochloride in 250 parts of hot water with a solution of 6 parts of potassium iodide in 15 parts of water, washing the precipitate, and drying it at a gentle heat in a dark place. The salt is difficultly soluble in cold water, but soluble in hot water, alcohol, and ether. It contains 71.71 per cent. of quinine.

Quininæ Hydriodidum Acidum. *Acid quinine hydriodide.* $C_{20}H_{24}N_2O_2(HI)_2.5H_2O$.—This salt crystallizes from a warm acidulated solution of quinine on the addition of potassium iodide. It forms glossy transparent prisms or scales, becomes opaque at 30° C. (86° F.), melts at 100° C. (212° F.) in its water of crystallization, and becomes completely anhydrous at 120° C. (248° F.); when exposed to a damp atmosphere the anhydrous salt combines again with $2H_2O$ (Hesse, 1865).

Quininæ Hypophosphis. *Quinine hypophosphite.* $C_{20}H_{24}N_2O_2.H_3PO_2$.—This salt may be prepared by mixing a solution of 25 parts of quinine sulphate dissolved in 400 parts of alcohol with a solution of 5 parts of calcium hypophosphite dissolved in 100 parts of water. After standing about 1 hour the solution is filtered, concentrated, and crystallized. Colorless prisms, soluble in alcohol, in 15 parts of boiling water, and in 70 parts of cold water. This salt is more stimulating than the other hypophosphites, and is an ingredient of many compound syrups and solutions of these salts. The dose is from 1 to 5 grains (0.06–0.30 Gm.).

Quininæ Iodas. *Quinine iodate.* $C_{20}H_{24}N_2O_2.HIO_3$.—Quinine iodate, according to C. A. Cameron (1882), is best prepared by digesting freshly precipitated quinine in a molecule of iodic acid previously dissolved in 10 parts of warm water; the soft mass should be evaporated at 15.5° C. (60° F.) and dried over sulphuric acid. The salt is in minute white pearly needles, is readily soluble in alcohol, soluble in 700 parts of cold water, and is not decomposed by boiling water. It contains 62.82 per cent. of quinine.

Quininæ Lactas. *Quinine lactate.* $C_{20}H_{24}N_2O_2.C_3H_6O_3$.—This salt is prepared by neutralizing quinine with the necessary equivalent of lactic acid in hot aqueous solution, and evaporated at a temperature not exceeding 60° C. (140° F.) and crystallized. Colorless prismatic needles, soluble in 3 parts of cold water, in about 1 part of boiling water, readily soluble in ether. It contains 78.26 per cent. of quinine.

Quininæ Phenylsulphonas. *Quinine phenolsulphonate, Quinine sulphocarbolate.* $C_{20}H_{24}N_2O_2.(C_6H_4[OH]SO_3H)$.—This salt may be prepared by adding a hot solution of 10 parts of quinine sulphate dissolved in 500 parts of water to a boiling solution of 6 parts of barium phenolsulphonate dissolved in 75 parts of water. The resulting precipitate is washed and dried. It is a yellowish-white resinous mass, melting on the application of heat, is difficultly soluble in water, but soluble in alcohol. It contains 65.06 per cent. of quinine.

Quininæ Phosphas. *Quinine phosphate.* $(C_{20}H_{24}N_2O_2)_2.H_3PO_4.8H_2O$.—Quinine phosphate may be prepared by dissolving quinine in warm dilute phosphoric acid or by decomposing quinine hydrochlorate with sodium phosphate. It crystallizes from hot water in long silky needles, which require at 10° C. (50° F.) 784 parts of water for solution, and contain 72.81 per cent. of quinine.

Quininæ Sulphovinas. *Quinine sulphovinate.* $C_{20}H_{24}N_2O_2.SH(C_2H_5)O_4$.—Carles (1878) prepares the neutral salt by dissolving 16.6 parts of sodium sulphovinate and 42.8 parts of quinine sulphate, the former in 200, the latter in 600, parts of alcohol, mixing the solutions, filtering from the precipitated sodium sulphate, and evaporating. It crystallizes with difficulty in prisms, dissolves in 3 parts of water at 15° C. (59° F.), in a less amount of alcohol, and dissolves likewise in acetic ether and glycerin, but not in strong ether or benzene. It contains 71.99 per cent. of quinine.

QUININÆ BISULPHAS, *U. S.*—Quinine Bisulphate.

Sulfate de quinine neutre, Fr. Cod.; *Chininum bisulfuricum, Quininæ sulphas acidus.*—*Acid quinine sulphate,* E.; *Sulfate acide de quinine,* Fr.; *Saures Chininsulfat, Chininbisulfat,* G.

Formula, $C_{20}H_{24}N_2O_2H_2SO_4 + 7H_2O$. Molecular weight, 544.33.

Quinine bisulphate should be kept in well-stoppered bottles in a dark place.—U. S.

Preparation.—Mix 100 grains of ordinary quinine sulphate with about 500 grains (9 fluidrachms) of warm distilled water; add to the mixture 115 grains of official diluted sulphuric acid; filter if necessary, and set aside in a moderately warm place to crystallize; dry the crystals over sulphuric acid at a temperature of 10° or 15° C. (50° or 59° F.), and preserve them in a well-stoppered bottle in a cool and dark place. The yield is 125 grains.

A solution of the salt may be prepared extemporaneously by dissolving 8 grains of

quinine sulphate in water with the aid of 9 minims (or 9½ grains) of diluted sulphuric acid; the solution will contain 10 grains of acid quinine sulphate.

Properties.—Quininæ bisulphate occurs as colorless, transparent or whitish, orthorhombic crystals or small needles, odorless, and having a very bitter taste. It effloresces on exposure to the air, and turns yellow on exposure to the light. Soluble in 8.5 parts of water, 18 parts of alcohol, 1770 parts of ether, 920 parts of chloroform, and in 18 parts of glycerin at 25° C. (77° F.); soluble in 0.68 part of water at 80° C. (176° F.), and in 0.5 part of alcohol at 60° C. (140° F.). When heated, the salt softens at 60° C. (140° F.), becomes semi-fluid at 70° C. (158° F.), and melts at about 160° C. (320° F.), with decomposition. It loses all of its water of crystallization at 100° C. (212° F.). On ignition, the salt is slowly consumed, leaving no residue. Its aqueous solution has a strongly acid reaction and shows a blue efflorescence.

Barium chloride test-solution produces a white precipitate, insoluble in hydrochloric acid. If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the remainder, cooled in a desiccator, should weigh not less than 0.77 Gm. (corresponding to 7 molecules or 23 per cent. of water of crystallization). If to 1 Cc. of an aqueous solution of quinine bisulphate (1 in 100) should be added 2 Cc. of bromine test-solution, and then 1 Cc. of ammonia-water, the liquid should acquire an emerald-green color (thalleioquin).—U. S. The salt fuses in a glass tube at 80° C. (176° F.), but heated in the air it melts near 135° C. (275° F.), and is converted into acid quinicine sulphate, which is easily soluble in alcohol and water, its solution in dilute sulphuric acid being yellow without blue fluorescence, and crystallizes in long yellow prisms. Quinine bisulphate contains 59.12 per cent. of quinine.

The pharmacopœial salt should not be confounded with the true *quinine bisulphate*, $C_{20}H_{24}N_2O_2(H_2SO_4)_2 + 7H_2O$, which is obtained from 100 grains of quinine sulphate and 350 grains of diluted sulphuric acid, the solution being crystallized over sulphuric acid. It contains 19.5 per cent. of water, readily acquires a brown-red color on exposure to light, is easily soluble in water with a strong blue fluorescence, and separates from boiling alcohol on cooling as a gelatinous mass, which on drying forms minute prisms.

Tests.—Sulphuric acid should produce not more than a faintly yellow tint (limit of carbonizable organic impurities). Dissolve 2 Gm. of quinine bisulphate, which has been dried at 50° C. (122° F.) for 2 hours, in 20 Cc. of distilled water, carefully neutralize with diluted sodium hydroxide test-solution, and evaporate the solution to dryness on a water-bath. Complete the test by following the directions given on page 1296, under QUININÆ SULPHAS (Test for Other Cinchona Alkaloids, Section II.).—U. S.

Action and Uses.—On account of its greater solubility this salt is to be preferred to the sulphate. It contains 15 per cent. less quinine than the sulphate, and the dose is correspondingly larger. Dose, as a tonic, 1 to 3 grains (0.06–0.20 Gm.); as an antiperiodic, 5 to 30 grains (0.30–2 Gm.).

QUININÆ HYDROBROMIDUM, *U. S.*—Quinine Hydrobromide.

Bromhydrate de quinine basique, Fr. Cod.; *Chininum hydrobromicum.—Bromhydrate de quinine*, Fr.; *Chininhydrobromid, Bromwasserstoffsaures Chinin*, G.

Formula, $C_{20}H_{24}N_2O_2HBr + H_2O$. Molecular weight, 420.06.

The hydrobromide of the alkaloid quinine. It should be kept in well-stoppered, amber-colored vials.—U. S.

Preparation.—This salt is prepared by double decomposition of quinine sulphate with barium bromide. A mixture of 100 grains of quinine sulphate and 1400 grains (3 fluidounces) of water is heated to boiling, and gradually mixed with a solution of 34 grains of barium bromide in 225 grains (½ fluidounce) of water; the precipitate is allowed to settle, and the clear hot liquid is tested for barium salt with a cold solution of quinine sulphate prepared without the aid of additional acid, and if free from barium is filtered and evaporated to crystallize. The yield is about 100 grains. Owing to the insolubility of barium chloride and the ready solubility of barium bromide in absolute alcohol, Boille (1874) recommends dissolving both the barium and the quinine salts in strong alcohol; the solutions are then mixed, taking care that the quinine sulphate is in slight excess; after filtering, water is added, the alcohol distilled off, the liquid cooled, filtered from any quinine sulphate which may crystallize out, and evaporated to crystallize. If the salt be not quite white, it should be recrystallized from water.

The salt may also be prepared by dissolving quinine in warm diluted hydrobromic acid until the acid reaction has completely disappeared. Or, according to Hager, 100 parts of quinine sulphate and 27.5 parts of potassium bromide are well triturated with 100 parts of water; the mixture is moderately heated, mixed with 400 parts of alcohol, the whole digested for an hour, filtered while warm from the precipitated potassium sulphate, and crystallized. Leger's process (1880) is similar to this.

Properties.—Quinine hydrobromide occurs as white, light, silky needles; odorless, and having a very bitter taste. The salt effloresces on exposure to the air. Soluble in 40 parts of water, 0.67 part of alcohol, 16 parts of ether, 8 parts of glycerin, and very soluble in chloroform at 25° C. (77° F.); soluble in 3 parts of water at 80° C. (176° F.). When heated to 100° C. (212° F.) the salt loses its water of crystallization. At 152° C. (305.6° F.) it begins to fuse, forming a syrupy liquid at 200° C. (392° F.). On ignition it is slowly consumed, leaving no residue. Its solutions are neutral or slightly alkaline to litmus-paper, and when acidulated with diluted sulphuric acid show a vivid blue fluorescence. Ammonia-water added to an aqueous solution of the salt produces a white precipitate, which is soluble in a large excess of the reagent. On precipitating a saturated aqueous solution of the salt with sodium hydroxide test-solution, filtering, supersaturating the filtrate with acetic acid, adding chloroform and a little chlorine-water, and shaking, the chloroform will separate with a yellow color. If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue should weigh not less than 0.957 Gm. (corresponding to 1 molecule, or 4.25 per cent. of water of crystallization). If to 1 Cc. of a solution of quinine hydrobromide (1 in 100) 2 Cc. of bromine test-solution be added, and then 1 Cc. of ammonia-water, an emerald-green color should be produced (thalleioquin).—U. S.

Tests.—Quinine hydrobromide should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of readily carbonizable organic impurities) nor produce a red color with nitric acid (difference from morphine). Aqueous solutions of the salt should not be rendered more than faintly turbid by barium chloride test-solution (limit of sulphate). If to 5 Cc. of a saturated aqueous solution of potassium ferricyanide 25 Cc. of water, 15 drops of ferric chloride test-solution, and 5 Cc. of diluted hydrochloric acid be added, a clear brown solution should result. On adding to this 0.1 Gm. of quinine hydrobromide, shaking well, and allowing it to stand for 5 minutes, no blue color should be developed (difference from morphine). Dissolve 3 Gm. of quinine hydrobromide, which has been dried at 50° C. (122° F.) for 2 hours, in 30 Cc. of hot distilled water in an evaporating dish, and add 1.5 Gm. of crystallized sodium sulphate gradually, with constant stirring, and evaporate the liquid on a water-bath to dryness. Complete the test by following the directions given on page 1296, under QUININÆ SULPHAS (Test for Other Cinchona Alkaloids, Section II.), using 30 Cc. of distilled water for maceration instead of 20 Cc. as there directed.—U. S.

Action and Uses.—This salt possesses no advantages over the bisulphate or hydrochloride. Unless given in very large dose the bromide radical exerts no influence. It is less soluble than the bisulphate, and consequently not so well suited for hypodermatic administration. The dose is the same as that of QUININE SULPHATE.

Allied Salt. QUININÆ HYDROBROMIDUM ACIDUM. *Acid quinine hydrobromide.* $C_{20}H_{24}N_2O_2(HBr)_2 + 3H_2O$.—Quinine sulphate is dissolved in water with the aid of sufficient dilute sulphuric acid, completely precipitated with a solution of barium bromide, avoiding an excess of the latter, the solution filtered from the barium sulphate, and evaporated to crystallize. This salt is soluble in 6 parts of water and is freely soluble in alcohol. It contains 60.02 per cent. quinine and 29.97 per cent. hydrobromic acid.

QUININÆ HYDROCHLORIDUM, *U. S., Br.*—Quinine Hydrochloride.

Chininum hydrochloricum, P. G.; *Chlorhydrate de quinine basique*, Fr. Cod.; *Muriate of quinine*, E.; *Chlorhydrate de quinine*, Fr.; *Chininhydrochlorid, Salzsaures Chinin*, G.

Formula, $C_{20}H_{24}N_2O_2HCl + 2H_2O$. Molecular weight, 393.76.

The hydrochloride of the alkaloid quinine. It should be kept in well-stoppered, amber-colored vials.—U. S.

Preparation.—The salt is perhaps best obtained by dissolving quinine in warm diluted hydrochloric acid until the solution is neutral, and crystallizing. The French Pharmacopœia directs that it be prepared by mutual decomposition as follows: A solu-

tion of 28 Gm. of barium chloride in 200 Gm. of distilled water is added slowly to a boiling solution of 100 Gm. of quinine sulphate in 800 Gm. of distilled water. The precipitated barium sulphate is removed by filtration, washed with boiling water, and the filtrate evaporated and allowed to crystallize in the cold.

Properties.—Quinine hydrochloride occurs as white, silky, glistening needles; odorless, and having a very bitter taste. The salt effloresces when exposed to warm air. Soluble in 18 parts of water, 0.6 part of alcohol, 240 parts of ether, 0.8 part of chloroform, and in 8 parts of glycerin at 25° C. (77° F.); soluble in 0.4 part of water at 80° C. (176° F.). When heated to 120° C. (248° F.) the salt loses its water of crystallization. At about 156° C. (312° F.) it begins to melt, but is not fully melted until the temperature reaches 190° C. (374° F.). On ignition, it is slowly consumed, leaving no residue. Its aqueous solution is neutral or faintly alkaline to red litmus-paper, and is not fluorescent except when greatly diluted, or when diluted sulphuric acid is added to it. Silver nitrate test-solution produces in aqueous solutions of the salt a white precipitate, insoluble in nitric acid. If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue should weigh 0.91 Gm. (corresponding to 2 molecules or 9.1 per cent. of water of crystallization). If to 1 Cc. of a solution of quinine hydrochloride (1 in 100) 2 Cc. of bromine test-solution be added, and then 1 Cc. of ammonia-water, an emerald-green color should be produced (thalleioquin).—U. S.

The British and German pharmacopœias give the solubility of quinine hydrochloride as 1 part in 35 parts of cold water or 3 parts of cold alcohol, whereas the French Codex states that 25 parts of water at 15° C. (59° F.) will dissolve the salt. On being exposed to light quinine hydrochloride gradually acquires a yellowish color, and its solution likewise becomes yellowish or brownish on keeping. It contains 81.73 per cent. of quinine.

Tests.—Sulphuric acid should produce no color (absence of organic impurities). Aqueous solutions of the salt should not be rendered more than faintly turbid by barium chloride test-solution (limit of sulphate). If to 5 Cc. of a saturated solution of potassium ferricyanide 25 Cc. of water, 15 drops of ferric chloride test-solution, and 5 Cc. of diluted hydrochloric acid be added, a clear brown solution should result. On adding to this 0.1 Gm. of quinine hydrochloride, shaking well, and allowing it to stand for 5 minutes, no blue color should be developed (difference from morphine). Dissolve 3 Gm. of quinine hydrochloride, which has been dried at 50° C. (122° F.) for 2 hours, in 30 Cc. of hot distilled water in an evaporating dish, and add 1.5 Gm. of crystallized sodium sulphate gradually with constant stirring, and evaporate the liquid on a water-bath to dryness. Complete the test by following the directions given on page 1296, under QUININÆ SULPHAS (Test for Other Cinchona Alkaloids, Section II.), using 30 Cc. of distilled water for maceration instead of 20 Cc., as there directed.—U. S.

Action and Uses.—Quinine hydrochloride may be used interchangeably with the other quinine salts and in the same doses. It is claimed for it that when administered by hypodermatic injection it is less liable to produce abscesses than the other salts.

QUININÆ HYDROCHLORIDUM ACIDUM, *Br.*—Acid Quinine Hydrochloride.

Chlorhydrate de quinine neutre, Fr.; *Saures Chininhydrochlorid, Saures Chlorwasserstoffsaures Chinin*, G.

Formula, $C_{20}H_{24}N_2O_2.2HCl + 3H_2O$. Molecular weight, 447.82.

The acid hydrochloride of an alkaloid obtained from the bark of various species of cinchona and remijia.—Br.

This salt was introduced into the British Pharmacopœia of 1898 on account of its greater solubility than the ordinary hydrochloride.

Preparation.—Acid quinine hydrochloride is conveniently prepared by adding a solution of 4.45 parts of crystallized barium chloride, dissolved in 50 parts of distilled water, to a solution of 10 parts of quinine bisulphate, dissolved in 50 parts of water. The solutions are thoroughly mixed and, after standing some time, filtered. The filtrate is evaporated at a temperature not exceeding 60° C. (140° F.) and crystallized. The salt may also be prepared from the official hydrochloride by dissolving 10 parts of quinine hydrochloride in 20 parts of distilled water, adding 3.7 parts of 25 per cent. hydrochloric acid, and crystallizing the salt.

Properties.—Acid quinine hydrochloride occurs as a white crystalline powder, soluble in less than its own weight of water, and yielding a somewhat acid liquid. It affords the reactions characteristic of hydrochlorides. It should yield only the slightest characteristic reactions with the tests for sulphates. Each gramme, when dissolved in 20 Cc. of water, should require for its complete neutralization not more than 2.5 Cc. of volumetric test-solution of soda. When converted into quinine sulphate, by dissolving it together with an equal weight of sodium sulphate in 10 times its weight of hot water, exactly neutralizing this liquid with solution of ammonia, and setting it aside at 15.5° C. (60° F.) to cool, it should respond to the characters and tests which are mentioned under QUININÆ SULPHAS. Dried at a temperature of 100° C. (212° F.), it loses not more than 12 per cent. of water.—Br. The salt contains 71.86 per cent. of quinine, 16.16 per cent. of hydrochloric acid, and 11.98 per cent. of water of crystallization.

Action and Uses.—This is a very soluble salt of quinine and is usually employed hypodermatically in the dose of from 1 to 5 grains (0.06–0.30 Gm.).

QUININÆ SALICYLAS, *U. S.*—Quinine Salicylate.

Salicylate de quinine basique, Fr. Cod.—*Salicylate de quinine*, Fr.; *Chininsalicylat, Salicylsaures Chinin*, G.

Formula, $2C_{20}H_{24}N_2O_2.C_7H_6O_3 + H_2O$ or $2C_6H_4(OH)COOH.C_{20}H_{24}N_2O_2 + H_2O$. Molecular weight, 935.54.

The salicylate of the alkaloid quinine. It should be kept in amber-colored, well-stoppered vials.—U. S.

Preparation.—Quinine salicylate is prepared by double decomposition of a quinine salt and a soluble salicylate. Dissolve 10 parts of quinine sulphate in 75 parts of water heated to boiling, and precipitate the hot solution with 3.89 parts of sodium salicylate dissolved in 30 parts of water. Allow the mixture to cool, and wash it with cold distilled water until free from sulphate.

Properties.—Quinine salicylate occurs as colorless needles, permanent in the air, but on keeping readily assuming a pinkish color. Soluble in 77 parts of water, 11 parts of alcohol, 110 parts of ether, 37 parts of chloroform, and in 16 parts of glycerin at 25° C. (77° F.); soluble in 35 parts of water at 80° C. (176° F.) and in 11 parts of alcohol at 60° C. (140° F.). When heated, it begins to melt at 183° C. (361.4° F.), with decomposition, and at 187° C. (368.6° F.) is entirely melted to a red liquid. When ignited it is slowly consumed, without leaving a residue. Its aqueous solution is alkaline to red litmus-paper and has a bitter taste. When heated with diluted sulphuric acid its aqueous solution develops a blue fluorescence. Its aqueous solution, when treated with a drop of ferric chloride test-solution, should give a violet color. Sulphuric acid containing about one-fifth of its volume of solution of formaldehyde gives a pink color. If 10 Cc. of a dilute aqueous solution of quinine salicylate be treated with 3 Cc. of bromine test-solution, and then an excess of ammonia-water, an emerald-green color should be produced (thalleioquin).—U. S. Quinine salicylate contains 68.8 per cent. of quinine, 29.92 per cent. of salicylic acid, and 1.91 per cent. of water. It is crystallizable from alcohol in anhydrous prisms.

Tests.—When heated at 100° C. (212° F.), to constant weight, it should lose not more than 2 per cent. in weight (absence of excessive moisture). Mix 2 Gm. of quinine salicylate with 10 Cc. of distilled water in a separator, add a slight excess of ammonia-water, and shake the liquid with three successive portions of 25, 20, and 10 Cc. of ether, collect the ether solution in a porcelain dish, and evaporate it to dryness on a water-bath, dissolve the residue in alcohol, add just sufficient sulphuric acid to render the liquid neutral, and again evaporate to dryness. Complete the test by following the directions given on page 1296, under QUININÆ SULPHAS (Test for Other Cinchona Alkaloids, Section II.).—U. S.

Action and Uses.—Aside from the employment of this salt as an antiperiodic it is used to relieve the pains of chronic rheumatism and gout. The dose as an antirheumatic is from 2 to 10 grains (0.12-0.60 Gm.).

QUININÆ SULPHAS, *U. S., Br.*—Quinine Sulphate.

Chininum sulfuricum, P. G.; *Sulfate de quinine basique, Sulfate de quinine officinal*, Fr. Cod.—*Quiniæ sulphas, Sulphate of quinia*, E.; *Sulfate de quinine*, Fr.; *Chininsulfat, Schwefelsaures Chinin*, G.

Formula, $(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 7H_2O$. Molecular weight, 866.15.

The sulphate of the alkaloid quinine. It should be kept in well-stoppered bottles, preferably of an amber color, and in a dark place.—U. S. The sulphate of an alkaloid obtained from the bark of various species of cinchona and remijia.—Br.

Preparation.—Formerly the alkaloids of cinchona bark, which are in combination with quinic, quinovic, and cinchotannic acids, were extracted by treating the ground bark with diluted hydrochloric or sulphuric acid, and then precipitated from the resulting solutions by means of alkalies. Commercially quinine is now commonly obtained by mixing the finely ground bark with milk of lime, whereby the alkaloids are liberated in a condition comparatively free from coloring-matter and other undesirable by-products. The resulting mixture is then treated with hydrocarbon oils from petroleum, which have the power to dissolve the free alkaloids. The latter solution is removed and thoroughly agitated with diluted sulphuric acid, which takes up all the alkaloids in the form of sulphates. By neutralizing the acid aqueous solution with sodium carbonate and crystallizing, an impure quinine sulphate is obtained containing much cinchonidine and hydroquinine, from which it is freed, after solution in hot water and treating with animal charcoal, by recrystallization and conversion into bisulphate and again crystallizing. The bisulphate is dissolved and carefully neutralized with sodium carbonate, when upon cooling of the solution quinine sulphate crystallizes out. Various modifications of the processes above outlined are no doubt used by manufacturers, and the exact methods employed for obtaining quinine sulphate of the purity demanded by the pharmacopœias are carefully guarded as secrets.

The World's Production of Quinine Sulphate.—According to a report by the director of plantations of cinchona for British India, the Madras Government in 1902 manufactured 15,711 pounds of quinine and Bengal 11,297 pounds, a total production for India of 27,008 pounds. The island of Java produced and exported 43,750 pounds.

The different countries producing the bark exported in 1902 the following quantities: Java, 14,726,000 pounds; India, 1,020,000 pounds; Ceylon, 407,000 pounds; South America, 775,000 pounds; Africa, 178,872 pounds; a total of 17,106,872 pounds.

There are 20 establishments in the world manufacturing quinine, distributed as follows: 5 in France, 3 in England, 2 in Germany, 2 in Italy, 1 in Holland, 4 in America, 1 in Java, 1 in Bengal, and 1 in the Madras Presidency.—*R. M. Bartleman, Consul, Cadiz, Spain, June 13, 1904.*

Properties.—Quinine sulphate occurs as white, silky, flexible, glistening crystals, or hard, prismatic, monoclinic needles, making a very light and easily compressible mass, odorless, and having a persistent, very bitter taste. It effloresces rapidly when it is exposed to dry air and then becomes lustreless; when exposed to light it acquires a brownish tint. Quinine sulphate sometimes crystallizes with 8 molecules of water of crystallization (16.18 per cent.). Soluble in 720 parts of water, 86 parts of alcohol, 400 parts of chloroform, and in 36 parts of glycerin at 25° C. (77° F.); very difficultly soluble in ether; soluble in 45 parts of water at 80° C. (176° F.), and in 9 parts of alcohol at 60° C. (140° F.). Diluted acids increase its solubility in water, and it is easily soluble in a mixture of chloroform 2 parts and absolute alcohol 1 part. Quinine sulphate which has been dried over sulphuric acid melts at 205° C. (401° F.). When heated to 60° C. (140° F.) or when exposed to dry air it loses all but 2 molecules of its water of crystallization, and upon heating it to 115° C. (239° F.) the remainder is expelled. Upon ignition the salt is slowly consumed, without leaving a residue. Its aqueous solution is neutral to litmus-paper, and when acidulated with diluted sulphuric acid develops a vivid blue fluorescence. Barium chloride test-solution produces a white precipitate, insoluble in hydrochloric acid. On treating 10 Cc. of an aqueous solution (about 1 in 1300) of the salt with 5 drops of bromine test-solution, then with an excess of ammonia water, the liquid should acquire an emerald-green color (thalleioquin). With proper adjustment of the reagents more diluted solutions will give a paler

tint, while more concentrated ones will acquire a deeper color or throw down a green precipitate.

Tests.—1 Gm. of the salt should dissolve completely when heated to 50° C. (122° F.) in 7 Cc. of a mixture of 2 volumes of chloroform and 1 volume of absolute alcohol, and should remain clear on cooling (absence of ammonium sulphate and inorganic salts). Sulphuric acid should impart to the salt not more than a faintly yellowish tint (limit of readily carbonizable organic impurities). Nitric acid should not produce a red color (difference from morphine). If 1 Gm. of the salt be dried at a temperature of 115° C. (239° F.) until it ceases to lose weight, the residue should weigh not less than 0.838 Gm. (indicating not more than 8 molecules, or 16.18 per cent of water).

Test for Other Cinchona Alkaloids.—I. Dry 2 Gm. of quinine sulphate in a porcelain dish on a water-bath for 2 hours at 50° C. (122° F.). II. Transfer the residue (which should be strictly neutral to test-paper) to a dry test-tube, add 20 Cc. of distilled water, and place the test-tube in a water-bath; heat it for ½ hour at 65° C. (149° F.), and then allow it to cool, keeping the temperature at 15° C. (59° F.) for 2 hours, shaking the test-tube occasionally. Filter the liquid, transfer 5 Cc. of the filtrate, having the temperature of 15° C. (59° F.), to a dry test-tube, and carefully add ammonia-water (which must be of official strength and have the temperature of exactly 15° C.—59° F.) until the precipitate which forms has just redissolved; not more than 6 Cc. of ammonia-water should be required to produce a clear solution. If the temperature at the end of the digestion has risen to 16° C. (60.8° F.), then 6.5 Cc. of ammonia-water should be required; if to 17° C. (62.6 F.), 7 Cc. of ammonia-water should be used. (In each case a clear solution indicates the absence of excessive amounts of other cinchona alkaloids).—U. S. This test is known as Kerner's test, and is likewise given in the German Pharmacopœia, where, however, the demand is somewhat more rigid, as not more than 4 Cc. of ammonia-water are allowed to produce a clear solution at 15° C. (59° F.). Schaefer's oxalate test is more delicate than the preceding, and will detect as little as 2 per cent. of foreign alkaloids (hydroquinine and cinchonidine). 1 Gm. of quinine sulphate is placed in a tared flask and dissolved in 35 Cc. of boiling distilled water. 0.3 Gm. of crystallized neutral potassium oxalate dissolved in 5 Cc. of water are then added, and distilled water added thereto until the contents of the flask weigh 41.3 Gm. The flask is then placed in a water-bath at 20° C. (68° F.) for ½ hour, and shaken occasionally, after which the solution is filtered through glass wool. To 10 Cc. of the filtrate add a drop of solution of sodium hydroxide. No turbidity should result in the course of a few minutes.

The British Pharmacopœia gives the following tests for the absence of other cinchona alkaloids:

Test for Cinchonidine and Cinchonine.—"Dissolve 4 Gm. of the quinine sulphate in 120 Cc. of boiling water. Cool the solution slowly to 50° C. (122° F.), with frequent stirring. Separate, by filtration, the purified quinine sulphate which has crystallized out. Concentrate the filtrate by evaporation until it is reduced to 10 Cc. or less; transfer to a small stoppered flask, and, when cold, shake with 10 Cc. of ether and half that amount of solution of ammonia. Set aside in a cool place for not less than 24 hours. Collect the crystals, which consist of cinchonidine and cinchonine, with quinine, on a tared filter, wash with a little ether, dry at 100° C. (212° F.), and weigh. These should not amount to more than 0.120 Gm."—Br.

Test for Quinidine.—"Dissolve 1 Gm. of the quinine sulphate in 30 Cc. of boiling water; cool, and filter. To the solution add solution of potassium iodide and a little alcohol (90 per cent.) to prevent the precipitation of amorphous hydriodides. Collect any separated quinidine hydriodide, wash with a little water, dry, and weigh. The weight represents about an equal weight of crystallized quinidine sulphate. None or only the slightest traces should be obtained."—Br.

Test for Cupreine.—"Shake the recrystallized quinine sulphate obtained in testing the original quinine sulphate for cinchonidine and cinchonine with 25 Cc. of ether and 6 Cc. of solution of ammonia, and to this ethereal solution, separated, add the ethereal liquid and washings also obtained in testing the original sulphate for the two alkaloids just mentioned. Shake this ethereal liquid with 6 Cc. of a 10 per cent. solution of sodium hydroxide, adding water if any solid matter should separate. Remove the ethereal solution. Wash the aqueous solution with more ether and remove the ethereal washings. Add diluted sulphuric acid to the aqueous liquid heated to boiling until exactly natural.

When cold collect any crystallized sulphate of cupreine on a tared filter; dry, and weigh. None or only the slightest traces should be obtained."—Br.

Test for Cinchonine and Amorphous Alkaloids.—"Dissolve 1 Gm. of the quinine sulphate in 30 Cc. of boiling water, add 1 Gm. of sodium potassium tartrate. Allow to cool with frequent stirring; filter. The solution when evaporated to small bulk should give little or no precipitate with solution of ammonia."—Br.

Action and Uses.—For the action and uses of this salt, see the article on QUININE.

QUININÆ TANNAS.—Quinine Tannate.

Tannate de quinine, Fr. Cod.; *Chininum tannicum*, P. G.—*Chinintannat, Gerbsaures Chinin*, G.

Formula, $C_{20}H_{24}N_2O_2.3C_{14}H_{10}O_9 + 8H_2O$ or $C_{20}H_{24}N_2O_2.2C_{14}H_{10}O_9 + 4H_2O$. Molecular weight, 1423.84 or 1033.66.

Preparation.—Quinine tannate may be prepared by dissolving 9 Gm. of quinine sulphate in 225 Gm. of water with the aid of 10 Gm. of 16 per cent. sulphuric acid and adding to the solution after filtration, with constant stirring, a solution of 21 Gm. of tannic acid and 3.5 Gm. of sodium bicarbonate in 250 Gm. of water. The precipitate is collected on a filter and washed with small quantities of water until the filtrate after acidulation with nitric acid is no longer rendered turbid by addition of barium chloride solution. It is finally dried at a temperature not exceeding 30° to 35° C. (86°–95° F.) and reduced to powder.

This is the official process of the Swiss Pharmacopœia. De Vrij (1898) proposed to make quinine tannate by triturating 1 part of quinine alkaloid, 4 parts of tannic acid, and 10 parts of water together, and evaporating the mixture to dryness at a temperature not exceeding 60° C. (140° F.). The French Pharmacopœia directs that quinine alkaloid be dissolved in water with the aid of acetic acid to very slight acidity. To this solution a solution of tannic acid is added in sufficient quantity to redissolve the resulting precipitate, and finally the liquid is neutralized with sodium bicarbonate. The final precipitate is filtered off and powdered, and then washed with distilled water, and again dried and powdered.

Properties and Tests.—Quinine tannate is a yellowish-white, amorphous, odorless powder, having a faintly bitter and barely astringent taste. It is soluble in about 800 parts of cold or 50 parts of boiling water; in 60 parts of cold or 6 parts of boiling alcohol; also in 100 parts of cold or 10 parts of hot glycerin. Solutions of quinine tannate are colored blue black by solutions of ferric salts. If 1 Gm. of quinine tannate be mixed with 4 Cc. of water, and the mixture made strongly alkaline with solution of sodium hydroxide and extracted with three successive portions of 7 Cc. of ether, the combined ether extracts, upon evaporation of the ether and drying the residue at 100° C. (212° F.), should weigh not less than 0.3 Gm. and answer to the requirements for the purity of the alkaloid quinine (P. G.). While the German Pharmacopœia demands that the salt shall contain 30 to 32 per cent. of anhydrous quinine, the Swiss Pharmacopœia demands from 30 to 35 per cent. and the French Codex from 20 to 21 per cent.

Action and Uses.—As quinine tannate is quite insoluble it cannot be successfully used when large doses of quinine are indicated, especially in malaria.

Because of its sparing solubility, and consequent but slightly bitter taste, it is administered to children and others who cannot swallow pills or capsules. In these cases it is given in powder, suspended in syrups or mucilages, or combined with powdered chocolate in lozenges called quinine chocolates. The dose is from 2 to 10 grains (0.12–0.60 Gm.).

QUININÆ VALERAS.—Quinine Valerate.

Valérianate de quinine, Fr. Cod.; *Quininæ valerianas*, U. S., 1890; *Chininum valerianicum*; *Quinine valerianate*, E.; *Valérate de quinine*, Fr.; *Chininvalerianat, Baldriansaures Chinin*, G.

Formula, $C_{20}H_{24}N_2O_2.C_5H_{10}O_2$. Molecular weight, 423.13.

Preparation.—The French Pharmacopœia directs that hydrated quinine alkaloid be dissolved in the least possible quantity of alcohol, and valerianic acid then added in small quantities until the solution shows a feeble reaction. The mixture is poured into

twice its volume of water and then allowed to evaporate at a temperature not exceeding 50° C. (122° F.), so as to cause crystals to form.

Properties.—Quinine valerate crystallizes in colorless, pearly, rhomboidal tables or in white triclinic needles having a weak odor of valerianic acid, a bitter, somewhat valerian-like taste, and a neutral reaction. The salt dissolves in 10 parts of cold and 40 parts of boiling water, in 6 parts of cold and 1 part of boiling 80 per cent. alcohol, and is easily soluble in ether (Fr. Cod.). On adding dilute sulphuric acid to the aqueous solution it becomes fluorescent, and the odor of valerianic acid is rendered more apparent. Ammonia gives a white precipitate soluble in an excess of the precipitant and in ether, and with chlorine-water and ammonia an emerald-green color is produced. The salt is permanent in the air; it melts at 90° C. (194° F.), forming a colorless liquid. At 100° C. (212° F.) it loses its water of crystallization and also begins to lose valerianic acid. When strongly heated on platinum foil it is decomposed, and burns slowly without leaving any residue. It contains 76.06 per cent. of quinine.

Tests.—On treating 10 Cc. of an aqueous solution (about 1 in 1300) of the salt with 5 drops of bromine test-solution, and then with an excess of ammonia-water, the liquid will acquire an emerald-green color. With proper adjustment of the reagents, more dilute solutions will show a paler tint, while more concentrated ones will acquire a deeper color or throw down a green precipitate.

The aqueous solution should remain clear or become merely turbid (produce not more than a slight precipitate on the addition of test-solution of barium chloride). The precipitate occasioned by ammonia-water should be readily dissolved on adding an excess of the latter (absence of cinchonine). The salt is tested for fixed impurities by incineration, for ammonia salt by lime or potassa, and for organic impurities, morphine, and other alkaloids, by strong sulphuric and nitric acid, as described under QUININÆ SULPHAS.

Action and Uses.—There seems to be no foundation for the belief that quinine valerate is superior to other quinine salts in migraine, neuralgia, or debility of nervous origin. The dose is from 1 to 5 grains (0.06–0.30 Gm.).

QUINOLINA.—Quinoline.

Chinolina.—Quinoline, Fr.; *Chinolin*, G.

Formula, C_9H_7N. Molecular weight, 128.12.

An artificial volatile alkaloid obtained by the destructive distillation of quinine and cinchonine, or strychnine and brucine, with potassium hydroxide, or synthetically by the action of sulphuric acid upon a mixture of glycerin, nitrobenzene, and aniline.

Preparation.—Runge (1834) separated a basic body, *leucoline*, from coal-tar, and Gerhardt (1842) obtained a pure base, *chinoleine*, by distilling quinine with potassium hydroxide. Both alkaloids were later (Hoogewerff and v. Dorp, 1883) shown to be identical with purified *quinoline*, obtained by Williams (1855). It is now prepared mostly by the method of Skraup: 24 parts of nitrobenzene, 38 parts of aniline, 120 parts of glycerin, and 100 parts of concentrated sulphuric acid are mixed, and only gently heated for some time to prevent a too violent reaction. It is then heated under a reflux condenser for several hours, and after completion of the reaction, the mixture is diluted with water and the nitrobenzene removed by distillation. Lime or sodium hydroxide is then added in excess, and the quinoline distilled in a current of steam. The distillate is purified by fractionation and the quinoline precipitated as an acid sulphate from its alcoholic solution by the addition of sulphuric acid. In this method glycerin is converted into acrolein by the sulphuric acid, and this combines with the aniline under the oxidizing influence of the nitrobenzene, forming quinoline. About 60 per cent. of the theoretical yield is obtained by this method.

Prepared from the cinchona alkaloids, quinoline is apt to contain some of the higher homologues—*lepidine*, $C_9H_6(CH_3)N$, and *despoline*, $C_{11}H_{11}N$, while that obtained from coal-tar may contain a large percentage of *quinaldine*, $C_9H_6(CH_3)N$, boiling at 239° C. (462.2° F.), and the isomer *iridoline*, boiling at 252° to 257° C. (485.6°–494.6° F.). Quinoline is a tertiary amine, and may be looked upon as naphthalene, $C_{10}H_8$, in which an atom of N has displaced one of the group CH. Two isomeric forms are possible.

Properties.—Pure quinoline is a colorless or faintly yellow, mobile, highly refractive liquid, with a peculiar aromatic odor, resembling that of oil of bitter almond, and a

pungent peppermint-like after-taste. Its specific gravity at 15° C. (59° F.) is 1.084 (1.093–1.096, Hager) and its boiling-point 237° C. (458.6° F.). It slowly volatilizes at ordinary temperatures, and, exposed to a freezing mixture of solid carbon dioxide and ether, congeals to a crystalline mass. It is difficultly soluble in hot water, but miscible with ethyl, methyl, and amyl alcohol, ether, benzene, chloroform, carbon bisulphide, fixed and volatile oils, and is a solvent of camphor and some resins. Although quinoline is quite insoluble in water, it is hygroscopic, and if exposed to a damp atmosphere forms a hydrate, $C_9H_7N+1\frac{1}{2}H_2O$, which becomes turbid at 40° C. (104° F.). Exposed to light and air it rapidly turns brown, but may be decolorized by shaking with fixed alkali hydroxide and slow rectification. It possesses strong basic properties and forms odorless crystallizable salts, which develop the quinoline odor on treatment with fixed alkali hydroxide. It is readily converted into quinoline sulphonic acid by the action of fuming sulphuric acid, and on fusion with potassium hydroxide yields oxyquinoline, C_9H_6NOH. (See KAIRIN.) With zinc and bismuth it forms crystallizable double salts.

Quinoline is precipitated from its aqueous solutions, not too dilute, by fixed alkali hydroxides, and by most of the reagents for alkaloids. Iodine in potassium iodide produces a reddish-brown precipitate (1 to 25,000 parts); phosphomolybdate, a yellowish-white precipitate (1 to 25,000 parts); potassium mercuric iodide, a yellowish-white *amorphous* precipitate (1 to 3500 parts), which, on the addition of hydrochloric acid, is converted into *amber-colored crystals;* picric acid, a yellow precipitate; potassium ferrocyanide, a deep-red solution. It dissolves without color in nitric and sulphuric acid. Heated with sodium, *diquinolyline*, $C_9H_6N.C_9H_6N$, is formed, and when polymerized, yellow needles of *diquinoline*, $(C_9H_7N)_2$, are obtained. By acting on quinoline with amyl iodide, and afterward with soda *cyanine*, a basic coloring-matter, crystallizing in golden-green plates having a metallic lustre and dyeing silk blue, is produced.

Tests.—Quinoline should dissolve clear in dilute hydrochloric acid, or, when shaken with about 50 parts of water and filtered, the filtrate should not give a violet color with chlorinated lime (aniline). It is identified by its odor, and the reactions with potassium ferrocyanide and potassium mercuric iodide.

Action and Uses.—Quinoline is of interest as being probably the first of the coal-tar products to be used as an antipyretic as a substitute for quinine. It was soon discovered, however, that while it produced a marked reduction in temperature in malaria, it exercised no influence upon the cause or duration of the disease. Profound collapse following its administration was not infrequent and its use was soon abandoned. This depression is less marked in some of its derivatives, notably analgen and thermofugin, but even they are more depressing than antipyrine or acetanilide and are rarely employed.

Salts and Derivatives of Quinoline.—QUINOLINÆ HYDROCHLORIDUM.—*Chinolinum Hydrochloricum. Quinoline Hydrochloride*, E.; *Chinolinchlorhydrat, Salzsaures Chinolin*, G. $C_9H_7N.HCl$.—A difficultly crystallizable colorless mass, melting at 94° C. (201.2° F.), sublimable without decomposition, soluble in water, alcohol, and chloroform, and has a sharp pungent taste.

QUINOLINÆ TARTRAS.—*Chinolinum Tartaricum. Quinoline Tartrate*, E.; *Chinolintartrat, Weinsaures Chinolin*, G. $3(C_9H_7N).4(C_4H_6O_6)$.—It is prepared by neutralizing quinoline with a slight excess of tartaric acid and recrystallizing the salt from hot alcohol, and occurs commercially as colorless, shining, needle-shaped crystals, soluble in about 75 parts (150 parts, Allen) of alcohol, 80 parts of cold water, 350 parts of ether, and melting at 125° C. (257° F.). Antipyretic and antiseptic. Dose, 5 to 15 grains (0.30–1 Gm.).

QUINOLINÆ SALICYLAS.—*Chinolinum Salicylicum. Quinoline Salicylate*, E.; *Chinolinsalicylat*, G.—A white crystalline powder, soluble in 80 parts of water, and readily soluble in alcohol, amyl alcohol, ether, chloroform, benzene, fixed and volatile oils, and glycerin. Used as the tartrate and in the same dose.

QUINOLINE SULPHOCYANATE (or RHODANATE).—A colorless to yellowish crystalline powder, difficultly soluble in cold water and ether, but readily soluble in hot water and alcohol, and melting at 137° to 138° C. (278.6°–280° F.).

QUINOLINE BISMUTH SULPHOCYANATE (or RHODANATE).—A coarse-grained reddish-yellow powder, insoluble in water, alcohol, and ether, and melts at 70° C. (158° F.).

ACETO-ORTHO-AMIDO-QUINOLINE, $C_9H_6N(NHCH_3CO)$, is an anologue of acetanilide, and occurs as colorless crystals, melting at 102.5° C. (216.5° F.).

DIAPHTHERIN.—*Oxyquinaseptol.*—Obtained by introducing into oxyquinoline phenolsulphonate a second molecule of oxyquinoline. A yellowish crystalline powder, very soluble in water, difficultly soluble in cold but readily in hot alcohol, and which melts at 85° C. (185° F.). Its aqueous solution is yellowish in color and colored bluish green on the addition

of ferric chloride, lead acetate, and barium chloride. In the aqueous solution, which is yellowish ferric chloride, addition of ferric chloride produces a bluish-green color, and lead acetate and barium chloride, yellow precipitates. Diaphtherin is used as an antiseptic in from $\frac{1}{2}$ to 1 per cent. solutions. It attacks surgical instruments.

DIAPHTHOL.—*Quinaseptol, Chinaseptol, Ortho-oxyquinoline-meta-sulphonic Acid.* $C_9H_5(OH)(SO_3H)N$.—It forms yellowish-colored crystals which are difficultly soluble in cold water, soluble in about 35 parts of hot water, and melt at 295° C. (563° F.). The aqueous solution is yellow colored, gives no precipitate with barium chloride (distinction from diaphtherin), but is precipitated bright yellow by lead acetate, and colored bluish green by ferric chloride. The properties of diaphthol are similar to those of diaphtherin.

KAIRINE.—*Ethyl Kairine, Kairine A, Oxyquinoline-ethyltetrahydride hydrochloride.* $C_9H_{10}(C_2H_5)NO.HCl$.—Kairine occurs as a grayish-white crystalline powder, having a bitter salty taste, and readily soluble in 6 parts of water and in 20 parts of alcohol. Potassium bichromate, added to the aqueous solution, develops a series of colors ranging from violet blue to purple. Ferric chloride similarly causes a violet coloration, rapidly changing to brown and precipitating. Antipyretic. Little used. Dose, 5 to 10 grains (0.30–0.60 Gm.).

KAIROLINE, A AND M.—*Quinoline-ethylhydride* (A) and *Quinoline-methylhydride* (M).—These compounds are respectively the acid sulphates of the ethyl and methyl hydrides of quinoline, and differ from kairine in not containing oxygen.

LORETIN.—*Meta-iodo-ortho-oxyquinoline-ana-sulphonic Acid.* $C_9H_4IN.OH.SO_3H$.—It forms bright yellow, odorless, stable crystals, which are but sparingly soluble in cold or hot water, and insoluble in ether and oils, melt at 270° C. (518° F.), and form neutral soluble salts with sodium, potassium, ammonium, and magnesium, yielding orange-yellow solutions. Loretin is used as a substitute for iodoform in powder, 5 to 10 per cent. ointments, or $\frac{1}{10}$ to $\frac{1}{5}$ per cent. solutions in water.

ANALGEN.—*Ortho-ethoxy-ana-mono-benzoyl-amido-quinoline, Benzanalgene, Quinalgine, Laboridin.* $C_{18}H_{16}N_2O_2$.—It forms colorless, tasteless crystals, which are insoluble in water, soluble in alcohol, and melt at 208° C. (406.4° F.). The name was formerly applied to the acetyl derivative. Analgen is used as an antineuralgic in doses of from 5 to 15 grains (0.30–1 Gm.).

QUINOSOL.—*Chinosolum, Oxy-quinoline-potassium-sulphate.* $C_9H_6N.OSO_3K + H_2O$.—It forms yellow crystals, having an astringent and aromatic taste, are readily soluble in water, give insoluble precipitates with barium chloride, lead acetate, and mercuric chloride, and a bluish-green solution when ferric chloride is added to the aqueous solution.

THALLINE SULPHATE. $2C_9H_{10}N(OCH_3).H_2SO_4 + 2H_2O$.—The base thalline, which is the methyl ether of tetrahydro-paraoxyquinoline, and its salts were discovered by Skraup in 1884, and is prepared from paraquinanisol by treatment with tin and hydrochloric acid. The last-named compound is an oily base, and is obtained by heating to about 145° C. (293° F.) a mixture of paramidoanisol, paranitranisol, glycerin, and sulphuric acid. The base thalline forms thick white prisms, which are freely soluble in alcohol, ether, and benzene, but dissolve sparingly in benzin and water. The sulphate, which has become known by the name of the base, thalline, is formed by dissolving the latter in dilute sulphuric acid and crystallizing or granulating.

Thalline sulphate is usually seen in the form of a white or whitish granular crystalline powder, which is permanent in the air, and has a slight anise-like odor and a nauseous, bitter, saline, and pungent taste, becoming more agreeable and aromatic in dilute solutions. The salt is freely soluble in hot water, sparingly soluble in chloroform and ether, and requires for solution 7 parts of cold water and 100 parts of alcohol, the solutions becoming darker on exposure to light. A solution of the salt in 10,000 parts of water acquires an emerald-green color on the addition of a little ferric chloride or other oxidizing agent, the color being not altered by sulphuric acid, but changed to purplish, reddish, or yellow by reducing agents. The solution of thalline sulphate is colored deep red on being heated with fuming nitric acid; it is not affected by tannic acid or mercuric chloride, but yields a yellow precipitate with picric acid, and alkalies separate from it the base in oily drops, becoming crystalline and having a cumarin-like odor. Thalline sulphate was official in the German Pharmacopœia of 1890, but was dropped at the last revision.

R.

RADIUM.—Radium.

Radium, Fr., G.

Symbol, Ra. Atomic weight, 223.3. Valence, 2.

History.—The metal radium is not known in the free state, but only by its salts, which were discovered in 1898 by Madame Sklodowska Curie, a Polish lady, assisted by her husband, Prof. Pierre Curie, of the École Polytechnique, at Paris. Radium is one of the most interesting and at the same time most puzzling discoveries of science, and it is occupying the attention of the most eminent minds in the field of physics and chemistry. Great discoveries are often the climax of a number of antecedent events, and this is true of radium. A brief account of the discoveries which led to the finding of radium may be interesting. On November 8, 1895, Prof. Wilhelm Konrad Roentgen, of Würzburg, Germany, accidentally discovered a peculiar kind of radiation, which is known as Roentgen or *x*-rays. When electric sparks are passed between the poles of a highly exhausted (Crookes') tube, a faint radiation in straight lines emanates from the cathode, known as cathode rays, and consisting of a stream of ultra-minute negatively charged particles. Where these cathode rays impinge on the walls of the glass tube, a brilliant golden-green fluorescence is produced, and passing out from the walls of the tube is a new kind of rays, the Roentgen, or *x*-rays, invisible to the eye, but made manifest by their effects. They proceed in straight lines, are not easily deflected by a magnet, cause many substances to become luminescent, pass through many objects which are opaque to ordinary light waves, affect photographic plates, produce physiological effects in living tissues, and change insulating media, such as air, paraffin, etc., into a conductor when they pass through them.

According to the now universally accepted theory, *x*-rays are considered to be electromagnetic waves.

It was thought that, inasmuch as Crookes' tubes emitting *x*-rays are fluorescent, bodies possessing the property of fluorescence might also give out *x*-rays. The salts of the metal uranium are noted for their fluorescence after exposure to sunlight, and they were found to affect a sensitive plate through a covering of black paper, which is impervious to ordinary light. On one occasion, in 1896, Prof. Henri Becquerel, the eminent chemist and physicist of Paris, placed some double sulphate of uranium and potassium on a covered photographic plate, but at that moment the weather became stormy, so that he could not expose the uranium salt to sunlight in order to render it fluorescent. The plate with the salt was placed in a drawer and left there for several days. Becquerel had the happy thought of developing the plate to see if anything had occurred in the dark, and, to his surprise, found the plate affected, and this without any fluorescence in the uranium salt. This led to the discovery of the remarkable radiations now known by the name of *Becquerel rays*. Becquerel also observed that uranium metal far surpassed any of its compounds in this property of emitting rays, which, though invisible, have the power of affecting a plate and of passing through opaque substances. Any substance which, like uranium, emits such invisible rays, is now said to be *radio-active*.

Among the workers who were attracted by Becquerel's discovery, the most noted is Madame Curie. She was soon led to suspect that *pitchblende*, or *uraninite*, a very complex mineral which is practically the source of all uranium salts, contained something that was far more radio-active than uranium or its salts. She and her husband commenced a most careful search for it, and discovered a substance associated with bismuth, which it resembled very much chemically, and which was named *Polonium*, in honor of her native land, Poland. In the same year, 1898, they discovered a second substance in pitchblende, associated with barium, which it resembled very closely, and which they called *Radium*. It would be out of place here to give the details of the method of extraction of radium, which is a most tedious operation, and may be found in *Chemical News*, 1903, pp. 134 and 145, which contains a translation of Madam Curie's thesis for the doctorate degree. Some idea of the enormous difficulty involved is learned from the fact that it takes 5000 tons of uranium residues (left after extraction of the uranium compounds) to produce 2.2 pounds of the radium salt, and the cost is $2000 per ton of

residue. One ton of pitchblende yields about 0.1 Gm. of radium salt. Chemically pure radium salt is enormously expensive, and perhaps less than 1 Gm. is in existence. The specimens in the market are more or less impure and of varying degrees of activity. Nearly pure radium salt costs about $6000 a gramme.

Properties.—Radium belongs to the alkaline-earth group of metals. The metal itself has not been isolated because of the scarcity of its compounds and of the fact that it would change rapidly by oxidation. All of its properties are learned through its compounds, which are very similar to those of barium in color, solubility, etc. The most remarkable property of radium is its strong radio-activity, by which it affects photographic plates through various opaque substances, makes gases conductors of electricity, causes fluorescence in various substances, discharges electrified bodies, and causes remarkable changes in living matter. Its radio-activity is 100,000 times stronger than that of uranium, taken as unity. The measuring of the activity is done by delicate electrical devices which are far more sensitive than the spectroscope. Radium salts are self-luminous, and this property increases with the purity. They also emit heat constantly—thus a flask containing 0.7 Gm. of radium bromide had a temperature of 3° C. higher than the surrounding air—the heat evolved is sufficient to melt more than an equal weight of ice every hour. Radium rays reduce silver salts, mercuric chloride, etc., transform white into red phosphorus in 24 hours, color glass, porcelain, paper, rock salt, just as cathode rays do, and cause a sensation of light when brought near the temples, or to the closed eyes. Substances placed near radium salts become themselves radio-active, and this induced activity lasts for some time. When the skin is exposed too long to radium rays, serious burns are produced, not at once, but after a considerable time, which are difficult to heal. Such a burn on the body of Prof. Becquerel required fifty-three days to heal. A few milligrams of a radium salt introduced beneath the skin of a mouse, near the vertebral column, produced death by paralysis in 3 hours. Rabbits and guinea-pigs are killed by exposure to the rays, and Henry Crookes (*Chemical News*, 1903, p. 306) killed bacterial cultures by exposing them to $\frac{1}{6}$ grain (10 Mgm.) of radium bromide through a mica screen at one inch from the plates (B. liquefaciens, B. coli communis, B. prodigiosus, etc.).

Nature of Radium Rays.—The effects produced by radium salts are due to the rays constantly sent forth. Prof. Ernest Rutherford, of Canada, an eminent authority, describes them thus: There are three kinds, α-, β-, and γ-rays. The β-rays have a marked power of penetration and of exciting phosphorescence in a large number of substances, such as barium platinocyanide, zinc sulphide, etc. They are readily deflected by a magnet, and are of the same character as cathode rays, consisting of streams of negatively charged "corpuscles" or "electrons," moving with enormous velocity and having a mass about one-thousandth-part of the hydrogen atom. The γ-rays appear to be a very penetrating kind of Roentgen rays, produced at the moment of sudden expulsion of the β-rays. They can penetrate a foot-thickness of iron. The α-rays have a relatively slight penetrating power, being completely absorbed by a few centimeters of air or a sheet of paper. They are not easily deflected by a magnet, and consist of streams of particles about twice as heavy as the hydrogen atom and positively charged, and moving with great velocity. It is thought that the self-heating of a radium salt is due to the bombardment by the α-rays in the mass of the salt.

The interpretation of these rays is that the radium atoms are very complex systems of smaller charged parts in unstable equilibrium. These complex atoms suffer spontaneous disintegration, which accounts for the material nature of the radiations, and for the fact that radium is constantly manufacturing from itself a radio-active substance or "emanation" quite distinct in properties from the parent element. This emanation possesses all the properties of a gas. It can be conducted away from the radium and condensed by extreme cold. Two other elements, thorium and uranium, both radio-active, also give off an emanation. The emanations finally lose their radio-activity and become transformed into a different substance. In 1903 Ramsay and Soddy found that radium emanations ultimately produced helium gas. This may account for the fact that helium is always found in radio-active substances.

The supposed complex nature of the atoms of the radio-active elements is apparently a blow at the atomic theory of modern chemistry, which holds that the atom of hydrogen is the smallest particle of matter that exists, and that atoms are indivisible. But the two views become reconciled if it is assumed that in the ordinary elements the mass of

particles making up the atom have reached a state of stable equilibrium, which cannot be upset by the chemical forces known at present, so that the complex atom behaves like a single particle—that is, constitutes the atom of the Dalton atomic theory. This explanation makes necessary the further assumption that all "elements" are complex, and leads to the idea of a primary substance or protyle, from which all elements are built up, a theory by no means new to the science of chemistry.

Action and Uses.—In medicine radium is employed chiefly for therapeutic purposes, although it has been employed to a limited extent for diagnostic uses. Up to the present time it has produced the best results when applied in such diseases as lupus, or cutaneous tuberculosis, and for epithelioma of a superficial nature. The sulphide of radium is diluted with chloride of barium. This is placed in a small rubber bag or disc, and this, in turn, is fastened upon the affected part for whatever time the physician thinks it is necessary to produce the results which he is seeking. In other instances the salt of radium is placed in a small cylinder, the end of which is held in close proximity, or directly against, the affected part. One of the difficulties in employing radium in this manner at the present time is that it is exceedingly expensive, and as no two samples are of the same strength, the activity of each is to be tested before it can be freely used, since by this means only can the physician gain a true conception of its power. As a summary of these remarks it may be stated that the therapeutic effects of radium are very closely allied to the effects produced by the *x*-ray in the same diseases. Indeed, in some cases the *x*-rays may be applied under the direct observation of the physician, and the patient may, at intervals, subject the growth to the action of a radium container, since in this way the effects of the ordinary *x*-rays may be increased.

RANUNCULACEÆ.—The Buttercup Family.

The Buttercup family is credited with 27 genera and about 1000 species, growing mostly in cold or temperate regions. Its useful properties pertain mostly to medicine and to ornamentation, it supplying many of the most valued of cultivated flowers—clematis, aconite, larkspur, columbine, peony, hellebore, anemone, buttercup, etc. The drugs of the family can be roughly grouped into 3 divisions: (*a*) bitter and astringent tonics of the HYDRASTIS class, including *Coptis* and *Xanthorrhiza*, considered below; (*b*) those affecting the circulation, like ACONITE, ADONIS, HELLEBORE, and PULSATILLA, separately considered, and *Actæa*, *Pæonia*, *Hepatica*, and *Clematis*, here described; (*c*) local irritants, like STAPHISAGRIA and RANUNCULUS.

Xanthorrhiza or *Yellow-root* (*Shrub yellow-root*) is the rhizome and roots of *Xanthorrhiza apiifolia* L'Her. (*X. simplicissima* Marsh), the only species of the genus, a slender shrub of the Allegheny region, and extending from New York to Texas. It grows in rich woodlands, especially in mountainous districts and along river banks. The stems are clustered, 1 to 2 feet high, smooth, grayish, and annulate from the distant leaf-scars. The leaves are alternate, crowded at the ends of the branches, long-petiolate, pinnate, and have 3 or 5 ovate or lanceolate, cleft and toothed leaflets, with wedge-shaped bases. The yellow flowers are polygamous and in compound drooping racemes, appearing in early spring, and are followed by fruits consisting of several small 1-seeded follicles. The slender, crooked, and much-branched rhizome sometimes exceeds a metre in length and varies from 3 to 20 Mm. ($\frac{1}{8}$–$\frac{4}{5}$ In.) in thickness. It is sparingly beset, especially on the branches, with slender and brittle roots. The surface is longitudinally wrinkled and light yellow brown. Internally, both the thin bark and the rather brittle wood are bright yellow, the latter showing a distinct pith and medullary rays. The fracture is short-fibrous. The odor is slight but characteristic, the taste very bitter and somewhat astringent, resembling that of berberis. *Yellow-root* contains as its active constituents something less than 1 per cent. of at least 2 alkaloids, principally berberine. With these occur several resins, besides starch, gum, and ordinary plant-constituents. Its properties and uses are identical with those of BERBERIS, which see.

Coptis or *Gold-thread* (*Canker-root*, *Mouth-root*, E.; *Gelbe* or *Kleine Niesswurz*, G.; *Coptide*, Fr.) is the rhizome of *Coptis trifolia* (L.) Salisb. (*Helleborus t.*—L.; *H. trilobus* Lam.; *H. pumilus* Salisb.; *Isopyrum t.*—Britt.). The plant is abundant in deep, mossy woods, especially where somewhat damp, throughout Canada and the northeastern United States. It sends up, from elongated, slender, much-branched, often somewhat matted, golden-yellow rhizomes, tufts of long and slenderly petioled, 3-parted, evergreen leaves, the divisions broadly cuneate-obovate, crenately toothed or lobed, the teeth slightly pointed, the upper surface dark green and shining and strongly veined. With these leaves occur, in early summer, slender, 1-flowered scapes about 10 to 15 Cm. (4–6 In.) high. The flower is white, about 1.2 Cm. ($\frac{1}{2}$ In.) broad, and consists of 5 to 7 deciduous sepals, as many small and inconspicuous hollow petals, numerous stamens, and several distinct carpels, becoming beaked follicles in fruit. The drug

should consist only of the filiform, matted, golden-yellow rhizomes with their very small roots, unlike any other article that appears in commerce. Frequently, however, the entire herb is supplied. The odor is slight, the taste similar to that of *Berberis* and *Xanthorrhiza*. Through imperfect cleaning, the drug is apt to contain much earthy matter, producing an undue amount of ash, this not exceeding 5 per cent. in a good article. Gold-thread contains much berberine and a very small amount of a white crystalline alkaloid which has been called *coptine*, but concerning the identity of which nothing is known, except that it dissolves in concentrated sulphuric acid without color, becoming purple on warming. The properties of *Coptis* are those of the berberine-yielding group in general. It is largely used as a masticatory or mouth-wash for canker-sores, and as a gargle in various forms of sore throat.

The genus *Coptis* contains 8 or 10 species, all probably sharing its constituents and properties. In India, *C. Tecta* Wall. is largely used under the names *Chinese gold-thread*, *Mishnee bitter*, in Chinese *Hong-lau*, *Chyn-len*, or *Soulin*. It is specially valued as an application for various eye-inflammations. *C. anemonifolia* Sieb. et Zucc. is a Japanese species, used in China under the name *Oh-ren* and in Turkestan under the name *Mamiran*.

Several species of *Thalictrum* also contain berberine. *T. aquilegüfolium* L. is the Japanese *Arikka*; *T. rubellum* L. is the Chinese *Shing-ma*; *T. revolutum* DC. and *T. Mexicanum* DC. constitute the Mexican drug *Cozticpatli*.

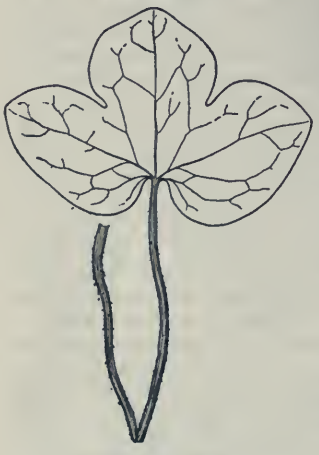
Actæa or *Baneberry* has been referred to in connection with CIMICIFUGA.

Pæonia or *Peony* is usually understood as the root of *Pæonia officinalis* L. (*Piny*, *Sheep-shearing rose*, E.; *Gicht-rose*, *Pfingstrose*, G.; *Pivoine*, Fr.; *Peonia*, Sp.), although most of the 15 species of the genus have been employed. This is the well-known red peony of the gardens, native of southern Europe. The roots are fleshy and starchy, irregularly fusiform, 5 to 10 Cm. (2–4 In.) long, and about 1.2 Cm. (½ In.) thick, the dark-brown bark usually removed from the commercial drug, which is then usually purplish or whitish, the fracture short, and showing short yellow wood-wedges. The drug has a strong and not very agreeable odor, as well as a distinct odor of bitter almond, and an acrid taste when fresh, but these are rapidly lost after drying. Fresh peony root probably contains oil of bitter almond, since Wigger obtained a distillate having that odor. Otherwise no special constituent has been encountered in it. The flowers and the seeds have also been employed.

Other Species.—*P. Moutan* Sims (*P. arborea* Don.), the *Tree-peony* (*Botan*, Jap.; *Mantan*, Chin.), contains a fat acid related to caprinic acid, crystalline, melting at 45° C. (113° F.), subliming at a higher temperature, and easily soluble in ether and alcohol. It also yields a volatile oil containing the crystalline body *pæonol*. This root is used in the Orient as an antispasmodic and emmenagogue. *P. rubra* Hort. is the Chinese carminative *Ch'ih-choh-yok*, *Ch'nen-choh*, or *Tian-chi*. *P. albiflora* Pall. (*P. edulis* Salisb.), and perhaps other species, yields an edible starchy root in Siberia, where it is known as *Peh-choh-yoh*. The seeds are used as a substitute for tea.

Hepatica or *Liverleaf*, incorrectly "Liverwort" (*Golden trifoil*, *Herb trinity*, *Ivy-flower*, E.; *Edelleberkraut*, *Leberblume*, G.; *Herbe de hepatique*, Fr.; *Hepatica*, Sp.), is the leaves of *H. Hepatica* (L.) Karst. (*Anemone Hepatica* L.; *H. triloba* Chaix.; *H. Americana* DC.; *H. nobilis* Moench), a low, acaulescent, evergreen herb occurring in woodlands almost throughout the north temperate zone. It grows from a dense cluster of fibrous roots, the rosette of leaves at first erect, at length becoming prostrate on long, villous petioles, the mature blades 5 to 7 Cm. (2–3 In.) broad, and nearly as long, cordate, deeply 3-lobed, the lobes oval-ovate, obtuse, entire, or the two lateral sometimes with a notch near the base, when young thin, light green and hairy, in age thick, smooth, deep green above, often purplish underneath, or even above. The flowers are solitary on scapes 10 to 15 Cm. (4–6 In.) long, range in color from deep blue to whitish, are 1.2 to 2 Cm. (½–¾ In.) broad, subtended by 3 ovate obtuse bracts which are shorter than the (mostly 4 to 8) colored sepals; petals wanting; stamens numerous, yellow; carpels several, distinct, becoming akenes in fruit. This is one of our very earliest and most pleasing spring flowers. The leaves lose about 70 to 75 per cent. in drying. The drug is nearly odorless and has a mucilaginous and slightly astringent taste. No analyst has succeeded in finding any constituent of importance. A little gum and tannin are the most noteworthy.

FIG. 335.



Hepatica (½ Nat.).

The northern and northwestern species, *H. acuta* (Pursh) Britton (*H. triloba acuta* Pursh; *H. acutiloba* DC.), has acute lobes.

Anemone, very closely related to both *Hepatica* and PULSATILLA, is a genus of nearly 100 species, a score of which are medicinally employed. They have acrid juices, similar to

that of Pulsatilla, with which they agree pretty well in constituents and properties. The drug *Anemone* (*Wood anemone, Wind-flower, Bow-bells,* E.; *Weisser Waldhahnenfuss,* G.; *Anêmone des bois* or *A. sylvie,* Fr.) is commonly understood as the fresh plant of *A. nemorosa* Mx., of Europe, or its American representative, *A. quinquefolia* L. (*A. nemorosa quinquefolia* A. Gray). These are low and delicate herbs, growing and blooming in earliest spring, in woodlands, from small fleshy, white rhizomes. The stem is simple, erect, slender, usually 10 to 20 Cm. (4–8 In.) high, and bears 3 petioled, 3- or 5-parted leaves close to the solitary, terminal flower, which is nearly 1 inch broad, white or purplish, and consists of (mostly 5) delicate sepals, numerous stamens, and several distinct carpels, becoming akenes in fruit. Later in the season the true leaves appear, these being radical, long-petioled, subrotund, and 5-parted. The principal constituent of the drug is *anemonin* (see PULSATILLA). The plant is poisonous like the last named, and its properties and uses are about the same.

Some pharmacopœias prefer it to pulsatilla.

Clematis is a genus of nearly 200 species, mostly herbaceous or soft-woody climbers, some 25 of which are recorded as in medicinal use. The drug, as commonly understood, is the herbage and flowers of *C. Virginiana* L., the *Virgin's* or *Ladies' bower, Love-vine, Traveller's-joy, Devil's-hair, Nigger's-wool,* or *Devil's darning-needle.* The fresh drug is said to be much more active. This is a soft-wooded shrub, climbing over fences, hedges, and bushes by means of the twisted petioles, and occurring throughout eastern and central North America. Leaf- and flower-habit are shown in the accompanying cut. The white flowers are diœcious and occur in abundance during middle and late summer, and are followed in the fall by dense white masses of the long-plumose akenes. The fresh herbage has a heavy odor and an acrid after-taste. The precise nature of its acrid constituent is unknown, but it occurs as an oily, volatile, irritating liquid.

C. recta L., the *Upright virgin's bower,* yielded the *Herba flammulæ jovis* of the ancients. *C. Vitalba* L. is the *European virgin's bower,* etc., *Gray-* or *Old-man's beard, White-vine, Snow-in-harvest, Smoke-weed.* Besides a volatile liquid, probably identical with that of the last-described drug, this has yielded a crystalline basic substance. *C. cirrhoza* L. is believed to be the *Clematis* of Dioscorides. *C. sericea* H. B. K., of tropical America, is the Mexican *Barbas de Chivo. C. triloba* Hayne is the East Indian *Laghu-karni* (Sansk.) or *Morwel.*

FIG. 336.

Clematis Virginiana: branch (½ Nat.); pistillate and staminate flowers (Nat.).

Ranunculus is a genus of some 250 species, mostly known commonly as *Buttercups.* Their juices are colorless and for the most part very acrid, on which account many of them have been employed more or less as counter-irritants, and *R. bulbosus* is a recognized drug. The general characters of the buttercups are too well known to require description. The species named is distinguished by the bulbous stem-base and the strongly reflexed sepals. It is of European nativity, but is abundantly naturalized in many parts of the United States. Its active constituent, as of the other species, is an irritant oily liquid, yielding anemonin; practically equivalent to that of *Pulsatilla.* It is an active blistering agent, but the blister, though but slightly painful, is very difficult to localize and control. Another species which has been considerably employed is *R. sceleratus* L., the *Cursed, Celery-leaved, Marsh, Ditch,* or *Biting crowfoot* or *Buttercup* or *Blisterwort,* a coarse, stout, rank-growing but small-flowered species growing in ditches, with thick, hollow, and weak stems. It has been used by beggars to create ugly-looking but little painful sores, designed to excite sympathy, whence one of its names, *Beggar's-weed.* In the Orient it is called *Kabikadisch.* These plants are violently poisonous when taken internally, and are believed to cause abortion when eaten by pregnant cattle.

RESINA, *U. S.*, *Br.*—Rosin.

Colophonium, P. G.—*Resin, Colophony*, E.; *Colophone, Arcanson*, Fr. Cod.; *Kolophonium, Geigenharz*, G.; *Pece Greca*, It.; *Colofonia, Pez griega, Brea seca*, Sp.; *Pez Lauri, Colophonie do commercio, Resina do Pinheiro*, Port.

The residue left after distilling off the volatile oil from turpentine. Official in all pharmacopœias.

Origin.—The origin of common rosin is sufficiently explained by the above definition and by our accounts of Terebinthina and Oleum Terebinthinæ.

Properties.—Rosin is a very brittle, pulverizable, transparent or translucent resin, having about the specific gravity 1.070–1.080, breaking with a glossy and shallow conchoidal fracture, nearly tasteless, and of a faint terebinthinate odor. It varies in color from a pale amber to a dark red brown, and is distinguished in commerce by the shade of its color, the darkest being called *black rosin*. For pharmaceutical purposes the amber-colored variety is used. *White rosin* is a light-colored variety, made by agitating the melted rosin with water. It dissolves readily in ether, chloroform, alkalies, benzene, carbon disulphide, and in the volatile and fixed oils; at 60° C. (140° F.) it is slowly soluble in its own weight of alcohol or of glacial acetic acid. It softens at the heat of a water-bath, melts completely above 100° C. (212° F.)—some varieties at about 135° C. (275° F.)—and at a higher heat burns with a dense yellow and sooty flame. When heated to above 200° C. (392° F.) it may be distilled apparently unchanged with a current of superheated steam, but on dry distillation it yields *rosin oil*.

Variation in the transparency of different lots of rosin depends upon the thoroughness of the distillation, the retention of a portion of the oil or of water. Variations in color depend upon the degree of heat employed or the condition of the trees yielding it. The virgin dip yields the lightest rosin, and the latter becomes darker with each succeeding year. It has been suggested that this is due to the fact that the later distillations are subjected to a greater degree of heat. Rosin is scarcely subject to adulteration.

Composition.—Rosin consists largely (80 to 90 per cent., Flückiger) of *abietic anhydride* ($C_{44}H_{62}O_4$), which, upon agitation with warm diluted alcohol, becomes *abietic acid* ($C_{44}H_{64}O_5$). The latter often occurs in irregular, glassy, crystalline points or white scales. Emmerling obtained it as a snow-white powder, by treating with strong ammonia-water, passing through muslin, and decomposing the resulting jelly-like mass with hydrochloric acid. Kelbe obtained it in long triclinic prisms by crystallizing it from glacial acetic acid. Statements concerning the melting-point are conflicting. The highest recorded (Maly) is 165° C. (329° F.). It is soluble in ether, chloroform, benzene, wood spirit, and carbon disulphide, and yields amorphous compounds with bases. The other constituents have not been determined. *Pinic* and *sylvic* acids have been reported, but it has been suggested that they are only impure abietic acid. Certainly, Shkateloff has proved that the corresponding acid of the resin of *Pinus sylvestris* has a different composition, though closely resembling the above in general characters. It is not unlikely that similar differences will be found in the composition of other coniferous resins.

Pharmaceutical Preparations.—Rosin Cerate, Compound Rosin Cerate, U. S. P.

Uses.—Resin is rarely given internally. It is added to ointments to render them stimulating and to plasters to increase their adhesiveness.

RESINA COPAL.—Copal.

This name has been indefinitely applied to a group of resins of widely different origin, but agreeing in general appearance, in being collected chiefly in a fossil state, and in being very hard and tough and specially adapted for the manufacture of varnishes. Botanically they form two principal groups: those pertaining to the *Leguminosæ*, which are the copals proper, and those pertaining to other families, the most important being *Kauri copal*, of the family *Pinaceæ* or *Coniferæ*.

Of the first-named group, the best and most important variety is *Zanzibar copal* or *Animi* (also called *Chakazzi copal*), produced by the large tree *Trachylobium Mozambicensis* K[1]., closely related, as are all of this group, to the trees yielding copaiba. The tree is a living one, and some resin is probably obtainable from living specimens; but it

is probably true here, as of others of the group, that resin thus collected is very inferior to that obtained from the ground in a fossil state. Little is known of the methods of collection, the resin being brought to the coast from the interior by natives. It is then "raw," encrusted with dirt and altered superficial resin, and has to be cleaned and scraped to prepare it for the market. It then presents itself in fragments ordinarily varying in size from a few pounds down to an ounce or so, but occasionally weighing a hundred pounds or more. It varies in color from pale yellow to deep red brown, and from beautifully transparent to opaque, except in thin fragments. The surface may be perfectly smooth and of subglossy lustre, longitudinally marked, as with wood-fibres, or warty with minute roundish projections, giving a "goose-flesh" appearance, such a surface being not shining. The last-mentioned sort is greatly preferred and brings a higher price. Animi is both hard and tough and of a splintery fracture, and has a specific gravity of about 1.04. Stephen describes it as follows: Melting, when finely powdered, at 140° C. (284° F.); completely though slowly soluble in alcohol; 30 per cent. soluble in benzol, chloroform, and glacial acetic acid; 34 per cent. in ether, 10 per cent. in petroleum spirit and carbon disulphide; on being boiled with alcohol it cakes, but by repeated digestion with alcohol all is dissolved, then precipitated with water, the precipitated resin soluble in boiling 0.1 per cent. solution of potash; not saponifiable; consists of 80 per cent. trachylolic acid, in minute sphero-crystalline masses melting at 168° C. (334.2° F.); 4 per cent. isotrachylolic acid; 6 per cent. α and β copal resins; volatile oil and bitter principle. The author regards it as a pathological product. Very similar resins come from Mozambique and Madagascar, the latter being probably produced by the closely related tree *Hymenæa verrucosa* Lam. From West Africa comes a copal supposed to be produced by one or more species of *Copaiba* (=*Guibourtia*). South American copal, usually very clear and light colored, and largely used by the natives for making ornaments, closely resembling those made of amber, is not very abundant in commerce. It is said to be produced by *Hymenæa Courbaril* L., *H. stilbocarpa* Hayne, *H. Martiana* Loc., and *Trachylobium Hornemanniana* Hayne. The writer has himself collected this resin upon the large pods of the first-named species.

Of the second class of Copals, *Kauri* (*Kowrie* or *Kari*) is by far the most important. It is often known as New Zealand Copal. This also is the product of a species still living, the *Kari* or *Kauri* tree, *Agathis australis* Rich. (*Dammara australis* Lamb.), but the resin of good quality is dug in a fossil condition, the collectors locating it by means of a sharpened steel rod thrust into the ground. The most of it comes from the district to the north of Auckland. It varies in size as does Animi. The fragments are more inclined to be massive—that is, less tabular and splintery—than are those of Animi. In color it varies from nearly white to nearly black. It is said to be darker when from swampy ground, and that from Walkato is the darkest. It is far less transparent than Animi, even the clear pieces exhibiting a sort of milkiness or opalescence in the interior. It is heavier than Animi (specific gravity about 1.11), but is not so hard. It can be softened between the teeth. Tschirch and Niederstadt give it the following composition: 1.5 per cent. *kaurinic acid* ($C_{10}H_{16}O_2$); 48 to 50 *α-* and *β-kaurolic acids* ($C_{17}H_{34}O_2$); 20 to 22 *kauronolic acid* ($C_{12}H_{24}O_2$); 12.5 volatile oil, about the same amount of resene, and 0.5 to 1 of bitter principle. All are amorphous except kaurinic acid, which is crystalline, and is separated by means of its solubility in ammonium carbonate solution. The kaurolic acids are dissolved out by sodium carbonate; kaurinic and kauronolic acids are soluble in potassium hydroxide solution. The essential oil has a pleasant balm- or lemon-like odor, and a specific gravity of 0.835 at 15° C. (59° F.) It boils between 150° and 160° C. (302° and 320° F.), the greater portion distilling between 156° and 160° C. (312.4° and 320° F.). It is soluble in all proportions in alcohol, chloroform, and ether. When first distilled, it is neutral in reaction, but becomes acid on exposure to the air in thin layers, and rapidly resinifies. Small quantities of a kind of copal are produced in the East Indies, differing from all of the foregoing, by the tree *Vateria Indica* L. (*Elæocarpus copalliferus* Retz.—Fam. *Dipterocarpaceæ*).

Resina Damar or *Dammar* is closely related to the last named, being produced by some species of *Shorea*, of the same family, in the East Indies. This resin is of totally different appearance from any of those described above. It occurs in rounded nodules or "tears," mostly of the size of an egg or smaller, the surface usually nodular or warty, and dull or powdery, and ranging in color from nearly white to pale-straw color. Its specific gravity is only about 1.08. It softens readily between the teeth and melts at about 120° C. (248° F.). It is softer than Kauri, breaks with a glassy fracture, is

odorless and tasteless, soluble in ether, chloroform, benzol, and carbon disulphide, less so in alcohol and benzin. Tschirch gives its composition as including 23 per cent. of crystalline *dammarolic acid* ($C_{56}H_{80}O_8$), 40 of *α-dammar resin* ($C_{11}H_{17}O$), 22.6 of *β-dammar-resin* ($C_{31}H_{52}O$).

Uses.—Copal is not used in medicine.

RESINA DRACONIS.—Dragon's Blood.

Sang-dragon, Fr. Cod.; *Drachenblut*, G.; *Sangre de drago*, Sp.

The resin obtained from the fruit of *Calamus Draco* Willd. (*Dæmonorops D.*—Blume) and probably from other species of *Calamus* (Fam. *Palmæ*).

Origin and Preparation.—This is a slender rattan palm of the East India islands, the stem extending sometimes for hundreds of feet, and climbing by hooks on the petiole and ribs of the leaf. The resin exudes and hardens in the form of small granules upon the surface of the scaly fruits, which are of the size and form of a pigeon's egg, and is shaken and brushed off. It is then made to cohere in masses by softening with the heat of the sun or hot water, and it is said to be invariably mixed with the milk-juice of a Garcinia, to increase the weight. It is sometimes molded into irregular small pellets or granules (*Tear dragon's-blood*), sometimes in balls or slabs, sometimes by hardening in small bags or saucers (all known as *Cake dragon's-blood*), but is most frequently seen in the American market in the *stick* form, the cylindrical sticks rather smaller than licorice extract sticks, each enclosed in a leaf and its surface more or less longitudinally marked by the impressions of the leaf-ribs. Owing to the article being chiefly used as a pigment, those lots having the brightest color are preferred, and the stick-form is generally regarded as inferior. The latter is said to be derived from a distinct species. Dragon's blood arrives in boxes containing from 100 to 500 pounds each.

Properties.—Dark red brown, internally brighter and occasionally brilliant red, somewhat porous, the fracture resinous but irregular, owing to mechanical impurities, transparent in very thin splinters; inodorous, but when heated yielding a slight benzoin odor, faintly sweetish and pulverulent on chewing; readily soluble in alcohol, amyl alcohol, benzene, and chloroform, less so in ether and oil of turpentine, insoluble in petroleum benzin.

Constituents.—Reports concerning the composition of dragon's blood are contradictory, due doubtless to the use of samples of different origin. That in which Trimble found 35 per cent. of oak tannin was doubtless entirely distinct from the one here considered, very likely from the *Pterocarpus draco*, mentioned below. Rather more than half of a good dragon's blood consists of a bright-red resin. Johnston's formula for this can hardly be constant, for Dieterich finds it to consist of benzoic and benzylacetic acids in combination with *dracoresinotannol*, although others have asserted that benzoic acid is not contained. Dieterich found 13.5 per cent. of *dracoresin* and 2.5 per cent. of the peculiar body *dracoalban*, which is white and non-crystallizable. There is a variable amount of impurities, as well as of ash, which in a good sample should not exceed 8 or 9 per cent. Harberger found 90.7 per cent. of the resin, which he called *draconin*, and for which he attempted to find a chemical formula. He also reported 3 per cent. of benzoic acid, 2 per cent. of fixed oil, and calcium oxalate and phosphate. The presence of the two last-named substances and of much volatile oil, as natural constituents of the resin, may be doubted without confirmation.

Action and Uses.—Dragon's blood was used in former times as a mild astringent in diarrhœa, but is now never given internally. It was formerly an ingredient of many plasters. At present it is used to impart a mahogany color to varnishes.

Other Varieties and Allied Products.—The genus *Calamus* contains some 200 species, most notable for their production of rattan and cane (*Malacca*) sticks. *C. niger* W. and *C. Scipionum* Lour. have been named as also yielding dragon's blood.

A kind of dragon's blood (really a *kino*) is yielded from incisions into the bark of *Pterocarpus Draco* L. (Fam. *Leguminosæ*), of the West Indies. The dragon's blood tree of the Canary Islands (*Dracæna Draco* L.—Fam. *Liliaceæ*) is notable for the existence of individuals supposed to be the oldest of living trees, and older probably than the history of the human race. Its product is said to be similar to that above described, but in the fresh state the juice is intensely acrid. *Socotrine* or Zanzibar dragon's blood ("*Katir*") has been regarded as the product of a related species, *D. Ombet* Kotschy, but this is now regarded as identical with *D. Draco*.

RESINA JALAPÆ, *U. S., P. G.*—Resin of Jalap.

Jalapæ resina, Br.—*Résine de jalap*, Fr.; *Jalapenharz*, G.

Preparation.—Jalap, in No. 60 powder, 1000 Gm.; alcohol, water, each a sufficient quantity. Moisten the powder with 300 Cc. of alcohol and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 2500 Cc. of percolate are obtained or until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol by means of a water-bath until the percolate is reduced to 250 Gm., and add the latter, with constant stirring, to 3000 Cc. of water. When the precipitate has subsided decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of hot water. After having drained off all the liquid, transfer the resin to a porcelain dish and heat to dryness on a water-bath. —U. S.

These directions are about the same as in the former pharmacopœia. The alcoholic tincture of the jalap containing the resin in solution is concentrated by distillation, and this liquid while still warm poured into water, stirring continually, so as to bring nearly all particles of the resinous matter in direct contact with water, whereby the solution of those constituents which are soluble in water is facilitated. After repeated washings with fresh portions of water the resin is collected and dried. By this treatment water removes sugar and some other principles of jalap, which are also soluble in water, and which possess some medicinal activity.

The British Pharmacopœia directs 1 part of water for 2 parts of jalap to be added to the percolate, from which nearly the whole of the alcohol may be recovered by distillation. The residue while hot is poured into an open dish and allowed to cool, when the liquid portion is decanted, the resin washed several times with hot water, and dried.

The German Pharmacopœia directs the jalap to be exhausted by digestion with alcohol, the tincture to be concentrated, and the resinous residue to be repeatedly washed with warm water (boiling water, Fr. Cod., P. A.) as long as this takes up coloring-matter. The resin may also be obtained by depriving jalap of its principles soluble in hot water, drying and powdering the residue, and exhausting it with alcohol. Good jalap yields about 12 per cent. of resin (not less than 8 per cent., U. S.).

Properties and Tests.—Resin of jalap occurs in yellow to brown masses or fragments, breaking with a resinous, glossy fracture, translucent at the edges, or a yellowish-gray to yellowish-brown powder, having a slight, peculiar odor, and a somewhat acrid taste. Permanent in the air. Soluble in alcohol in all proportions; insoluble in carbon disulphide, benzene, and fixed or volatile oils. Its alcoholic solution has a faintly acid reaction to blue litmus-paper. Not more than 10 per cent. of resin of jalap should be soluble in ether, and not more than 35 per cent. in chloroform. Slowly but completely soluble in 5 times its weight of ammonia-water; when this solution is acidified with hydrochloric acid, only a slight turbidity should appear (absence of rosin, guaiac, and other resins). Resin of jalap should not suffer any material loss of weight when heated at 100° C. (212° F.) (absence of water). Anhydrous resin of jalap melts at about 150° C. (302° F.). Water triturated with resin of jalap should neither become colored nor dissolve any portion of it (absence of soluble impurities). No greenish-blue color should be produced on adding a few drops of ferric chloride test-solution to some of the powder moistened with alcohol (absence of guaiac). 1 Gm. of resin of jalap when dissolved in 50 Cc. of alcohol containing 1 Cc. of phenolphthalein test-solution should require not more than 0.5 Cc. of tenth-normal alcoholic potassium hydroxide solution to produce a red color (limit of acid resins). If to 1 Gm. of resin of jalap, dissolved in 50 Cc. of alcohol in a flask, 25 Cc. of tenth-normal alcoholic potassium hydroxide solution be added, and the mixture be heated on a water-bath for 1 hour, and if the excess of alkali be titrated with tenth-normal sulphuric acid solution, using 2 drops of phenolphthalein test-solution as indicator, the difference between the number of cubic centimeters of tenth-normal sulphuric acid solution required and the 25 Cc. of tenth-normal alcoholic potassium hydroxide solution taken should not exceed 5 Cc. (limit of saponifiable substances).—U. S. An adulteration with rosin may be detected by the solubility

in oil of turpentine, and the presence of aloes manifests itself by its bitter taste and the production of picric acid when treated with nitric acid. "1 part of resin of jalap should dissolve in 5 parts of warm ammonia-water; on cooling the solution should not gelatinize (absence of colophony), and should remain clear after being supersaturated with an acid."—P. G.

Pharmaceutical Preparations.—SAPO JALAPINUS, P. G.—*Jalap Soap*, E.; *Jalapenseife*, G.—Equal parts each of resin of jalap and medicinal (white Castile) soap, both in fine powder, are thoroughly mixed. This preparation is of a brown-yellow color, is soluble in alcohol, and yields with about 10 parts of water a nearly clear solution, which becomes somewhat cloudy, but does not separate any resin.

PILULÆ JALAPÆ, P. G.—Mix jalap soap 3 parts and powdered jalap root 1 part. Each pill is to weigh 0.10 Gm. and to be dusted with lycopodium.

COMPOUND CATHARTIC PILLS, VEGETABLE CATHARTIC PILLS, U. S. P.

Action and Uses.—Since this resin contains practically all the purgative principles of jalap, it may be substituted for the crude drug. The dose is from 2 to 5 grains (0.12–0.30 Gm.) when used alone. Combined with other cathartics it may be given in smaller dose.

RESINA PODOPHYLLI, *U. S.*—Resin of Podophyllum.

Podophylli resina, Br.; *Podophyllinum*, P. G.—*Resin of May-apple*, E.; *Résine de podophyllum*, Fr.; *Podophyllin, Podophyllumharz*, G.; *Podofilina*, Sp.

Preparation.—Podophyllum, in No. 60 powder, 1000 Gm.; hydrochloric acid, 10 Cc.; alcohol, water, each a sufficient quantity. Moisten the powder with 480 Cc. of alcohol and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 1600 Cc. of percolate are obtained, or until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol by means of a water-bath until the percolate is reduced to the consistence of a thin syrup, and pour it slowly, with constant stirring, into 1000 Cc. of water, previously cooled to a temperature below 10° C. (50° F.), and mixed with the hydrochloric acid. When the precipitate has subsided decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of cold water. Spread it in a thin layer upon a strainer, and dry the resin by exposure to the air in a cool place protected from the light. Should it coalesce during the drying or aggregate into lumps having a varnish-like surface, it should be removed, broken in pieces, and rubbed in a mortar.—U. S.

The low temperature directed in the precipitation and drying is the chief distinction from the process of the British Pharmacopœia, which permits the resin to be dried on a stove.

On pouring the concentrated tincture of podophyllum into acidulated water the extractive matters remain in solution while the resin is precipitated. The addition of hydrochloric acid appears to exert no action on the product, and to be useful merely in hastening the deposition of the resin from the aqueous liquid. Both the British and French pharmacopœias omit the hydrochloric acid. The yield is between 4 and 5 per cent. of the weight of podophyllum used; by exhausting the rhizome with alcohol of specific gravity 0.930, G. H. C. Klie (1877) claimed to have obtained as much as 7¼ per cent.

Properties and Tests.—An amorphous powder, varying in color from grayish white to pale greenish yellow, turning darker when subjected to a heat exceeding 35° C. (95° F.) or when exposed to light. It has a slight, peculiar odor and a faintly bitter taste; very irritating to the mucous membrane, especially to that of the eyes. Soluble in alcohol in all proportions; not less than 75 per cent. of resin of podophyllum should be soluble in ether, not less than 65 per cent. in chloroform and not more than 25 per cent. in boiling water. A hot, aqueous solution deposits most of its contents on cooling, and if the cooled liquid be filtered, the filtrate has a bitter taste, and turns brown upon the addition of a few drops of ferric chloride test-solution. Soluble in potassium or sodium hydroxide test-solution, forming a deep yellow liquid, which gradually becomes

darker on standing, and from which the resin is reprecipitated by acids. Not less than 99 per cent. of resin of podophyllum should be soluble in alcohol; the solution should be clear or, at most, slightly opalescent, and should have a faintly acid reaction. Upon incineration, resin of podophyllum should yield not more than 0.7 per cent. of ash.—U. S. According to Power, podophyllum resin becomes soft at 120° C. (248° F.), and is completely melted at 124° C. (255° F.). Sulphuric acid colors it intensely yellow, the color changing to purplish and to brown on the addition of a trace of nitric acid. Among the oxidation products by nitric acid are oxalic acid and an amorphous yellow substance.

Composition.—F. B. Power (1877) observed that the largest portion of the resin consists of at least four compounds, differing in their solubility in ether and hot water and in their behavior to alkalies, ferric chloride, and lead acetate; fused with potassa, *protocatechuic acid* was obtained, but no resorcin. The official resin contains also a little fatty matter, and yields a small proportion of ash, consisting chiefly of sodium and potassium salts. Podwissotzki (1880) obtained from podophyllum resin yellow needles resembling quercetin, a green oil, a crystalline fat acid, podophyllic acid (without activity, soluble in hot water), and two poisonous principles: one of these, *podophyllotoxin*, is obtained from the concentrated chloroform solution by treating it with benzin, which will remove the oil and fat acid; it has the composition $C_{23}H_{24}O_9$ (Kürsten, 1891), crystallizes from benzene, is white, very bitter, faintly acid, sparingly soluble in water, and by treatment with ammonia yields podophyllic acid and *picropodophyllin*. The latter is intensely bitter, freely soluble in chloroform, ether, and, according to Kürsten, has the same composition and yields the same decomposition products as podophyllotoxin, but is more sparingly soluble.

Gordin and Merrell have proposed a method for the valuation of commercial resin of podophyllum, based upon its podophyllotoxin content, which involves the conversion of the latter constituent into picropodophyllin by means of calcium hydroxide. In view of the fact that resin of podophyllum is often found of inferior quality on the market, these authors claim that it should yield at least 22 per cent. of crude picropodophyllin when assayed by the method which they propose. (See *Proc. Amer. Pharm. Assoc.*, 1902, p. 343 *et seq.*)

Action and Uses.—This resin, commonly called podophyllin, is given in the dose of from $\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003–0.006 Gm.) as a laxative, $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.03 Gm.) as a purge (see PODOPHYLLUM).

RESINA SCAMMONII, *U. S.*—Resin of Scammony.

Scammoniæ resina, Br.; *Résine de scammonée*, Fr. Cod.; *Scammoniaharz*, G.; *Resina de escamónea*, Sp.

Preparation.—Take of scammony, in No. 60 powder, 1000 Gm.; alcohol, water, each a sufficient quantity. Digest the scammony with successive portions of boiling alcohol until exhausted. Mix the liquids, filter, and reduce the mixture to a syrupy consistence by distilling off the alcohol. Then add the residue in a thin stream, with active stirring, to 2500 Cc. of water, separate the precipitate formed, wash it thoroughly with water, and dry it with a gentle heat.—U. S.

Take of scammony root, in coarse powder, 8 ounces (150 Gm.), alcohol (90 per cent.), distilled water, of each a sufficient quantity. Exhaust the scammony root with the alcohol by percolation; place the resulting tincture in a still; recover the greater part of the alcohol; slowly pour the liquid which remains after the distillation of the tincture into three times its volume of the distilled water, constantly stirring; allow the mixture to stand for the resin to subside; then wash the resin on a filter with boiling water, distilled water, and dry it on a water-bath.—Br.

Prof. Markoe (1877) showed that the alcoholic extract of scammony yields to water only 2 per cent. of soluble matter, which is removed by washing, as directed in the first formula. The French Codex directs an alcoholic solution of scammony to be treated with animal charcoal for the purpose of removing most of the coloring-matter; after filtration the alcohol is recovered by distillation and the resulting resin dried on plates in a warm room. The yield of resin varies with the quality of scammony employed.

Properties and Tests.—Resin of scammony occurs in yellowish-brown or brownish-yellow masses or fragments, breaking with a glossy resinous fracture, translucent at

the edges; or a yellowish-white or grayish-white powder, having a faint, characteristic odor, and a slight, peculiar taste. Soluble in alcohol in all proportions, completely soluble in oil of turpentine, and almost completely soluble in ether and chloroform. Ammonia-water and solutions of alkalies dissolve it with the aid of a gentle heat, and from these solutions the resin is not reprecipitated by acids. When incinerated, it should not yield more than 1 per cent. of ash. Sulphuric acid, when stirred in a porcelain dish with an equal weight of resin of scammony, should not gradually turn red (absence of rosin).—U. S.

Action and Uses.—This resin represents the medical properties of scammony and is about twice the strength of the crude drug. It is rarely administered alone, but in combination with other cathartic drugs. Because of its insipid taste it may be readily administered to children, usually made into an emulsion with milk or mucilage and sweetened. The dose as an active purge for adults is from 5 to 15 grains (0.30–1 Gm.).

RESORCINOL, *U. S.*—Resorcinol.

Resorcinum, P. G.; U. S., 1890.—*Résorcine*, Fr. Cod.; *Resorcin, Metadioxybenzene, Metadihydroxybenzene*, E.; *Résorcine*, Fr.; *Resorcin*, G.; *Resorcina*, Sp.

Formula, $C_6H_6O_2$ or $C_6H_4(OH)_2$. Molecular weight, 109.22.

A diatomic phenol obtained usually by the reaction of fused sodium hydroxide upon sodium metabenzene-disulphonate. Resorcinol should be kept in dark amber-colored vials.—U. S.

Origin.—Resorcinol was discovered by Hlasiwetz and Barth (1864) on melting galbanum, ammoniac, or guaiacum resin with potassa. It is produced in a similar manner from asafetida, sagapenum, ascaroid resin, and from phenol-sulphonic acid and other derivatives of phenol; likewise on the dry distillation of extract of Brazil-wood.

Preparation.—Resorcinol is now manufactured on a large scale from benzene. The latter is heated with about 4 times its weight of fuming sulphuric acid to 275° C. (527° F.), whereby benzene metadisulphonic acid is formed ($C_6H_4(HSO_3)_2$). When cool the acid is dissolved in water and neutralized with milk of lime; after removal of calcium sulphate by means of a filter-press, sodium carbonate is added, the mixture again filtered, and the solution of sodium benzene-metadisulphonate evaporated to dryness. The sodium salt thus obtained is heated for 8 or 9 hours at 270° C. (518° F.) with 2½ times its weight of caustic soda, sodium-resorcin, $C_6H_4(ONa)_2$ being formed, together with sodium sulphite. Continued boiling of a solution of the saline mass expels the sulphurous acid, and the tar-like residue is then extracted with ether, which latter, upon distillation, leaves impure resorcin. By sublimation or recrystallization from water or benzene pure resorcinol is obtained.

Properties and Tests.—Resorcinol occurs in colorless, needle-shaped crystals, having a faint, peculiar odor, and a sweetish, followed by a bitter taste. It acquires a pinkish tint on exposure to light and air. It is soluble in 0.5 part of water at 25° C. (77° F.), slightly more soluble in alcohol; very soluble in boiling water or in boiling alcohol; also readily soluble in ether and glycerin; very slightly soluble in chloroform, carbon disulphide, and benzene. When heated to 119° C. (246.2° F.) resorcinol melts, and at a higher temperature is completely volatilized. It boils at 276.5° C. (529.7° F.), and is slightly volatile in a current of steam. The aqueous solution is neutral or only slightly acid to litmus-paper. On adding a few drops of ferric chloride test-solution to 10 Cc. of an aqueous solution of resorcinol (1 in 200) the liquid assumes a bluish-violet color, changing to brownish yellow on the addition of ammonia-water (distinction from catechol and quinol). Lead acetate test-solution should produce no precipitate when added to an aqueous solution of resorcinol (distinction from, and absence of, catechol). If 0.1 Gm. of resorcinol be dissolved in 1 Cc. of potassium hydroxide test-solution and a drop of chloroform added, the mixture upon being heated will assume an intense crimson color. If a slight excess of hydrochloric acid be then added, the color will change to a pale straw yellow. On cautiously heating 0.05 Gm. of resorcinol with 0.1 Gm. of tartaric acid and 10 drops of concentrated sulphuric acid, a thick carmine-red liquid will be formed, becoming pale yellow when diluted with water. A concentrated aqueous solution of resorcinol (1 in 20) should be colorless (absence of empyreumatic bodies), and when gently heated should not emit the odor of phenol.—U. S. Resorcinol precipitates metallic silver from ammoniacal solution of silver nitrate. Its solution in ammonia when

exposed to the air turns rose red and brown, and, when heated, green and blue, this color being changed to red by acids. The aqueous solution of resorcinol yields with bromine-water needles of tribromresorcin, $C_6Br_3H(OH)_2$. Resorcinol carefully fused with sodium nitrite yields *lacmoid*, a blue coloring-matter similar to litmus. To detect small quantities of resorcin a few drops of nitric acid containing nitrous acid are added to an ether solution of the resorcinol. On standing, *diazoresorcin* crystallizes out. The crystals yield a blue solution with ammonia (Hager).

When carefully heated in a test-tube, resorcinol should melt to a clear colorless liquid; on increasing the heat it should volatilize, producing white vapors, and leaving no residue, or merely a minute amount of charcoal. Heated in a porcelain or platinum dish, it should volatilize without residue.

Chemically, resorcinol is a dihydroxybenzene, of which three varieties have been obtained, named, respectively, ortho- meta-, and para-dioxybenzene; the first is known as catechol or pyrocatechin, the second as resorcinol or resorcin, and the third as hydroquinol.

Unfortunately, the name resorcinol has (1893) also been applied to a compound obtained by heating to the point of fusion a mixture of equal parts of resorcin and iodoform; it is an amorphous coffee-colored substance of an iodine-like odor and disagreeable taste.

Resorcinol is used as the basis for the manufacture of a number of important dyes, *resorcin-blue*, -brown, -green, -purple, resorcin-phthalein, and the commercial *fluorescein* and *eosines*.

Action and Uses.—Resorcinol possesses antiseptic properties resembling those of phenol. It arrests decomposition of organic substances, deodorizes, and prevents putrefactive changes by destruction of the organisms upon which they depend. Applied to the unbroken skin it does not irritate and is not absorbed, but in substance or saturated solution it acts as a mild caustic to mucous membranes or ulcerations of the integument.

The caustic property is not exhibited in weaker solutions.

In animals, lethal doses cause at first trembling, soon followed by epileptiform convulsions, probably of spinal origin, which increase in severity until the animal is too weak to respond to spinal irritation.

Respiration at first accelerated, becomes jerky, rapid, and shallow, death being due largely to respiratory depression.

The heart becomes rapid, irregular, and gradually weaker, continuing to beat, however, after respiration has ceased.

Resorcinol has rarely been the cause of death in man. The ingestion of 150 grains of it was followed by dizziness, confused vision, deafness, and vertigo; presently loss of consciousness supervened, and epileptiform convulsions and tetanic rigidity of the muscles of the neck occurred. Respiration was greatly embarrassed and cardiac action hurried and enfeebled. The individual recovered.

Administered in large medicinal doses (20 to 40 grains—1.3–2.6 Gm.) to fever patients resorcinol brings about a lowering of temperature, probably from the profuse sweating produced, and it also reduces the rate of the pulse, but the headache, dizziness, and other unpleasant symptoms which it causes are responsible for its disuse as an antipyretic.

It is eliminated largely by the urine and may be detected by the addition of ferric chloride, which produces a violet color.

In gastric ulcer, gastralgia, catarrh of the stomach, and fermentative dyspepsia, resorcin has been recommended as an efficient remedy, but the results of its employment for these conditions have not been uniform or satisfactory, and it is rarely given. It is employed chiefly for its antiseptic and local anæsthetic virtues in the treatment of skin diseases, particularly those of subacute or chronic character, as eczema, when the skin is greatly indurated, psoriasis, seborrhœa capitis of the dry and scaly type, parasitic diseases, as tinea and scabies. It is applied either in solution containing 10 to 20 grains (0.60–1.30 Gm.) to the ounce (30 Cc.) of water, to which a little glycerin is usually added, or in ointment of the strength of ½ to 1 drachm (2–4 Gm.) to the ounce (30 Gm.). In powder or saturated ethereal solution it is sometimes efficient in the treatment of sluggish syphilitic and non-specific ulcerations. In 1 to 3 per cent. solutions it may be applied as spray or irrigation in catarrhal and ulcerating inflammations of the nasal, aural, pharyngeal, bladder, or uterine mucous membranes.

The dose is from 2 to 5 grains (0.12–0.30 Gm.).

Allied and Derivative Compounds.—CATECHOL.—*Pyrocatechin, Orthodioxybenzene.*—This, the third of the group of isomerides having the general formula $C_6H_4(OH)_2$, is contained among the products of the destructive distillation of several tannins and vegetable extracts; it may also be obtained by fusing orthophenolsulphonic acid with caustic potassa for some time at 320° to 360° C. (608°–680° F.); but the best process for manufacturing it is to heat guaiacol to 195° to 200° C. (383°–392° F.), and then passing in hydriodic acid as long as methyliodide distils over. Catechol occurs in acicular crystals or prisms, readily soluble in water, alcohol, ether, and hot toluene, melting at 104° C. (219.2° F.) and boiling at 245° C. (473° F.). With ferric chloride it strikes an emerald-green color which, on addition of sodium bicarbonate, is changed to a beautiful violet red. Catechol dissolves in solutions of alkali hydroxides to brown or black solution. It is a strong reducing agent, reducing silver nitrate in the cold and Fehling's Solution on warming. Pyrocatechin has been used as an antipyretic, but is a dangerous remedy.

HYDROQUINOL.—*Hydroquinone, Hydrochinone, Paradioxybenzene.*—This isomer of resorcin was discovered by Wöhler (1844). It may be obtained by the dry distillation of kinic, succinic, and oxysalicylic acids, but is usually prepared by oxidation of aniline with potassium dichromate and sulphuric acid, and subsequent reduction of the quinone formed by sulphurous acid. Hydroquinol forms long colorless and odorless dimorphous crystals, which have a sweetish taste and melt at 169° C. (336.2° F.). It is soluble in about 17 parts of water at 15° C. (59° F.), and very soluble in hot water, alcohol, and ether. With ferric chloride hydroquinol in strong solution yields green quinhydrone, or, if the iron be added in excess, yellow quinone; these reactions distinguish it from resorcin. Hydrochinone resembles resorcin in its properties, but is more powerful. Large doses cause disturbed cerebration, unconsciousness, convulsions, marked cardiac and circulatory depression, and distinct lowering of body-temperature. Like other drugs which simply lower febrile temperature without shortening the course or diminishing the severity of the disease, its use as an antipyretic has been abandoned. It is eliminated by the urine, to which it imparts a greenish-brown color. It is extensively employed in photography as a developer. The dose is from 10 to 20 grains (0.6–1.30 Gm.).

EURESOL.—*Resorcinmonacetate, Monacetylresorcin.* $C_6H_4(OH)CH_3CO_2$.—Euresol is prepared by heating resorcin with acetic anhydride. It is a yellowish, transparent, syrupy mass having an agreeable odor. It is soluble in acetone. It boils at 283° C. (541.4° F.).

FLUORESCEIN, or *Anhydride of Resorcinolphthalein,* $C_{20}H_{15}O_5$, is obtained by fusing together 7 parts of resorcin and 5 parts of phthalic anhydride; it occurs as yellowish-red to dark-brown crystals, which form with ammonia a red solution, exhibiting a beautiful green fluorescence. Fluorescin is difficultly soluble in water, ether, and benzene. It is soluble in alcohol with yellowish-red color and strong yellowish-green fluorescence, perceptible in solutions apparently colorless by transmitted light. Recommended for the diagnosis of corneal lesions and detection of minute foreign bodies imbedded in that tissue. When aqueous solution is dropped upon the cornea, those parts, however small, which are deprived of their epithelium are colored green, while foreign bodies are surrounded by a green ring (Straub).

RESOPYRINE.—When 30 parts of antipyrine and 11 parts of resorcin, each dissolved in three times its weight of water, are mixed, a crystalline mass separates, which upon resolution in alcohol may be obtained in rhombic crystals. To this compound the name resopyrine has been given. It is odorless and has a faintly pungent taste; insoluble in water, but soluble in 5 parts of alcohol, 30 parts of chloroform, or 100 parts of ether. It differs chemically from resorcin in not forming a precipitate with lead subacetate nor a blue color with ferric chloride.

THIORESORCIN, $C_6H_4O_2S_2$, is a yellowish non-crystallizing powder, readily soluble in solutions of the alkali hydroxides, carbonates, and sulphides, but insoluble in other solvents. It is obtained by heating 1 molecule of resorcin with 3 molecules each of sulphur and sodium hydroxide, with addition of water until solution results; upon acidulating the solution, amorphous yellow flocculi separate, which may be purified by resolution in alkalies and subsequent addition of acid. Thioresorcin has been applied as a substitute for iodoform, but its use was followed by unpleasant symptoms.

RHAMNUS PURSHIANA, *U. S.*—Cascara Sagrada.

Cascara Sagrada, Br., Fr. Cod.—*Chittim-wood bark, Sacred bark,* E.

The dried bark of *Rhamnus Purshiana* DC. (Fam. *Rhamnaceæ*), collected at least 1 year before being used.—U. S.

Cascara Sagrada is official in all the more important pharmacopœias, except the German.

The plant is a large shrub or small tree inhabiting the northwestern United States and adjacent British America, extending south to northern California. The dried quills of bark are now mostly broken up and packed tightly under pressure before being marketed.

Description.—In short quills, mostly 1 to 2.5 Cm. ($\frac{1}{2}$–1 In.) in diameter, or in curved pieces of the same, about 2 to 5 Mm. ($\frac{1}{12}$–$\frac{1}{5}$ In.) thick; outer surface purplish or reddish brown, usually more or less, often completely, covered with grayish or whitish lichens, shallow, wrinkled, and fissured, but never distinctly rough, except in the root-bark; inner surface at first yellowish, becoming darker, and at length of a very dark or blackish brown with keeping, very finely short-striate; fracture short, sharp, and granular, dark red in the outermost, light yellow in the middle, and darker yellow in the inner layers, the last mentioned showing shortly projecting yellow bast-fibres; under the microscope the transverse section exhibits the medullary rays with their outer ends regularly curved together to form dome-shaped groups; odor characteristic, aromatic; taste bitter, slightly aromatic.

When the medullary rays are irregularly curved and grouped, the bark is not of this species.

Adulterants and Substitutes.—This bark was formerly substituted largely by that of *Rhamnus Californica* Esch., a small shrub growing in clumps in California and southeastward. Indeed, there is some reason to believe that the latter was the bark first introduced under the name Cascara Sagrada. Its collection has now entirely ceased. It is in smaller quills, and they are inclined to be of a duller gray, with less purplish red upon the surface. The medullary-ray characters are indicated at the close of the above description. In the powdered condition, Frangula is apt to be substituted or admixed. If the former, stone-cells will be wanting; if the latter, the stone-cells are fewer and the longer bast-fibres of Frangula are to be seen. The Swiss Pharmacopœia mentions that the 1 per cent. decoction of R. Purshiana is merely slightly darkened by ammonia, while that of Frangula is deeply colored. The parenchymatous elements of Cascara Sagrada are colored yellow by chlorinated potash, while those of Frangula are colored deep red.

FIG. 337.

Rhamnus Purshiana (branch, ½ Nat.; bark, Nat.).

FIG. 338.

Rhamnus Californica (½ Nat.).

Constituents.—Cascara sagrada contains much resin and emodin, a small amount of a body that is apparently iso-emodin, about 2 per cent. of tannin, glucose, fixed oil, a little strongly odorous yellow-green volatile oil, rhamnol (apparently identical with quebrachol), a non-laxative hydrolytic enzyme, and a substance yielding syringic acid on treatment with acids. The ash-yield is about 7 per cent. Much effort has been devoted to isolating the active constituent, which Cabannes locates in the layers of bast immediately adjoining the cambium, and in the medullary rays of that layer, but without success. Jowett, who in 1904 made an exhaustive experimental review of the work of preceding investigators, showed that the "cascarine" and "purshianin," reported by them, were impure emodin, and that the emodin is not active. Purshianin probably contains the active constituent, as it was found laxative in $\frac{1}{5}$-grain doses. The active principle is probably a derivative of a glucoside present in the bark, but this is not experimentally proved. Jowett found that the alcoholic extract, extracted with water,

precipitated with lead subacetate, and this precipitate extracted with ethyl-acetate, yielded a non-crystalline, sticky mass which contained the active principle.

Pharmaceutical Preparations.—Extract of Rhamnus Purshiana, Fluidextract of Rhamnus Purshiana, Aromatic Fluidextract of Rhamnus Purshiana, U. S. P.

Action and Uses.—Cascara sagrada is considered to be the best drug we have for habitual constipation due to functional inactivity of the intestine or lack of digestive secretions. It not only increases the secretions of the gastro-intestinal canal, but because of its bitterness acts as a tonic, improves the appetite and digestion, and prevents the constipation which usually follows the use of similar drugs. So marked are the tonic effects of cascara that its dose may be gradually diminished and its use finally discontinued without return of the constipation.

It should never be given as a purge, only as a laxative. It operates usually without causing pain or discomfort, producing semi-solid stools. Cascara tends in some persons to produce hemorrhoids if given over a long period of time. Cascara is usually given in a single dose at night, frequently morning and night. The *aromatic* fluidextract in the dose of 10 to 30 minims (0.60–2 Cc.) is preferred on account of its pleasant taste. The ordinary fluidextract, given in the same dose, has quite a bitter taste, which is difficult to mask. The dose of the solid extract is from 2 to 8 grains (0.12–0.50 Gm.). Larger doses than these may produce irritation of the bowel and intestinal catarrh.

Other Species of Rhamnus.—The genus contains some 70 species, and most of those barks which have been tested were found to possess laxative properties. A number of these are so employed, notably those of *R. alnifolia* L'Her., the *Alder-leaved* or *Dwarf buckthorn*, and of *R. Caroliniana* Walt., of the southeastern United States, the *Southern*, *Carolina*, or *Alder buckthorn*, *Bog birch*, or *Indian cherry*.

Rhamnus cathartica L. (*Cervispina c.*—Moench), of central and southern Europe and adjacent Africa and Asia, the *Purging* or *Hart's buckthorn*, *Rain-* or *Rhineberry* (*Kreuzdorn*, *Hirschdorn*, G.; *Naprun purgatif*, Fr.; *Espina Cerval*, *Ramno Catartico*, Sp.), yields a drug of these names, consisting of the nearly ripe fruits, *Fructus* or *Baccæ rhamni catharticæ* or *Spinæ cervinæ*). The plant is a much and densely branched shrub of thickets, its small branchlets spinose. The dried fruit is globose, about 3 Mm. (⅛ In.) in diameter, strongly wrinkled, and slightly grooved between the seeds; of a dull greenish-gray color. It is seated in a persistent, usually 4-lobed calyx, attached to a slender pedicel about twice the length of the fruit. A small disk is interposed between the calyx and the fruit, the latter consisting of a thin sarcocarp enclosing (usually 4) 1-seeded nutlets, the putamen parchment-like. It has a slight, disagreeable odor, increased on soaking, and a nauseous and bitter taste, and tinges the saliva yellow. Tschirch and Polace isolated 3 yellow coloring-matters, *rhamnocitrin*, *rhamnolutin*, and *rhamnochrysin*. *Rhamnonigrin* is a glucoside yielding chrysominic acid, or, boiled with potassa, emodin. Emodin is also present, apparently identical with that of Frangula, together with sugar, pectin, gum, fat, and a bitter principle. Aside from its medicinal use, this fruit has been employed in dyeing, as have those of *R. infectoria* L. (*French berries*, E.; *Gelbbeeren*, G.; *Graines d'Avignon*, Fr.), which are more brown in color and mostly 2- or 3-grooved and -seeded. *Persian berries* are the somewhat similar fruits of *R. aleoides* L. (*R. amygdalina* Desf., and probably other species. A *Chinese green indigo* is said to be yielded by the fruits of several Asiatic species.

Fig. 339.

Rhamnus cathartica (× 2).

Rhamnaceæ (*The Buckthorn Family*).—This peculiar and somewhat incongruous family comprises, according to Weberbauer, 46 genera and nearly 500 species. It is very difficult to generalize concerning its properties, but it may be said that while one group of species is noted for its laxative or cathartic properties, as above explained, another, represented by *Ceanothus* (see under Krameria), is distinguished by its astringency. As in the case of that plant, so the leaves of *Sageretia theazans* (L.) Brongn. (*Rhammus t.*—L.) are used in China as a substitute for tea. Quite a number of edible fruits are yielded by the genera *Zizyphus* and *Hovenia*. Several of the former are known as *Jujuba*, or *Jujube berries* (*Brustbeeren*, *Judendornbeeren*, G.; *Jujube*, Fr.; *Azufayfas*, Sp.), and were formerly quite an important article of trade. They are produced chiefly in the Mediterranean region, from large spiny shrubs on small trees, both wild and cultivated. The fruits are oval, from 1.25 Cm. (½ In.) to nearly 2.5 Cm. (1 In.) long, bright-red, smooth and shining when fresh, drying brownish and much wrinkled, drupaceous in structure, containing 1 or 2 stones. The pericarp is sweet and mucilaginous.

The wood of *Colletia spinosa* Lam. (*C. horrida* Willd.), of tropical America, is purgative and contains the amaroid or glucoside *colletin*, as probably do several other species of the same regions. The bark of *Discaria febrifuga* Mart., of Brazil, has been used as a cinchona-sub-

stitute. The fruit *Tapura Guianensis* Aubl. is used in Guiana as a fish-poison. The same is true in Mexico of the bark of *Gouania tomentosa* Jacq. (called *Barbasco* or *Castilla de vaca blanca*). It contains saponin and is used in catarrh and otherwise medicinally.

Chewstick is the stem of *Gouania Domingensis* L., chewed by the natives as a sialagogue, stomachic, and carminative, and also credited with disinfectant properties, and used in gonorrhœa. In the same districts, the bark (*Mabee bark*) of *Colubrina reclinata* Brongn., containing a glucoside, is also used as a stomachic.

RHEUM, *U. S.*—Rhubarb.

Rhei radix, Br.; *Radix rhei*, P. G.—*Radix rhubarbi*, Dan., Russ.; *Radix rheorum*, Nor.; *Rhubarb-root*, E.; *Rhubarbe*, Fr.; *Rhabarber*, G.; *Ruibarbo*, Sp.; *Rhuibarbo*, Port.; *Rabarboro*, It.

The dried rhizome of *Rheum officinale* Baillon, *Rheum palmatum* L., and the variety *tanguticum* Maxim., or probably of other species of *Rheum* (Fam. *Polygonaceæ*), deprived of most of the bark and carefully dried.

All pharmacopœias agree in referring this drug wholly or in part to *R. officinale*. Quite a number name also *R. palmatum*. The Dutch and Russian mention *var. tanguticum* Maxim. of the latter species.

Origin.—All genuine Rhubarb used in this country is Chinese rhubarb, in the sense that it is produced in northwestern China or the region near it. Other varieties will be considered at the close of this article. One of the genuine Chinese rhubarb plants is cultivated to some extent in England, but the rhizome is small and commercially inferior and is wholly consumed at home. Turkish or Russian rhubarb is now a name only. Formerly, as a result of treaty arrangements, the very choicest of the Chinese product was exported *via* Russia or Turkey, its selection being controlled by the Russian government, so that there was technically a Turkish or Russian variety, but this arrangement long ago ceased to exist. The best grades of Chinese rhubarb are the Tze-chuen and Shensi products. The great bulk is known commercially as Canton, though this name has gradually ceased to be correct as a designation of geographical origin. These varieties are distinguished chiefly by their "bouquet" or odor, and the inexperienced can scarcely hope to identify them by means of any description. In China, the Hsining product is regarded as much the choicest.

The rhubarb plants possess the same general appearance as that of ordinary garden rhubarb or pie-plant. The leaves and stem proceed from a very thick and fleshy, short, vertical rhizome or "crown," from which a number of thick roots commonly branch. It is dug in the fall, the roots removed, the corky layer peeled off, and the larger rhizomes frequently sliced to facilitate drying. The larger roots are also preserved, though regarded as inferior and commonly known commercially as "tails." The pieces thus trimmed are commonly perforated and hung upon strings for drying. This process is tedious, requiring many weeks, and the article meantime is subject to various dangers. If the process be perfectly conducted, a drug of fine smooth surface and delightful fragrance results. Frequently the producer prefers a surer or more rapid process, and resorts to drying in kilns or ovens, this product being known commercially as "high dried." Such rhubarb bears broad grooves, alternating with ridges, upon its surface, a blackish color commonly existing in at least some of the grooves. Its odor is heavy, rank, and slightly empyreumatic.

Rhubarb is very subject to insect-attack, best prevented by keeping in the tightly closed container a tuft of cotton saturated with chloroform.

Description.—Rhubarb occurs in cylindraceous, somewhat tapering or barrel-shaped pieces, mostly 5 to 12 Cm. (2–5 In.) long and about half as thick, or in vertical halves or slices of the same, the latter usually representing larger rhizomes. The former is known as "round" rhubarb and is commonly preferred to the latter, which is called "flat." The rounded surfaces are mostly slightly angular, evidently as a result of peeling, bright yellow and powdery, the yellow powder being easily rubbed off, when the reddish or brownish medullary rays and intersecting intermediate bands of grayish parenchyma can be seen forming a fine network upon the surface. The odor is peculiar and pleasantly fragrant, the taste bitter, astringent, mucilaginous, and somewhat aromatic, and a decidedly gritty sensation is produced upon chewing, the saliva being colored yellow. Rhubarb is hard and rather heavy. The fracture is irregular and its surface more or less reticulated by the medullary rays. On transverse view, the direction of the medullary rays is seen to be very irregular. The rays

are of a reddish-brown color, running through a grayish parenchymatic tissue. The fibro-vascular bundles are usually present, in the rhizomes only, in a more or less continuous circle near the periphery, and each possesses a peculiar and rather pretty stellate form. In structure, they possess the peculiarity of having their xylem tissue external to the phloem. English-grown rhubarb, besides being smaller, bears much more of the bark, is roughly ridged or wrinkled, and is much softer and lighter in weight than that from China. On scraping down to the medullary rays, the exposed surface is found but little reticulated.

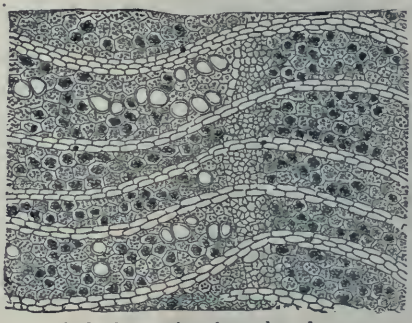
Powdered rhubarb ranges from a rather bright yellow brown to reddish brown. Under the microscope, its most prominent element is the numerous and large rosette-crystals of calcium oxalate, a majority of them being more than 50 mikrons in diameter. Both simple and compound starch-grains occur, the latter rarely of more than 3 granules, and they average about one-third as large as the crystal rosettes. Many smaller rosettes, of few slender crystals, of a deep reddish-brown color are also present. Fibrous elements should be scarce.

Adulteration.—Rhubarb in the entire condition is scarcely subject to adulteration, except by the easily detected Rhaponticum or garden rhubarb described below. Turmeric is often rubbed upon its surface to brighten its appearance. In the powdered condition it is highly subject to such adulteration, the commonest addition being Curcuma, easily detected by its starch-grains (see AMYLUM). Several pharmacopœias call

FIG. 340.

Chinese rhubarb: transverse section.

FIG. 341.



Rhubarb: section through and near cambium (× 40).

attention to the fact that a dark-blue color is produced by ferric chloride, a blood-red color by potassa. The Swiss states that if 50 Gm. of a 5 per cent. solution of sodium carbonate or borax be added to 0.5 Gm. of powdered rhubarb and 5 Cc. of the filtrate diluted to 200 Cc. the color should still be strongly reddish yellow. Also that if it be rubbed up with equal parts of ether and chloroform and spread upon filter-paper, the stain, after drying, should not become orange red upon the addition of a saturated solution of borax nor afterward blackish blue with ammonia (absence of Curcuma). The same substance is indicated when a few grains of the suspected powder added to a few drops of a colorless volatile oil imparts a strong yellow color to the oil about the edges of the particles, as seen under the microscope.

Constituents.—Procter ascertained that alcohol extracts from rhubarb from 30 to 36 per cent. of its weight; diluted alcohol with hydrochloric acid, 16 to 17 more; water with potassium hydroxide, about 26; the insoluble residue being from 21 to 27 per cent. The odorous principle, an oily substance extracted by chloroform, appears to be a derivative, since more of it forms after extraction. Active substances which have been extracted are the resinous matters and "cathartic acid," both of them apparently mixtures of two or more chemical substances. Cathartic acid has been removed by maceration and extraction with water, mixing the filtrate with 95 per cent. alcohol, again filtering, concentrating and treating with absolute alcohol, by which the substance is precipitated, to the extent usually of from 3 to 5 per cent. of the weight of the rhubarb. It is similarly obtained from Senna and some other purgative drugs. It has been found to possess, in doses of 2 to 5 grains, the general purgative properties of rhubarb.

It cannot be said that the activity of rhubarb has been located in any one chemical body. The best résumé of the characteristic constituents is that of Hesse (see *Pharm. Journ.*, 1895, 325), who has studied chiefly the crystalline constituents, which possess little or no activity. These he enumerates as follows: *chrysophanic acid*, or di-oxymethyl-anthraquinone, $C_{14}H_5(CH_3)(OH)_2O_2$, melting at 188° C. (370.4° F.); *emodin*, $C_{14}H_4(CH_3)(OH)_3O_2$; *rhein*, $C_{14}H_3(CH_3)(OH)_4O_2$. Tschirch obtained 1.5 per cent. of

emodin from rhubarb. These three substances are successive oxidation-products of an undetermined body which Hesse thinks is not the substance chrysophan so described by some. All were extracted by ether, together with the active resins, which were then removed by alcohol. From the crystalline residue, chrysophanic acid was obtained by repeated extraction with a dilute solution of potassium carbonate at 40° C. (104° F.), the remainder dissolved in alcohol or glacial acetic acid, and repeatedly recrystallized until the crystals melted at 178° C. (352.4° F.). After its removal it will re-form in rhubarb by exposure to air and water, especially under the influence of potassium hydroxide. It is improperly called an acid. The diluted potassium carbonate removes the emodin and rhein together. They are purified by acidulating with hydrochloric acid and extraction with ether. The emodin is then separated in boiling toluene. It dissolves in caustic alkalies and in potassium or sodium carbonate with a purple color. Lead acetate precipitates from the ammonia solution an amorphous, flocculent, purple body. From the residue, rhein is purified by recrystallization from hot glacial acetic acid. Rhein is practically insoluble in toluene, benzene, ether, cold glacial acetic acid, and is sparingly soluble in alcohol, the solution acid, and in hot glacial acetic acid. It melts to a black liquid at "considerably above 280° C." (336° F.). An amorphous, purple mass separates when the potassium carbonate solution is mixed with solid potassium carbonate. The resin of rhubarb is but little known, although it has been separated into phæoretin, aporetin, and erythroretin. The tannin of rhubarb is known as rheotannic acid. It is a glucoside, yielding *rheumic acid* ($C_{40}H_{32}O_8$). Gilson claims to have separated from it the following crystalline bodies: the glucoside *glucogallum* ($C_{15}H_{16}O_{10}$), a compound of glucose and gallic acid; *tetrarin* ($C_{32}H_{32}O_{12}$), consisting of glucose, gallic acid, and cinnamic acid; and the aldehyde *rhœosmin* ($C_{10}H_{12}O_2$), which melts at 795° C. (175° F.) and has the odor of rhubarb. The remainder, he says, is catechin. Rhubarb contains an unknown bitter principle, considerable starch, and an amount of calcium oxalate which has been reckoned as high as a third of the total powder, though this estimate is probably too high.

No comparison of the constituents of different species of Chinese rhubarb has been made.

According to Tschirch (*Arch. d. Pharm.*, 1902) rhubarb contains no resins whatever, and the purgative activity of the drug is due wholly to the presence of anthraglucosides and their derivatives already named above. Besides the anthraglucosides, tannoglucosides are also present, both evidently the result of primary formation in the plant. Both classes of glucosides are characterized by ready decomposition and conversion into secondary products, such conversion resulting even during the treatment of the drug with ordinary solvents. To what degree the primary anthra- and tannoglucosides have undergone hydrolysis in the drug itself, it is difficult to determine; while it is certain that the drug contains a considerable quantity of free oxymethylanthraquinones, it is possible that the formation of the secondary glucosides results during the extraction of the drug. The same author states that *rhein*, yielding only a diacetyl derivative, cannot be regarded as tetraoxymethylanthraquinone, as stated by Hesse, and has the composition $C_{15}H_8O_6$.

Pharmaceutical Preparations.—Extract of Rhubarb, Fluidextract of Rhubarb, Compound Powder of Rhubarb, Pills of Rhubarb, Compound Pills of Rhubarb, Aromatic Syrup of Rhubarb, Syrup of Rhubarb, Tincture of Rhubarb, U. S. P.

Action and Uses.—The action of rhubarb varies somewhat with the quantity administered. In small doses it is tonic and astringent, improves the appetite, digestion, and intestinal tone, but its continuous use will result in constipation. It produces catharsis if given in sufficient quantity for its purgative principle to be effective. The stools are soft and stained a yellowish brown. It was formerly supposed that this color was due entirely to the presence of the drug, but the investigations of Rutherford and Vignal seem to prove that rhubarb excites the flow of bile, to which the color is partly attributed. After the bowels have been evacuated the astringent principle exerts its influence and constipation results. The coloring-matters of rhubarb are absorbed from the alimentary canal and stain the perspiration, urine, and milk a yellowish tinge. The milk may, indeed, exhibit a bitter taste and purgative properties. If the urine be alkaline, it may be colored carmine. Rhubarb, as a tonic, is applicable to those cases of dyspepsia and duodenal catarrh accompanied by constipation. Its prolonged use, however, may increase the constipation instead of relieving it. As a laxative it is particularly efficient in the summer diarrhœas of infants and children, for, after it has unloaded the bowels of irritating, fermentative products, its astringent influence asserts itself and checks the

diarrhœa. The aromatic syrup is the preparation ordinarily preferred. If the stools are acid and irritating, alkalies, such as magnesium oxide or sodium bicarbonate, should be prescribed with the rhubarb. The constipating after-effect of rhubarb prohibits its use as a laxative in habitual costiveness. The preparations of rhubarb are unnecessarily numerous. The purgative dose of the drug in substance is from 20 to 40 grains (1.3–2.6 Gm.); the laxative or tonic dose is from 5 to 10 grains (0.30–0.60 Gm.). The aromatic syrup, in the dose of from 1 to 2 drachms (4–8 Cc.), is preferred for children. The soap in the pills increases the laxative effect of the rhubarb; 1 to 3 pills constitute a dose. The other preparations are discussed under their respective titles.

Related Drugs and Products.—The medicinally employed rhizomes and roots of other species of Rheum than those discussed above are classed under the general title *European Rhubarb* or *Rhaponticum*, though much of it, especially of that from the continent, is from other species than *R. rhaponticum* L., Holmes naming *R. undulatum* L. and *R. compactum* L. as the sole other sources of that seen in London commerce. Rhaponticum is usually less than half the size of rhubarb, more inclined to a conical form, harder, and lighter colored. The surface is wanting in the parti-colored reticulation, the medullary rays being straighter and the intervening spaces not exhibiting the grayish-white color of genuine rhubarb. The transverse section shows a strong dark cambium zone, and a less irregular radiation. Such stellate bundles as exist are not in a distinct and continuous circle, but more or less scattered. The taste is more bitter and astringent and the effect less gritty. The constituent *Rhapontin* ($C_{22}H_{24}O_9$) is distinct from any found in Rheum. Rhaponticum acts much like rhubarb, but is very inferior to it. Various pie-plant roots have been occasionally seen in commerce in the form of the unpeeled and untrimmed, wrinkled and blackish rhizome and roots. In India, the use of the rhizome and roots of *R. Emodi* Wall. is said to be steadily increasing.

Fig. 342.

Phaponticum: transverse section.

Rhubarb or Pie-plant stems have been found by Otto to contain 0.2 to 0.3 per cent. of oxalic acid, free or in soluble form. (For allied drugs and products, see Polygonaceæ.)

RHUS GLABRA, *U. S.*—Sumach.

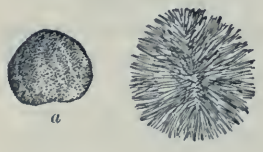
Smooth, Sleek, Scarlet, White, Pennsylvania or *Upland Sumach, Shoe-make, Vinegar-tree*, E.; *Sumach*, G.; *Sumac*, Fr.; *Zumaque*, Sp.

The dried fruit of *Rhus glabra* L. (*Toxicodendron glabra* Mill.—Fam. *Anacardiaceæ*).

This drug is not official in any other pharmacopœia.

Origin.—The plant, which grows in dry localities throughout most of North America, is a handsome, widely-spreading, soft-wooded shrub, often reaching a height of 10 or 12, occasionally 20 feet, and a trunk diameter of 6 or 8 inches or more. The bark is thin, brownish-gray and smooth, except for its small warts. The leaves are from 1 to nearly 3 feet in length and consist of from 11 to 31 leaflets, which are 2 to 4 inches long and a third to a half as broad, lanceolate, acuminate, rounded at the base, sharply serrate, thin, smooth, whitish underneath. The flowers are polygamous, mostly dicœcious, greenish-yellow, and come in large, dense, pyramidal, terminal panicles. The fruit is also in large, dense panicles, often a foot long and 6 inches broad, and of a bright crimson, becoming dark red or blackish as it clings upon the plant during the winter months. The wood, though soft and weak, takes a high satiny polish and is used in cabinet work. Both bark and leaves are largely used in tanning. The latter frequently bear small excrescences, which are especially rich in tannin.

Fig. 343.



a *b*

a, Rhus Glabra: b, R. hirta, (× 3).

Description.—A flattened-ovoid drupe about 4 Mm. ($\frac{1}{6}$ In.) long and equally broad or slightly broader, obtuse, truncate at the base, the epicarp deep crimson and glandular-tomentose, enclosing a yellowish, smooth stone containing a single seed; inodorous; taste acidulous and astringent.

Fruits having a long shaggy epicarp are not of this species.

This drug is subject to adulteration with the fruit of other species of *Rhus*. That of *R. hirta* (L.) Sudw. (*Datisca h.* L.; *R. typhina* L.), the

Staghorn, Velvet, Hairy or *Virginia sumac,* common in eastern and especially in northern North America, is readily distinguished by its shaggy coating of long, rather straight hairs. The plant is named in allusion to the velvety covering of the young stems. The fruit of *R. aromatica* Ait. (*R. Canadensis* Marsh.; *Toxicodendron crenatum* Mill.), the *Sweet* or *Fragrant sumac,* of the eastern and central United States, is smaller, less compressed and more nearly spherical. That of *R. Coriaria* L., the *European* or *Tanner's sumac,* is much rougher, or hispid.

Constituents.—Rhus glabra contains much malic acid in the epicarp and hairs, part of it combined with calcium. It contains also about 2 per cent. of tannic and some gallic acid. The seeds contain fixed oil.

Pharmaceutical Preparations.—Fluidextract of Rhus Glabra, U. S. P.

Action and Uses.—Rhus glabra is a very efficient gargle in acute and subacute inflammations of the throat. It is used either in infusion, made by adding 1 ounce (30 Gm.) of the berries to 1 pint (480 Cc.) of boiling water, or by adding the fluidextract to water and glycerine. The addition of potassium chlorate to saturation to either formula adds to the efficiency of the preparation.

Allied Drugs.—(See also Galla and Rhus Toxicodendron.) The bark and the leaves described above are employed medicinally, as well as for tanning, the bark containing 9 to 15 per cent. of tannin, the leaves 15 to 25 per cent. All the other species named above have a similar composition and are more or less used similarly.

Rhus aromatica.—The root-bark of this species is largely used among the eclectics. It is about 2 Mm. ($\frac{1}{12}$ In.) thick, covered with a fissured and warty brown cork (underneath which the bark is orange-red), and is whitish or pale-brownish in color. It is brittle, breaks with a short, granular fracture, yields an ochre-colored powder, and has a slight pleasant odor and an astringent, aromatic and bitterish taste. The bark contains scattered oil-cells, and has a somewhat checkered appearance from the tangential arrangement of the bast-layer and the radiating delicate medullary rays. In addition to the tannin, as in other species, this contains an alcohol-soluble balsamic oleoresin. Its fruits contain about 10 per cent. of citric acid (Claassen).

The leaves and bark of many other of the 120 recognized species of Rhus are used for their tannin.

RHUS TOXICODENDRON.—Rhus Toxicodendron.

Folia toxicodendri.—Mercury or *Black mercury, Poison oak, Poison, Climbing* or *Three-leaved ivy, Climbing* or *Trailing sumac, Piery, Poison-vine,* E.; *Giftsumach, Giftbaum,* G.; *Sumach vénéneux,* Fr.; *Toxicodendro, Zumaque venenoso,* Sp.; *Sumagre venenosa, S. pubescente,* Port.

The fresh leaflets of *Rhus radicans* L. (*R. Toxicodendron* L. *Toxicodendron vulgare* Mill.—Fam. *Anacardiaceæ*).

Poison ivy is official only in the Spanish and Portuguese pharmacopœias.

Origin.—From a slender shrub, abundant throughout the greater part of North America and somewhat naturalized in Europe. It either trails over the ground, often for several yards, or climbs fences and trees by means of a hair-like growth of false roots which serve no other purpose than to give support. Occasionally, the stem thickens so as to stand erect without other support. This is common with the southern form, to which the name *R. Toxicodendron* (*T. pubescens* Mill.) was applied by Linné. The leaves are long-petioled and have 3 or occasionally 5 leaflets, described below, the lateral sessile or nearly so, the terminal long-stalked. The small greenish flowers are produced in June, in loose drooping panicles, about 2 to 10 Cm. (1 to 4 In.) long, which become somewhat larger in fruit. The fruit is an elongated-globose, gray-green drupe, about 4 Mm. ($\frac{1}{6}$ In.) in diameter. This plant is sometimes mistaken for the Virginia Creeper (see Vitaceæ), which is quite harmless. Poison Ivy is probably the most important vegetable cutaneous poison in existence (see *Action and Uses*). The popular impression that poisoning can result without direct contact with the plant is fully verified. This may occur to one who whips the leaves from a little distance, or even by standing in a strong wind blowing from the plant, and has been explained upon the theory that pollen-grains, or the minute hairs loosened from the leaf, are deposited upon the skin. Both these parts have been experimentally proved capable of producing poisoning. Smoke from the burning plant is also regarded as poisonous, but no proof has ever been recorded in such a case that the poisoned individual had not handled the material. Cases are

recorded of reputed poisonings by being present in a room where the tincture was being bottled. The milky juice turns black upon exposure and can be used as an indelible ink, although it is soluble in ether.

Description.—The leaflets vary from 3 to 20 Cm. (1 to 8 In.) long and more than half to nearly as broad, and are equilaterally (the terminal) or inequilaterally (the lateral) ovate, abruptly short-acuminate, often cuneate (the terminal) or rounded (the lateral) at the base. The margin varies from entire to coarsely and irregularly toothed or crenate, occasionally lobed. The surface varies from smooth and slightly satiny-lustrous to more or less pubescent, especially underneath. The texture is very thin and flaccid, the venation pinnate and slender. They are inodorous, slightly astringent, saline and acrid to the taste.

FIG. 344.

Rhus toxicodendron: leaf (½ Nat.).

Constituents.—Tannin, wax, gum, starch, and resin have been found in this drug, together with the peculiar alcohol-soluble fixed oil or fat *toxicodendrol*, closely allied to *cardol* (see ANACARDIUM). The active principle was regarded by Khittel as a volatile alkaloid, but no one else has been able to confirm the statement. Maisch regarded it as a volatile acid (*toxicodendric acid*), but Pfaff and Orr declare this, when purified, to be non-toxic and to agree with the characters of acetic acid. They find the toxicodendrol to be intensely poisonous, very minute portions producing sensible effects. It has been found present in the leaves to the extent of 3 per cent., and is easily soluble in alcohol, ether, benzene, and chloroform. It produces an insoluble compound with lead. The chemical characters of this fat require further study. It appears reasonable to suppose that, as in the case of Croton oil and similar fats, the active principle is the freed fat-acid, and this has not been studied. It may be, as stated by Maisch, volatile.

Action and Uses.—On man the volatile acid from the living plant of rhus toxicodendron is a powerful local irritant, some individuals being so susceptible to its influence that air impregnated with exhalations from the plant is sufficient to produce the characteristic eruption in them. Herbivorous animals devour its leaves with impunity, but its juice is fatal to dogs. The cutaneous inflammation produced by poison ivy begins to appear between a few hours to several days after exposure, and is characterized by intense itching, redness, and swelling, followed by heat, pain, and vesication. Many remedies have been suggested for the treatment of the eruption.

None of them are curative, but are designed to relieve the itching and irritation. The fresh juice of Impatiens is said to be beneficial when locally applied. Probably the most effective, certainly the most frequently employed, are lead-water and laudanum, or fluidextract of grindelia diluted with alcohol and water. Internally in large doses it gives rise to a burning sensation in the throat and œsophagus, thirst, nausea, faintness, vertigo, delirium, and convulsions. The pupils are dilated and the pulse, at first slow and full, later becomes rapid, irregular, and feeble. In some cases of poisoning by the plant, taken internally, vesicular eruptions have appeared on the skin. Recommended formerly as an internal remedy in incontinence of urine dependent upon atony of the bladder, acute articular and chronic muscular rheumatism, paralysis, and other affections, its use has not produced good results and has been abandoned.

Allied Plants.—Not only do other species of this section of the genus, distinguished by their smooth fruits containing a grooved stone, share the poisonous properties of *Rhus radicans*, but several related genera do likewise. The following are those best known:

Rhus Vernix L. (*R. venenata* DC.; *Toxicodendron pinnatum* Mill.), the *Poison* or *Swamp sumac* or *Dogwood*, *Poison-elder*, *-ash* or *-tree*, is abundant in eastern and central North America. It somewhat resembles *R. glabra*, but is readily distinguished by its reddish petioles and midribs, green lower leaf-surfaces, very loose, open, slender panicles, drooping in fruit, and its smooth fruit. It always grows in wet ground.

FIG. 345.

Rhus vernix L.

R. diversiloba T. et G. (*R. lobata* Hook.) is the *Californian*, *Pacific*, or *Western poison oak*. It quite closely resembles *R. radicans* in habit and appearance.

R. microcarpa (Mx.) Steud. (*R. Toxicodendron microcarpa* Mx.), of Michigan, with somewhat of the habit of Poison Ivy, *R. Michauxii* Sargent (*R. pumila* Mx.), of the eastern United States, and *R. Ryderbergii* Small, of the western United States, are little-known species.

R. vernicifera DC. (*R. Vernix* Thunb.) is the *Japanese lacquer tree* or *varnish-tree*, the varnish or lacquer being the very poisonous milk-juice which exudes from incisions made for the purpose, and suitably prepared. Violent poisoning is common among the workmen. This species closely resembles *R. Vernix* L.

Metopium Linnœa Engl. (*Rhus Metopium* L.; *R. oxymetopium* Griseb.) is the *Coral sumac, Mountain manchineel, Bum-wood,* or *Poison-wood* of Florida and tropical America. It is one of the sources of the Hog-gum or Doctor's gum (see ACACIA). It is the largest of this poisonous group, reaching to 30 feet in height. Its leaves bear 5 long-stalked, ovate, entire, smooth, thickish leaflets and the fruit is red. *M. venosum* (Griseb.) Engl., of Cuba, is very similar.

Comocladia, P. Browne (*Dodonœa* Plum.), contains some 9 species of West Indian and Central American shrubs and trees, mostly with spiny-toothed, coriaceous leaflets. Most, if not all of them, are intensely poisonous, and several are known by the vernacular name *Guao.* In 1900 a number of men forming a landing-party from the U. S. Ship "Richmond" were severely poisoned by *C. platyphylla* A. Rich. The spread of the poison was readily checked by applying fluidextract *Grindelia robusta,* and still better by collodion.

Lithræa caustica Miers (*Rhus c.* Hook), the *Litli,* occupies a similar position as an agent of poisoning in Chile, which *Rhus radicans,* etc., do in the United States, and *Comocladia* in the West Indies. *Pseudosmodingium perniciosum* (H. B. K.) Engl. (*Rhus p.* H. B. K.) does the same in Mexico, where it is known as *Goarchitin* or *Stinking wood.* Its milk-juice has been used as a purgative and diuretic. *Melanorrhœa laccifera* Pierre, of Eastern Asia, is to be compared with *Rhus vernicifera,* yielding like it a juice which is used as a black dye or varnish, and being similarly poisonous. *Holigarnea ferruginea* March., of the East Indies, contains a poisonous cardol-like substance. *Gluta Renghas* L., of southeastern Asia, has a similar poisonous juice. The oily juice of the pericarp of *Anacardium* has been known to produce cutaneous poisoning, as has that from several species of *Semecarpus,* and it is quite likely that very many other plants of this family, not now suspected, will be found poisonous in greater or less degree.

ROSACEÆ.—The Rose Family.

This family, if we include in it as subfamilies the *Drupaceæ* or Plum family and *Pomaceæ* or Pear family, comprises neary 100 genera and 1500 species. From a medicinal point of view it is rather uninteresting, its drugs being mostly astringents, though we have elsewhere discussed the important articles RUBUS, ROSA, OLEUM ROSÆ, QUILLAJA, CUSSO, GILLENIA, PRUNUS VIRGINIANA, and the AMYGDALÆ, besides a number of astringents in connection with GERANIUM and RUBUS. Otherwise than medicinally the family is of great importance. It is first among fruit-producing families, supplying the apple, pear, quince, medlar, peach, plum, apricot, cherry, nectarine, strawberry, raspberry, blackberry, service-berry, etc. In the ornamental species which it contributes to cultivation it is also among the first families. The principal minor drugs of the family are the following:

Spiræa or *Hardhack* (*Purple* or *Spice hardhack, Pink meadow-sweet* or *-queen*) is the root, bark, leaves, or flowers of *Spiræa tomentosa* L., a shrub about a meter high, of peculiar appearance, growing throughout eastern and central North America, in poor soil, especially where slightly boggy or moist. The stems are strict, little erect-branched, pubescent, densely clothed with the more or less erect leaves, which are short-petioled, 3 to 5 Cm. (1–2 In.) long, and a little more than half as wide, ovate, irregularly and rather coarsely serrate, smooth above, rusty or white woolly underneath. The flowers are borne in narrow, steeple-shaped terminal panicles, of a beautiful rosy pink. They are usually only about 4 Mm. ($\frac{1}{6}$ In.) broad, and have a small 4- or 5-lobed calyx bearing an equal number of petals and numerous conspicuous stamens. The pistils are several, distinct, and become follicles in fruit. The drug has a little bitterness with its astringency, and the flowers are somewhat fragrant. The drug is used wholly for the contained tannin, the amount of which has not been determined.

S. salicifolia L., the *Common* or *Willow-leaved meadow-sweat, hardhack* or *Queen-of-the-meadow, Mock-willow* or *Bridewort,* is abundant in the same region and also grows through northern Europe and Asia. It is more inclined to grow in dryer ground, and has a more spreading habit, its leaves smooth, its flowers usually white (sometimes pink), in broader, shorter, and looser panicles. It is used similarly, as is the European *S. Filipendula* L. (*Filipendula vulgaris* Moench), called *Dropwort* or *Droopwort.* The genus comprises some 40 species and about a dozen of these are recorded as being similarly used.

Ulmaria, Meadow-, Honey-, Maid- or *Bride-sweet* (*Ulmarispiräe, Medesüss, Krampf, Geissbart,* G.; *Ulmeira, Siene des piês,* Fr.), is the herbage of *Ulmaria Ulmaria* (L.) Barnh. (*Spiræa u.*—L.; *U. palustris* Moench; *Filipendula u.*—Maxim.), of Europe. It is one of 9 species, long confused with *Spiræa,* and containing, in addition to tannin, considerable volatile oil, consisting chiefly of salicylous acid. The plant is a branching perennial herb, with interruptedly pinnate leaves, the leaflets lance-oblong to ovate, and serrate, the small white flowers in long-peduncled corymbs. *Aruncus Aruncus* (L.) Karst. (*Spiræa A.*—L.), the *Goat's-beard* (*Bock-bart,* G.; *Barbe chèvre,* Fr.), is a somewhat similar herb, but with the white flowers in ample panicles. It is native of northern Europe and North America and a related

species is a favorite flower of cultivation. Its constituents and properties are similar to those of the last.

Sorbus or *Mountain-ash* (*Wild ash, Whistle-wood, Witch-wood, Wicker* or *Rowan-tree*, E.; *Eberesche, Vogelbeere*, G.; *Sorbar*, Fr.) is *Sorbus Aucuparia* L. (*Mespilus A.*—Scop.; *Pyrus A.*—Gærtn.), a small tree of Europe and adjacent Asia, and cultivated for ornament. It has large pinnate leaves, whence its resemblance to the ash, and terminal corymbs of white flowers, followed by light-red, ovoid, juicy fruits, tipped by the calyx-lobes and containing about three 2-seeded cells. These fruits are the portion used, in either the fresh or the dried state. They contain tartaric acid before, citric and malic acids after ripening; two sugars, sorbin and sorbit, the latter often fermentative; parasorbic acid ($C_6H_8O_2$), which is aromatic and is converted into isomeric sorbic acid by heating under pressure with potassa; bitter, acrid and coloring-matters.

The bark is astringent, and yields amygdalin. The American species *S. Americana* Marsh. (*Pyrus A.*—DC.; *S. microcarpa* Pursh.), which bears many local names, is very similar. A large number of species of this, and of the related genus *Pirus*, are employed. The related genus, *Crotoneaster nummularea*, F. et M., of Persia and India, yields an *Oriental manna*, believed to be the same as *sorbit*.

Agrimonia or *Agrimony* (*Herba Agrimoniæ.—Odermening, Leberklette*, G.; *Aigremoine, Eupatoire des Grecs*, Fr.) is the dried plant *Agrimonia Eupatoria* L., a perennial herb of Europe, about 2 feet high, growing along roadsides, about houses, and in the borders of morasses and thickets. The root is fibrous, several-headed, and brown; the stem almost simple; the leaves about 13 Cm. (5 In.) long below, pinnate, with 4 to 8 pairs of elliptic-oblong, coarsely toothed leaflets, intermixed with several pairs of minute ones; the stipules semi-cordate, clasping, and coarsely serrate. The yellow flowers are rather small, in slender spicate racemes, and have a persistent top-shaped calyx, which is covered with hooked bristles. The plant is collected while flowering from June to September and deprived of the coarse stems. It has a very faint aromatic odor and a bitterish, mildly astringent taste, which is stronger in the root. Bowman reported it as containing 4.75 per cent. of tannin, besides which there is a bitter volatile oil. The genus contains about 20 species, and all are apparently closely similar in constituents and properties.

Fig. 346.

Agrimony (½ Nat.).

Closely related to Agrimonia are the genera *Poterium, Acœna*, and *Alchemilla;* a dozen or more species of these have been used as astringents, almost precisely like Agrimonia.

Geum or *Water-avens* (*Radix caryophyllatæ aquaticæ, R. benedictæ sylvestris.—Purple* or *Drooping avens, Throat-root, Chocolate-root*, or *Indian chocolate*, E.; *Sumpfnelkenwurzel, Wasser-Benedikten-Wurzel*, G.; *Racine de bénoite aquatique* or *des ruisseaux*, Fr.) is the dried rhizome and roots of *Geum rivale* L., a perennial herb of wet places almost throughout the north-temperate zone. It has a stem 30 to 60 Cm. (1–2 Ft.) high, with lyrate or interruptedly pinnate root-leaves and trifoliolate or 3-lobed stem-leaves, the leaflets or lobes being obovate or cuneate-oblong; the bell-shaped calyx is purplish brown; the 5 petals are clawed, purplish yellow, and veined. The rhizome is nearly horizontal, 5 to 7 Cm. (2–3 In.) long, about 6 Mm. (¼ In.) thick, somewhat branched, tuberculate above from the bases of the stems, and there densely beset with red-brown hairy leaf-sheaths. It is externally blackish brown, breaks with a rather short and waxy fracture, and has a thin purplish-brown bark, brown-gray pith, and small distant light-colored wood-wedges. It has a very faint, somewhat clove-like odor and a bitterish-astringent taste.

Fig. 347.

Purple avens (¾ Nat.).

Geum urbanum L. is commonly known as *Avens* or *Yellow avens*, also *City avens*, *Clove-root*, *Bennett* (*Radix caryophyllatæ—Nelkenwurz*, G.; *Benoite*, Fr.). It is a yellow-flowered species, of Europe, somewhat naturalized in the United States. Its rhizome is oblique or perpendicular, 25 to 50 Mm. (1–2 In.) in length, abrupt below, or passing into the main or tap-root; it is hard, dark-brown, tuberculate, and beset with dark-brown membranous scales; the numerous thin fibers are pale-brown, and 7 to 10 Cm. (3–4 In.) long; the wood is in 5 or 6 broad and rounded wedges and encloses a large purplish pith. It has a distinct clove-like odor and a bitter astringent taste.

Two white-flowered species of eastern North America are *G. Virginianum* L., the *Rough white avens*, or *Red-root*, and *G. Canadense* Jacq. (*G. album* Gmel.), the *American white avens*.

G. urbanum has been found to contain tannin, volatile oil, and a bitter principle, resin, gum, fat, and sugar.

Several other of the 40 species of the genus are similarly used.

The unripe fruits of various species of *Crataegus* or *Hawthorn*, especially *C. Oxyacantha* L., the English Hawthorn, are used for their astringent properties.

Cercocarpus ledifolius Nutt., or *Mountain mahogany*, of the great western desert plains of the United States, is a much-used astringent among frontiersmen. *Cowania Mexicana* Don, a closely related plant or the same region, besides being astringent, bears upon its leaves and twigs an abundance of a strongly odorous oleoresin, and is extremely bitter. Its constituents and properties are well worthy of investigation.

ROSA GALLICA, *U. S.*—Red Rose.

Rosæ gallicæ petala, Br.; *Flores rosarum rubrarum.—Red-rose petals*, E.; *Essigrose, Sammtrose, Zuckerrose*, G.; *Rose rouge, Rose de Provins*, Fr. Cod.; *Flore. do Rosa Rossa*, It.; *Rosa roja, R. rubra*, Sp.; *Rosas rubras, Rosa Franceza Dobrada*, Port.

The dried petals of *Rosa gallica* L. (Fam. *Rosaceæ*), collected before expanding.

Red-rose petals are official in nearly all pharmacopœias.

Origin.—This species, which bears bristly prickles and a few curved spines, and the leaflets of which are slightly cordate at the base, is a native of southern Europe and the Levant, and is everywhere cultivated for ornament in many varieties. For the production of the commercial petals it is chiefly cultivated in southern France, though the industry is carried on to some extent in nearly all parts of central and southern Europe. With a sharp knife, the unopened corolla-bud is circumcised near the base, so as to leave the stamens behind upon the calyx. The resulting cones should be quickly dried and kept entire as nearly as possible.

FIG. 348.

Rosa gallica.

Description.—Mostly in small cones consisting of the naturally imbricated petals, deep purplish-red, and with a velvety looking surface; the unfolded petals roundish, retuse at the summit, narrowed at the base into a short, broad, yellow claw, the most of which has been trimmed off; of a fine rose-like odor, and a bitterish, slightly acrid and astringent taste.

Constituents.—The important constituent of Red Rose is the red coloring-matter. It was isolated by H. Lenier (1877) by exhausting the petals with ether, and afterward with alcohol; the tincture was precipitated with lead acetate, and this precipitate decomposed by an insufficient quantity of sulphuric acid in the presence of alcohol. The coloring-matter becomes deep-red, with a bright-green fluorescence, by alkalies; it decomposes carbonates, yields with alkalies crystallizable compounds, and is precipitated by salts of alkaline earths and metals, the lead salt having the composition $Pb_2C_{21}H_{29}O_{30}$. The astringency is due to a little gallic acid and the glucoside *quercitrin*, together with a little quercetin, a decomposition-product of the former. The presence of tannic acid is in question. The odor is due to a very small amount of volatile oil, not identical with the official OLEUM ROSÆ. A considerable amount of sugar, gum, fat, etc., are also present.

Pharmaceutical Preparations.—FLUIDEXTRACT OF ROSE, HONEY OF ROSE, SYRUP OF ROSE, U. S. P.

Action and Uses.—Formerly employed for their mild astringency, red rose leaves are to-day used almost solely to impart their pleasant odor to pharmaceutical preparations.

Allied Products.—ROSA CENTIFOLIA or PALE ROSE (*Rosæ centifoliæ petala*, Br.; *Flores rosæ*, P. G.; *Flores rosarum incarnatarum.—Cabbage rose-petals, Hundred-leaved Rose*, E.;

Centifolienrose, Rosenblätter, G.; *Rose à cent feuilles, Rose pâle*, Fr. Cod.; *Flores di Rosa Pallida*, It.; *Rosa pallida, Rosa de Castilla*, Sp.; *Rosas Pallidas*, Port.) is the petals of *Rosa centifolia* L. It is official in nearly all pharmacopœias. This well-known shrub, which is by some botanists regarded as a cultivated variety of the red rose, is probably indigenous to Western Asia, and is cultivated in innumerable varieties in all countries. Its branches are covered with numerous nearly straight spines; the petioles and peduncles are nearly unarmed, but more or less clothed with glandular bristles, and the leaves have 5, or sometimes 7, ovate or elliptic-oval serrate, glandular, and, beneath, soft-hairy leaflets. The flowers are collected and deprived of the calyx and ovaries, the petals alone being employed. The petals are roundish-obovate, retuse at the apex or almost obcordate, of a pink color, a delicious rose odor, and of a sweetish, somewhat bitter, and slightly astringent taste. In drying, they become brownish and less fragrant. The constituents of White Rose are closely similar to those of the Red. There is very little coloring-matter, apparently identical with that of Red Rose. A little tannin is present.

Rosa Caninæ Fructus, Rose Fruit or *Rose hips* (*Cynosbata, Fructus cynosbata.—Dog-rose fruit*, R.; *Gratte-cul*, Fr.; *Cynorrhodon*, Fr. Cod.; *Hagebutte*, G.; *Cinosbato, Escaraninjo, Uva de gato*, Sp.), long official in the B. P., but now discarded, is the ripe fruit of *Rosa canina* L., and of other species of Rosa. This, the Dog-rose of Europe, is very similar to the Sweetbriar rose, and is slightly naturalized in eastern North America. The fruits are about 25 Mm. (1 In.) in length, ovate, contracted above, of a bright-red color, shining, internally stiff-haired, and enclose a number of ovate, hairy, brownish, bony akenes. Hips are at first tough and crowned with the 5-cleft deciduous calyx-lobes; later in autumn they are naked above, softer, and more fleshy. They are inodorous and have a sweet acidulous and somewhat astringent taste. For medicinal use, the hard akenes are removed and the fleshy calyx-tube alone is employed. Scheele noticed malic and citric acids in the pulp. Biltz (1824) obtained 7.78 per cent. of malic and 2.95 of citric acid; also 30.6 of sugar, 25 of gum, and small quantities of tannin, resin, wax, malates, citrates, and other salts. Hips are described as slightly refrigerant and astringent, but they are used in medicine only to prepare the confection of hips.

ROSMARINUS.—Rosemary.

Folia rosmarini, F. roris marini, F. anthos.—Old man, E.; *Rosmarin, Meerthau*, G.; *Romarin*, Fr. Cod.; *Romero*, Sp.

The dried leaves of *Rosmarinus officinalis* L. (Fam. *Labiatæ*).

This pretty, much and slenderly branched evergreen shrub, about a meter high, and bearing small pale-blue axillary flowers, is a native of the Mediterranean basin. It is cultivated for ornament and as a domestic herb, and to some extent for the distillation of its oil, but the drug, as well as the oil, is chiefly derived from wild sources.

Description.—About 2.6 Cm. (1 In.) long, linear by the strong revolution of the margins, oblong when flattened, sessile, obtuse at both ends, entire, of leathery texture, dark-green above, densely woolly and glandular-dotted underneath; odor peculiarly aromatic, somewhat camphoraceous; taste pungently aromatic.

Constituents.—The drug contains from 1.5 to 2 per cent. of volatile oil (see Oleum Rosmarini), together with considerable resin, tannin, and a small amount of an unstudied bitter principle.

Action and Uses.—The uses of rosemary are the same as those of the oil (see Oleum Rosmarini).

RUBIACEÆ.—The Madder Family.

Genera about 350, species nearly 5000, most abundant in the tropics, throughout the world, and decreasing as the climate becomes cooler. The family yields many edible fruits, but scarcely any of them are very good, and it cannot be considered of any importance as a food-producer. Its timbers have been little used, though many of them have most valuable properties, and will, without doubt, become highly prized for special uses. Many of its species are highly ornamental, in both foliage and flowers, and have become favorites for decorative purposes. The principal economic importance of the Rubiaceæ has been as a producer of dyestuffs, and even more so as a producer of drugs. The number of species yielding drugs to commerce is remarkably small, in view of the great number of domestic remedies, of undoubted activity, that the family produces. The most interesting characteristic of the family is the great number and variety of its alkaloids, in which it is scarcely excelled by any other. The physiological properties of the Rubiaceous drugs are very

diverse in character, though bitter tonics and febrifuges predominate. The astringent drug GAMBIR has been separately discussed. Although this property is shared by many species, yet astringency can scarcely be regarded as characteristic of this family. Many of the fruits, in an unripe condition, are so used, much like persimmon. Such is the case with those of several species of *Genipa*, especially *G. Americana* L., though edible when ripe. It contains tannin, the glucoside genipin and mannit, in which last the leaves are said to be very rich. Mannit is also abundant in the leaves and bark of *Basanacantha spinosa ferox*. The constituents and properties of the ripe and unripe fruits of *Gardenia Brasiliensis* Spr. are practically the same as those of Genipa. That of *G. jasminoides* Ell., the Japanese *Shang-shih-see*, Chinese *Shan-chi-tsze*, has many medicinal uses in the Orient. Many other species of Gardenia are employed medicinally. *G. radicans* Thunb. is the Chinese *Hwang-chi-tsze*. *G. suaveolens* Vell. is the Brazilian *Lasanjus de mate*. *G. gummiifera* L. and *G. lucida* Roxb. yield the East Indian Elemi-like substance *Decamala resin*. The fruits, as well as the barks, of various species of *Randia* are used as astringents, though the fruit-pulp of *R. Mussænda* DC. is a laxative. The fruit of *R. dumetorum* L. (*R. spinosum* Bl.), of the East Indies, is used medicinally and as a fish-poison, and bears a large number of local names. Its root is a nauseant and antispasmodic.

The properties of *Caffea*, of this family, are also separately considered. The seed of *Diplospora sphærocarpa* Hook. is said to be used in India as a coffee-substitute.

Under IPECACUANHA, many species have been cited as possessing properties similar to those of that drug, but the number, pertaining to this family alone, might have been greatly extended.

Of Cinchona-substitutes the same is true. Dozens of barks of this family are employed domestically, and many of them professionally, in tropical countries, for properties similar to those of Cinchona.

Some of the more important of the minor drugs of this family are the following:

Mitchella, Squaw-vine or *-plum, Partridge-, Chicken-, Cow-, Deer-, Box-, Fox-, Snake-*, or *Two-eyed berry, Running-* or *Ground-box* or *Winter clover*, is the dried stems and leaves of *Mitchella repens* L., a slender creeping evergreen of eastern and central North America. The stems reach 1 foot or 2 feet in length; leaves opposite, short-petioled, about 8 to 12 Mm. ($\frac{1}{3}$–$\frac{1}{2}$ In.) long, roundish-ovate, entire, thickish, deep-green or bearing whitish margins. The flowers are in pairs, often dicœcious, have a white or pale-purplish funnel-shaped corolla, and 4 exserted or included stamens, and produce a rather dry berry-like scarlet-red fruit, which is composed of 2 united ovaries and contains 4 bony nutlets. The flowers are fragrant; the leaves are inodorous, somewhat astringent, and bitter. Brenneiser (1887), besides the usual constituents of plants, found a saponin-like body, precipitable by baryta, and frothing in aqueous solution, and also a principle yielding precipitates with tannin and picric acid, but being neither alkaloid nor glucoside.

Various species of *Galium* have been employed in medicine, chiefly as diuretics, and for various skin diseases. That commonly employed is *G. verum* L. (*G. luteum* L.; *G. floridum* Salisb.), the *Tallow* or *Lady's bed-straw* or *Cleavers, Curdwort* or *Cheese rennet plant* (*Megerkraut, Labkraut, Liebfrauenstroh*, G.; *Caille lait jaune*, Fr.; *Cuajaleche*, Sp.), a slender, much-branched perennial herb of Europe and temperate Asia and naturalized in North America. The root is light red, the stem weak and smooth, the leaves in whorls of 8, narrowly linear, rough, the panicled flowers small, yellow, fragrant, the fruit small, strongly 2-lobed, smooth. The herb is astringent, acidulous, and bitter. Little is known of its constituents, except that it contains several common vegetable acids and some tannin, but it probably also contains one or more alkaloids. It has been used to curdle milk. *G. Aparine* L., known generally by the same names, also *Catch-, Cling-, Snatch-*, or *Grip-weed* or *-grass*, and by very many other domestic names, is a very slender European species, abundant in the United States, which has also been much used. The stem is long, reclining, sharply quadrangular, and retrorsely hispid on the angles. The leaves are commonly 6-whorled, lance-linear, mucronate, and retrorsely hispid, the white flowers scattered. *G. triflorum* Mx., the *Sweet-scented bed-straw*, exhales the odor of cumarin produced in drying. The same is true of *Asperula odorata* L., the *Sweet woodruff* or *Sweet hay-plant* (*Waldmeister, Herzfreude, Sternleberkraut*, G.; *Aspérule*, Fr.), which yields the European *Herba asperulæ, cordialis*, or *matrisilvæ*. *Galium tinctorium* L. yields a red coloring-matter and is often called *Wild madder* or *Dyers'-cleavers* or *bed-straw*. *G. circæzans* Mx. and *G. lanceolatum* Torr., of the eastern United States, have a liquorice-like sweetness and are sometimes called *Wild liquorice*. Some 25 species of *Galium* and *Asperula*, very closely related, have been employed.

Cephalanthus, Buttonbush, Buttonwood, Swamp dogwood, Crane willow, Wild liquorice, Honeyball, or *Pinball*, is the bark, more especially of the root, of *Cephalanthus occidentalis* L. The shrub grows in swamps almost throughout the United States, and extends into southern Canada. It is a large, widely spreading shrub, with rich glossy foliage. The leaves (sometimes in two's) and flower-heads are here illustrated. The commercial bark occurs in small fragments, about 1 or 2 Mm. ($\frac{1}{25}$ or $\frac{1}{12}$ In.) thick. That of the stem is grayish brown, finely striate and somewhat glossy if young, or dull ashy gray, fissured and scaly if older. That

of the root is in shorter and more irregular fragments and of a brown and somewhat rusty color. The inner surface is whitish when fresh, becoming light rusty brown, and very finely striate. The fracture is rather tough-fibrous. It is nearly odorless, bitter and slightly astringent. The bark contains cephalanthin, cephalin, starch, sugar, gum, fat, several resins, tannin, and a saponin-like principle. *Cephalanthin* ($C_{22}H_{34}O_6$) is an amorphous, very bitter glucoside, soluble in alcohol and acetic ether, and with difficulty in ether, chloroform, and water. The aqueous solution foams on shaking. Boiled with acids, it yields crystalline *cephalanthein* ($C_{16}H_{28}O_3$) and sugar. *Cephalin* is a yellowish-white, crystalline, tasteless glucoside soluble in alcohol, ether, and chloroform, and with difficulty in water. It is strongly fluorescent in solution. With acids it yields sugar and crystalline *cephaletin*, which fluoresces in alkaline solution.

FIG. 349.

Cephalanthus twig (½ Nat.), with flower (× 3).

Cahinca Root (*Radix caincæ* or *cainanæ.*—*Caincawurzul*, G.; *Cainça*, Fr.) is the root of the tropical American *Chiococca brachiata* R. et P. (*C. densifolia* Mart.; *C. anguifuga* Mart.) and of *C. alba* (L.) Rusby (*Lonicera a.*—L.; *C. racemosa* Jacq.). There is considerable doubt as to the applications of the names to the respective drugs, owing doubtless to the great variability of the species. They are also called *Snowberry*, *Brazilian snake-root*, *Rais preta do Brazil*, etc. They apparently have important tonic properties. The woody root occurs in pieces 7 to 15 Cm. (3–6 In.) long, about 2 to 6 Mm. ($\frac{1}{12}$–$\frac{1}{4}$ In.) thick, more or less bent, externally blackish- or grayish-brown, finely wrinkled longitudinally, with narrow transverse corky ridges and fissures, with a thin brown bark of a resinous lustre internally, and with a whitish wood. It is usually mixed with portions of the lower stem, which are 12 to 25 Mm. ($\frac{1}{2}$–1 In.) thick, and have deep longitudinal furrows, with intervening rounded, often very prominent, ridges produced by separated wood-bundles, which have not been developed into separate branches; the porous wood encloses a thin pith and is radiate. The bark has a nauseous, bitter and acrid taste. It contains green fatty matter, of a nauseous odor, yellow coloring-matter, a colored viscid substance, tannin (caffeotannic acid?), and *cahincin* or *cahincic acid* ($C_{40}H_{64}O_{18}$). This latter forms white, odorless, very bitter, and slightly astringent silky needles, soluble in 600 parts of water and readily in alcohol. Treated with dilute hydrochloric acid it yields at first glucose and chiococcaic acid ($C_{28}H_{42}O_7$), and by prolonged boiling, *caïncetin* ($C_{22}H_{34}O_5$), the alcoholic solution of which gelatinizes on the addition of water. Cahincic acid exists in the root partly free and partly as a calcium salt.

Rubia, or *Madder* (*Krapp*, *Färberröthe*, G.; *Garance*, Fr.; *Granza*, Sp.), is the root of *Rubia tinctoria* L., a perennial herb, native of the Levant and largely cultivated in various countries for its value as a dye, its medicinal use having nearly ceased. The roots are numerous, elongated, cylindrical, about as thick as a quill, light blood red, easily separable into a gray-red corky layer, a thin dark brown-red inner bark, and a spongy red wood, with irregular medullary rays. It is of a feeble color, and a sweetish, bitterish, somewhat acrid and astringent taste. Madder is usually found in the shops in the form of a coarse powder. The fresh root contains a yellow coloring-matter, while the commercial article contains the decomposition-products, many being glucosides, yielding *alizarin*. *Rubian* is amorphous, dark yellow, bitter. *Rubihydran* and *rubidehydran* are gum-like (Schunck, 1847–56). Rochleder's *ruberythrinic acid*, $C_{20}H_{22}O_{11}$ (1855, etc.), crystallizes in silky yellow prisms. The most important constituent is *alizarin*, $C_{14}H_8O_4$, which crystallizes in orange-red sublimable needles, is soluble in boiling water, alcohol, and ether, and yields purple or red-colored compounds with bases. Other compounds obtained from madder are *rubitannic acid*, *rubichloric acid*, *purpurin*, *rubiretin*, etc. The artificial production of alizarin was discovered by Graebe and Liebermann,

and it is now manufactured from *anthracene*, $C_{14}H_{10}$, a crystalline constituent of coal-tar, which is oxidized to *anthraquinone*, $C_{14}H_8O_2$; this is then converted into a sulphonic acid or a bromo-compound, which by the action of alkalies yields alizarin. A half dozen other species of *Rubia* are similarly employed, and some of them are employed medicinally for disorders connected with the blood, probably in consideration of their color. *R. cordifolia* L. (*R. cordata* Thunb.) is called *Manjith*, *Tamra-valli*, and by other names, in India. *R. Munjistin* Roxb. is the Chinese *Si-ts'au-kan*. Three coloring-matters have been isolated from *R. Sikkimensis* Kurz., which are claimed to be distinct from those of madder.

Morinda (*Al-Dye*).—A red dye very similar to that of madder is prepared in the East Indies from the roots of a number of species of *Morinda*, especially *M. citrifolia* L. and the perhaps distinct species *M. tinctoria* Roxb. The coloring-matter is called *morindin*. The use of this dye is somewhat complicated, and is fully treated in *Agricult. Ledger*, 1895, No. 9, and 1896, No. 22. Articles dyed with it are said not to be attacked by insects. The leaves of *M. citrifolia* are used as an astringent, the fruit in hepatic disorders. The fruit of *M. Royoc* L., of tropical America, is used as a purgative; the leaves of *M. tomentosa* Heyne, of India, as a vulnerary, the bark of *M. bracteata* Roxb. as an anthelmintic, and the juice of the fruit and leaves of other species as antispasmodics.

Oldenlaudia umbellata L. (*Hedyotis Indica* R. et Sch.) yields the East Indian root *Ghé*, or *Chayavar*, from which a red dye is obtained, and which is also used medicinally, as are its leaves. The same is true of *O. lactea* DC., which has many local names in India. *O. dichotoma* Hook. is the *Papata* or *Kazuri*.

The root of *Mussœnda frondosa* L. is very largely employed in India, under many names and for many purposes, depending chiefly, it would appear, upon the saponin contained.

Triodia irritans R. Br. is supposed to be the plant the root of which yields *Spinifax* resin, used by the Australian natives for cementing arrow-heads. This is described as an exceedingly tough resin, of a dirty dark-bronze color, and a very persistent and disagreeable odor, slightly resembling beeswax.

Several species of *Rondeletia*, of tropical America, yield oleo-resins which are used as vulneraries.

Bothriospora corymbosa Hook. (*Evosmia c.* Schombk.), of Guiana, is said to be poisonous, and the same is true of the berries of *Kraussia coriacea* Sond., of Natal. The root of *Guettarda speciosa* L. is vesicant. That of *Plectronia parviflora* Bedd., of India, is used as an anthelmintic under the name *Kirni*. The very bitter bark of *Sarcocephalus esculentus* Lab., of west Africa, is used as a refrigerant and tonic under the name *Dundaki*, and is chewed like Coca. The wood is also used under the name *Nijmo*. The alkaloid *dundakine* has been isolated. Given hypodermically to frogs, it produces a paralytic or cataleptic condition, and kills by suspending respiration, without affecting the heart.

Nauclea inermis R. Br., related to *Ourouparia*, is used in the Soudan in the form of the leaf-infusion, as an anti-emetic and to allay rheumatic pain.

Several hundred additional species of Rubiaceæ have been recorded as in use medicinally.

RUBUS, *U. S.*—Blackberry.

Bramble, Finger-berry, E.; *Brambeeren*, G.; *Ronce noir, Ronce sauvage*, Fr. Cod.; *Zarzamora*, Sp.

The dried bark of the rhizome of *Rubus villosus* Ait., *R. nigrobaccus* Bailey, and *R. cuneifolius* Pursh. (Fam. *Rosaceæ*).

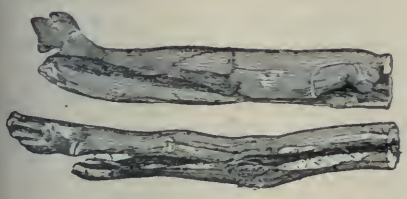
Blackberry bark is not official in any other pharmacopœia.

Origin.—The genus *Rubus* L. contains about 250 species, divided into two well-distinguished groups, the Raspberries, in which the mature fruit leaves the torus behind, and the Blackberries, in which the torus comes away as a part of the fruit. Most of the species belong to the latter group, and they are so closely related and so variable that their study presents very great difficulties. Recent researches have shown clearly that *Rubus villosus* does not occur at all in North America, the common high bush blackberry, which has long been so called, being *R. nigrobaccus*. *R. Canadensis* L. and *R. trivialis* Mx., heretofore named in the U. S. P. definition, are both low, or running blackberries, and the vertical habit of growth of the roots, and the thinness and fragility of their barks, effectually prevent collection. The European *R. villosus*, the American *R. nigrobaccus*, and especially *R. cuneifolius*, the very abundant Sand-blackberry of the Eastern and Southern States, all have long horizontal rhizomes, with a thick bark which slips off easily, in quills, after a longitudinal incision has been made upon one side. The blackberry plants are too well known to require description.

Description.—The drug is in elongated, tough, flexible quills from 3 to 6 Mm. ($\frac{1}{8}$–$\frac{1}{4}$ In.) in diameter, or in similar bands, the bark 1 to 2 Mm. ($\frac{1}{25}$–$\frac{1}{12}$ In.) thick; outer surface

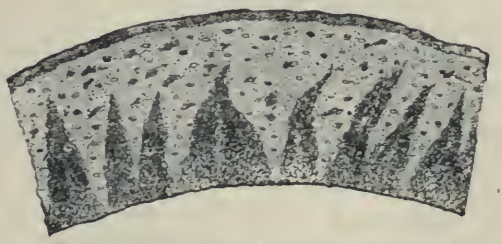
deep red brown or dark gray brown, occasionally blackish brown, smoothish or somewhat scaly; inner surface yellow or pale brownish, strongly and coarsely long straight-striate; fracture tough-fibrous; readily splitting; inodorous; taste strongly astringent and bitterish.

FIG. 350.



Rubus (Nat.).

FIG. 351.



Rubus villosus: transverse section through bark (× 15).

Constituents.—The important and active constituent of Blackberry root is from 10 to 20 per cent. of tannic and a little gallic acid. There is nearly 1 per cent. of the bitter glucoside *villosin*, apparently related to saponin, which can be extracted with water, but more readily with alcohol. It occurs in fine silky needles and is readily decomposed into *villosic acid* and sugar. About 7 per cent. of resin, a little volatile and fixed oil, wax, etc., also occur. An alkaloid has been reported, but probably does not exist.

Pharmaceutical Preparations.—FLUIDEXTRACT OF RUBUS, SYRUP OF RUBUS, U. S. P.

Action and Uses.—Blackberry and dewberry roots possess tonic and strongly astringent properties. They are favorite household remedies in the treatment of summer diarrhœas of children and adults. A decoction, made by boiling 1 ounce (30 Gm.) of the bark of the root in 1½ pints (720 Cc.) of water until 1 pint (480 Cc.) remains, is given in the dose of 1 to 2 ounces (30–60 Cc.) every 3 or 4 hours. Blackberry cordial is frequently used for the same purpose. The dose of the powdered root is from 20 to 30 grains (1.3–2.0 Gm.), of the fluidextract, 20 to 30 minims (1.3–2.0 Cc.), and of the syrup, 1 to 2 drachms (4–8 Cc.).

Allied Drugs.—The leaves of *Blackberry* and *Raspberry* (*Folia Rubi Idæi*), like those of many related plants (see ROSACEÆ), are used like Rubus, as intestinal astringents. They possess the advantage over the bark of containing large amounts of gum, which imparts rather distinct and in many cases superior properties. They are largely used as household remedies. Blackberry fruit, even when ripe, is more or less astringent, and its wine is highly valued for this property.

Rubus Idæus (*Raspberry; Himbeeren*, G.; *Framboise*, Fr. Cod.; *Frambuesa, Sanguesa*, Sp.) is the fresh ripe fruit of the cultivated European Raspberry, though the 1890 Pharmacopœia allowed the native red Raspberry (*R. strigosus* Mx.) and the native Black Raspberry or *Black cap* (*R. occidentalis* L.) to be used when the other is not obtainable. This fruit contains no distinctively medicinal constituent, and is valued solely for making a pleasant syrup to be used as a vehicle or adjuvant. Besides the water, raspberries contain 4.5 to 8.7 per cent. of insoluble matter, 4 to 8 per cent. of ash, and 7 to 8.5 per cent. of organic constituents, about one-half of which is sugar, one-fourth is malic and citric acids, and the remainder consists of proteids, pectin, etc. The odor is due to a volatile oil consisting of compound ethers, and when distilled with water the distillate separates a white flocculent stearopten. The only use of raspberries in medicine is for the preparation of an agreeable syrup.

RUMEX.—Rumex.

Radix rumicis, R. lapathi.—Dock, E.; *Grindwurz, Mengelwurz*, G.; *Patience*, Fr.; *Lapato*, Sp.

The dried root of *Rumex crispus* L. and of other species of Rumex (Fam. *Polygonaceæ*).

Origin.—The genus *Rumex* L. contains more than 100 species, mostly of the north-temperate zone, through which they are rather evenly distributed. Only a few of them have been employed under the official title, and probably none other than the two following to any appreciable extent. *R. crispus* L. is the *Curled, Curly*, or *Narrow-leaved dock*, and is preferred. It is a native of Europe and Asia and very exten-

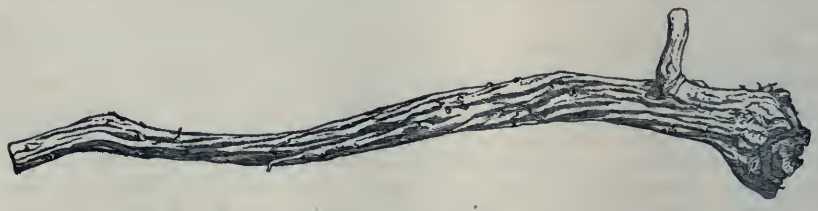
sively naturalized in North America as a field and roadside weed. Its lowermost leaves are often more than 1 foot in length, linear-lanceolate and strongly crisped and wavy-margined. The upper leaves are similar but successively smaller. The erect stem is rather slender, coarsely angled, and the inflorescence a large, slender, terminal panicle, which at length becomes a dense mass of rusty-brown, 3-winged capsules, each about 3 to 4 Mm. ($\frac{1}{8}$–$\frac{1}{6}$ In.) long. These leaves are largely consumed in the spring as a pot-herb, and exercise an excellent laxative and antiscorbutic effect.

R. obtusifolius L. is the *Yellow, Common, Broad-leaved* or *Blunt-leaved, Bitter* or *Butter dock.* It has the same nativity and range as the last, but is far more abundant along roads, and in cultivated ground, and is more largely used in European countries. It is well distinguished by its broad, blunt, nearly flat leaves. Dock-root should be collected in autumn.

Description.—From 20 to 30 Cm. (8–12 In.) long and 1 to 2 Cm. ($\frac{2}{5}$–$\frac{4}{5}$ In.) thick, nearly simple, tapering or somewhat fusiform, with few if any rootlets, finely annulate above, very strongly wrinkled and usually twisted, deep red brown, marked with small indented, often transversely elongated, scars; fracture short but somewhat splintery-fibrous; transverse section whitish, becoming yellow, the bark thick, the wood finely radiate in the outer portion; odor slight, peculiar; taste bitter and astringent.

Rumex obtusifolius is darker, and usually divides near the crown into a number of smaller parallel branches, with more adhering rootlets.

FIG. 352.



Rumex crispus (½ Nat.).

Constituents.—The chemical constituents of dock are closely similar in kind to those of *Rheum*, though the relative proportion of the astringent principles is much greater in Dock. The *rumicin* and *lapathin* of earlier investigators were regarded by von Tann as identical with chrysophanic acid, but this is probably incorrect, since Hesse finds the rumicin of *R. Nepalensis* Wall. ($C_{15}H_{10}O_4$) to be isomeric with chrysophanic acid, but with a different melting-point, and that of Dock is probably the same. With the *rumicin*, occur nepodin and lapodin. *Nepodin* ($C_{18}H_{16}O_4$) occurs in long greenish prisms, melting at 158° C. (314.4° F.). *Lapodin* ($C_{18}H_{16}O_5$) occurs in fine crystals.

Action and Uses.—Yellow dock possesses astringent and tonic virtues allied to those of rhubarb. It is not extensively employed at the present time, but was formerly an esteemed remedy, given internally and applied locally in scabies and chronic cutaneous eruptions, especially those of a scrofulous nature. Some species of Rumex were used in indigestion and hepatic congestion. A decoction, made by boiling 2 ounces (60 Gm.) of the fresh root, or 1 ounce (30 Gm.) of the dried root in 1 pint (480 Cc.) of water, was given in 2-ounce (60 Cc.) doses. For external application the root was made into cataplasm, ointment, or decoction.

Other Species.—*R. sanguineus* L., the *Bloody* or *Red-veined dock, Blood-wort* or *Olcott-root,* and *R. aquaticus* L., the *Water dock,* both of Europe, the former somewhat naturalized in the United States, are astringent, especially their fruits. *R. alpinus* L., of Europe and Asia, is compared with rhubarb for its bitterness and astringency. *R. acutus* L., of Europe, has been much used in pulp as a dressing for foul ulcers.

R. acetosa L. (*Acetosa magna* Gilib.; *A. officinalis* Gueld.; *A. pratensis* Mill.), the *Green, Meadow, Cock, Ginger,* or *Kitchen sorrel, Sour-grass, Sharp dock, Ginger sauce* or *Sour sauce, Sourock, Sauerampfer* (G.), *Oseille commune* (Fr.), *Acedera* (Sp.); *R. Acetosella* L. (*Acetosa A.* Mill.; *Acetosella vulgaris* Four.), the *Horse, Sheep, Cow, Field, Mountain, Red-top, Food,* or *Gentleman's sorrel, Red-weed* or *Ranty-tanty;* and *R. scutatus* L. (*Acetosa s.* Mill.), the *French sorrel,* represent a different class, being small herbs with slender creeping rhizomes and strongly acid herbage like that of *Garden pieplant.* They are natives of Europe and the two former, especially the second named, are among the worst meadow-weeds of the United

States. The leaves, the part used, contain oxalic acid as potassium binoxalate, and oxalic acid is also found in the rhizome when young.

R. hymenosepalus Torr. (*Canaigre, Wild* or *Texas Pieplant*), very common through the southwestern United States and adjacent Mexico, and becoming very extensively cultivated for tanning purposes, forms a sort of connecting link between the two groups already considered. Its leaves are acid and its roots highly astringent, containing from 25 to 40 per cent. of tannin, together with a large amount of starch.

Oxalis and Oxalidaceæ.—This genus and family may be considered in connection with the acid-leaved *Rumices*, since they owe similar refrigerant and antiscorbutic properties to the same constituent, potassium binoxalate (Salt of Sorrel). The species understood by the name *Oxalis*, is *O. Acetosella* L. (*Oxys A.* Scop.), the *Wood-sorrel* or *Wood-sour, Ladies' Sour-grass, Clover sour, Sleeping clover, Cuckoo-sour* or *Cuckoo's bread, Laverocks, Shamrock, Sauerklee* or *Hasenklee* (G.), *Surel* or *Alleluia* (Fr.), *Acerdilla* or *Soayol* (Sp.). It is a low and tender, pubescent herb of deeply shaded forests of North America, Europe, Asia, and northern Africa. It grows from a scaly rhizome which sends up long-petioled, stipulate, trifoliolate leaves, the leaflets broadly obcordate, and still longer scapes, each bearing a single, very pretty, white, purple-veined, bell-shaped flower. Several other species are common little weeds, with branched stems and yellow flowers. They possess a similar herbage and can be similarly employed. A species of Brazil is there used as a refrigerant under the Portuguese name *Raiz de azedinha grama*. Many species of *Oxalis* are cultivated in houses and gardens for ornament. Of the 250 to 300 species, some, of the tropics, become very large, their succulent trailing stems several yards in length and an inch or two in thickness. They usually have acid properties.

Averrhoa Carambola L. and *A. Bilimbi* L. are small trees of the Orient, which yield very curious, crisply succulent, finely acid fruits, the *Bilimbi* and *Averrhoa* (*Wo-lien-tsze* of the Chinese), used for their refrigerant properties, and to some extent for preserves. Under the Tagala name *Kamias*, also *Bilimbin*, these fruits are eaten and preserved in the Philippines, and are used to remove ink and rust stains.

RUTA.—Rue.

Rue, Fr. Cod.; *Garden rue, Herb-of-grace*, E.; *Raute*, G.; *Ruda*, Sp.

The leaves of *Ruta graveolens*, L. (Fam. *Rutaceæ*).

Origin and Description.—The Rue plant is a perennial herb, or sometimes a weak undershrub, of southern Europe, and is often cultivated there and in other countries as a domestic medicinal herb. The lower leaves are long-petioled, the twice or thrice pinnately compound blades 7 to 15 Cm (3-6 In.) long, broadly triangular-ovate, smooth, grayish- or yellowish-brown, the ultimate divisions from oblong-obovate to spatulate, more or less wedge-shaped at the base, rounded at the summit, usually somewhat crenate, thickish, glandular and pellucid-dotted as seen against the light. The upper leaves become more shortly petioled, smaller, narrower and less compound. The yellowish flowers occur in terminal corymbs. The capsules are 4- or 5-lobed and contain numerous angularly ovoid blackish seeds. The odor is peculiar, heavy and rather disagreeable, the taste aromatic, bitter and acrid.

FIG. 353.

Rue leaf (¾ Nat.).

Constituents.—The important constituent of Rue is a small fraction of 1 per cent. (0.06 per cent., according to Gildemeister and Hoffmann) of a volatile oil which is colorless or more or less yellow and is said to be the lightest of all volatile oils (specific gravity, 0.833 to 0.840). It is extremely unpleasant and odorous unless greatly diluted, when it is less unpleasant. It has been found to contain a peculiar ketone, but its composition is mostly unknown. It was official in the U. S. Pharmacopœia from 1870 to 1890. Rue also contains the glucoside *rutin* (*rutic* or *rutinic* acid, $C_{42}H_{50}O_{25}$), which is yellow and crystalline and is believed to be iden-

tical with the barosmin of Buchu. It occurs also in Capers. The decomposition of rutin is the source of *quercetin*, which also occurs in Rue in large amounts. There is also considerable sugar, and a volatile alkaloid has been reported, though its presence is doubtful.

Action and Uses.—Locally applied, rue is an irritant and vesicant.

Internally it is stimulant, carminative, and emmenagogue. In large doses it is an irritant poison, producing severe gastro-enteritis, vomiting, abdominal pain and distention, bloody stools, strangury, and epileptiform convulsions, rarely death. In moderate quantity it may be given as a uterine stimulant in menorrhagia, metrorrhagia, and amenorrhœa due to atonic conditions of the uterus, but its employment as an abortifacient is attended with great danger to the mother. It is sometimes used for the removal of round worms, but is not a safe anthelminitic. Rue is given in the dose of 15 to 30 grains (1–2 Gm.), usually in infusion. The dose of the oil is from 3 to 6 minims (0.20–0.40 Cc.), best given in capsule.

RUTACEÆ.—The Rue Family.

The *Rutaceæ*, including the *Aurantiaceæ* as a subfamiily, comprises, according to Engler, about 111 genera and nearly 1000 species, almost all tropical, a very few extending into cool-temperate regions. The important Citrus fruits pertain to the subfamily named above. These have been considered under LIMONIS, AURANTIA, etc. Except for these, economic interest in the family is almost wholly medical, and is very great. As separate articles, we have considered the drugs CUSPARIA, XANTHOXYLUM, PILOCARPUS, and BUCHU, which fairly represent the constituents and properties of the family. The former are most generally volatile oils, indicated by the pellucid dots seen when the leaves are held against the light. They are commonly, if not generally, associated with resins, which are themselves often active. Both alkaloids and glucosides are very common. The active constituents of the drugs are in general highly diffusible and act powerfully on the glandular system, both secretory and excretory, so that the drugs are largely used as alteratives. A very large number of them are used as febrifuges, antiperiodics, and bitter tonics. It is rather remarkable that a family so rich in native and domestic remedies, and these of such marked activity, should be so sparingly represented in professional materia medica.

Ptelea or *Shrubby trefoil* (*Wafer* or *Stinking-ash, Hop-, Quinine-*, or *Sang-tree, Wing-seed*, etc., E.; *Hopfenbaum, Kleebaum*, G.; *Orme à trois feuilles*, Fr.) is usually understood as the bark, especially of the root, of *Ptelea trifoliata* L., though the leaves and fruit are also somewhat employed. The plant is a handsome shrub or small tree of eastern North America, extending into southern Canada and northern Mexico. The leaves, downy when young, like the twigs, are alternate, petiolate, light-green, and trifoliolate, with sessile, pointed, indistinctly serrate, and finely pellucid-punctate leaflets, of which the lateral ones are obliquely ovate, and very uneven toward the base, the outer half being broadest, while the larger terminal one is elliptic or obovate and wedge-shaped at the base. They are from 7 to 12 Cm. (3–5 In.) long, when broken exhale a rather unpleasant odor, and have a bitter and somewhat astringent taste. The small greenish-white polygamous flowers are in compound terminal cymes, have a disagreeable odor, and are followed by a flat orbicular fruit, which is 2-celled and 2-seeded, and is surrounded by a circular membranous and slightly emarginate wing, the whole fruit being about 2 Cm. ($\frac{4}{5}$ In.) in diameter and of a pleasant hop-like flavor. The bark occurs in fragments and irregular quills of a brown color, longitudinally wrinkled, lighter and smooth on the inner surface, breaks with a short fracture, and has a bitter and pungent taste. The bark contains at least 3 active constituents, namely, a powerful volatile oil, a soft acrid resin, and an alkaloid. The latter is probably the same as that found in various other plants of the family and supposed to be berberine; but it is quite likely that it will be found distinct therefrom. There are also an inert resin, fat, gum, potassium nitrate, and the alkaloid *arginine* ($C_6H_{14}N_4O_2$).

Fraxinella, or *White fraxinella* (*Dittander, Bastard dittany, Garden ginger*, E.; *Weisse Dictamwurzel, Escherwurzel, Specht wurzel*, G.), is the root of *Dictamnus albus* L. (*D. Fraxinella* Pers.), a tall perennial herb or soft shrub of southern Europe and adjacent Asia. It is an object of curiosity because of a slight explosion of volatile oil which takes place when a lighted match is brought near to its stem. It is rich in volatile oil and bitter constituent, and is an old-time remedy, used as a diaphoretic, diuretic, emmenagogue, and bitter tonic.

The following domestic and native drugs are worthy of investigation:

Toddalia aculeata Pers. yields one of the roots which have been called *Lopez root*. It is used in the East Indies as a febrifuge and in dysentery, and has been occasionally seen in commerce. The leaves of *Orixa japonica* Thunb. (*Sijo-kus-chi-zu*, Chinese) as well as the root (*Si-you-san*, Chin.; *Kokusagi, Haneboku*, Jap.) are used as antiperiodics and insecticides. The bark is said to contain berberine. The bark of the Australian tree *Melicopa erythrococca*

Benth. contains an alkaloid which is a heart poison. *Boronia rhomboidea* Hook., of New South Wales, is anthelmintic. The bark of *Lunasia amara* Blanco (*Rabelasia philippinensis* Planch.; *Mytilococcus zollingeri* Miq.) contains the poisonous glucoside *rabelaisin*, and is used as an arrow poison in the Philippines. The leaves of various species of *Agathosma* and *Coleonema*, of the Cape region, are used like Buchu, and those of *Adenandra fragrans* R. et S., of the same region, are used as a tea-substitute. *Geijera salicifolia* Schott. yields a kind of copaiba in New South Wales. Venezuelan Sandal-wood is obtained from *Spiranthera odoratissima* St. Hil. *Ticorea febrifuga* St. Hil. yields the *Tres folhas brancas* bark of Brazil, used as a cinchona-substitute, as is that of *Hortia brasiliana* Vand. Elemi-like oleoresins are obtained from various species of *Amyris*, especially *A. hexandra* Ham., of the West Indies. *Clausena excavata* Burm. yields the important Chinese drug *Hwang-p'i-kwo*.

Resedaceæ.—This little family, of 6 genera and about 66 species, nearly all in the genus *Reseda*, though not very closely related to the *Rutaceæ*, is much like them in properties. The family is represented in medicine almost wholly by several species of *Reseda* or *Mignonette*. *R. odorata* L. is the *Common* or *Garden mignonette*. *R. luteola* L. is the *Dyers' mignonette*, *weed*, or *rocket*, *Italian* or *Yellow rocket* or *Wild-wood* (*Gelbkraut*, *Wau*, or *Waid*, G.). As its common names indicate, it is used for coloring purposes. It contains the glucoside *luteolin*, and yields the yellow dye *gaude*. It is also used as a diuretic and diaphoretic.

S.

SABADILLA.—Cevadilla.

Cévadille, Fr. Cod.; *Indian barley-caustic*, E.; *Sabadillsamen, Läusekörner*, G.; *Cebadilla* (or *Cevadilla*), Sp.

The dried ripe seed of *Asagræa officinalis* (Ch. et Sch.) Lindl. (*Veratrum o.*—Ch. et Sch.; *Schœnocaulon o.*—Gray; *Helonias o.*—Don; *Sabadilla o.*—Brandt.—Fam. *Liliaceæ*).

Origin.—The Sabadilla plant is a poisonous bulbous perennial, indigenous to the tropical coast of the Gulf of Mexico. The seeds are produced, 2 to 6 in a cell, in a small 3-celled capsule, in which they are commonly exported from Mexico.

FIG. 354.

Asagræa officinalis, *Lindley:* fruit, nat. size; seed and longitudinal section magnified.

Description.—From 5 to 8 Mm. ($\frac{1}{5}$–$\frac{1}{3}$ In.) long, narrowly lanceolate or lance-oblong, the smaller end terete and tapering, the larger somewhat shovel-shaped, with a short ridge running the length of the hollowed side; dark red brown or brownish black, strongly wrinkled; endosperm whitish and oily, and containing at the base a small linear embryo; nearly odorless, but the powder highly sternutatory; taste very bitter and persistently acrid.

Constituents.—The important constituent of sabadilla is about 1 per cent. of several alkaloids (see VERATRINA), which exist with fat, wax, gum, coloring-matter, and *sabadillic* or *cevadic acid* and *veratric acid* ($C_9H_{10}O_4$), the latter crystalline, soluble in alcohol and hot water, fusible and sublimable, like the former.

Action and Uses.—Sabadilla is of interest medicinally as the source of veratrine. It was employed as a tæniacide in the dose of 5 to 20 grains (0.30–1.30 Gm.), but its administration was occasionally productive of such severe vomiting and drastic purging that it has been discarded as a remedy in internal medicine. Several deaths from its employment are recorded. It may be used in ointment or decoction to destroy body lice and other vermin, and as an application in scabies.

SABAL, *U. S.*—Saw-palmetto.

The partially dried ripe fruit of *Serenoa serrulata* (R. et S.) Hook. f. (*Sabal s.*—R. et S.; *Brahea s.*—Wendl.; *Chamærops s.*—Pursh.—Fam. *Palmæ*).

Origin.—From a stout, evergreen shrub, with a large underground trunk, orbiculate leaves 3 to 7 Dm. broad, with cleft segments, borne on long, stout, spiny-toothed petioles, and paniculate inflorescence and fruit. It is abundant along the southern Atlantic and Gulf coasts of the United States. The bark and wood of the trunk constitute an important tanning agent. The ripe fruit is partially dried, preferably in a fruit-evaporator, and marketed, chiefly in barrels. It is considerably employed in Florida as a food for fowls.

Description.—Fruit 1.2 to 2.5 Cm. long and about half as thick, oblong-ovoid, of a deep red brown or blackish and smooth, except for some wrinkles caused in drying. The epicarp is thickish and strongly cutinized, the sarcocarp juicy and somewhat stringy, the putamen thin and smooth, the seed elliptical oblong, a little flattened on one side, and hard and bony. The odor is peculiar, cheesy, and not very agreeable, the taste sweetish, but slightly acrid and not agreeable.

Constituents.—These fruits contain a large amount of glucose, volatile and fixed oil, resin, and a very little alkaloid. The volatile oil is present in the pulp, and is in very small amount, though yielded by the fresh fruits to the extent of more than 1 per cent. It has a specific gravity of about 0.865, is of a greenish to brownish color, and consists of caproic, caprylic, capric, lauric, palmitic, and oleic acids and their esters.

Uses.—Sabal is thought to possess sedative, tonic, diuretic, and expectorant properties, and has been recommended in the treatment of subacute and chronic inflammations of the genito-urinary tract, chronic bronchitis, pulmonary tuberculosis, and atonic impotence. A fluidextract may be employed in doses of from 1 to 2 fluidrachms (3.7–7.4 Cc.).

SABINA, *U. S.*—Savin (Savine).

Sabinæ cacumina, Summitates (*Herba*) *sabinæ.*—*Savin-tops, E.*; *Sadebaumspitzen, Sevenkraut,* G.; *Sabine,* Fr. Cod.; *Sabina,* Sp.

The tops of *Juniperus Sabina* L. (*Sabina officinalis* Garche.—Fam. *Pinaceæ*).

Origin.—A low, spreading shrubby cedar-tree, bearing a semi-pendulous fruit, somewhat larger than that of the common cedar. It is widely distributed through the north-temperate zone, extending southward in North America to the northern United States. The drug comes chiefly from central Europe.

Fig. 355.

Branch of savin.

Description.—As met with in commerce, savin is in small and thin subquadrangular pieces, consisting of slender twigs, which are densely covered with minute, scale-like, imbricate leaves, arranged alternately in decussating pairs. The leaves are rhomboid-lanceolate, rather obtuse, and closely appressed, and on the back have a shallow groove containing a gland, which is mostly oblong in shape. Older leaves are more pointed and more or less spreading. Savin has a persistent somewhat terebinthinate odor, which is stronger after bruising the branchlets; the taste is nauseous, resinous, and bitter. The drug is frequently mixed with some fruits which are about 5 Mm. (¼ In.) in diameter, globular, but more or less shrivelled, blackish-blue or brownish, contain usually 2 seeds, and have odor and taste similar to but stronger than the branchlets.

Constituents.—The important constituent of Savin is its volatile oil (see Oleum Sabinæ), of which the yield is variously stated at from 4 to 5 per cent. and as high as 10 per cent. With this are tannin, a large amount of resin, and salts of potassium and calcium. The uses of the drug depend wholly upon its volatile oil.

Pharmaceutical Preparation.—Fluidextract of Savin, U. S. P.

Action and Uses.—Savin possesses irritant and stimulant properties. The oil of savin applied to the skin may cause vesication. Medicinal doses produce a sense of warmth in the stomach, stimulate cardiac action and the flow of bronchial secretion, and act as a stimulant to the uterine tissues. It is employed chiefly in amenorrhœa, painful menstruation, and menorrhagia dependent upon atony of the uterus, but is never to be used if congestion of the pelvic viscera exists, or in a condition of general plethora. It must be given cautiously if at all in pregnancy. Its administration in sufficient quantity to cause abortion is attended by alarming symptoms, violent vomiting and purging, strangury, and not infrequently collapse and death. In infusion or decoction, savin has been esteemed, especially by the Germans, as a remedy to be given internally and applied locally in chronic rheumatism and gout. In powder, slightly moistened, it has been used to remove venereal warts and condylomata, and as a stimulating application to indolent ulcers. The dose of savin is from 5 to 10 grains (0.30–0.60 Gm.) in powder, infusion, or decoction. The oil in the dose of from 2 to 5 minims (0.10–0.30 Cc.) is generally employed, dispensed in capsule or emulsion.

Other Junipers and Cedars.—The genus *Juniperus*, L., comprises some 30 species of evergreen trees and shrubs, more or less similar to Savin and with fruits like those of Juniperus. The genus, as is true of most of the species, is widely and abundantly distributed through the northern hemisphere. *J. communis* has been considered under the title Juniperus; *J. Oxycedrus*, under Oleum Cadinum. *J. Bermudiana* L., of the West Indies, is known as the Bermuda pencil cedar. Various other species have also been distilled for their volatile oils. Next to those named above, the most important is the following:

Juniperus Virginiana L., the *Red, Pencil, Virginia* or *Carolina cedar,* E.; *Cèdre de Virginie,* Fr.; *Virginische Ceder, Rothe Ceder,* Ger., is abundant throughout almost the entire eastern and central parts of North America. Its branchlets quite closely resemble those of

Savin, and there has indeed been considerable difference of opinion as to whether these are specifically distinct. The branches which bear the fruit are not recurved as are those of Sabina, and the leaves are somewhat narrower than those of the latter. The constituents of these twigs are almost identical with those of Savin.

The oil of the wood yields *Cedrene camphor* ($C_{15}H_{26}O$), obtained by congealing and expression. The liquid portion thus resulting is *cedrene* ($C_{15}H_{24}$), its odor distinct from and stronger that that of the camphor and its taste at length peppery.

"*Cedar*" is a name generally equivalent to Juniper, but it has also been applied to the following, as well as to other less important, plants: *Cedrela odorata* L. (*C. Cedro* L. f.; *Cedrus o.* Mill.—Fam. *Meliaceæ*), the *Sweet tropical* or *Spanish red cedar*, or *Cigar-box cedar*, also known by a number of local tropical American geographical names. It yields *Oleum Cedrelæ*. The Australian species is *C. Toona* Roxb., and is known as *Toon tree* or *Indian mahogany*. It yields the Toon-tree gum. *Thuja occidentalis* (see THUJA), *Libocedrus decurrens* Torr., the *Post* or *Incense cedar* of our Pacific coast, and *Chamæcyparis thyoides* (L.) B. S. P. (*Cupressus t.* L.; *Thuja sphæroidalis* Rich.), the *Spanish* or *Swamp cedar* of the southeastern United States, are all known as White Cedar, as are some related species in other sections. *Cedrus Cedrus* (L.) Lyons (*Pinus C.* L.; *C. Libani* Barrel; *C. Libanotica* Link; *Abies C.* Poir.) is the *Cedar of Lebanon*. A mistake among the different coniferæ called cedars is not serious, since they exhibit a great general similarity in constituents and properties.

SACCHARUM, *U. S., P. G.*—Sugar.

Saccharum purificatum, Br.—*Refined sugar, Cane-sugar, Sucrose*, E.; *Sucre, Sucre de canne*, Fr.; *Zucker, Rohrzucker*, G.; *Azúcar, Azúcar de caña*, Sp.

The refined sugar obtained from *Saccharum officinarum* L. and from various species or varieties of sorghum (Fam. *Gramineæ*); also from one or more varieties of *Beta vulgaris* L. (Fam. *Chenopodiaceæ*).—U. S. A crystallized sugar, obtained from the juice of the sugar-cane.—Br.

Formula, $C_{12}H_{22}O_{11}$. Molecular weight, 339.60.

Origin.—The sugar-cane appears to have been indigenous to India and other parts of southern and eastern Asia, and has been cultivated from time immemorial. At present it is not known in the wild state, but it is raised in most tropical and subtropical countries, and in many of them for the production of sugar. It is a perennial, and produces a stem which is from 2.4 to 3.6 M. (8–12 Ft.) high, 2 to 5 Cm. (1–2 In.) thick, cylindrical, jointed, and, with the exception of the flowering tops, which are hollow, filled with a juicy pith. The leaves are from 1.2 to 1.5 M. (4–5 Ft.) long, 5 Cm. (2 In.) wide, and linear; and the flowering panicles large, pyramidal, and with spreading branches. Several varieties are known, differing chiefly in the color and hairiness of the stem. *Saccharum chinense* Roxb., which is the principal species cultivated in China, has a slender erect panicle, and is probably a distinct species. Cane-sugar is present in a large number of grasses, particularly in those having a rather thick stem, such as *Sorghum saccharatum* Pers., *S. Holcus saccharatus* L., *Zea Mays* L., and others. From the thorough researches of H. Leplay, published in 1882, it appears that the sugar is produced in the leaves and transferred to the stem, where it gradually accumulates, and when the fruit begins to develop it is conveyed to the grain, where it is converted into starch, the sugar at the same time disappearing from the leaves and diminishing very materially in the stem. It is also present in the juice of the different species of maple, birch, palm, and other trees, and in many fleshy roots, prominent among which is a cultivated variety of *Beta vulgaris* L., or *sugar-beet*, which is largely used in Europe in preparing sugar.

Preparation.—Recently collected sugar-cane yields by crushing and expressing about 80 per cent. of juice, which contains from 78 to 84 per cent. of water, 16 to 21 per cent. of sugar, 0.3 to 0.4 per cent. of mucilaginous, resinous, fatty, and albuminous matters, and nearly the same amount of salts. The juice is a grayish, turbid, sweet liquid, which is clarified by heating, a little lime being at the same time added for the purpose of neutralizing free acid; it is then concentrated by rapid evaporation in open pans, transferred to coolers, where it is frequently stirred, and afterward into casks perforated at the bottom and arranged in such a manner that the liquid portion may drain off and be collected in suitable tanks. The granular solid product thus obtained constitutes the *raw* or *muscovado sugar* of commerce; the liquid portion is known as *treacle* or *molasses*. Raw sugar is refined by dissolving it in water, the solution is heated with

blood, the impurities are skimmed off, and the liquid is filtered through recently burned granular animal charcoal. The clear and colorless filtrate is concentrated in a vacuum-pan, and when of sufficient density run off into conical molds, the narrow orifice of which is closed by a plug. It solidifies as a dense crystalline mass, which is drained by the removal of the plug, and freed from the remaining colored mother-liquor by percolating through it a concentrated solution of pure sugar, after which it is dried and sent into commerce as *refined* or *loaf sugar*. By concentrating the mother-liquors they are made to yield more sugar of an inferior grade, until finally a thick syrupy liquid is obtained, which refuses to crystallize, and is known as *sugar-house molasses*, and in England as treacle.

The method of obtaining sugar from the sugar-beet is very similar to that described, but is attended with greater difficulties, owing to the presence of larger quantities of proteids and other foreign constituents. Sugar-beets contain about 9 to 19 per cent. and yield about 9 per cent. of cane-sugar.

Sugar-cane was practically the sole supply of sucrose until the discovery of sucrose by Andreas Sigismund Marggraf in 1747 in beets opened a new source, which, however, was not commercially successful until the application of improved methods about 1825. By scientific cultivation the original forage beet with a sugar content of 6 per cent. has been developed into the present sugar beet containing as high as 20 per cent., and the actual sugar crop from this source at the present time is equal to, if not greater, than that from the sugar-cane, and in 1901 reached the enormous total of 6,750,478 tons in Europe alone.

The sugar crops of the world during 1901, 1902, 1903, and 1904 are estimated as follows (Willet & Gray, Dec. 15, 1904):

	1904-5.	1903-4.	1902-3.	1901-2.	
Cane-sugar	4,607,000	4,251,699	4,149,632	4,081,509	tons.
European beet-sugar	4,690,000	5,852,043	5,561,257	6,750,478	"
U. S. beet-sugar	191,000	208,135	195,463	163,126	"
Total	9,488,000	10,311,877	9,906,352	10,995,113	"

The beet-sugar crop in 1892 amounted to only 10,000 tons, and to 25,000 tons in 1898.

The consumption of sugar in the United States during the past two years is as follows (Willet & Gray):

	1904.	1903.	
Total of all sugars from all sources	2,767,162	2,549,643	tons.
Consisting of domestic cane	323,646	292,800	"
Consisting of domestic beet	170,135	247,563	"
Consisting of maple	12,000	5,150	"
Total consumption of domestic sugars	521,094	567,038	"
Total consumption of foreign cane-sugar	2,137,036	1,968,946	"
Total consumption of foreign raw beet	102,194	9,028	"
Total consumption of foreign refined beet	6,838	4,631	"
Total from foreign countries and insular possessions	2,246,068	1,982,605	"
Of which from Hawaii	330,745	357,850	"
Of which from Porto Rico	116,942	85,989	"
Of which from Philippine Islands	22,100	29,947	"

Properties.—Sugar occurs in white, dry, hard, distinctly crystalline granules, odorless, and having a purely sweet taste. It is permanent in the air, and soluble at 25° C. (77° F.) in 0.46 part of water and in 137.2 parts of alcohol; also soluble in 0.2 part of boiling water and in 28 parts of boiling alcohol, and in 80 parts of boiling absolute alcohol, but insoluble in ether, chloroform, and carbon disulphide. Its aqueous solution, saturated at 25° C. (77° F.), has a specific gravity of about 1.340, is miscible with water in all proportions, should be colorless, and is dextrogyrate. The aqueous and alcoholic solutions of sugar are neutral to litmus-paper.—U. S. Refined sugar is also seen in commerce broken into small pieces or lumps, known as crushed sugar, and in regular cubes, known as cut-loaf sugar, which are hard and have a granular crystalline texture and a pure white color. Somewhat inferior kinds of sugar are softer, and those having a yellowish tint are often artificially improved in appearance by adding, while crystallizing, a minute quantity of blue pigment, like ultramarine, with the view of neutralizing the objectionable tint and making the sugar appear whiter; such sugar will

yield a yellowish solution with water, and on standing will gradually separate the pigment. Sugar may be obtained in large transparent rhombic prisms, known as *rock candy, saccharum candidum*, which does not differ from lump sugar except that this is in crystalline masses from disturbed crystallization. Sugar has the specific gravity 1.58 (Kopp), and dissolves at ordinary temperatures in one-half its weight of water, yielding a dense, sweet, and colorless liquid known as syrup; saturated at 15° C. (59° F.) such a solution contains 66 per cent. of sugar, and this has the density 1.345082 (Michel and Kraft). At the boiling-point sugar dissolves in water almost in all proportions. At 15° C. (59° F.) 1 part of sugar dissolves in 2 parts of 50 per cent. alcohol, in 7.7 parts of 75 per cent. alcohol, in 14.7 parts of 80 per cent. alcohol, in 31.6 parts of 85 per cent. alcohol, in 175 parts of 92 per cent. alcohol, and in 228 parts of methyl alcohol of the same strength (Casamajor). Sugar dissolves also in glycerin, the solubility being increased on dilution with water. It combines with sodium chloride, yielding deliquescent crystals which contain 14.9 per cent. of that salt. Definite compounds have likewise been obtained with several other salts and with alkalies and alkaline earths (see SYRUPUS CALCIS).

The saccharates of barium and strontium are difficultly soluble. A saccharate of calcium is in commercial use under the name of "Viscogen" for stiffening or giving body to milk and cream.

When sugar is heated to 160° C. (320° F.) it melts without losing in weight, and congeals on cooling to a transparent amorphous yellowish mass known as *barley sugar, saccharum hordeatum*, which becomes gradually opaque on the surface from the formation of minute crystals. If sugar is kept in the melted state between 160° and 170° C. (320° and 338° F.) for a short time, it is converted into a deliquescent mixture of *glucose* and *levulosan;* $C_{12}H_{22}O_{11}$ yields $C_6H_{12}O_6 + C_6H_{10}O_5$; the latter is not fermentable until after it has been boiled with water or dilute acids. When heated to between 180° and 200° C. (356° and 392° F.) sugar turns brown, evolves a peculiar odor, and is converted into *caramel*, $C_{12}H_{18}O_9$, parting at the same time with 2 molecules of water; the pure product of this composition, *caramelan*, was obtained colorless by Gelis (1862). Caramel may be prepared in the same manner from inferior qualities of sugar, from molasses, and from glucose, and the conversion is hastened in the presence of small quantities of alkalies; the addition of a little ammonium carbonate, which is again volatilized by the heat, is of service, for the reason stated. Subjected to dry distillation sugar yields aldehyde, acetone, acetic acid, tarry products and carbon dioxide, carbonic oxide and marsh gas. According to Lassaigne, iodine heated with a solution of sugar is converted into hydriodic acid. Sugar is not directly fermentable, but under the influence of ferments, as well as of dilute acids, cane-sugar is converted into *invert-sugar*, which is a mixture of equal parts of *dextrose* and *levulose*, and is then fermentable. *Invertin* or *invertase*, the enzyme of yeast, inverts sucrose, but not milk-sugar. The inversion of sugar takes place slowly on boiling with water, but cold aqueous solutions keep unaltered for a long time if kept free from germs. Under the same conditions, according to the investigations of Kreusler, Lemoine, and others, light does not exert the inverting effect reported by Raoul (1871). Strong mineral acids quickly invert sucrose. For analytical purposes a 10 to 20 per cent. sugar solution is mixed with 10 per cent. of its volume of concentrated hydrochloric acid, and the mixture heated to 67° C. (152.6° F.). Nitric acid inverts sucrose, and when heated with it produces saccharic, racemic, tartaric, and oxalic acids. Solutions of sucrose are strongly dextrorotatory, but after inversion lævorotatory. Its specific angle of rotation $= +66.5$. It does not reduce Fehling's Solution direct, but does after inversion.

Tests.—The purity of cane-sugar is ascertained by the physical properties described above, and by its complete solubility in water and alcohol. "Both the aqueous and alcoholic solutions of sugar should be clear and transparent. When kept in large, well-closed, and completely filled bottles they should not deposit a sediment on long standing (absence of insoluble salts, ultramarine, Prussian blue, etc.). If 1 Gm. of sugar be dissolved in 10 Cc. of boiling water, the solution mixed with 4 or 5 drops of silver nitrate test-solution, then about 2 Cc. of ammonia-water added, and the liquid quickly brought to the boiling-point, not more than a slight coloration, and no black precipitate, should appear in the liquid after standing at rest for 5 minutes (absence of glucose and of more than a slight amount of inverted sugar)."—U. S. "Aqueous and alcoholic solutions of sugar should have no effect on litmus-paper. The aqueous solu-

tion (1 to 20) should give no turbidity with hydrogen sulphide solution, and give at most a slight opalescence with test-solutions of ammonium oxalate, silver nitrate, or barium chloride."—P. G. "Refined sugar should yield no reaction with the test for calcium, chlorides, and sulphates. When sugar dissolved in half its weight of water is heated to about 82.2° C. (180° F.) with solution of potassio-cupric tartrate or with solution of copper sulphate and excess of solution of potassium hydroxide, there should not result more than a trace of a red or yellowish precipitate (absence of glucose)."—Br.

Action and Uses.—In small quantity sugar is demulcent and slightly sedative to the respiratory mucous membrane. A certain aperient effect is produced by cane-sugar if taken in large quantity, and a diuretic effect by glucose or grape sugar. As a food product sugar, like other hydrocarbons, tends to increase the fatty tissue of the body. This property is exhibited to a greater degree by glucose, which is more easily digested than cane-sugar. Sugar is extensively employed in pharmacy to disguise or improve the taste of medicines or to preserve them from decomposition.

Other Sugars.—GLUCOSE (see GLUCOSUM, p. 722).

LACTOSE (see SACCHARUM LACTIS, p. 1342).

LEVULOSE.—*Chylariose* or *Fruit-sugar.* $C_6H_{12}O_6$. Molecular weight, 178.74.—It frequently accompanies grape-sugar in fruits, also in honey; in some plants it is associated with cane-sugar. It is usually a colorless, uncrystallizable syrup, has nearly the same sweetness as cane-sugar, and is lævorotatory; its angle of rotation = −90.2°. It may be obtained in fine silky needles which are insoluble in absolute alcohol and ether, but dissolve readily in aqueous liquids. Levulose is produced from inulin by treatment with dilute acids; with nascent hydrogen it yields mannite. Among the products by oxidation with nitric acid are succinic, acetic, and oxalic acids.

INOSITE.—*Phaseo-mannite.* $C_6H_{12}O_6.2H_2O$. Molecular weight, 214.50.—It is present in the juice of some meats, in the green fruit of many leguminosæ, in asparagus, and in other plants. It is verp sweet, crystallizes readily from water and alcohol, is insoluble in ether, does not undergo alcoholic fermentation, and yields with nitric acid oxalic acid and explosive compounds.

INVERT SUGAR.—*Invertzucker*, G.; *Sucre inverti*, Fr. $(C_6H_{12}O_6)_2$. Molecular weight, 357.48.—Invert sugar occurs naturally in fruits, honey, and molasses. It is commercially prepared by inverting cane-sugar (sucrose) by means of *invertase* or dilute acids. It consists of equal parts of glucose (dextrose) and fructose (levulose). It is readily fermentable, the dextrose fermenting more readily than the levulose. It reduces Fehling's Solution and is lævogyre to polarized light. A solution which polarizes +100 before inversion will polarize −42.66° at 0° C. (32° F.), and will polarize 0° at a temperature of 90° C. (194° F.).

MALTOSE.—*Malt Sugar.* $C_{12}H_{22}O_{11}$. Molecular weight, 339.60.—Maltose is obtained by the action of diastase upon starch, or by boiling the latter with dilute mineral acids. It occurs in malt extract and certain varieties of commercial glucose. By continued action of the mineral acids it is convertible into dextrose. It is crystallizable in the form of thin needle-shaped crystals, $C_{12}H_{22}O_{11}.H_2O$. It is soluble in water and alcohol. It reduces Fehling's Solution. By heating with acids its reducing power is increased and its rotatory power decreased. It exhibits birotation, which is prevented by the addition of ammonia. Its normal specific rotatory power is $[a]_D = +139$. 10 Cc. Fehling's Solution = 0.0807 Gm. maltose.

RAFFINOSE.—*Melitriose. Pluszucker*, G. $C_{18}H_{32}O_{16}$. Molecular weight, 500.46.—Raffinose is contained in small quantity, about 0.02 per cent., in the sugar beet, and also in some varieties of manna, and in the cotton seed. It crystallizes in the form of thin needles, $C_{18}H_{32}O_{16} + 5H_2O$, which partly melt at 87° C. (188.6° F.) and become anhydrous at 110° C. (230° F.). The crystals are soluble in 7 parts of water at 20° C. (68° F.), in 10 parts of absolute methyl alcohol, in about 900 parts of 90 per cent. alcohol, and insoluble in absolute alcohol. It is dextrogyre; its angle of rotation = +104.5°. Like cane-sugar it does not reduce Fehling's Solution until it has been previously inverted. Boiling dilute acids invert it to dextrose, levulose, and galactose, thereby lowering its dextrorotatory power.

Classification of Sugars.—In composition and constitution sugars belong in part to the alcohols and in part to the aldehydes and ketones. To embrace the large number of synthetical sugars[1] the chemical nomenclature of the carbohydrates has been adapted to indicate the number of carbon atoms in the molecule by the prefixes *bi*, *tri*, *tetra*, *penta*, *hexa*, *hepta*, etc., and a molecular classification into Monoses and Polyoses—according to whether the molecule is simple or compound—*i. e.*, made up of a union of two or more of the simpler monoses. Accordingly the carbohydrates may be classified into:

[1] For a résumé of sugars see Lehrbuch der Organischen Chemie, by Victor Meyer and Jacobson, p. 876 *et seq.*, and the articles by Emil Fischer in Rer. *23*, p. 2114; *27*, p. 3189.

1. Monoses.

A. Saccharoids. Composition $C_nH_{2n+n}O_n$.—Nonfermentable. Alcohols in constitution, and yield the corresponding aldehyde on reduction.

(Triatomic alcohol) $C_3H_8O_3$, Glycerol. (Tetratomic alcohol) $C_4H_{10}O_4$, Erythritol. (Pentatomic alcohol) $C_5H_{12}O_5$, Arabitol, Xylitol. (Hexatomic alcohol) $C_6H_{14}O_6$, Dulcitol, Mannitol, Sorbitol.

B. Monosaccharides. Composition $C_nH_{2m}O_n$. Fermentable. Aldehydic in character, reduce Fehling's Solution, and yield characteristic *osazones* with phenylhydrazine.

Trioses. $C_3H_6O_3$. Glycerose. *Tetroses.* $C_4H_8O_4$. Erythrose.

Pentoses. $C_5H_{10}O_5$. Arabinose, Xylose, Ribose, Rhamnose (methyl-pentose).

Hexoses. $C_6H_{12}O_6$. This series is commonly termed glucoses. Formose, Fructose (Levulose), Galactose, Glucose (Dextrose), Mannose, Rhamno-hexose (methyl-hexose), Sorbose, Talose.

Heptoses. $C_7H_{14}O_7$. Gala-heptose, Gluco-heptose, Fructo-heptose, Manno-heptose, Rhamno-heptose.

Octoses. $C_8H_{16}O_8$. Manno-octose, Gluco-octose.

Nonoses. $C_9H_{18}O_9$. Manno-nonose, Gluco-nonose.

2. Polyoses. Polysaccharides. $(C_nH_{2n}O_n)_n$.

(*a*) Saccharoses. Compounds more or less readily hydrolized into simpler forms on heating with mineral acids, or by the action of enzymes.

C. Dioses. Disaccharides.

Dipentoses. $C_{10}H_{18}O_9$. Arabinon.

Di-hexoses. $C_{12}H_{22}O_{11}$. Sucrose (cane-sugar, maple sugar, refined beet sugar), Lactose (milk sugar), Maltose, Iso-maltose, Melebiose, Trehalose, Turanose.

D. Trihexoses. Trisaccharides. $C_{18}H_{32}O_{16}$. Raffinose, Melixetose.

(*b*) Compounds nonfermentable, but are hydrolized by continued *boiling* with mineral acids into the simpler form of glucose.

E. Polyoses. Polysaccharides. $(C_6H_{12}O_6)_n$.

Mostly amorphous compounds, including cellulose, dextrin, gums, glycogen, inulin, pectin, starch.

The *osazone* test for sugars is a very important one, as the resulting osazones are differentiated by crystalline form and melting-point. The test is performed as follows: To 1 part of the "sugar" add 2 parts of pure phenylhydrazine, 3 parts of sodium acetate (crystals), and 20 parts of water. The solution is then heated in boiling water for from 2 minutes to 1 hour. The following are the melting-points of some of the osazones from different sugars: arabinosazone 160° C., xylosazone 160° C., sorbinosazone 164° C., rhamnosazone, 180° C., galactosazone 193° C., glucosazone 205° C.

SACCHARUM LACTIS, *U. S.*, *Br.*, *P. G.*—Sugar of Milk.

Lactose, Milk-sugar, E.; *Sucre de lait, Lactine,* Fr.; *Milchzucker,* G.; *Azúcar de leche,* Sp.

A peculiar crystalline sugar obtained from the whey of cows' milk by evaporation and purified by recrystallization.

Formula $C_{12}H_{22}O_{11} + H_2O$. Molecular weight, 357.48.

Preparation.—Milk-sugar is one of the constituents of the milk of mammals, and appears to be present in larger proportion in the milk of herbivorous animals than in that of the carnivoræ. To obtain it the butter and casein are first removed, the whey is concentrated, and the liquid permitted to crystallize in large tanks, the crystallization being facilitated by the introduction of thin sticks or cords; the impure crystals are once or twice recrystallized from water. Prior to 1890 nearly all the milk-sugar used in America was produced in Switzerland, but since then large quantities are being made in this country, and at present the importation of Swiss milk-sugar has almost ceased. The present annual production of milk-sugar in the United States is estimated to amount to 1,500,000 pounds. Milk-sugar was manufactured as early as 1619, and was introduced into medicine by Testi in 1698.

Properties.—Sugar of milk occurs in commerce in white, hard, crystalline masses, or a white powder, feeling gritty on the tongue, odorless, and having a faintly sweet taste. It is permanent in the air. On incinerating a portion, the percentage of ash remaining should not exceed 0.25 per cent. Sugar of milk is soluble in 4.79 parts of water at 25° C. (77° F.) and in 1 part of boiling water, but is insoluble in absolute alcohol, ether, or chloroform. Its aqueous solution is neutral to litmus-paper, and is dextrogyrate. On adding to 5 Cc. of a hot, saturated, aqueous solution of sugar of milk an equal volume of sodium hydroxide test-solution and gently warming, the liquid

will turn yellow and finally brownish red. On the further addition of a few drops of cupric sulphate test-solution a brick-red precipitate will appear.—U. S. When heated to 130° C. (266° F.) milk-sugar parts with its water of crystallization without fusion, and leaves a white mass which again absorbs water, at a higher heat becomes yellow, and melts at 203.5° C. (398° F.) (Lieben); but above 170° C. (338° F.) it is converted into *lacto-caramel*, $C_6H_{10}O_5$, and afterward into products similar to those obtained on the dry distillation of cane-sugar and glucose. Milk-sugar does not readily undergo vinous fermentation until after it has been boiled with diluted sulphuric acid, which converts it into *galactose*, $C_6H_{12}O_6$, and glucose. In the presence of casein it is converted into *lactic acid*, alcohol being formed at the same time, but in small quantity only if the free acid is neutralized as fast as it is produced. By boiling with dilute nitric acid it is converted into mucic, saccharic, tartaric, racemic, and finally into oxalic, acid. Its hardness renders it serviceable for reducing other substances to a fine powder.

Citric acid in dilute solution does not alter milk-sugar on boiling (cane-sugar is inverted). In the reduction by Fehling's Solution 1 Cc. of Fehling's Solution is equivalent to 0.006786 Gm. of milk-sugar.

Tests.—If 1 Gm. of sugar of milk be sprinkled upon 5 Cc. of sulphuric acid contained in a flat-bottomed dish and covered with a watch-glass, the acid should acquire at most a greenish or reddish, but no brown or brownish-black color within half an hour (absence of cane-sugar). An aqueous solution of sugar of milk (1 in 10), mixed with a few drops of hydrochloric acid, and warmed to about 50° C. (122° F.), should not be colored or rendered turbid by the addition of an equal volume of freshly prepared hydrogen sulphide test-solution, after standing, well stoppered, in a warm place, 35° C. (95° F.), for at least ½ hour, nor should the further addition of ammonia-water to this solution cause a coloration or turbidity therein (absence of heavy metals). If 1 Gm. of powdered sugar of milk be boiled for 5 minutes with 50 Cc. of distilled water and the solution cooled, no blue coloration should be produced upon the addition of 1 drop of iodine test-solution (absence of starch).—U. S. It is important in applying the sulphuric acid test for the presence of cane-sugar that heat be avoided, as sugar of milk will char at an elevated temperature.

If 15 Gm. of pulverized milk-sugar be left in contact with 50 Cc. of dilute alcohol, and the mixture frequently agitated and filtered at the end of half an hour, 10 Cc. of the filtrate should give no turbidity when mixed with an equal volume of absolute alcohol, nor yield more than 0.04 Gm. of residue on evaporation (P. G.).

It should not leave more than 0.25 per cent. of ash on complete incineration. 1 Gm. dissolved in 10 Cc. of water gives a red color with solution of phenolphthalein after the addition of 3 drops of the volumetric solution of sodium hydroxide (limit of lactic acid) (Br.).

Action and Uses.—Sugar of milk is employed in medicine largely as a vehicle or diluent for other powders. It is not so sweet as cane-sugar, is less apt to irritate the stomach, and is considered to be more readily digested. In doses varying from 1 to 6 ounces (30–180 Gm.) in 24 hours it possesses distinct diuretic properties, and has been found of value in cardiac dropsy. It is the sweetening agent added to the formulas for modified milk given to bottle-fed infants, and when thus employed its diuretic property should be borne in mind.

SAFROLUM, *U. S.*—Safrol.

Safrol, Fr., G.

Formula, $C_{10}H_{10}O_2$ or $CH_2:CH.CH_2.C_6H_3\begin{matrix}O\\ \diagup\ \diagdown\\ O\end{matrix}CH_2$. Molecular weight, 160.86.

The methylene ether of allyl pyrocatechol, found in oil of sassafras, camphor oil, and other volatile oils, purified, if necessary, by repeated crystallization.—U. S. It is also found in the beans of Nectandra Puchury major and minor, in the barks of Athersperma Moschatum, Doryphora Sassafras, and Mespilodaphne Sassafras, and in the oil of various species of Cinnamomum.

Although safrol is the principal constituent of oil of sassafras, which contains as much as 80 per cent., it is commercially obtained from red oil of camphor by fractional distillation, by collecting the fraction boiling at about 230° C. (446° F.). The latter is further purified by repeated chilling and crystallizing.

Properties.—Safrol occurs as a colorless or faintly yellow liquid, with a sassafras-like odor. Its specific gravity is from 1.105 to 1.106 at 25° C. (77° F.), and its boiling-point lies at about 233° C. (451.4° F.). Safrol is optically inactive. On cooling to —20° C. (—4° F.) or below, it solidifies to a mass of crystals, which do not melt below 11° C. (51.8° F.). It is soluble in about an equal volume of strong alcohol, and in about 30 parts of 70 per cent. alcohol, and is miscible in all proportions with ether and chloroform.—U. S.

Safrol crystallizes in well-defined, colorless, monoclinic crystals, having the specific gravity of 1.108, melting at 12° C. (53.6° F.), and recongealing at —20° C. (—4° F.). It may be heated to 280° C. (536° F.) without decomposition. Heated with alcoholic potassium hydroxide solution, isosafrol is formed, which is less toxic than safrol. With bromine, safrol yields crystals of $C_{10}H_5Br_5O_2$.

Action and Uses.—Safrol is highly toxic in its action. It is employed in place of oil of sassafras, and reduces arterial pressure by depressing the vasomotor centre. When taken in small amounts for a protracted period it produces fatty degeneration of the heart, and particularly of the liver and kidneys. It is eliminated from the system principally as piperonalic acid.

SALEP.

Tubera Salep, P. G., *Radix salep.*—*Salep*, G., Fr., Sp.

The dried tubers of various species of *Orchis* and of allied plants (Fam. *Orchidaceæ*).

Origin.—Salep is collected in central and southern Europe and Asia, though the use of the oriental product has greatly declined. The varieties represent two forms, the one with branched, the other and preferable one with rounded and unbranched tubers. The tubers occur in pairs, one a little larger than the other. They are collected in autumn. When fresh, they are bitter. Partly to remove this bitterness and partly to make them dry more readily, they are immersed for a short time in boiling water, after collection.

Description.—Oriental salep is 25 to 40 Mm. (1–1⅗ In.) long, and usually dark-colored; European salep is always smaller. Salep is globular, pyriform, ovate, or oblong in shape, somewhat flattened or wrinkled, with a scar of the terminal bud at the apex, of a pale-brownish-yellow color, somewhat translucent, of a horny texture, hard, inodorous, and of an insipid, very mucilaginous taste. It is generally kept in the form of powder, which has a yellowish color. The tissue consists of thin-walled parenchyma filled with starch, the granules of which are more or less ruptured from scalding, and of large, nearly globular, cells containing gum. The scattered fibro-vascular bundles are small and thin, and a few cells contain raphides.

FIG. 356.

Salep: tubers and transverse section.

Branched salep tubers (*Radix palmæ Christi*) are somewhat flattened, and palmately 2- to 5-branched. The elongated mucilage-cells are not so large as in the other form.

Constituents.—The constituents of salep are subject to great variation in relative amounts, with the season of collection. Raspail found the old tuber, collected in autumn, to be free from starch, while the young one was richly supplied with it. The important constituents are starch and gum, with a little sugar and about 5 per cent. of proteid. The ash should be about 2 per cent.

Action and Uses.—Salep is nutritious and demulcent. Made into jelly, it is employed in some parts of Europe and Asia as an article of diet. To allay irritation of the gastro-intestinal canal it is used in mucilage made by shaking 1 part of powdered salep with 10 parts of cold water until it is uniformly diffused, when 90 parts of boiling water are added and the whole well agitated.

The oriental *Royal salep* is believed to have been derived from a plant related to the onion.

SALICINUM, *U. S.*, *Br.*—Salicin.

Orthohydroxybenzylglucoside.—*Salicine*, Fr.; *Salicin*, G.

A glucoside obtained from several species of salix and populus (Fam. *Salicaceæ*). Salicin should be kept in well-stoppered bottles.—U. S.

Formula, $C_{13}H_{18}O_7$ or $C_6H_{11}O_5.O.C_6H_4.CH_2OH$. Molecular weight, 283.99.

Origin.—Salicin exists in the bark of most species of salix and populus, and to a small extent also in the leaves and pistillate flowers. According to Herberger, it is best prepared from the bark of young wood, which contains it in relatively larger proportion than the trunk bark, and associated with smaller quantities of other compounds, which interfere with its isolation. It may also be prepared from populin by boiling it with lime-water or with solution of barium hydroxide. Salicin was discovered by Leroux (1830); in the same year Braconnot obtained from it saligenin and saliretin, without, however, recognizing their relations to salicin; these and the glucoside nature of the latter were first established by Piria (1838, 1845). The amount of salicin in the bark is very variable, and has been found to depend largely upon the species, sex of the tree, and the season, and also varies for different parts of the bark. David Brown (*Pharm. Jour.*, 1903, p. 588) found the following per cent. of salicin in the different parts of the bark of salicin purpurea: outer bark 2.5 per cent., middle bark 8 per cent., inner bark 11.3 per cent., whole bark 5.8 per cent. Salicin has also been obtained synthetically (Lesenko, 1864) from *helicin* by the action of sodium amalgam.

Preparation.—A decoction of willow-bark is deprived of tannin and coloring-matter by digesting it with levigated litharge (Duflos) or by precipitating with basic lead acetate (Peschier); in the latter case the free acid is afterward neutralized with calcium carbonate. The filtrate on concentration yields crystals which require purification by recrystallization. The tannin may also be removed by milk of lime, and the salicin taken up by alcohol from the filtrate concentrated to a soft extract.

Properties and Tests.—Salicin occurs in colorless, silky, shining, crystalline needles, rhombic prisms, or a white crystalline powder; odorless, and having a very bitter taste. Soluble in 21 parts of water and in 71 parts of alcohol at 25° C. (77° F.), in 3.3 parts of water at 80° C. (176° F.), and in 22 parts of alcohol at 60° C. (140° F.); insoluble in ether and chloroform. It melts at 201.4° C. (394.5° F.). Upon ignition, it is consumed, leaving no residue. Its aqueous solution is lævogyrate and neutral to litmus-paper. On heating a small portion of salicin in a test-tube until it turns brown, then adding a few Cc. of water, and afterward a drop of ferric chloride test-solution, a violet color will be produced. Sulphuric acid produces a red color, which disappears upon the addition of water. Upon gently heating 0.1 Gm. of salicin with 0.2 Gm. of potassium dichromate and 2 Cc. of diluted sulphuric acid, the odor of salicylic aldehyde will be developed. Sulphuric acid containing a trace of molybdic acid produces with salicin a violet color, changing to a deep brownish red. Sulphuric acid containing a trace of potassium iodate produces a dark red color, changing to deep purple. Sulphuric acid containing about one-fifth of its volume of solution of formaldehyde produces a deep purplish-red color. If to a small quantity of salicin a few drops of nitric acid be added, the liquid evaporated to dryness, and the resulting yellowish residue treated with ammonia-water and heated upon a water-bath with a fragment of potassium cyanide, a blood-red color will be developed. The aqueous solution of salicin is not precipitated by tannic or picric acid test-solution nor by mercuric potassium iodide test-solution (absence of, and difference from, alkaloids).—U. S.

Concentrated sulphuric acid dissolves salicin with a bright-red color; upon addition of a little water the liquid becomes colorless and deposits a red pulverulent substance, to which the name rutilin has been applied. When moderately warmed with diluted mineral acids salicin takes up water and splits up into dextrose and saligenin or salicylic alcohol, $C_7H_8O_2$, but if boiled with diluted acids the hydrolysis results in the formation of dextrose and saliretin, a yellowish-white, fusible, resinous body, $C_{14}H_{14}O_3$, insoluble in water, but readily soluble in alcohol, ether, and glacial acetic acid. Cold nitric acid of specific gravity 1.16 oxidizes salicin, with the production of *helicin*, $C_{13}H_{16}O_7$, which crystallizes in white needles, and is by ferments and dilute acids resolved into sugar and salicylic aldehyde. If nitric acid of specific gravity 1.09 is employed, salicin yields *helicoidin*, $C_{26}H_{34}O_{14}$, which may be regarded as a compound of salicin and helicin. These interesting reactions have been chiefly investigated by Piria (1837, etc.).

Action and Uses.—Salicin possesses antiseptic and antiferment properties similar to those of salicylic acid. Because of its bitter taste it may be employed as a stomachic to improve the appetite and promote digestion, and is of especial service if the impairment of these functions is partly due to decomposition of food in the stomach or intestine. After an extensive employment of salicin as a substitute for salicylic acid in the treatment of acute rheumatic fever, it is now regarded as inferior to the latter drug, but may be given if contraindications to the administration of salicylic acid exist. Although employed as an antiperiodic, it is much inferior to the cinchona alkaloids in malarial fever. It is largely used in cases of influenza. Salicin is given in the dose of 5 to 30 grains (0.30–2 Gm.) every 3 or 4 hours, usually dispensed in capsule or cachet.

Allied Glucoside.—SALINIGRIN.—Formula, $C_{13}H_{16}O_7$.—Discovered by H. A. D. Jowett (*Jour. Chem. Soc.*, 1900, Trans., p. 707) as the glucoside of Salix discolor. It forms needle-shaped anhydrous crystals, which melt without decomposition at 195° C. (383° F.) and solidify on cooling to a crystalline mass. It is soluble in about 52 parts of water and in 218 parts of alcohol, and is strongly lævorotatory; its angle of rotation = — 87.3°. It dissolves in concentrated sulphuric acid without producing a color (distinction from salicin).

SALIX.—Salix; Willow.

Weide, G.; *Saule*, Fr.; *Sauz* or *Sauce*, Sp.

The bark of various species of *Salix*, L. (Fam, *Salicaceæ*), principally that of *S. alba* L. (*White, European*, or *Duck willow*). The genus comprises more than 150 species of diœcious trees and shrubs, ranging through the north-temperate and Arctic regions, and a few extending into the southern hemisphere. They vary in size from large trees to creeping undershrubs, some not more than an inch or two in height. They are of great interest as contributing the most northern arborescent and shrubby vegetation, becoming thus of the greatest economic importance in Arctic regions. The young branches are usually very smooth, and, by their color, divide the genus into 2 sections, the twigs of the one inclining to red or purple, of the other to yellow. It is said that the latter contain the larger percentages of tannin, the former of salicin. These 2 constituents give to the barks their medicinal importance. The plants are of further economic importance because the wood yields a charcoal very pure as to its carbon, and useful for gunpowder manufacture. The young branches are the sources of osiers, of such great value in construction work.

FIG. 357.

Willow-bark: transverse section (× 15).

S. alba is a very common European species and has been largely naturalized in this country, where it grows, not very tall, but with a thick trunk and widely spreading crown, along streams and in other damp localities. The trunk-bark is blackish and rough-scaly, the twigs yellowish, shining, and attached in a frail manner to their branches, the latter character giving to this and some other species, mostly of the yellow barked class, the name of *Crack willows*. This name is sometimes applied distinctively to *S. fragilis* L., the species most used in the manufacture of salicin. The mature wood is soft and weak, although the twigs are tough. The stipules are deciduous and broadly lanceolate, the leaf-blades on short petioles and 2 to 4 or 5 inches long, one-third to two-thirds of an inch wide, narrowed toward the base, finely serrate, more or less silky-hairy, at least when young. The flowers are in yellow or greenish cylindrical catkins an inch or two long and about a quarter of an inch thick and appear with the young leaves in early spring. During the spring flow of sap the bark is very easily separated, and that is the time of collection.

Description.—Mostly in quills or irregular strips which are tough and flexible; bark 1 to 2 Mm. ($\frac{1}{25}$ to $\frac{1}{12}$ In.) thick, externally smooth or somewhat wrinkled, somewhat shining, yellowish brown to grayish brown and more or less warty, the warts small, roundish, mostly dark colored; inner surface long- and fine-striate, from pale brownish to cinnamon brown. Underneath the thin corky layer occurs a green layer. The bast-layer is transversely striated by very fine medullary rays, has a tangential structure and is readily separable into thin shreds; odor scarcely any; taste bitter and astringent.

An inferior form is sometimes collected from old wood, and deprived of its cork, when it has a dull, fibrous outer surface similar to the inner. This bark is less bitter than that which is younger. Willow-bark should not be kept on hand for a long time, since it undergoes a rapid loss of its salicin.

Constituents.—As stated above, the important constituents of Salix are salicin and tannin, which occur with gum, wax, fat, and sugar. Salicin (see SALICINUM) exists to the extent usually of between 1.5 and 2 per cent., though in some species it reaches 3 per cent. or even more. Tannic acid is present to the extent of about 10 per cent. This tannin is a glucoside, blue-black with ferric salts, then purplish-red on the addition of soda. The relative percentages of these constituents are believed to differ with the season of collection, but there is little definite information to be had on the subject. There is also a small amount of a third glucoside, *helicin* ($C_{13}H_{16}O_7 + \frac{3}{4}H_2O$), which is neutral, bitterish, has a melting-point of 175° C. (347° F.), is soluble in 64 parts of cold water and in alcohol, but not in ether, and is colored yellow by concentrated sulphuric acid.

Action and Uses.—Willow bark was formerly used as a stomachic and as an antiperiodic in the treatment of intermittents, but is to-day rarely prescribed in regular medicine. The dose of willow bark as a tonic is from 10 to 30 grains (0.60–2 Gm.) 3 times a day, in powder, infusion, or decoction. As an antiperiodic, 1 ounce (30 Gm.) should be given during the interval.

Other Varieties.—*Black willow bark* is considerably employed in this country, but has nothing to entitle it to preference. Its buds are also used and possess some slight aromatic properties in addition to those pertaining to the bark.

Salicaceæ.—The family contains only the two genera *Salix*, described above, and *Populus*, L., containing the Poplars, Cotton-woods, and Aspens. The latter are distinguished from the willows by the fringed scales subtending their flowers, those of the willows being entire. The poplars also produce numerous seeds upon each of the placentæ, the willows only a few. The constituents of Poplar bark are practically the same as those of Willow bark. Poplar bark contains also the glucoside *Populin* or *Benzoyl-salicin* ($C_{20}H_{22}O_8$), which crystallizes in white, sweetish and somewhat acid needles, and yields with dilute acids benzoic acid, then the same decomposition-products as those from salicin. Treated with nitric acid, populin yields *benzohelicin* ($C_{20}H_{20}O_8$). The leaves of these plants also contain populin. The Poplar bark commonly employed is that of *P. alba* L., the Old World *White* or *Silver poplar* or *popple*, *Great aspen*, or *Abele*, its bark often known as *White bark*. This species is naturalized to some extent, though very locally, in the United States. The bark of the common *European aspen* (*P. tremulus* L.) and that of the *American aspen*, *Quaking asp*, *Quiver leaf* or *Trembling poplar* (*P. tremuloides* Mx.) are also considerably employed, as is that of the *Black*, *English*, *Catfoot*, or *Willow poplar* (*P. nigra* L.). The buds of the last-named species are also used like willow buds.

From *P. balsamifera* is obtained, by incision, an oleoresin which is often miscalled "Tacamahac balsam," and which is very similar to that contained in the buds.

SALVIA, *U. S.*—Salvia; Sage; Picked Sage.

Folia Salviæ, P. G.; *Sauge officinale*, Fr. Cod.; *Garden sage*, *Meadow sage*, *Save*, E.; *Salbei*, G.; *Sauge*, Fr.; *Salvia*, It., Sp.; *Salva*, Port.

The dried leaves of *Salvia officinalis* L. (Fam. *Labiatæ*).

Origin.—Sage is a gray-pubescent suffruticose perennial, native of Europe and everywhere cultivated for medicinal purposes or as a condiment. The plant is 60 to 90 Cm. (2 to 3 Ft.) high, much-branched, the branches erect-spreading, woody only at the base, quadrangular; leaves as described below; flowers 3-cymose in the axils of leaves and bracts toward the end of the branches, forming a narrow thyrsoid spike; calyx narrowly campanulate, bilabiate, brownish, pubescent, its segments mucronate; corolla much longer, violet-blue, strongly bilabiate, with the mouth ringent, the tube short, the upper lip depressed, helmet-shaped, notched, the lower lip spreading, 3-lobed; stamens 2, the cells of each widely divergent, one sterile; style long, exserted, slenderly 2-cleft.

For use as a drug, the leaves only should be collected, by hand, and they should be carefully dried in the shade. For distillation, the entire plant is mowed down, and such a product, carelessly dried, is often substituted for the official article. This article is often distinguished commercially as "Italian baled Sage," though sage leaves also come in large bales.

Description.—Rather long- and stout-petioled, the blades 3 to 7 Cm. (about 1 to 3 In.) long and nearly half as broad, oblong or slightly broader below the middle, rounded or subcordate at the base, mostly blunt at the summit, crenulate, thickish, gray-green and densely hairy, especially underneath, very strongly veined, the veins finely reticulate, often pinkish or purplish, as is the petiole; aromatic in odor and taste, the latter also bitter and somewhat astringent.

FIG. 358.

Salvia officinalis L.

FIG. 359.

Sage-leaf: upper and lower surface.

Constituents.—The important constituent of Sage is its volatile oil (see OLEUM SALVIÆ), usually a little less than 1 per cent. from the fresh leaves but 2 to 3 times as much from a first-class dried article. There is also an unstudied bitter principle which, from its sensible properties and effects, appears to be similar to the amaroid marrubium of horehound. Although it has been claimed that these leaves contain no tannin, they not only give clear tannin reactions with ferric salts, but they are distinctly astringent, this property giving part of their value as used for gargling. They also contain resin and gum.

Action and Uses.—Sage was highly esteemed by the ancients as a remedy in many different affections, as chronic pulmonary complaints, uterine derangements, excessive sweating, sore throat, etc. It possesses aromatic, astringent, and tonic properties in a mild degree, and though rarely employed as a modern scientific therapeutic agent, it is used by the laity as a remedy in dyspepsia, and as a diaphoretic given in infusion in the early stages of some febrile diseases. The dose of powdered sage is from 20 to 30 grains (1.3–2 Gm.), of the infusion 1 to 2 ounces (30–60 Cc.).

Other Salvias.—The genus *Salvia*, L., comprises some 500 species. Like most Labiate plants, they contain, generally, aromatic properties similar to those of the above, and *S. pratensis* L. and *S. Sclarea* L. have been official in some pharmacopœias, though generally regarded as inferior.

The name "Sage," with various prefixes, is popularly applied upon our western plains to many plants not at all related to Salvia, nor to one another, many of them being nutritious and important products, and some popular local medicines.

Chia is a Mexican name applied to the seed-like fruits of a number of species of Salvia. They are considerably used as foods, or for adding, in a powdered condition, to the poor water of alkaline regions to render it more palatable. The large amount of mucilage contained probably carries down part of the suspended impurities. They contain enough sugar to render them distinctly sweetish. In Persia, the seeds of *Lallemantia Royleana* Benth. are similarly used under the name *Tukmi-balung*.

Phlomis fruticosa L., a related plant, is used in Europe as a vulnerary, similarly to Salvia.

SAMBUCUS.—Sambucus; Elder Flowers.

Sambuci flores, Br.; *Flores Sambuci*, P. G.—*Sweet elder, Black elderberry*, E.; *Flieder, Hollunder*, G.; *Sureau*, Fr.; *Sahuco* or *Sauco*, Sp.; *Sambuco*, It.; *Sabugueiro*, Port.

The dried flowers of *Sambucus Canadensis* L. (Fam. *Caprifoliaceæ*).

The British and German pharmacopœias specify the flowers of *S. nigra* L., the common European Black Elderberry; the Portuguese names *S. vulgaris* Lam. (the author should be Neck.), which is a synonym for *S. nigra*.

Origin.—The plant yielding this drug is widely distributed throughout North America. It is a shrub some 2 or 3 M. (6 to 10 Ft.) high, the stems stout, simple or sparingly branched. It propagates by long root-like rhizomes and forms large clumps, chiefly along streams and in other moist places, especially in the edges of woods and thickets. The bark is light gray and smoothish and the wood-zone thin, enclosing a pith which usually occupies about three-fourths of the stem-diameter. This pith is considerably used for holding small objects for sectioning for microscopical purposes. The leaves are opposite, large, pinnate, the leaflets 7 to 11, short-stalked, lance-oblong, pointed, serrate. The creamy white, fragrant flowers are in very large flat-topped compound cymes and are succeeded by similar (but usually drooping) bunches of purplish black, shining, juicy, sweet and acidulous fruits, largely used for wine-making and somewhat for pie-making, preserving, etc. The flowers should be gathered as soon as fully opened and rapidly and carefully dried.

FIG. 360.

Elder: branch (½ Nat.); flower (× 3); fruit (× 5).

Description.—A yellowish or pale-brownish mass, consisting of shrivelled flowers free from stems, which, when expanded after soaking are about 5 Mm. (⅕ In.) broad; calyx-teeth 5, superior, minute; corolla rotate, deeply 5-lobed, the 5 stamens borne upon its throat, alternating with its lobes; odor mild, peculiar; taste mucilaginous, somewhat aromatic and bitterish.

When the microscope does not reveal tufts of short hairs in the sinuses of the calyx, the drug is not of this species.

Most pharmacopœias specify that dark-brown or blackish flowers should be rejected. This appearance may be due to their having been collected some time after opening, to carelessness in drying, or to having been preserved too long.

Constituents.—The constituents of the American drug do not appear to have been studied, but there is no reason to doubt their practical identity with those of the European. The latter contains less than half of 1 per cent. of a volatile oil, though the yield is apparently greater, owing to the water which comes over with it. This oil is the important constituent. It is best obtained by saturating the aqueous distillate with salt and removing the oil by means of ether. This oil is a yellow or greenish-yellow butter-like mass, melting when warmed. It possesses a very powerful odor and a bitter, warming and afterward cooling taste. Its composition has been little investigated. With it exist considerable gum, a little acrid resin, a little tannin, and calcium and potassium malates.

Action and Uses.—Elder flowers are almost devoid of active medicinal virtue, and are rarely employed, except as a household remedy. When in infusion, ointment, or poultice, they are applied to sores, blisters, hemorrhoids, etc.

Other Products.—Fresh Elderberries have been found to possess sudorific properties similar to those of the flowers, but weaker. The coloring-matter extracted from them has been considerably used as an indicator for alkalies, with which it gives a green color, being red with acids. According to Cowie, this coloring-matter is best extracted, in the form of a 20 per cent. tincture, from the refuse remaining after the expression of the fresh juice.

All the other parts of the Elderberry plant, excepting the wood and pith, are more active than either the flowers or the fruit. The inner bark of the stem of both the foreign and the American species has been much employed as a diuretic, and has been found to contain small amounts of volatile oil and valerianic acid, together with resin, sugar, and fixed oil. Statements differ as to the presence of tannin. Starch is wanting. The young shoots and leaves of *S. nigra* not only share the diuretic and, in larger doses, purgative properties of the inner bark, but they have also been found valuable as an insecticide, and especially for keeping away flies and other insects, which apparently find the odor highly objectionable. The juice of the root has been known from ancient times as a nauseant, in moderate doses producing both vomiting and purging. The fresh root of *S. Canadensis* has been found extremely poisonous, producing death in children within a short time after being eaten, and with symptoms very similar indeed to those of poisoning by Cicuta. De Sanctis claims to have isolated the alkaloid coniine from the branches and leaves of *S. nigra*. Alpers (*Proc. Amer. Pharm. Assoc.*, 1900, p. 190) found undoubted evidences of an alkaloid in the roots of *S. Canadensis*, its odor being somewhat similar to that of coniine and also suggesting nicotine. This alkaloid was evidently volatile. It appeared to be much less abundant in the dried roots after some months' keeping.

The genus *Sambucus* L., contains about 20 species, and there are indications that many of them share in the properties described above.

SANDARACA.—Sandarac.

Sandaraca or Sandarac (*Juniper resin*, E.; *Sandarak*, G.; *Sandaraque*, Fr.) is the product of several species of *Callitris*, small trees or large shrubs, especially of *C. quadrivalvis* Vent. (*Thuja articulata* Vahl.), which grow in northwestern Africa. The oleoresin exudes from natural openings, and incisions are also made for it. The tears are mostly less than an inch in length, of a stalactite form, mostly slender and angular, often compound. They are pale yellow, mostly dusty, and have a sharp glassy fracture, clear in the centre, pulverulent at the edge. Sandarac has a terebinthinate odor, slight except after warming. It is pulverulent and not at all plastic on being chewed, and there is a slight bitter with the sharply terebinthinate taste. It melts at 135° C., has an acid number of 136 to 140, and is soluble in ether, acetone, and alcohol, but only partly in chloroform, carbon disulphide, and essential oils.

Substitutes.—Several spurious sandaracs have appeared upon the market, the most important being that of Australia and Tasmania, produced by the *Actinostrobus acuminata* Parl., as well as by a number of species of *Callitris*. It agrees so closely with the African in all respects that it seems almost improper to speak of it as a substitute at all. A much more serious matter is the sale (see Haneki, *Pharm. Jour.*, No. 1596, p. 79) of a fictitious Spanish article, apparently manufactured from ordinary rosin. It was described as in terete tears and becoming somewhat plastic on chewing, melted on the water-bath, had an acid number of 168, and had very much the solvency of rosin.

Constituents.—Besides a very small amount of an unknown bitter principle, Sandarac consists essentially of several resins, 3 according to Unverdorben. Tschirch reports it as consisting principally of 85 per cent. of *Sandaracolic acid* ($C_{45}H_{84}O_8$) and 10 per cent. of *Callitrolic acid* ($C_{65}H_{54}O_8$). The amount of volatile oil which can be separated depends entirely upon the freshness of the sample, since it evaporates very rapidly after collection. It consists chiefly of a diterpene, boiling at 265° C. (509° F.).

Action and Uses.—Sandarac is used chiefly as an ingredient in rapidly drying varnishes. It has been given internally in chronic affections of the bronchial and urinary mucous membranes, and used as an ingredient of many stimulating ointments.

SANGUINARIA, *U. S.*—Sanguinaria.

Bloodroot, Red puccoon, Tetterwort, Red Indian paint, E.; *Blutwurzel*, G.; *Sanguinaire*, Fr.

The dried rhizome of *Sanguinaria Canadensis* L. (Fam. *Papaveraceæ*), collected after the death of the foliage.

Sanguinaria is official in no other pharmacopœia.

Origin.—The bloodroot plant is a native of eastern and central North America, occurring in greatest abundance on rocky, partly shaded banks, in rich soil. It is one of the earliest and most pleasing of wild flowers, producing its pure white flowers before the development of its leaves, which afterward enlarge greatly. The plant is smooth and the leaves are of a pale glaucous green. By midsummer the fruit is matured and the foliage is dead, after which the aërial portions of the plant quickly disappear. All parts of the plant exude a red juice. The form of the Gulf region presents quite marked distinctions from that of the North, and may yet be found specifically distinct.

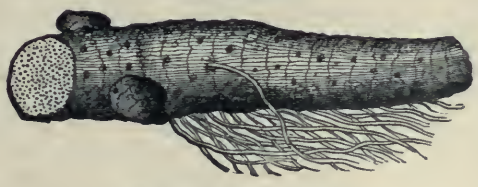
Fig. 361.

Bloodroot (plant, ½ Nat.; dried rhizome, Nat.).

Description.—From 2 to 7 Cm. (about 1 to 3 In.) long and 0.5 to 1 Cm. ($\frac{1}{5}$ to $\frac{2}{5}$ In.) thick, often with several short branches, oblong to cylindrical, straight or crooked, inconspicuously and incompletely annulate, finely wrinkled externally, of a rich- or reddish-brown; fracture short and sharp, the rather thin bark red-brown, the remainder whitish or yellowish, marked with numerous small red resin-dots, or of a nearly uniform orange-red to brownish-red color; odor slight, the powder sternutatory; taste persistently bitter and acrid.

The red powder exhibits numerous large bright-red resin-cells, parenchyma filled with starch, the grains mostly single, of roundish form, and mostly 10 to 15 microns in diameter. Bloodroot is occasionally contaminated with other substances, but we have never seen it actually adulterated, and its cross-section is distinct from that of everything which otherwise at all resembles it.

Fig. 362.



Bloodroot, fresh rhizome.

Constituents.—The important constituents of Sanguinaria are its alkaloids, of which at least 5 are present, namely, sanguinarine, chelerythrine, fumarine (protopine), and β- and γ-homochelidonine. Most of these alkaloids have been considered elsewhere in this work. *Sanguinarine* ($C_{20}H_{15}NO_4 + H_2O$) is generally regarded as the most important constituent from a medicinal point of view, though chelerythrine is many times more abundant. The former occurs in colorless crystals and yields brilliant red salts, by which character alone it can be readily recognized. It is exceedingly difficult of separation in a pure state, and comparatively little is known of it. Schlotterbeck reports that the sanguinarine nitrate of the market is not a pure article, but consists chiefly of chelerythrine instead. With the alkaloids occur citric and malic acids, red resin, much starch and unimportant constituents.

Pharmaceutical Preparations.—Fluidextract of Sanguinaria, Tincture of Sanguinaria, U. S. P.

Action and Uses.—In small doses sanguinaria produces a sense of warmth in the stomach and stimulates gastric secretion. Moderate doses produce nausea and circulatory depression, and in large doses it inflames the stomach, causing intense burning, thirst, vomiting, dimness of vision, vertigo, great prostration, and collapse. Powdered sanguinaria snuffed up the nostrils is sternutatory, and applied locally it acts as a stimulant to indolent ulcers and as an escharotic to fungous granulations. The physiological

action of sanguinaria bears no relation to its principal therapeutic application, namely, as a stimulating expectorant in subacute and chronic bronchitis. It was formerly employed to stimulate duodenal secretion in catarrh of the duodenum and secondary catarrh of the bile ducts, as an emmenagogue in atonic and functional amenorrhœa, as an alterative in chronic syphilis, and as an aphrodisiac, but for these purposes it is at present rarely administered. The expectorant dose of sanguinaria is from 1 to 5 grains (0.06–0.30 Gm.), and of the tincture, in which it is preferably administered, from 10 to 40 minims (0.60–2.60 Cc.). As an emetic the crude drug may be given in the dose of from 10 to 40 grains (0.60–2.60 Gm.). The physiological action of sanguinarine is practically identical with the crude drug. Its dose as an expectorant is from $\frac{1}{12}$ to $\frac{1}{8}$ grain (0.005–0.008 Gm.), as an emetic from $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015–0.03 Gm.).

SANTALUM RUBRUM, *U. S.*—Red Saunders.

Pterocarpi lignum, Br.; *Lignum santalinum rubrum, Rasura ligni.—Red santal* or *sandal-wood, Ruby-wood*, E.; *Rothes Sandelholz*, G.; *Santal rouge*, Fr.; *Sandalo rojo*, Sp.; *Sandalo rubro*, Port.

The heart-wood of *Pterocarpus santalinus* L. f. (*Lingoum s.*—Kuntze—Fam. *Leguminosæ*).

Red Saunders is official in most pharmacopœias, though a number specify the wood of *P. Indicus* Willd. (*P. Draco* Lam.).

Origin and Description.—This is a small tree, native and cultivated in the East Indies. The wood is commonly imported in billets, but is usually supplied to the pharmacist in the form of a coarsely rasped powder, sometimes as chips or splinters. It is hard and very heavy, splitting easily in a straight line, and varies in color from a deep, slightly purplish-red when fresh to a blood-red or brownish-red after exposure. The ducts are relatively large. It is nearly odorless and tasteless, does not tinge the saliva nor yield its color to water, while alcohol is colored by it deep-red, then dark-violet on the addition of ferric chloride.

Constituents.—Although Red Saunders contains several crystallizable principles (*pterocarpin*, a little tannin, etc.), it is valued solely for its red coloring-matter, *santalic acid* or *santalin* ($C_{15}H_{14}O_5$). This occurs in fine red, odorless, and tasteless needles, melting at 104° C. (219.2° F.), insoluble in water, soluble in alcohol with a blood-red color, in ether yellow, in concentrated sulphuric acid deep red, and in alkalies violet. It is also soluble in the volatile oils of cloves, cinnamon, bergamot, and bitter almond, but insoluble in most other volatile and fixed oils. The amount of santalic acid present in the wood ranges apparently from 0.25 to 0.5 per cent.

Action and Uses.—Red Saunders is used only as a coloring-agent. It has no medicinal virtues.

A very similar article, closely related and probably containing the same coloring-matter, is the African *Cam-wood*, derived from *Baphia nitida* DC., of the same family. *P. erinaceus* Poir., also of Africa, yields a kind of rose-wood, and the sap is converted into *African Kino*. *P. Draco* L. (not Lam.) yields *West Indian dragon's-blood*.

SANTONICA, *U. S.*—Santonica.

Flores Cinæ, P. G.; *Flores artemisiæ, Semen cinæ, Santonici, contra* or *sanctum.—Levant, Turkestan, Aleppo*, or *Alexandria wormseed*, E.; *Wurmsamen, Zittwersamen, Cinablüthen*, G.; *Semen-contra, Semencine, Barbotine*, Fr.; *Semen santo, Flore di Cina*, It.; *Simiente de Alejandria, Yantonica*, Sp.; *Barbotina*, Port.

The dried unexpanded flower-heads of *Artemisia pauciflora* (Ledeb.) Weber (*A. maritima pauciflora* Ledeb.; *A. maritima Stechmanniana* Besser; *A. Lercheana* Kar. et Kir.—Fam. *Compositæ*).

Santonica is official in most pharmacopœias, though the titles named above are variously employed. Most of them refer the drug to *Artemisia Cina* Berg. The Belgian refers it to *A. Contra* L.

Origin.—The plant is a low and scraggly undershrub, with erect branches, abounding in the deserts of Turkestan, where the whole of the drug is collected, in July and August, by native tribes. It pertains to a perplexing group of species of this difficult

genus, variously regarded by different botanists as distinct species or as varieties of the polymorphous species, *A. maritima* L., of the Mediterranean basin and northeastward.

Description.—A yellowish green (at length greenish brown), somewhat glossy, mobile mass; having a strong and peculiar, somewhat camphoraceous odor and an aromatic and bitter taste; heads 2 to 4 Mm. ($\frac{1}{12}$ to $\frac{1}{6}$ In.) long, oblong-ovoid, slightly flattened, obtuse, consisting of an involucre of about 12 to 18 closely imbricated, glandular scales with broad midribs, enclosing 4 or 5 rudimentary florets.

Fig. 363.

Santonica: head and longitudinal section (× 10).

Santonica should be carefully protected against exposure to light and atmosphere, and not kept too long, since its active constituent becomes transformed. This change is commonly indicated by an increase in the brown coloration. The greater part of the crop is manufactured into santonin in its own home, and the exportation of the inferior lots of santonica appears too common.

Constituents.—The only constituents of note in Santonica are its 2 or 3 per cent. of volatile oil, santonin (see Santoninum), and artemisin. Oil of Santonica is a commercial article. It is yellowish-white, clear, having the odor of Santonica, though more camphoraceous, and a specific gravity of from 0.915 to 0.940. It consists chiefly of cineol and possesses the properties of that substance. Artemisin is a crystalline body, apparently oxysantonin, and exists in variable amount. Of santonin there should be from 2.5 to 3.5 per cent., yet the commercial article rarely yields more than 2 per cent., often less.

Action and Uses.—Since the isolation of santonin from santonica, the use of the crude drug has been practically abandoned. It may be used as a vermicide for round worms, when it is administered either in infusion or in an electuary in combination with molasses or honey. Its dose is from 10 to 40 grains (0.60–2.60 Gm.).

Allied Drugs. (See also Chenopodium.)—*Barbary wormseed* is a somewhat similar product, apparently derived from a closely related species of northwestern Africa. The heads are shorter, more rounded, and somewhat gray-downy. *East Indian wormseed* is much smaller and is hairy.

SANTONINUM, *U. S., Br., P. G.*—Santonin.

Santonine, Fr. Cod.; *Santonina, Santonine, Anhydride santonique*, Fr.; *Santonin*, G.; *Santonina*, Sp.

Formula, $C_{15}H_{18}O_3$. Molecular weight, 244.29.

The inner anhydride or lactone of santonic acid, obtained from Santonica.—U. S. A crystalline principle prepared from the dried unexpanded flower-heads or capitula of Artimisia maritima, var. Stechmanniana, Besser.—Br.

Santonin was discovered in 1830 simultaneously by two German apothecaries, Kahler and Alms, and later investigated by Tromsdorff, Liebig, and others.

Preparation.—Santonin is obtained by mixing 5 parts of crushed santonica with 1 part of slaked lime and then exhausting the mixture repeatedly with hot water, or the mixture may be boiled for some time with water and then strained. In either case a solution of calcium santoninate is obtained, which is concentrated by evaporation to a syrupy consistence, and then decomposed with hydrochloric acid. Crude santonin is precipitated but contaminated with resinous matter, from which it may be freed by washing with dilute ammonia-water, or by recrystallization from hot alcohol, a little charcoal being used to remove coloring-matter, the resin remaining dissolved in the alcohol. The yield may vary from 1½ to 3 per cent., some loss occurring in the process. Santonin is now produced cheaply and in large quantities at Tschimkent in Turkestan.

Properties and Tests.—Santonin occurs in colorless, shining, flattened, rhombic prisms; odorless and nearly tasteless when first put into the mouth, but afterward developing a bitter taste; permanent in the air, but turning yellow on exposure to light. It sublimes without decomposition, and is soluble in alkalies and in most volatile and fatty oils. Santonin which has become yellow may be converted into white crystals by recrystallization from alcohol. Soluble in 5300 parts of water, 34 parts of alcohol, 78

parts of ether, and in 2.5 parts of chloroform at 25° C. (77° F.); soluble in 800 parts of water at 80° C. (176° F.), and in 5 parts of alcohol at 60° C. (140° F.). It melts at 170.3° C. (338.5° F.). When ignited it is consumed, leaving no residue. Its solutions are lævogyrate and neutral to litmus-paper. If 0.5 Gm. of santonin be heated with 5 Cc. of alcoholic potassium hydroxide test-solution, a red color will be developed. Upon shaking 0.01 Gm. of santonin with a cold mixture of 1 Cc. each of sulphuric acid and water, heating to 100° C. (212° F.), and adding a minute trace of very dilute solution of ferric chloride, a violet color will result. Sulphuric acid added to santonin should not produce more than a faintly yellow color (absence of sugar and other readily carbonizable organic impurities). If 2 Gm. of santonin be boiled with 80 Cc. of water and 5 Cc. of diluted sulphuric acid, and the liquid, after frequent shaking, be allowed to become cold and then filtered, mercuric potassium iodide test-solution or iodine test-solution should produce no cloudiness in 10 Cc. of the filtrate, mixed with 10 Cc. of distilled water, even after standing for 3 hours (absence of alkaloids).—U. S. The above-mentioned reaction of santonin with potassium hydroxide is not entirely satisfactory, and can be improved by following the suggestion of Percy Paine (*Brit. Pharm. Conf. Trans.*, 1901), to dissolve a few crystals of santonin in 2 or 3 Cc. of alcoholic solution of ethyl nitrite and then add a few drops of alcoholic solution of potassium hydroxide, when a beautiful rose-red color will appear. Aloin and resorcin will develop a rose-red color before addition of the alkali, but santonin not until after the addition has been made. The Ph. G. gives the solubility of santonin at 15° C. (59° F.) as 1 part in 5000 parts of water, or 44 parts of alcohol, or 4 parts of chloroform. The same authority gives the following test for possible presence of strychnine: If 1 part of santonin be boiled with 100 parts of water and 5 parts of diluted sulphuric acid, the mixture allowed to become cold and then filtered, the filtrate should not possess a bitter taste nor be precipitated upon addition of a few drops of potassium dichromate solution.

Santonin has been found adulterated with boric acid, which latter may be recognized by its insolubility in chloroform and its non-volatility. If boric acid be present, the residue left upon heating the suspected santonin on platinum foil, if dissolved in water and acidulated with hydrochloric acid, will color yellow turmeric-paper brown. There is little or no danger of confounding santonin turned yellow from exposure to light with picric acid, as the latter readily forms yellow-colored solutions with cold and hot water.

If santonin be melted it yields a colorless liquid, which, if slowly cooled, becomes crystalline, but if rapidly cooled, remains amorphous and gum-like, the latter becoming again crystalline on warming to a little over 40° C. (104° F.) or on moistening with alcohol or ether. If carefully heated, santonin may be sublimed in the form of needle-shaped crystals.

If a solution of santonin in sulphuric acid be heated on the water-bath for several hours and then diluted with water, an isomeric body, isosantonin, having the melting-point 138° C. (280.4° F.), will be precipitated. Santonin is transiently colored red by hot alkalies and alkaline earths, the colorless solutions containing the alkali salts of santoninic acid, and yielding precipitates of santoninates with most of the salts of the metals. At 120° C. (248° F.) santoninic acid, $C_{15}H_{20}O_4$, is decomposed into santonin and water. On boiling santonin with a solution of barium hydroxide for 12 hours, an isomer of santoninic acid, santonic acid, melting at 161° to 163° C. (321.8°–325.4° F.), is obtained.

If a 7 per cent. solution of santonin in 80 per cent. acetic acid be exposed to the action of sunlight for 30 days or more, bibasic photosantonic acid, $C_{15}H_{22}O_5$, will be formed, which may be obtained in prismatic crystals melting at 153° C. (307.4° F.) and slightly soluble in water, but readily so in alcohol, ether, and chloroform. By exposing a 2 per cent. alcoholic solution of santonin in a similar manner, photosantonin, $C_{15}H_{19}(C_2H_5)O_4$, the ethyl ether of the above-named acid, is produced.

Pharmaceutical Preparation.—Santonin Lozenges, U. S. P.

Action and Uses.—Santonin is sometimes employed to restore the acuity of vision when it is impaired by disease of the optic nerve. In persistent incontinence of urine it may produce a cure after all other remedies have failed. Its most important use is as an anthelmintic for the removal from the intestine of the Ascaris lumbricoides, or round worm. It has little or no effect upon the tapeworm. Toxic doses produce alarming symptoms, the most constant of which are muscular tremors, vertigo, cold sweats, mydriasis, stupor, and epileptiform convulsions. A remarkable and not uncommon effect of

santonin, even in medicinal doses, is the production of xanthopsia, a condition in which objects appear as if viewed through a yellow glass, although other colors, as red, green, or blue, may appear. This effect is thought by some observers to be due to the staining of the humors of the eye by the drug; by others, to its action upon the retina and perceptive centres in the brain. To the urine santonin imparts usually a deep-yellow color, and if the dose be large or the urine alkaline in reaction, it may be stained red or purple. As an anthelmintic, santonin should be administered on a fasting stomach. In from 4 to 6 hours after its administration a dose of calomel should be given, and this followed in 2 hours by a saline. Santonin is given preferably in crystals, which are more slowly dissolved and absorbed than the powder. Although it is almost tasteless, it is usually combined with sugar or powdered chocolate, or made into troches. The official troche contains ½ grain (0.03 Gm.) of santonin. The dose to an adult is from 1 to 2 grains (0.06–0.12 Gm.); the usual dose to a child is from ¼ to ½ grain (0.015–0.03 Gm.).

Derivative Compounds. SANTONINOXIME. $C_{15}H_{18}O_2.NOH$. It is prepared by heating for about 7 hours a mixture of 5 parts of santonin, 4 parts of hydroxylamine hydrochloride, 50 parts of alcohol, and 4 parts of calcium carbonate. After filtration of the mixture, santoninoxime is precipitated from the alcoholic liquid by addition of water. It occurs as colorless needle-shaped crystals, which are insoluble in water, but quite soluble in alcohol, oils, and fats. It melts at 216° to 217° C. (420.8°–422.6° F.). Santoninoxime is used medicinally for the same purpose as santonin, and is said to be far less toxic than the latter.

Sodium Santoninate. $C_{15}H_{19}NaO_4 + 3\frac{1}{2}H_2O$. This salt, which was at one time (1880) recognized in the U. S. Pharmacopœia, may be obtained by heating a mixture of 10 parts of santonin, 40 parts of water, and 9.5 parts of 15 per cent. sodium hydroxide solution on a water-bath until solution is effected. The liquid is then concentrated and allowed to crystallize. Sodium santoninate occurs as colorless, transparent, tabular crystals, having a bitter and mildly saline taste. It is soluble in 3 parts of cold water and in 13 parts of alcohol. Sodium santoninate and other santoninates should not be employed. They are more soluble than santonin and more readily absorbed from the stomach, properties undesirable in vermicides which are to act locally in the intestine.

SAPO, *U. S.*—Soap.

Sapo durus, Br.; *Savon médicinal,* Fr. Cod.; *Sapo medicatus,* P. G. *Sapo hispanicus.—Hard soap, Castile soap,* E.; *Savon médicinal, Savon amygdalin,* Fr.; *Medizinische Seife, Spanische Seife, Oelseife,* G.

Soap prepared from sodium hydroxide and olive oil.—U. S. Soap made with sodium hydroxide and olive oil; containing about 30 per cent. of water.—Br.

Although the name Soap is officially restricted to the compound designated above, it is in general use for all compounds of fatty acids with alkaline bases, which are soluble in water and alcohol, and the process involved in the manufacture of such compounds is known as saponification. The compounds of fatty acids with earthy and metallic bases, while chemically analogous to soluble soaps, are usually designated as plasters or insoluble soaps, such as lead plaster and lime liniment.

The general plan of saponification consists in boiling fats or fixed oils with a solution of sodium or potassium hydroxide, or with metallic oxides in the presence of water, and involves the decomposition of the fat by the base, new fatty acid salts being formed and glycerin being liberated. In the case of the alkali hydroxides, the newly formed soap enters into solution in the water together with the glycerin, and is subsequently recovered. The lye used in this operation is employed in a rather dilute state, is gradually added, and an excess of it mostly used, since saponification is thereby much facilitated, and the free alkali may be removed from the soap. The decomposition of fats and fixed oils progresses gradually, the triolein, tripalmitin, or tristearin being first converted into the di- and mono-acid compounds of glyceryl before saponification is completed, and hence the mixture must be kept boiling until it becomes transparent and rather tenacious. The soap is finally separated from the lye by adding a solution of common salt to the liquid, soap being insoluble in the solutions of most salts of potassium and sodium. When the soap has separated from the liquor and sufficiently solidified, it is transferred to wooden trays until it is stiff enough to be cut into pieces, which are exposed to the air in a warm place until they become hard and dry.

Neither the U. S. nor Br. Pharmacopœia gives an official process for the manufacture of soap. The Ph. G. directs that a mixture of 50 parts each of lard and olive oil, previously melted together, be heated for ½ hour, constantly stirring, with 120 parts of a 15 per cent. sodium hydroxide solution, after which 12 parts of alcohol are added, and finally 200 parts of water together with small quantities of the above sodium hydroxide solution, if necessary, until a uniform transparent soap results, perfectly soluble in hot water. Finally, a filtered solution of 25 parts of sodium chloride and 3 parts of sodium hydroxide in 80 parts of water is added, and the mixture heated until the soap is precipitated. After removal of the soap it is washed with small portions of water, strongly expressed, and dried.

The French Codex orders the official soap to be made from oil of sweet almond by mixing it with ½ its weight of soapmaker's lye (29 per cent. solution of sodium hydroxide), and keeping the mixture in a moderately warm place, with occasional stirring, until it solidifies.

Properties.—Soap is a white or whitish solid, hard, yet easily cut when fresh, having a faint, peculiar odor free from rancidity, a disagreeable, alkaline taste, and an alkaline reaction. It is soluble in water and in alcohol, more readily with the aid of heat (soluble in 20 parts of cold or 1½ parts of hot water, and in 90 per cent. alcohol, Br.).—U. S.

The consistence of soap depends mainly on the particular alkali employed, but also in part on the nature of the fat used. Soda soaps are invariably harder than potash soaps, and drying oils yield softer soaps than non-drying oils; fats rich in palmitic or stearic acid yield firmer and less soluble soaps than fixed oils consisting chiefly of olein. Potash soaps are mostly deliquescent; dry potassium palmitate readily absorbs from the air about ½ its weight of moisture, and potassium oleate about 1½ times its weight, whereas the corresponding sodium compounds absorb only 8 and 12 per cent. respectively.

The well-known detergent properties of soap depend upon its decomposition by a large quantity of water into acid and basic salts, of which the latter contain about 50 per cent. more alkali than the former, and act as solvents of fats and other matters; in this respect their action is similar to, but milder than, that of caustic alkali. Alcohol does not have this dissociating effect on soap. So-called hard water is unsuited for washing on account of calcium or magnesium salts which are contained in solution, and which form insoluble soaps by double decomposition.

Tests.—On placing 0.5 Gm. of soap, together with about 10 Cc. of alcohol, in a tared beaker containing 1 Gm. of dry clean sand, evaporating the resulting solution of the soap to dryness, and drying the residue at 110° C. (230° F.) to a constant weight, the loss should not exceed 36 per cent. (absence of an undue amount of water). An alcoholic solution of soap (1 in 25) should not gelatinize on cooling (absence of animal fats). An aqueous solution of soap (1 in 20) should remain unchanged in color upon the addition of ammonium sulphide test-solution, and upon acidulating another portion of the solution with hydrochloric acid and filtering, the filtrate should remain unchanged in color when an equal volume of hydrogen sulphide test-solution is added and the mixture is allowed to stand well-stoppered in a warm place for ½ hour (absence of metallic impurities). On dissolving 20 Gm. of soap in alcohol, with the aid of heat, transferring the undissolved residue, if any, to a tared filter, and washing it thoroughly with boiling alcohol, it should, after drying, weigh not more that 0.8 Gm. (limit of sodium carbonate, etc.); of this residue not more than 0.2 Gm. should be insoluble in water (limit of silica and other accidental impurities). If a solution of 5 Gm. of soap in 50 Cc. of hot water be mixed with 3 Cc. of tenth-normal oxalic acid solution, the subsequent addition of a few drops of phenolphthalein test-solution should not produce a pink or red tint (limit of alkalinity).—U. S. A solution of 1 Gm. of medicinal soap in 5 Cc. of alcohol, prepared with aid of a gentle heat, should not be reddened by addition of 1 drop of phenolphthalein solution, and not be affected by addition of hydrogen sulphide solution.—P. G. Although the Pharmacopœia allows as much as 36 per cent. loss of moisture, good air-dry Castile soap, as a rule, does not contain more than 12 or 15 per cent. of water.

Pharmaceutical Preparation.—Soap Liniment, Soap Plaster, U. S. P.

Action and Uses.—Soap is mildly laxative and antacid. As a laxative it is rarely used alone, but usually in combination with resinous or other laxative drugs, as scammony, aloes, rhubarb, etc., to enhance their activity and prevent griping. Because it is

so easily obtained, it is one of the best antidotes in poisoning by strong mineral acids, and should be freely administered in watery solution. In constipation, when hardened fecal masses are retained in the rectum or colon, a copious enema of soap suds forms one of the most efficient remedies that can be employed for its relief. If constipation is accompanied with much flatulence, the efficacy of the soap will be increased by the addition of oil of turpentine. A simple method of relieving constipation in young children is to insert a soap suppository into the rectum. The suppository should be dipped in water to make it slippery. Externally, soap is applied in alcoholic solution (Linimentum Saponis) to sprains and bruises, and sometimes in paste or thick lather as a local stimulant to chronic cutaneous eruptions. Soap is given in the dose of from 2 to 20 grains (0.12–1.30 Gm.).

Unofficial Soaps.—*Mottled Castile Soap* is obtained by adding a small quantity of ferrous sulphate to the cooling mass of olive soap, which causes greenish streaks to appear, and these afterward turn red on the surface of the soap. *Marine Soap* is made from cocoanut oil by boiling it with a calculated quantity of sodium hydroxide solution. It retains all the glycerin liberated from the fat, and forms a semitransparent mass which has the property of forming a lather with sea water, which ordinary soap does not do. *Rosin Soap* is usually made by adding ordinary rosin, to the extent of about 50 per cent. of the fat employed, to the mass in the soap boiler, toward the end of the process, the result being a yellow, smooth product. *Transparent Glycerin Soap* may be made by melting together 10 parts each of tallow, cocoanut oil, and glycerin, and 6 parts of castor oil, heating the mixture to 50° C. (122° F.), adding 12 parts of 40 per cent. sodium hydroxide solution and 12 parts of 95 per cent. alcohol, and stirring until the mass becomes transparent, after which a small quantity of sugar is usually added, and also the desired flavoring. Cocoanut oil has the property of being easily saponified at a temperature far below that of boiling water, and forms a hard soap, firmly retaining the glycerin which has been liberated.

Medicated Soaps.—While soaps intended simply as detergents may, without detriment, contain a very slight excess of alkali, it is desirable when medication of the soap is intended that, prior to its application, a perfectly neutral substance be employed; it has, in fact, been found that soap containing uncombined fat is even preferable to neutral or normal soap, for not only does it render the skin softer, but reaction between the soap and any medicinal agent added is also thereby avoided, or at least retarded. Such soaps, containing an excess of fat, are known as *Superfatted Soaps*, and have been largely used for the past 15 or 20 years. In preparing them it is customary to add an excess of 3 or 5 per cent. of fat or fixed oil in the beginning of the operation, which then remains intimately mixed with the newly formed soap. In a few cases the excess of fat has been incorporated with the freshly made neutral soap while yet in a soft, pasty condition. Both olive oil and lanolin are used in the manufacture of superfatted soaps, having been found preferable to all other fats in their action on the skin and toward chemicals.

In the manufacture of medicated soaps, the plan followed is identical with that for ointments. The medicinal agent is first intimately mixed (either in the form of solution or impalpably fine powder) with a small portion of the superfatted soap by means of suitable apparatus, which mixture is then added to such a further quantity of the same vehicle as may be necessary to establish the required percentage strength of the finished product. Among the various medications of superfatted soaps are tar 5 per cent., sulphur 10 per cent., salicylic acid 5 per cent., borax 5 per cent., carbolic acid 5 and 10 per cent., corrosive sublimate 0.1 and 0.5 per cent., camphor 5 per cent., and others.

SAPO ANIMALIS, *Br.*—Curd Soap.

Sapo sebacinus; Sapo domesticus; Savon animal, Fr. Cod.; *Animal soap, Tallow soap, Stearin soap*, E.; *Talgseife, Stearinseife, Hausseife*, G.

Soap made with sodium hydroxide and a purified animal fat, consisting principally of stearin; containing about 30 per cent. of water.—Br.

Preparation.—No process of manufacture is given in the Brit. Pharm., but the general directions given in the preceding article may be followed. Beef-tallow is generally employed, and mutton-suet may likewise be used, care being taken to thoroughly cleanse the fat and remove all adhering membrane. The Fr. Cod. directs that 500 Gm. of tallow be melted in the presence of 1000 Gm. of distilled water and, while stirring, 250 Gm. of 29 per cent. sodium hydroxide solution be added and the heat continued until complete saponification has been effected. 100 Gm. of sodium chloride are then added and heat continued until the soap has separated, after which it is removed when cold, washed with water and dried.

Properties and Tests.—Curd soap occurs in firm white or very light-grayish masses or cakes. It is dry and nearly inodorous, becoming readily pulverizable when exposed in warm air, and is easily molded when heated. While only slightly soluble in cold water, it dissolves more readily in hot water, undergoing hydrolysis into an acid soap (which is partly deposited on cooling) and free alkali. It is soluble in 90 per cent. alcohol, more freely when heated, and the latter solution upon cooling congeals to a semi-transparent gelatinous mass. The Brit. Pharm. demands the absence of free alkali and prescribes the following test, in which hydrolysis is prevented by the use of alcohol as a solvent: 5 Gm. of the dried and powdered soap, digested in boiling 90 per cent. alcohol, filtered while hot, and the filter washed thoroughly with more boiling alcohol, should yield a filtrate which does not afford a red or pink coloration with solution of phenolphthalein. "If the filter from the previous operation be washed with hot water, a solution is obtained which, on adding phenolphthalein solution, should not require more than 3 Cc. of tenth-normal sulphuric acid to discharge the resulting red color (limit of alkali carbonate). Curd soap should not impart a greasy stain to white unglazed paper (absence of free oil and fat). When incinerated it should not yield an ash which deliquesces (absence of potassium soap). It should lose about 30 per cent. of moisture when dried at 110° C. (230° F.)."—Br. Curd soap may be readily distinguished from the official olive oil soap by its lesser solubility in water, and especially by the character of the fatty acids separated when a solution of 5 Gm. of the soap in shavings or powder in 100 Cc. of hot water is treated with diluted sulphuric acid until an acid reaction ensues. The fatty acids, being insoluble, will rise to the surface, and upon cooling will form a hard cake in the case of animal soap, and a soft or semiliquid mass in the case of olive oil soap, the former melting at 45° to 50° C. (113°–122° F.), and the latter at or below 25° C. (77° F.).

Uses.—Pharmaceutically, curd soap is of importance in the manufacture of certain preparations for external use, such as the liniment of soap and potassium iodide and solid opodeldoc, where its sparing solubility in water and hydro-alcoholic liquids is taken advantage of to produce solid liniments which will liquefy at the temperature of the body.

SAPO MOLLIS, *U. S., Br.*—Soft Soap.

Sapo kalinus, P. G.; *Sapo viridis.—Green soap*, E.; *Savon mou, Savon vert*, Fr.; *Kaliseife, Grüne Seife*, G.

Preparation.—Linseed oil, 400 Gm.; potassium hydroxide, 95 Gm.; alcohol, 40 Cc.; water, a sufficient quantity. Heat the linseed oil in a deep, capacious vessel, on a water-bath or steam-bath, to a temperature of about 70° C. (158° F.). Dissolve the potassium hydroxide in 450 Cc. of water, warm the solution to about 70° C. (158° F.), add it to the linseed oil and mix thoroughly; then incorporate the alcohol and continue the heat (without stirring) until a small portion of the mixture is found to be soluble in boiling water without the separation of oily drops. Then allow the mixture to cool, and transfer it to suitable vessels. The potassium hydroxide used in this process should be of the full strength directed by the Pharmacopœia (85 per cent.). Potassium hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 8075 by the percentage of absolute potassium hydroxide contained therein.—U. S.

The Br. P. gives no process of manufacture, but directs soft soap to be made from olive oil and potassium hydroxide. The directions of the P. G. are almost identical with those of the U. S. P.

In place of linseed oil or olive oil, other oils have been used at different times with the object of producing a soap less disagreeable in odor or more decidedly green in color than the official article. Cottonseed oil will yield an almost colorless soap, but its odor is less objectionable than the linseed oil soap. Malaga olive oil, which itself possesses a decided green color, produces a green or, at least, a yellowish-green soap, while hempseed oil yields a much greener soap. Some manufacturers, judging from the dark-green color of their product, perhaps add some coloring-matter, as indigo, which, when mixed with the yellowish soap, forms a deep-green color. As will be seen below under *Properties*, official soft soap has no green color, but in some localities physicians demand a dark-green color, which was characteristic of the green soap formerly imported in large quantities from Germany.

Properties.—Soft soap occurs as a soft, unctuous, yellowish-brown (yellowish-white to yellowish-green, Br.) mass, having a characteristic odor (almost inodorous, Br., slight soap-like odor, P. G.), and an alkaline taste. An aqueous solution shows an alkaline reaction to red litmus-paper. It is soluble in hot water to a nearly clear liquid; also in alcohol without leaving more than 3 per cent. of residue (limit of potassium carbonate, insoluble soaps, etc., Br.). If to a solution of 5 Gm. of soft soap in 50 Cc. of water 2 drops of phenolphthalein test-solution be added, not less than 2.3 Cc. nor more than 4.5 Cc. of tenth-normal oxalic acid solution should be required to discharge the red tint (limit of free alkali).—U. S. The P. G. requires that a solution of 10 Gm. of soft soap in 30 Cc. of alcohol, after addition of 0.5 Cc. of normal sulphuric acid, shall not give a red color upon further addition of 1 drop of phenolphthalein solution.

Besides the above product, an inferior article is recognized in the P. G. under the name *Sapo Kalinus Venalis—Schmierseife*, which no doubt is of variable composition and made from mixtures of linseed oil, rapeseed oil, fish oil, hempseed oil, etc. It forms an almost clear solution in water, and should yield at least 40 per cent. of fatty acid when tested as follows: To a solution of 5 Gm. of the soap in 100 Cc. of hot water add 10 Cc. of diluted (16 per cent.) sulphuric acid, and heat the mixture on a water-bath until the separated fatty acid floats as a clear layer on the surface. When cool add 50 Cc. of petroleum benzin, and dissolve the fatty acid by agitation. If 25 Cc. of the solution be evaporated to constant weight at a temperature not exceeding 75° C. (167° F.), the residue should weigh not less than 1 Gm.—P. G.

Pharmaceutical Preparations.—Liniment of Soft Soap.—U. S. P.

Action and Uses.—Soft soap is used for cleansing purposes and as a stimulating application to chronic sluggish skin diseases, notably eczema rubrum, psoriasis, ichthyosis, and lupus. For this purpose the tincture of green soap (Linimentum Saponis Mollis) is applied over the diseased area until some slight inflammatory reaction is set up, when the soap is removed by thorough washing and a bland ointment applied.

SAPONARIA.—Soaproot; Soapwort.

Saponary, Bruise-wort, Bouncing-bet, Sweet Betty, Scourwort, Wild Sweet-William, Latherwort, etc., E.; *Seifenwurzel*, G.; *Savonnière*, Fr.; *Saponaria*, Sp.

The dried roots and smaller rhizomes of *Saponaria officinalis* L. (Fam. *Caryophyllaceæ*).

Origin.—This plant is a perennial herb a foot or two high, native of Europe and naturalized in North America, where it grows in the greatest abundance, in many localities, along roadsides and about old buildings. Its habit is shown in the accompanying illustration. The flowers vary in color from rose pink to nearly white.

Fig. 364.

Saponaria (½ Nat.).

Description.—The root, which should be collected in the spring or autumn without the creeping runners, is 25 to 38 Cm. (10 to 15 In.) long, cylindrical, about 3 to 6 Mm. (⅛ or ¼ In.) thick, gradually tapering below, somewhat branched, longitudinally wrinkled, and of a red-brown color externally. It breaks with a short fracture, and is internally white, with a rather thick bark and a soft yellowish, and in the centre whitish, wood which has nomedullary rays, and is surrounded by a fine dark-colored cambium-line. The root is inodorous, and has a sweetish and bitter, afterward persistently acrid, taste.

Constituents.—Until recently, saponaria was supposed to contain but one active constituent, an amorphous neutral glucoside, to which the name *saporubrin* had

been given, and which is described at length in Van Rijn's excellent work entitled *The Glucosides* (Berlin, 1900). Kobert, who has again investigated the subject, has been able to determine the presence of two constituents closely resembling those found in soap bark (see under QUILLAJA), and has designated them as *saporubrin* and *saporubric acid* respectively. The former is not affected by neutral lead acetate, nor by ammonium sulphate, but is precipitated from its aqueous solution by basic lead subacetate. Saporubric acid is precipitated by ammonium sulphate, and its presence in soapwort was determined by Kobert in this way.

Action and Uses.—The physiological action of saponin, the active ingredient of soapwort, bears no relation to the former application of the drug as an alterative in chronic cutaneous diseases, syphilis, gout, and rheumatism. It is probably without influence in these diseases. It has been administered in decoction (1 ounce to 1 pint [30 Gm.–480 Cc.]), the dose of which was 1 to 2 ounces (30–60 Cc.).

Allied Products.—Under the title CARYOPHYLLACEÆ, reference has been made to the general presence of saponin in the plants of this family. Two of these yield commercial drugs of more or less importance, as follows :

Levant or *Spanish soaproot* is the root of *Gypsophila Struthium* L., collected in the Mediterranean region. It is about 30 Cm. (12 In.) long, 5 Cm. (2 In.) thick, transversely and longitudinally wrinkled, pale-brownish externally, internally white, with a rather hard wood and numerous medullary rays. In sensible properties and in composition it resembles the preceding.

Red Sand-spurry or *Sandwort* (*Arenaria rubra*, Fr. Cod.) is the herb *Tissa rubra* (L.) Britton (*Arenaria r.*—L.; *Buda r.*—Dumort; *Spergularia r.*—Presl.), an Old World species, naturalized in sandy regions in many parts of eastern and central North America. It has a prostrate stem, opposite, linear, gray-green leaves, lanceolate, cleft stipules, small pink flowers, and 3-valved, many-seeded capsules; odor and taste slight. Vigier (1881) obtained from the plant a stearopten and some odorous resin; the decoction is stated to have an alkaline reaction. The commercial drug, as used in France, consists of a number of allied species.

Sapindaceæ.—This family, which contains, according to Radlkofer, 118 genera and almost exactly 1000 recognized species, is noted for the prevalence in its plants of saponin, on which account a great many of them are used as fish-poisons and several as drugs. The family yields a number of edible fruits, the most important being the Oriental *Lichee*, or "Chinese fruit," derived from various species of *Nephelium*.

Soap-berries, the fruits of various species of *Sapindus*, have been found to contain as much as 35 per cent. of saponin. These fruits are nearly spherical, usually about 1.2 Cm. in diameter, from yellow to deep-brown-red in color, wrinkled on drying, and consist of a soft, gummy pericarp containing a single large seed, a considerable space separating the two. The fruit has a bitter, sweetish, and acrid taste. The species most commonly used is *S. Saponaria* L. *Cardiospermum Halicacabum* L., the common *Balloon-vine*, *Heart-seed* or *-pea*, or *Indian-heart*, of cultivation, wild in nearly all tropical countries, and *Dodonœa viscosa* Jacq., also common in all tropical regions, are used as purgatives and expectorants, and also for washing purposes, on account of their saponin.

SAPONINA.—Saponins.

The first use of the name saponin occurred in connection with the saponaceous constituent of the root of Saponaria rubra, discovered in 1808 by Schrader. While formerly the view prevailed that the peculiar substance called saponin, as found in different plants, is identical, careful investigation of the subject by R. Kobert and his associates and pupils has demonstrated the fact that the name saponin should be applied to a group of plant constituents having certain chemical and physical properties in common, yet differing in constitution, physiological effect, etc.

Although saponins are met with in several hundred plants, both monocotyledons and dicotyledons, distributed among 46 or more families, practically nothing is known regarding the important part they may play in plant physiology. They occur in all parts of plants; thus in the root of sarsaparilla, saponaria, senega, and helonias (chamælirium), the bulb of cyclamen, the bark of quillaja and guaiacum, the fruit of sapindus, the seed of æsculus, entada, and agrostemma, the stem of dulcamara, and the leaves of digitalis and guaiacum. Kobert inclines to the view that the saponins are formed in the leaves and deposited later in other parts of the plant.

One of the chief characteristics of the saponins, and to which they owe their group name, is the property of forming aqueous solutions which foam strongly upon agitation,

like solutions of soap, even when very dilute (1 in 10,000). The bubbles of froth, which in some cases are quite persistent, are destroyed if alcohol or ether be allowed to drop upon them. Another common property is the ability to hold fatty and resinous substances, when in a finely divided state, in perfect suspension in aqueous mixtures, thus producing emulsions of great stability. Finely divided vegetable substances are also kept in suspension in watery fluids by the presence of saponins. With few exceptions the saponins are readily soluble in water (all are soluble if the water be made slightly alkaline), and also in diluted alcohol, preferably if warmed. Some are soluble in cold absolute alcohol, but thus far none has been found soluble in ether, benzene, or carbon disulphide. A few dissolve with difficulty in chloroform. Many, but not all, saponins are precipitated from their solutions by addition of a saturated solution of ammonium sulphate, and this fact has been utilized as a means of separation. In some instances precipitation occurs in the cold, immediately or after the lapse of some time, while in others the application of heat is necessary, especially in weaker solutions. By this method it has been possible to separate polygalic acid from senegin in a decoction of senega, quillajic acid from quillajasapotoxin in a decoction of soap-bark, and saporubric acid from saporubrin. The sapotoxin present in Levant soapwort, *saponaria alba*, which is precipitated by ammonium sulphate, has thus been shown not to be identical with the sapotoxin in quillaja.

All saponins have glucosidal properties, and are hydrolyzed when their solutions are heated with dilute mineral acids, being split up into dextrose and a non-toxic body, soluble in cold water, called sapogenin. The latter body, which is not identical for all saponins, has acid properties, and forms water-soluble crystallizable salts with the alkalies. Some saponins are precipitated by neutral lead acetate, others by basic lead subacetate, and still others are affected by both reagents. Those precipitated by neutral lead acetate show an acid character toward litmus and Congo-red, and are designated as acids; thus, melanthinic acid, polygalic acid, quillajic acid, etc. The other saponins are neutral, some being known as sapotoxins, while others have been given specific names, such as assamin, chamælirin, senegin, etc. One drug, at least, is known to contain 3 neutral saponins—namely, sarsaparilla, the same being named parillin, sarsasaponin, and smilasaponin.

As a rule, saponins are amorphous bodies, but parallin and sarsasaponin are crystalline. They are characterized by a bitterish, acrid taste, sometimes accompanied by a burning sensation, and in fine powder are intensely irritating and sternutatory. With few exceptions saponins are decidedly toxic and have a solvent effect on red blood-corpuscles. This poisonous property prevents their use in pharmacy in many cases, where their property of permanently suspending oils and resinous matter would otherwise make it very desirable. The saponin obtained from the root of helonias dioica, and known as chamælirin, is said to have been used at times for codliver oil emulsions because less toxic than the saponins of quillaja bark; but inasmuch as the saponins present in guaiacum bark and leaves have been found almost entirely devoid of toxic properties, these would naturally seem preferable to all others for emulsifying purposes.

The following color reactions observed by Kobert are worthy of special note: A characteristic red coloration occurs with many saponins if they are mixed with concentrated sulphuric acid and exposed to the air for some time, or carefully warmed. With an alcoholic solution of sulphuric acid, to which a drop of dilute solution of ferric chloride has been added, a greenish-blue coloration is produced, which reaction is useful for detection of saponins in microscopic sections of vegetable drugs. A solution of selenous acid in concentrated sulphuric acid (Mecke's reagent) produces a cherry-red color with the acid saponin of *cereus grandiflorus* and other saponins, while a beautiful violet color is produced with guaiac-saponic acid. A very delicate reaction, resulting in an intense red color, is produced by adding to soap-bark saponins some Millon's reagent as modified by Nasse (a solution of mercuric acetate to which a drop of potassium nitrite solution has been added just before using), and warming. Kobert states that this last reaction is useful for detection of quillaja preparations in oil emulsions.

Two general formulas have been proposed to represent the composition of the saponins, C $H_{2n-10}O_{18}$ by Flückiger, and $C_nH_{2n-8}O_{10}$ by Kobert, to one of which nearly all known saponins may be referred. To the first group belong quillajic acid $C_{33}H_{56}O_{18}$, chamælirin $C_{36}H_{62}O_{18}$, parillin (Flückiger) $C_{40}H_{70}O_{18}$, digitonin $C_{33}H_{56}O_{18}$, sarsasaponin $C_{40}H_{70}O_{18}$, and others, while quillajasapotoxin $C_{17}H_{26}O_{10}$, melanthinic acid $C_{29}H_{50}O_{10}$, sen-

egin $C_{18}H_{28}O_{10}$, smilasaponin $C_{20}H_{32}O_{10}$, polygalic acid $C_{19}H_{30}O_{10}$, and the acid and neutral saponins of guaiacum bark, $C_{21}H_{34}O_{10}$ and $C_{22}H_{36}O_{10}$, are members of the second group.

Inasmuch as the saponins are capable of forming insoluble lead compounds, Kobert recommends the following method for their extraction: To the concentrated decoction or tincture of the drug, solution of lead acetate is added; the resulting precipitate, after filtration, is mixed with some alcohol, treated with hydrogen sulphide, and again filtered. The residue is boiled with several portions of alcohol, the solutions added to the filtrate, and the whole evaporated to a syrupy consistence. Upon addition of ether to the cooled liquid, the saponins are precipitated. In order to recover any saponin not precipitable by lead acetate, solution of basic lead subacetate should be added to the original filtrate and the process then continued exactly as directed for the treatment of the precipitate obtained with neutral lead acetate.

The process of salting out by means of ammonium sulphate may also be employed for precipitation and separation of saponins (as given under QUILLAJA) in place of the lead acetate method mentioned above.

Due acknowledgment is hereby made of the recent very interesting and valuable publication by Professor R. Kobert, of Rostock, Germany, entitled "Contributions to the Knowledge of the Saponin-Substances," from which the above brief abstract has been made.

Action and Uses.—The saponins as isolated principles are not used in medicine, but they represent the active ingredients of many medicinal plants, as sarsaparilla, senega, quillaja, etc. As a class they possess distinctly irritating properties. Applied to the skin in the form of ointment, they set up an inflammation characterized by itching, heat, redness, and eventually pustulation. Their solutions injected into the subcutaneous tissues produce local anæsthesia, not, however, until they have caused so much irritation as to preclude their use for this purpose. Their irritant local action on the nasal and bronchial mucous membranes causes sneezing and coughing, while nausea and vomiting result from their effect upon the membranes of the mouth, pharnyx, and stomach. Some of the saponins (sapotoxins), notably those derived from quillaja, cyclamen (sowbread), and agrostemma (corncocle), are exceedingly poisonous, while others, from senega and sarsaparilla, are less toxic. Large quantities injected into the blood stream prove rapidly fatal, death being due to paralysis of respiration, the heart continuing to beat for some time after respiratory arrest. Smaller lethal doses similarly administered produce general depression, loss of appetite, an enfeebled and irregular circulation, convulsions, collapse, and death. The post-mortem changes after these smaller lethal doses are widely disseminated extravasations of blood into the serous and mucous membranes. Large quantities given by the mouth, even if they do not produce vomiting, are rarely fatal, as most of the saponins are not absorbed through an intact mucous membrane. The saponins in concentrated solution are powerful poisons to all living protoplasm. They induce paralysis and alterations in structure if applied directly to muscle. Nervous tissue is similarly affected. When brought in contact with red blood corpuscles, either within the vessels or extravascularly, the saponins destroy the cells and liberate the hæmoglobin. The therapeutic applications of the different saponins are discussed under the drugs from which they are derived.

SAPOTACEÆ.—The Sapota Family.

The Sapota, or Gutta-percha family, comprises 31 genera and about 350 species of tropical trees and shrubs. It is chiefly interesting as being the source of the important resinous substances Gutta-percha, Balata, Chicle, and many similar substances, and because it yields many important tropical fruits.

Bassia oil is the fat extracted from the seeds of various species of *Bassia*. That from *B. butyracea* Roxb. is known as *Fulwa-butter*. These fats are used externally in the treatment of rheumatism, in India, as are the similar substances obtained from the seeds of various species of *Payena*. *Bassia longifolia* L. is of interest as being one of the few plants whose flowers are used as foods. It is known in India as the *Mahwa*, *Elloopa*, and by various other names.

Monesia or *Monesia Bark* is the dried bark of *Chrysophyllum glyciphlœum* Casaretti, a Brazilian tree. The bark is in flat or curved pieces 3 to nearly 6 Mm. (⅛ to ¼ In.) thick, often 5 to 7 Cm. (2 or 3 In.) broad, externally marked with confluent ridges, forming large irregularly quadrangular or hexagonal meshes, which are covered with a thin, smooth, whitish

tissue while the bark is young. The inner surface is cinnamon-colored, and longitudinally striate, otherwise smooth. The bark is very hard, breaks with a granular fracture, and shows in the interior alternate layers of brown and pale-reddish tissue. It is inodorous and has a peculiar taste, which is at first sweet like liquorice, afterward bitterish, somewhat acrid and astringent. It contains tannin, glycyrrhizin, and saponin, with a trace of volatile oil, coloring-matter, and other substances of no medicinal interest.

Sideroxylon Cantoniense Lour. yields the Chinese bark *Shan-kan-shii*, much used as a tonic and astringent. The unripe fruits of many species are also used as astringents, like persimmons.

SARSAPARILLA, *U. S.*—Sarsaparilla.

Sarsæ radix, Br.; *Radix Sarsaparillæ*, P. G.; *Sarsaparilla*, G.; *Salsepareille*, Fr.; *Salsapariglia*, It.; *Zalzaparilla*, Sp.; *Salsa Americana*, *Salsaparrilha*, Port.

The dried root of *Smilax medica* Chamisso et Schlechtendal (Mexican, Vera Cruz, or Tampico Sarsaparilla), *Smilax ornata* Hooker f. (Jamaica, Central America, Costa Rica, or Lima Sarsaparilla), *Smilax papyracea* Duhamel (Brazilian, Para, or Rio Negro Sarsaparilla), or *Smilax officinalis* Kunth (?), known commercially as Honduras Sarsaparilla (Fam. *Liliaceæ*).

Sarsaparilla is official in all pharmacopœias, most of which recognize one or more of the species above named, though they differ greatly in their preferences, most of them preferring the Honduras variety, and most allowing "other undetermined species also." The B. P. recognizes only *S. ornata* Hook. f.; the Italian recognizes *S. syphilitica* Kunth, and states that the best varieties are those with bark and pith relatively small; the Belgian rejects those which are pale, blackish inside, or tasteless.

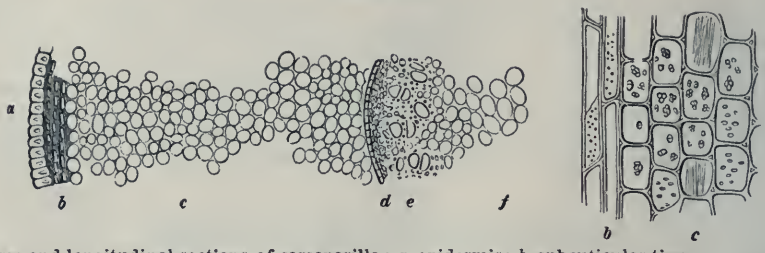
Origin.—The genus *Smilax*, Tourn., contains some 200 species, both of the Old and New Worlds. Several are common in our northeastern States, and are known as *Greenbriar*, *Catbriar*, *Bread-and-butter vine*, etc. They are tough and strong, though slender, woody and sharply thorny climbers, with smooth and shining coriaceous leaves, the stipules formed into tendrils. They produce umbels of small, 3-merous, greenish flowers and blue-black berries, the latter often red in the tropical species. The northern species are scarcely medicinal, though the root of our common *S. rotundifolia* L. (*S. caduca* L.; *S. quadrangularis* Willd.) is somewhat used as an alterative. Those of our Southern States are somewhat medicinal, and several of the tropical species, beginning with those of Mexico, become important drugs. They resemble the northern in habit, but are very much larger, often climbing or running for hundreds of feet. The strong rhizomes also frequently run near or at the surface of the ground for a great distance, giving off at their nodes fascicles of slender roots which are themselves often several yards in length, and of nearly uniform thickness throughout most of their length. Those of the different species differ greatly in the number and character of the small lateral rootlets which they produce. The rhizomes are torn up at those seasons when the ground is soft. The fascicles of roots are cut away, with or without short sections of their rhizome, according to the custom of the respective locality, and are dried and variously bundled or baled. (See *Varieties.*) The collector usually bundles it but loosely, the compact rolls of commerce being afterward formed by the native dealer.

Description.—Mostly more than a meter (more than a yard) in length and 4 to 6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ In.) thick, with few or many fine roots adhering; externally varying from light-gray-brown and smooth, with few deep and sharp wrinkles, to dark- or orange-brown and less smooth, and with more and smaller wrinkles; internally whitish, with a thick, mealy, or sometimes horny cortex, a circular wood-zone and a thick pith; fracture tough; nearly inodorous; taste mucilaginous, somewhat sweetish and bitter, slightly acrid.

The thick, woody, knotty rhizome, if present, should be rejected.

The transverse section exhibits an epidermis of one layer of cells; a subcuticular layer of two or three layers, the cells axially elongated and with thickened walls; a cortex of many parenchymatic layers containing starch in grains or in a pasty mass, some of the cells containing raphides; an endoderm (*nucleus-sheath* or *bundle-sheath*) of one layer of cells, their form and thickening characteristic in the different species; a woody zone, the vessels of the scattered bundles large and radially arranged; a central parenchyma called *pith*, similar to the cortex and containing starch, a few vascular bundles often scattered through it.

Fig. 365.



Transverse and longitudinal sections of sarsaparilla: *a*, epidermis; *b*, subcuticular tissue; *c*, parenchyma; *d*, nucleus-sheath; *e*, woody zone; *f*, central parenchyma.

Varieties.—The more important varieties are the following:

Honduras.—The botanical origin of this is undetermined, but it is commonly believed by medical botanists that it is derived from *S. officinalis*, originally collected in New Grenada. It is collected in Honduras, Guatemala, etc., the rhizome entirely excluded, the roots folded and bound very tightly into cylindrical rolls about 2½ feet long and 3 inches in diameter, the exposed doubled ends not trimmed off, otherwise entirely covered by the binding root; the color a rich brown; the roots of medium thickness, bearing

Fig. 366.

Honduras sarsaparilla.

Fig. 367.

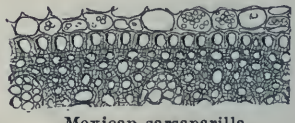
Honduras sarsaparilla (× 3).

many small longitudinal wrinkles and an exceedingly variable number of rootlets. The endodermal cells are nearly uniformly thickened on all sides, and have a nearly quadrangular appearance in transverse section. The cortex and medulla are relatively thin, and the cells well filled with granular starch. The Mexican variety is often falsely rolled

Fig. 368.

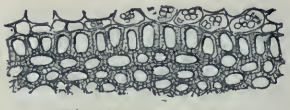
Honduras sarsaparilla.

Fig. 369.



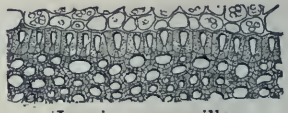
Mexican sarsaparilla.

Fig. 370.



Rio Negro sarsaparilla.

Fig. 371.



Jamaica sarsaparilla.

Sections through nucleus-sheath, showing above one row of cells of bark-parenchyma, and beneath it several rows of cells of the woody zone (× 80).

to imitate the Honduras, besides which a variety is largely exported from Honduras, collected there and rolled in the same way, which is closely similar to the Central American Jamaica article.

Central American Jamaica, Costa Rica, or Lima.—This is the product of *S. ornata* Hook. f., and is collected chiefly in Costa Rica. It came to be called "Jamaica" from being exported through that province. It is tied into rolls a little larger but far looser than the last, and the binding root is passed around it only a few times. The doubled ends are not trimmed off. Much of it also comes pressed into large bales. The rhizome

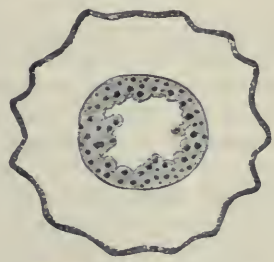
is entirely excluded. It is considerably darker than the last, and the roots are distinctly thinner and leaner, and are strongly clothed with rather coarse rootlets. It is much more sharply wrinkled and not nearly so well supplied with granular starch. Its taste is rather muddy and not so good as that of the Honduras. Its cortex is relatively thick; its endodermal cells much narrowed inwardly, as to the lumen, by the greater thickening of the walls there.

Native Jamaica (*Roja Inglesa*).—This is the product of *S. utilis* Hemsly (long called *S. officinalis*), from plants cultivated in Jamaica. Though sometimes baled, it is usually put up like the last variety, the rolls commonly somewhat shorter and thicker. It is of an orange or orange-red color and of beautiful appearance, thick and moderately

FIG. 372.

Native Jamaica sarsaparilla.

FIG. 373.



Jamaica sarsaparilla (× 4).

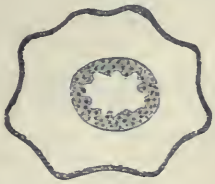
wrinkled and well supplied with rootlets. Its structure is much like that of the last. A variety occasionally exported from Venezuela (*Caracas sarsaparilla*) is possibly the same, and, if so, this is doubtless the original source of the Jamaica cultivated.

Mexican (*Vera Cruz or Tampico*).—This is from *S. medica*. Most of it is now baled, but a good deal is also put up in loose rolls, slightly bound, the doubled ends not

FIG. 374.

Mexican sarsaparilla.

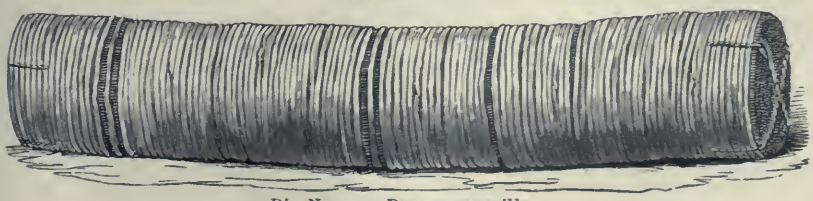
FIG. 375.



Mexican sarsaparilla (× 3).

trimmed off, one end much larger, owing to the presence of one or more nodes of the rhizome for each fascicle of roots, in which particular it differs from all others. The root is distinguished by its few and extremely deep wrinkles, its pale color, freedom from rootlets, and smooth surface. It contains comparatively little granular starch. The endodermal cells are nearly quadrangular, their walls rather more thickened internally, and their lumen nearly oval.

FIG. 376.



Rio Negro or Para sarsaparilla.

Rio Negro, Brazilian, or Para.—This is from *S. papyracea*. It comes in enormous, very tight rolls, about 4 feet long by a foot in diameter, completely covered by a binding

vine, the doubled ends trimmed smoothly off. It is very dark, the roots of medium thickness, with numerous small wrinkles, abundantly clothed with fine rootlets and very starchy. It has a thin cortex, and the endodermal cells are large, radially elongated, and with a large lumen.

Fig. 377.

Rio Negro sarsaparilla (× 3).

Constituents.—Sarsaparilla contains about 3 per cent. of saponin-like substance, which is separable into 3 glucosides, up to 15 per cent. of starch, a little resin, volatile oil, pectin, calcium oxalate, and other unimportant substances. Of these, the first named undoubtedly represents all that is important in the activity of the drug. The most important of its 3 bodies is *sarsasaponin* ($C_{22}H_{36}O_{10}$), which is crystallizable, and soluble in water and alcohol, especially on warming, as are both the others. *Parillin* ($C_{26}H_{44}O_{10}$) is also crystallizable. *Smilasaponin* ($C_{20}H_{32}O_{10}$) is not crystallizable. Sarsasaponin is regarded as 3 or 4 times more active than the other two. "Smilacin" is a name which has been applied to both of the last two. Some attempts have been made to determine the relative amounts of total glucosidal constituents in the several varieties, but the results are not conclusive.

Pharmaceutical Preparations.—Compound Fluidextract of Sarsaparilla, Compound Syrup of Sarsaparilla, Fluidextract of Sarsaparilla, U. S. P.

Action and Uses.—No drug in the materia medica has been the subject of so much discussion as to its efficacy as has sarsaparilla. Since its introduction into medicine during the sixteenth century as a remedy in syphilis, it has been regarded by some as almost a specific, and denounced by others as entirely inert. There is certainly no relation between its physiological action and the power that it seems to possess over the general system. When given alone it exercises little influence, but in combination with mercury or the iodides it seems to increase their efficiency in the treatment of cases of obstinate syphilis which fail to yield to them alone. It is claimed to be of particular service in subjects debilitated by the ravages of syphilis and the injudicious use of mercury and iodine. The compound decoction of sarsaparilla has been recommended in chronic gout and rheumatism and in certain sluggish skin diseases. Sarsaparilla is largely used in domestic medicine as a "blood purifier," and is perhaps the least important ingredient of many patent medicines which bear its name. The compound syrup, in the dose of 1 to 4 drachms (4–16 Cc.), is the preparation commonly administered. The fluidextract is given in the dose of ½ to 1 drachm (2–4 Cc.).

Other Sarsaparillas and Substitutes.—The most important species, next to those above considered, are *S. China* L. and *S. glabra* Roxb. (*Radix Chinæ, China root; Chinawurzel, Pockenwurzel, Chinaknolle*, G.; *Squine*, Fr. Cod.; *Choh-chini*, Ind.; *Too-fuh*, Chin.; *Sankira*, Jap.), of eastern Asia, including Japan. It is used in its home very much like Sarsaparilla, but is of totally different appearance, consisting of root-tubercles. They are irregularly oval, flattened, rusty brown externally, white or pinkish internally, starchy and without much odor or taste. They are often peeled before being marketed. No notable constituent except a glucoside was found by Prof. David Hooper. *S. ovalifolia* Roxb. is also an Indian species, and its root resembles Sarsaparilla, and is there used as such. *Smilax Pseudo-China* L. and *S. tamnoides* L., of the southeastern United States, yield tuberous roots, *Bamboo-briar root*, which somewhat resembles the China root, but they are not so heavy and are of a light-brown color. A similar article is used in Mexico as *Raiz de China de Mexico* (*Mexican China-root*). Its origin is not determined. *S. aspera* L., of southern Europe, is similarly used. We have recently seen a very slender, blackish root, bearing sharp conical projections, which is used as a sarsaparilla in Honduras. It is apparently from a Smilax. A somewhat similar one, apparently not a Smilax, is so used in Santo Domingo.

Among the Sarsaparilla-substitutes not of the genus *Smilax* is the root of an *Agave*, collected in Porto Rico, and called Porto Rico Sarsaparilla. The gall-covered root of a *Philodendron* was reported as being sold in Hamburg as a sarsaparilla-substitute. In India, the root of *Hemidesmus Indicus* Br. (*Indian Sarsaparilla*) is extensively used. Like sarsaparilla, it is a long, slender root, but is tortuous, dark-brown or purplish-brown, longitudinally fissured, with the odor of cumarin, which it contains, and of a sweetish and acrid taste. Its structure is dicotyledonous, and the bark contains numerous laticiferous ducts. The rhizome of *Carex arenaria* L. (*Sand-sedge, German sarsaparilla*, E.; *Laiche*, Fr.; *Sandriedgras, Rothe Quecke*, G.—Fam. *Cyperaceæ*) is similarly used, as is *C. hirta* L. Greenish, in 1894, reported the importation to England of the slender rhizomes of some ferns, thought to be perhaps *Pteris aquilina* L. and sold as Sarsaparilla, and he refers to the early similar use of *Polypodium Colaguala* Goebel et Kuntze, in Peru.

SASSAFRAS, *U. S.*—Sassafras.

Cortex Sassafras, Swiss P.—*Sassafras bark*, *Saxifrax*, E.

The dried bark of the root of *Sassafras Sassafras* (L.) Karsten (*Laurus S.* L.; *L. variifolius* Salisb.; *Sassafras v.* Kuntze; *S. officinale* Nees—Fam. *Lauraceæ*).

The Sassafras tree, sometimes known as *Cinnamon wood*, *Ague tree*, or *Saloop*, is represented, in one form or another, in most pharmacopœias. *Sassafras radix*, of the B. P. and of most other pharmacopœias, is defined as the dried root. *Lignum Sassafras* of the German Pharmacopœia (*Lignum pavanum* or *Lignum Fœniculi*, *Fenchelholz*, *Panamaholz*, *Sassafrasholz*) is defined as the wood of the root. A number of pharmacopœias specify that the trunk-wood should be rejected, though the Belgian includes it, and the Italian includes that of the lower portion of the trunk, and stipulates that it must contain 1.5 per cent. of volatile oil.

Origin.—Sassafras grows abundantly throughout the eastern and southeastern United States and to some extent in southern Canada, preferring a sandy or light soil and rather open situations. It is a dicœcious tree, ordinarily rather small, but occasionally exceeding 3 feet in diameter and 50 feet in height. The young twigs are green, soon developing brownish corky warts, and later becoming brown and fissured. The bark of the trunk is ashy-gray and deeply and roughly fissured. The branches contain a large pith (see SASSAFRAS MEDULLA). The root is large, very irregularly branched, externally of a creamy-white color when first exposed, but quickly changing to a gray. The wood of the root and trunk is at first whitish, becoming on exposure, especially the former, reddish- or rusty-brown. The form of the thickish, smooth, or when young somewhat downy, leaves is indicated in the accompanying illustration. Frequently they bear but a single lateral lobe. The flowers are of a light-yellow color and somewhat, especially those of the staminate tree, precede the leaves. The pedicle and basal portion of the fruit are of a bright crimson or scarlet, the drupe itself bluish-black. All parts are very mucilaginous. The bark of the branches is strongly aromatic, but quite bitter and of a different flavor from that of the root-bark.

FIG. 378.

Sassafras (branch, ½ Nat.; root-bark, Nat.).

Description of Root-bark.—In irregular, warped, chip-like fragments, 5 Mm. (⅕ In.) or less in thickness, the thicker pieces deprived of most of the gray corky layer; bright rust-brown, or with more or less of the gray-brown cork adhering and exhibiting its outer surface softly and rather finely scaly, from numerous short, intersecting, shallow fissures; inner surface obscurely short-striate; light, soft, and fragile, with a short, weak fracture which exhibits a broad, irregular, whitish layer between two rust-brown ones; strongly and peculiarly fragrant; taste sweetish and bitterish, aromatic, mucilaginous, and slightly astringent.

The stem-bark is in strips or elongated pieces, with a lighter-gray, more deeply and longer fissured outer surface, and is less aromatic, more mucilaginous, and bitter.

In the powder the parenchymatic cells are seen to be very thin-walled, almost always without pores and well-filled with starch grains, in which particulars they differ from those of the stem-bark. Furthermore, bast-fibers are very rare and are always completely detached. The starch-grains are mostly in groups. The single ones are lenticular and occasionally reach a diameter of 12 to 15 microns.

Constituents.—The important constituents of the official product are from 6 to 9 per cent. of volatile oil (see OLEUM SASSAFRAS), about 6 per cent. of tannin and 9 of *sassafrid*, together with a large amount of gum. A considerable amount of starch and

a little resin are also present. The tannin of sassafras bark gives a bluish-green color with ferric salts. It is gradually transformed by oxidation into sassafrid, which, according to Procter, is not present in the fresh bark. Sassafrid is soluble in alcohol, but not in ether, and crystallizes in yellowish-brown granules. Its solutions are colored red by alkalies, precipitated carmine-red by alkaline earths, dark greenish-brown by ferric salts, and whitish by lead acetate.

Other Parts of the Plant.—Sassafras wood of the root and lower portion of the stem yields an oil identical with that from the root-bark, but occurring in much smaller amount, usually between 1 and 2 per cent. The leaves and green bark of the twigs yield an oil which apparently does not contain saffrol, but is, on the contrary, more allied with lemon oil.

Sassafras Medulla, U. S., or Sassafras Pith, is the dried pith of the stem of the plant described above. It occurs in cylindrical, straight, curved or coiled pieces, 1 to several inches in length and 3 to 8 Mm. (⅛ to ⅓ In.) in diameter, or in split portions of the same; white, very light, and spongy; inodorous or with a slight odor, as well as taste, of sassafras, very mucilaginous.

Macerated in cold water, 2 Gm. in 100 Cc., it forms a mucilaginous liquid recognized in the U. S. P. as Mucilago Sassafras Medullæ.

Its only important constituent is a very large quantity of gum, forming with water a mucilage not precipitated by alcohol. It contains enough volatile oil to give it a faint sassafras odor and taste.

Action and Uses.—The bark of sassafras root possesses aromatic, stimulant, and astringent properties. It is used chiefly as a flavoring agent to mask the taste of less agreeable drugs. An infusion of 1 fluidounce to 1 pint (30 Gm.–480 Cc.) is used as a popular household remedy for its diuretic and diaphoretic effect in febrile states. The dose is ad libitum. Sassafras pith, made into mucilage, is employed as a demulcent in dysentery and inflammations of the air-passages and stomach. The mucilage forms an agreeable and efficient collyrium in acute conjunctivitis, and serves as a vehicle for more active remedies.

Several other plants of the family are elsewhere known as Sassafras, but none of them is so recognized in general commerce. In Venezuela a sassafras oil is collected by boring into an undetermined Lauraceous tree, very much as Copaiba is collected. This oil consists chiefly of apiol. Several trees are said to be known as Queensland sassafras, and there is a Brazilian *Mespilodaphne Sassafras* Meissn.

SCAMMONIUM, *U. S., Br.*—Scammony.

Scammonium Alepense.—*Scammonium*, G.; *Scammonée*, Fr.; *Scammoneo*, It.; *Escamonea*, Sp., Port.

The resinous exudate from the living root of *Convolvulus Scammonium* L. (*Calystegia S.*—Pritz.—Fam. *Convolvulaceæ*).

Scammony is official in most pharmacopœias, several of which add a qualifying adjective equivalent to our term "native," or "virgin," to indicate the natural exudate, in distinction from the extracted resin or other modified product. The British requires that at least 70 per cent. dissolve in ether and that it yield not more than 3 per cent. of ash. Others allow as high as 8 per cent. of ash. The Italian places the ether-soluble portion as high as 75 to 80 per cent., and requires that it dissolve almost completely in 90 per cent. alcohol.

Origin.—Scammony is obtained from a kind of morning-glory plant, native of the Levant. The upper part of the large fleshy root (described below) is exposed and the top sliced off obliquely, when the juice flows into a receptacle, usually a mussel-shell, suitably placed to receive it. The contents are dried, usually imperfectly, to avoid unnecessary reduction of weight, and then massed together, more or less decomposition usually resulting and imparting a peculiar sour odor, usually denominated "cheesy," to the product.

Description.—Scammony is met with in commerce in irregular angular pieces or circular cakes of a greenish dark ash-gray, dark-brown, or nearly black color, of a peculiar sour and somewhat cheese-like odor, and of a slight but distinctly acrid taste; it breaks readily with an angular or splintery fracture, and exhibits in the interior small fissures and cavities and a resinous lustre. It is somewhat translucent in thin fragments. When triturated with water,

it yields a greenish emulsion; its powder has a gray or greenish-gray color. It yields to alcohol or ether not less than 75 (U. S.), and sometimes as much as 95, per cent. of its weight, and when the solvent has been evaporated and the resinous residue dissolved in warm solution of potassium hydroxide, no precipitate is produced on the addition of an acid. The portion left undissolved by alcohol or ether is of a gray color, and is not colored blue by iodine.

Adulteration and Substitution.—Scammony is very commonly and greatly adulterated, the "Smyrna" article being usually regarded as most subject thereto. Such adulteration usually consists of the addition of starch or farinaceous substances, or of earthy matters, recognized by their insolubility in ether. Scammony thus adulterated is frequently smooth externally, dense, heavy, and effervesces when thrown into dilute hydrochloric acid, or its decoction with water yields a blue color on the addition of iodine. One such product, consisting almost wholly of damaged flour or similar material, has received the commercial designation "skillip." The residue left after extraction of the resin has been used as an adulterant, as have also guaiac and other resins. The resin extracted from the dried root has often been substituted. It may be recognized by its peculiar leathery odor.

Montpellier scammony, employed to a limited extent in France, was claimed to be the milk-juice of *Cynanchum monspeliacum* L. (Fam. *Asclepiadaceæ*). The commercial article was found by Laval (1861) to contain from 10 to 21 per cent. of resinous matter, 50 to 59 of starch, and 11 to 18 of earthy substances.

It is said that the resin extracted from the root of *Convolvulus althæoides* L., of the Mediterranean region, has been substituted.

Constituents.—The important constituent of scammony is its glucosidal resin called *scammonin*, which is said to sometimes reach a percentage of 95 of the scammony. Scammonin is soluble in ether. It is elsewhere considered. Almost the entire remaining portion of scammony is gum. Traces of the natural starch of scammony root may exist.

Scammony root, though little used in this country, is official in the B. P. It is the dried root of the above-named plant. It sometimes reaches a yard in length, though usually occurring in short pieces, and is about 5 Cm. (2 In.) thick at the summit, tapering rather gradually to near the end. It is cylindrical, more or less twisted, yellowish-brown, furrowed, and wrinkled externally, whitish, more or less changed to grayish-brown internally; hard and heavy, with a fibrous fracture; bark about one-eighth to one-sixth of the diameter and, like the parenchyma of the meditullium, containing numerous resin-cells; wood-bundles irregularly arranged; odor slight but peculiar; taste sweetish, afterward acrid. The active principle of the root is the same as that of scammony. Starch, gum, and sugar are also contained.

Pharmaceutical Preparation.—Resin of Scammony, U. S. P.

Action and Uses.—Scammony is a drastic hydragogue, slightly cholagogue purge, producing, when administered alone, a good deal of griping. Its action is uncertain, because of its frequent adulteration and its insolubility in the gastro-intestinal contents if they are acid. It is contraindicated if inflammation of the stomach or intestines exist. Large doses may produce severe gastro-enteritis and fatal purgation. Scammony should never be given alone, but in combination with aromatics or other cathartics, which modify its harshness. On account of its tastelessness, it is occasionally given as a purge to children. Scammony is given in the dose of 10 to 20 grains (0.60–1.30 Gm.), the resin in the dose of 3 to 10 grains (0.20–0.60 Gm.), usually in pill form.

SCILLA, *U. S., Br.*—Squill; Squills.

Bulbus scillæ, P. G.—*Scille*, Fr. Cod.; *Squille*, Fr.; *Meerzwiebel*, G.; *Escila, Cebolla albarrana*, Sp.; *Cebola Albarra, Alvarra Branca*, Port.

The bulb of *Urginea maritima* (L.) Baker (*Scilla m.*—L.; *Ornithogalum m.*—Tournef.; *Urginea Scilla* Steinheil.—Fam. *Liliaceæ*), deprived of its dry, membranaceous outer scales, cut into thin slices, and carefully dried, the inner portions being rejected.

Squill is official in all pharmacopœias, many of which caution specifically against a dark-colored, damp, or badly dried article.

Origin.—The squill plant, native of sandy grounds in the Mediterranean basin, is frequently seen cultivated in pharmacists' windows. It produces a large, tunicated, pear-

shaped, greenish bulb, sometimes weighing several pounds, long, flat, leek-like smooth leaves, and a central erect scape about a yard long, terminating in a raceme of greenish-white, 3-merous flowers. Within the bulb the scales may be either white or reddish. The bulb is gathered after the herbage has withered. In its home, it is frequently used fresh, but for our market is prepared according to the above definition. The central portions should be rejected, being the youngest growth and deficient in activity. Being transversely sliced, the segments are then dried in the sun or by artificial heat. Owing to the mucilaginous and hygroscopic nature of the tissue, drying is tedious and difficult, and

FIG. 379.

Scilla maritima L.

FIG. 380.

Squill (Nat.): *a*, inferior central portion.

damage to the drug is very apt to occur in the process. The fresh juice is highly irritating to the skin, often producing an intolerable itching. This is probably due in part to the specific constituents, in part to the raphides. The largest collections are made in the island of Malta.

Description.—In irregular, more or less curved segments, several centimeters (about 1 to 2 In.) long and 4 to 8 Mm. ($\frac{1}{6}$ to $\frac{1}{3}$ In.) broad, thinner in one direction, with 2 to 4 sharp edges; yellowish-white or somewhat reddish, slightly translucent, brittle, and pulverizable when dry, tough and flexible when damp; inodorous and of a mucilaginous, bitter, and acrid taste.

When consisting of very narrow, short, closely curved or coiled segments, from the inner portion of the bulbs (Fig. 380, *a*), it should be rejected.

Microscopical examination reveals very large cells containing well-formed bundles of acicular raphides enveloped in a thick mucilage. The mucilage which fills the non-crystal-bearing cells of the parenchyma is of a different character.

Upon exposure to dampness, squill will absorb from 10 to 15 per cent. of moisture, becoming thus flexible, then drying again. In the powdered state it may thus become converted into a solid, hard mass. These changes are detrimental to its quality.

Constituents.—The important medicinal constituents of squill are glucosides. E. Merck (1879) separated the following three, the last two of which are poisonous; *scillin* (crystalline, pale-yellow, sparingly soluble in water, more freely soluble in alcohol and hot ether, colored by sulphuric acid red-brown, by nitric acid yellow, and on heating green); *scillipicrin* (amorphous, whitish, hygroscopic, and bitter); and *scillitoxin* (amorphous, cinnamon-brown, insoluble in water and ether, soluble in alcohol, colored red and brown by sulphuric acid and orange-red and green by nitric acid). These substances are not regarded as pure chemical bodies, and their relation to *scillein* and *scillain*, isolated by others, are not known. The last, isolated by Kurtz, is probably more nearly free than any other, but it may be merely a purer form of one of the above. It is an amorphous, extremely bitter powder, evidently a glucoside, soluble in water and alcohol, but not in ether. Squill also contains a little volatile oil, about 22 per cent. of sugar, and the peculiar mucilage *sinistrin*, which yields levulose on being boiled with dilute acids. Calcium oxalate exists in large amount.

Pharmaceutical Preparations.—COMPOUND SYRUP OF SQUILL, FLUIDEXTRACT OF SQUILL, SYRUP OF SQUILL, TINCTURE OF SQUILL, VINEGAR OF SQUILL, U. S. P.

Action and Uses.—Squill is largely used for its stimulating, expectorant, and diuretic properties. In poisonous doses it produces violent inflammation of the gastro-intestinal and genito-urinary tracts, manifested by nausea and vomiting, abdominal pain and purging, strangury and bloody urine, and in addition dulness, stupor, convulsions, a marked fall in temperature, an enfeebled circulation, and infrequently death. The employment of squill as an expectorant is largely empirical, as the study of its physiological action does not satisfactorily explain its effect. It appears to stimulate the bronchial mucous membrane and is contraindicated in the presence of fever and acute bronchial inflammation. It may be given with benefit in bronchitis after the subsidence of the acute inflammation, if the sputa are tenacious and raised with difficulty, or if they are very profuse, owing to the lowered tone of the bronchi. In combination with other stimulating expectorants squill is useful, too, in chronic bronchitis. As a diuretic it is frequently employed in dropsy, whether due to chronic disease of the kidneys or to the renal congestion consequent to chronic cardiac disease. It operates not by stimulation of the secreting epithelium of the kidneys, but by toning up, through its irritant action, the depressed condition of these organs. Squill is not to be used if the kidneys are acutely inflamed. In the treatment of cardiac dropsy squill is frequently combined with digitalis. A pill containing 1 grain (0.06 Gm.) each of digitalis, squill, and calomel is popularly known as Niemeyer's pill. The dose of squill in substance is 1 to 5 grains (0.06–0.30 Gm.); of the fluidextract, 1 to 5 minims (0.05–0.30 Cc.). The syrup in the dose of 15 to 60 minims (1–4 Cc.) is the preparation commonly administered in bronchitis.

Other Species.—About 24 species of *Urginea* are recognized, and at least one, *U. Indica* Kunth (*Scilla I.* Roxb.), is used in India in the same way as Squill. It grows in similar localities, has a similar habit, though somewhat smaller, and closely resembles it in every respect. The bulbs of several species of *Scilla* L. (Sect. *Ledebouria*) are there sold as substitutes for it under the name of "Small Squill."

The bulb of *Scilla Peruviana* L. (*Alvarro do Peru*, Port.) has also been exported for use as a substitute for squill.

Many other bulbous plants related to Scilla (*Hyacinthus, Muscari, Narthecium, Gagea,* etc.) are used as diuretics, much like squill, and probably contain related, if not identical, substances.

SCOPARIUS, *U. S.*—Scoparius.

Scoparii cacumina, Br.; *Spartium, Herba scoparii.—Broom, Broom-tops, Irish* or *Scotch broom, Besom*, E.; *Besenginster, Besenkraut, Pfriemenkraut*, G.; *Genêt à balais*, Fr.; *Giesta*, Port.

The dried tops of *Cytisus Scoparius* (L.) Link (*Spartium S.*—L.; *Sarothamnus S.*—Koch; *Genista S.*—Lam.—Fam. *Leguminosæ*).

The Portuguese Pharmacopœia forbids the substitution of *C. grandiflorus* DC.

Origin.—The Broom is a densely growing shrub, usually about 4 or 5 feet high, native of Europe and adjacent Asia, and sparingly naturalized in sandy soil in North America. Its long, slender, erect, and tough branches grow in large, close fascicles, thus rendering it available for broom-making, whence its name.

Description.—Consisting of very long, much-branched, tough, and flexible twigs, which lie parallel with and close to one another, and are about 1 to 2 Mm. ($\frac{1}{25}$ to $\frac{1}{12}$ In.) thick, narrowly 5-winged, with alternating, slight nodes, dark-green and usually naked; internally greenish white; odor peculiar when bruised; taste disagreeably bitter.

The trifoliolate leaves, or the uppermost often reduced to a single leaflet, are sometimes present, as well as the flowers, and occasionally a fruit. The leaflets are sessile, mostly 6 to 12 Mm. ($\frac{1}{4}$ to $\frac{1}{2}$ In.) long, and vary from lance-oblong to obovate. The flowers are about 12 Mm. ($\frac{1}{2}$ In.) long, strongly papilionaceous and deep yellow. In Europe, these are considerably employed separately, under the name *Flores genistæ* or *F. scoparii*. Their buds are said to be sometimes employed as a substitute for capers.

The quality of the drug deteriorates with keeping, and this condition can be determined by the partial or complete loss of the peculiar odor of the recently dried drug.

Constituents.—Broom contains two principles, upon one or both of which its activity depends. *Sparteine* ($C_{15}H_{26}N_2$), discovered in 1851 by Stenhouse, of which about 0.03 per cent. is present, is a transparent, oily liquid, colorless when fresh, turning brown on exposure, of an aniline-like odor and a very bitter taste. It may be obtained by extracting the drug with acidulated water, concentrating the infusion, and distilling after addi-

tion of an excess of sodium hydroxide as long as the distillate shows an alkaline reaction. For the purpose of purification the distillate is neutralized with hydrochloric acid, the solution evaporated, and the residue decomposed by means of solid potassium hydroxide, and distilled. Sparteine is heavier than water, and boils at 288° C. (550° F., Hager), 311° C. (593.8° F., Brühl). It is but slightly soluble in water, but readily so in alcohol, ether, and chloroform, and is insoluble in benzene and benzin. Sparteine is a diacid base, and its solutions show strongly alkaline reaction. It imparts to the drug its cardiant properties. Its sulphate is separately considered. *Scoparin* ($C_{21}H_{22}O_{10}$) is a glucoside occurring in pale-yellow crystals, odorless and tasteless, soluble in alcohol and hot water. It yields a green-yellow precipitate with lead acetates and yields picric acid when treated with nitric acid. It probably represents most of the direct diuretic activity of broom.

FIG. 381.

Scoparius: *a*, branch (reduced); *b*, twig (Nat.); *c*, cross-section (× 2).

Pharmaceutical Preparation.—INFUSION OF BROOM, B. P.

Action and Uses.—Although scoparius and sparteine were formerly highly esteemed as stimulants to and regulators of the heart, their infrequent employment to-day in cardiac disease perhaps best expresses the opinion of the medical profession as to their value. Careful investigations, both clinical and experimental, by many observers, have elicited opposing views of the exact mode of action of scoparius upon the nervous and circulatory systems. Without specifying what part of the nervous apparatus is affected by the drug, it is certain that its action is depressant and that in overdose it probably kills by paralyzing the respiratory centres. Upon the circulation sparteine produces a transient rise in arterial pressure, followed by a longer period of decreased vascular tension. The contention of some investigators that it is a cardiac stimulant, and of others of equal reputation that it is depressant demonstrates that more extensive study of the action of the drug upon the heart is necessary for final decision. Small doses first slow the heart for a short period of time and then hasten its rate and at the same time increase the volume of the pulse. Large doses distinctly depress the heart muscle and pneumogastric nerves. Its effect upon the heart begins to be manifested in from 20 to 30 minutes after its administration and persists for 6 or 8 hours. It has no cumulative action. Those who advocate its employment claim that it is a useful heart tonic and regulator in the incompetency of chronic valvular disease and in cardiac arrythmia from any cause. The efficiency of scoparius as a diuretic is conceded by all, and is probably dependent upon the contained scoparia, whose action upon the renal epithelium is similar to that of buchu and uva ursi. It is employed in dropsy, either that of cardiac disease or of chronic parenchymatous nephritis, but is contraindicated in the presence of acute renal inflammation. For its diuretic action scoparius is given in decoction made by adding ½ ounce (16 Gm.) to 1 pint (480 Cc.) of water and boiling down to ½ pint (240 Cc.); and of this 1 ounce (30 Cc.) should be taken every 3 hours. The dose of the fluid-extract is 15 to 30 minims (1–2 Cc.). The dose of sparteine is variable. Some claim to obtain results from as little as $\frac{1}{20}$ grain (0.003 Gm.), while others recommend that it be given in 2- to 4-grain (0.12–0.25 Gm.) doses. It is probably best to begin with a small dose, $\frac{1}{10}$ grain (0.006 Gm.), and rapidly increase the dose until some effect is noted.

Allied Drugs.—*Spanish broom* is *Spartium junceum* L. (*Spartianthus j.*—Link; *Genista Hispanica* Lam.), a near relative of the last, native of the Mediterranean region, and commonly naturalized in subtropical America. Its branches are much stouter and are nearly terete, and its leaves are pubescent underneath. Its properties are similar to those of Scoparius.

Coronilla is the herbage of various species of the genus of that name, natives of Europe, and some naturalized in North America. The drug (at least that from *C. scorpioides* Koch) contains the glucoside *coronillin* ($C_7H_{12}O_5$), a yellow powder soluble in water and alcohol, but very little in ether and chloroform. The action and uses of the drug are very similar to those of broom.

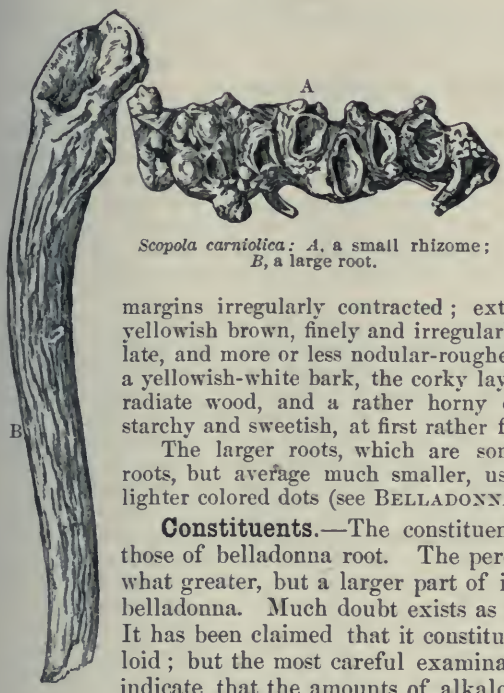
SCOPOLA, *U. S.*—Scopola.

Belladonna Scopola, Scopola Belladonna, Japanese Belladonna (incorrectly).

The dried rhizome and larger roots of *Scopola carniolica* Jacq. (*Hyoscyamus Scopolia* L.; *S. trichotoma* Moench; *S. atropoides* Link.—Fam. *Solanaceæ*).

Origin.—The plant is a European perennial herb, especially abundant in Austria. It grows chiefly in rocky ground, and somewhat resembles belladonna, though much smaller. The rhizome is very largely collected to be used as a substitute for belladonna root, and the leaves are added, as an adulterant, to belladonna leaves.

Fig. 382.



Scopola carniolica: *A*, a small rhizome; *B*, a large root.

Description.—Rhizome of horizontal growth, more or less curved and shortly and sharply flexuose, cylindrical or slightly vertically flattened; occurring mostly in pieces from 2.5 to 7.5 Cm. (1 to 3 In.) long, and 0.8 to 1.6 Cm. ($\frac{1}{3}$ to $\frac{2}{3}$ In.) broad, often split before drying; upper surface marked by large, closely set, cup-shaped stem-scars, their margins irregularly contracted; externally varying from dark brown gray to yellowish brown, finely and irregularly longitudinally wrinkled, obscurely annulate, and more or less nodular-roughened; fracture short and sharp, exhibiting a yellowish-white bark, the corky layer dark brown, a light brown, indistinctly radiate wood, and a rather horny central pith; odor slight, peculiar; taste starchy and sweetish, at first rather faint, afterward acrid.

The larger roots, which are sometimes present, are similar to belladonna roots, but average much smaller, usually of a browner color, and marked by lighter colored dots (see Belladonna).

Constituents.—The constituents of Scopola are almost identical with those of belladonna root. The percentage of total alkaloid is usually somewhat greater, but a larger part of it is usually hyoscyamine than of that of belladonna. Much doubt exists as to the extent to which scopolamine exists. It has been claimed that it constitutes as much as a tenth of the total alkaloid; but the most careful examinations which we know to have been made indicate that the amounts of alkaloids other than atropine and hyoscyamine are much smaller than has been supposed.

The Pharmacopœia requires that scopola shall yield not less than 0.5 per cent. of its alkaloids, when assayed by the process given for belladonna leaves and root (see p. 286), and using 10 Gm. of scopola in No. 60 powder.

Pharmaceutical Preparations.—Extract of Scopola, Fluidextract of Scopola, U. S. P.

Action and Uses.—The sedative action of scopola depends upon the presence of the alkaloid scopolamine, which is identical with hyoscine (see Hyoscine Hydrobromide). It is given as a hypnotic in the insomnia due to mania, hysteria, and delirium tremens. It is of service in some cases of spermatorrhœa and nocturnal emissions caused by irritation of the spinal centres. Scopola is given in the dose of 1 to 3 grains (0.05–0.15), the fluidextract in the dose of 1 to 3 minims (0.05–0.15), and the extract in the dose of $\frac{1}{4}$ to $\frac{1}{2}$ grains (0.016–0.03).

S. Japonica Maxim., of Japan, yields the true *Japanese belladonna*, which the Japanese Pharmacopœia permits to be used as a substitute for belladonna root whenever the latter is prescribed. This plant is so like that of *S. carniolica* that botanists have the gravest doubts as to their being distinct species. The only observable difference in the rhizomes is the somewhat larger size of the Japanese, and a slight difference in the prominence of the vascular bundles. The constituents appear identical. 4 or 5 species of Scopola are recognized.

SCOPOLAMINÆ HYDROBROMIDUM, *U. S.*—Scopolamine Hydrobromide.

Scopolaminum hydrobromicum, P. G.; *Hyoscinæ hydrobromidum*, Br.; *Bromhydrate d'hyoscine*, Fr.; *Hyoscine hydrobromide*, E.; *Skopolaminhydrobromid*, G.

Formula, $C_{17}H_{21}NO_4.HBr + 3H_2O$. Molecular weight, 434.92.

The hydrobromide of an alkaloid obtained from scopola and other plants of the Solanaceæ; chemically identical with hyoscine hydrobromide.—U. S.

(This salt has been fully described under Hyoscinæ Hydrobromidum, which see on p. 795.)

Action and Uses.—The physiological action, therapeutical application, and dose of scopolamine hydrobromide are identical with those of hyoscine hydrobromide (which see).

SCROPHULARIACEÆ.—Figwort Family.

A family of nearly 200 genera and about 2500 species, occurring mostly in temperate and subtropical regions, and many of them producing flowers of great beauty, on which account they are frequently cultivated. Unlike the Labiatæ, to which they are rather closely related, these plants seldom contain much volatile oil, though resinous substances are common. The most important constituents are glucosides, and many of them are poisonous, or powerfully active. Elsewhere we have considered the important drugs DIGITALIS and LEPTANDRA. Minor drugs worthy of consideration here are Verbascum, Scrophularia, Chelone, Gratiola, Euphrasia, and Linaria.

Verbascum or *Mullein* (*Wollkraut*, *Königskerze*, G.; *Bouillon-blanc*, *Molène*, Fr. Cod.; *Gordoloba*, Sp.) is usually understood as the leaves (*Folia verbasci*) of *V. Thapsus* L. (*V. Schraderi* G. Meyer; *Thapsus s.*—Opiz), native of Europe and Asia, and exceedingly abundant as a naturalized weed in the eastern United States. The plant has a great variety of common names (*Great*, *Velvet*, or *Common mullein*, *Mullein dock*, *Blanket-leaf*, *Flannel leaf*, *Feltwort*, *Adam's blanket*, *Velvet-plant*, *etc.*). It is a very stout, woolly perennial, bearing a radical rosette of leaves often 1 to 2 feet long, and successively smaller ones upward upon the stem, which is simple, may reach a height of 6 or 8 feet, is winged by the strongly decurrent leaves, and terminates in a long, thick spike of flowers. The leaves are mostly oblong, but vary to lance-oblong and obovate, the summit broad but acutish, entire, very thick and densely and softly tomentose. They are nearly odorless, and of a mucilaginous and bitterish taste. They contain gum as their principal constituent, together with 1 to 2 per cent. of resin, divisible into two parts, one soluble in ether, the other not, a readily soluble amaroid, a little tannin, and a trace of volatile oil.

The flowers (*Flores verbasci*) are also considerably employed. The part used is the sulphur-yellow corolla, which is rotate, about 2.5 to 3.7 Cm. (1–1½ In.) broad, tomentose on the back, and bears in its throat 5 stamens, the 3 upper with reniform, the 2 lower with elongated anthers. These flowers contain gum, resin, coloring-matter, glucoside, and yield a small amount of volatile oil.

More than a dozen other species of Verbascum are employed medicinally. *V. phlomoides* L., of Europe, and *V. pulverulentum* Vill., of Madeira, are used as tænicides and fish poisons.

Gratiola, *Herba gratiolæ* or *Hedge-hyssop* (*Herb-of-grace*, E.; *Gnadenkraut*, *Gottesgnadenkraut*, *Wildauran*, G.; *Gratiole*, Fr.; *Graciola*, Sp.) is the dried herb of *G. officinalis* L., though the rhizome is sometimes used separately. The stem grows from a creeping scaly rhizome to the height of 15 to 30 Cm. (6–12 In.), has opposite, sessile, lanceolate, finely serrate, 3-nerved, smooth, pale-green leaves, and solitary axillary whitish or reddish 2-lipped flowers, with yellow hairs in the tube. The plant is inodorous and has a very bitter somewhat acrid taste. Its active constituent is the bitter, crystalline glucoside *gratiolin* ($C_{25}H_{40}O_5$), which splits under the influence of acids into sugar, amorphous *gratiolaretin*, and scaly *gratioletin*. Walz also isolated the reddish amorphous bitter principle *gratiosolin*, which is soluble in water and alcohol, and is likewise a glucoside. *Gratioloic acid* crystallizes in white scales of a fatty odor. A half dozen other species are employed.

Chelone or *Balmony* (*Snakehead*, *Turtlehead*, *Shellflower*, *Fish-mouth*, *Bitter-herb*, etc., E.; *Chelone*, G., Fr.) is the dried herb *Chelone glabra* L. It is a perennial, smooth herb of swamps, lake- and river-sides throughout eastern North America. It reaches a height of 2 to 4 feet, branches sparingly, the stems slender, the leaves opposite, nearly sessile, lance-oblong, pointed, sharply serrate, shining, the white or purplish flowers in a short, dense terminal spike, the corolla inflated, obovoid, 2-lipped, the mouth slightly open, which appearance gives it its common names. The lower lip is bearded in the throat and the 4 filaments and heart-shaped anthers are woolly. The odor is slight, the taste markedly bitter. The bitter principle is soluble in alcohol and water, but its value is unknown. There is a little gallic acid. Several other species are employed.

Scrophularia, *Figwort*, or *Scrofula plant* (*Square-stalk*, *Carpenter's-square*, *Kernel-wort*, *Pile-wort*, *Throat-wort*, etc., E.; *Kropfwurz*, *Knotenwurz*, G.; *Scrophulaire*, Fr. Cod.; *Escrofularia*, Sp.) is the leaves and flowering tops, also the rhizome and roots, of *S. nodosa* L., a European perennial, smooth herb. The American plants long referred to this species are now known to comprise several distinct species. The plant has a horizontal branching fleshy rhizome, to which numerous oblong or oval tubers of the thickness of the thumb are attached. The leaves are opposite, petiolate, ovate-oblong, rounded or heart-shaped at the base, and cut-serrate on the margin. The flowers are in a terminal loose panicle, have a greenish-brown, tubular-globose, 5-lobed corolla with 4 stamens, and produce a 2-celled many-seeded capsule. The fresh plant, bruised, has an unpleasant odor and a nauseous, bitter, and acrid taste; on drying it loses about 75 per cent. in weight and becomes nearly inodorous. Our information as to the constituents is very contradictory, owing doubtless to the materials examined having pertained to different species. A strongly bitter principle in the root has been called an alkaloid, but is said not to be present in the herb. A peppery resin, tannin, gum, etc., also exist.

Euphrasia or *Eye-bright* (*Euphrasy*, *Eye-wort*, E.; *Augentrost*, G.; *Euphraise*, Fr.; *Eufrasia*, Sp.) is the herb *E. officinalis* L., of Europe. This is a tender little annual, about 6 inches high, growing in damp places, almost throughout Europe, and represented by very similar species in America. It has opposite, shortly petiolate or sessile, ovate or lanceolate leaves, which are about 8 Mm. (⅓ In.) long, and have 4 or 5 teeth on each side; the upper (floral) leaves are alternate, nearly rhomboid, and bristly-toothed. The axillary flowers have a 4-cleft calyx and a white or lilac 2-lipped corolla with a yellow throat, 4 ascending stamens, and an oblong, many-ovuled ovary. When fresh, the plant has a faint balsamic odor which is almost completely lost on drying; the taste is somewhat saline, bitter, and scarcely astringent. The constituents of Eye-bright are very little known. Guz found the recent plant to contain 62 per cent. of moisture and 10.8 per cent. of cellulose, the remainder being tannin, a little volatile oil, an acrid and bitter principle, several organic acids, mannit, glucose, and other common principles. The tannin precipitates ferric salts dark-green, and lead salts of a bright-green color.

Veronica or *Speedwell* (*Paul's betony*, *Fluellen*, E.; *Ehrenpreis*, G.; *Véronique mâle*, Fr.; *Veronica*, Sp.) is the dried herb of *V. officinalis* L., a slender, creeping hairy perennial herb, native of the Old World, but abundantly naturalized in the eastern United States, where it grows in open, grassy places. The leaves are opposite, short-petioled, about 2.5 Cm. (1 In.) long, elliptical-obovate, crenate-serrate. The flowers are in 1 or 2 axillary racemes on the upper part of the branches, are on short pedicels, and have a wheel-shaped 4-parted pale-blue corolla with dark-blue stripes and 2 exserted stamens. The fruit is an inversely heart-shaped 2-celled capsule. The fresh herb is faintly aromatic; after drying it is inodorous and has a bitterish and slightly astringent taste. Speedwell contains an alkaloid, a saponin-like body, a little tannin, resin, etc.

There are nearly 200 species in the genus Veronica, some 20 of which have been employed as drugs. *V. Beccabunga* L. is the European *Brooklime* (*Bachbungen*, G.; *Beccabunga*, *Cressonée*, Fr.), which grows in and about running water. It has an ascending smooth stem, with opposite, short-petioled, oval-oblong, crenate-serrate, obtuse, smooth leaves about 3.8 Cm. (1½ In.) long, and bears loose axillary racemes of pale-blue and veined flowers. It is used in the fresh state, and is bitter, somewhat saline, and pungent. In Asia Minor the root of *V. peduncularis* Bieb. (*V. nigricans* Koch) is used under the name *Batitjoe*.

Linaria or *Toad-flax* (*Herba linariæ.—Snap-dragon*, *Butter-and-eggs*, *Ramstead*, *Whin*, E;. *Leinkraut*, *Flachskraut*, *Löwenmaul*, G.; *Linaire commune*, Fr.: *Linaria*, Sp.) is the plant *Linaria Linaria* (L.) Karsten (*Antirrhinum L.*—L.; *L. vulgaris* Miller), a rather handsome-flowering perennial herb of Europe, and very abundant along roadsides, in fence-rows, and other waste places in the eastern United States. It is 30 to 45 Cm. (1–1½ Ft.) high, has alternate, sessile, lance-linear, almost 3-nerved, smooth, and light-green leaves, 25 to 38 Mm. (1–1½ In.) long; and terminal racemes of showy yellow flowers, which have a personate corolla, continued at the base into a curved spur of the same length. When fresh the herb has a slight disagreeable odor and a bitterish somewhat acrid taste. Linaria contains the crystalline amaroid *linariin*, an acrid resin, tannin, volatile oil, and volatile *antirrhinic acid*.

Curanga amara Juss. (*Herpestis a.*—Benth.; *Gratiola a.*—Roxb.) yields the important East Indian tonic and febrifuge *Curanja* or *Koen-tao-tjao*. It contains the bitter, alcohol-soluble glucoside *curanjiin* ($C_{48}H_{77}O_{20}$).

The tropical American herb *Vandellia diffusa* L. is used like Gratiola. The dried plant has a strong odor of tobacco. *Bonnaya rotundifolia* Benth. is the East Indian *Tsjanga-puspam*, used as an antispasmodic. *Scoparia dulcis* L., a common weed of tropical America, is used as an astringent and antispasmodic under the name *Vaçourinha*. More than a hundred other species of the family are in medicinal use, nearly all of them containing bitter substances, and many possessing anthelmintic properties.

SCUTELLARIA, *U. S.*—Scutellaria.

Hoodwort, Madweed, Mad-dog or *Side-flowering skullcap, Blue pimpernel, Hooded willow-herb*, E.; *Helmkraut, Schildkraut*, G.; *Scutellaire*, Fr.

The dried plant *Scutellaria lateriflora* L. (Fam. *Labiatæ*).

Origin.—This pretty little plant is common on rocky banks of lakes and streams, in the edges of marshes and other damp and partly shaded localities, almost throughout North America, except in the far north. It blossoms in middle and late summer. It should be gathered when in full bloom and carefully dried in the shade.

FIG. 383.

Scutellaria lateriflora (½ Nat.).

FIG. 384.

Scutellaria canescens (½ Nat.).

Description.—Dark-green, smooth, or slightly puberulent on the younger portions, the branches elongated, slender, sharply quadrangular; leaves opposite, exstipulate, shortly petioled, the blades rarely exceeding 8 Cm. (3 In.) long and about a third as broad, ovate, rounded or truncate at the base, acuminate, obtusish or acutish, shortly and obtusely serrate, thin, veiny; flowers in axillary, peduncled, mostly simple and secund racemes, nearly sessile, about 6 Mm. (¼ In.) long, the calyx bilabiate, in fruit becoming closed and developing a large helmet-shaped crest, the corolla deep-blue, bilabiate, the stamens didynamous; fruit of 4 depressed-globose papillose nutlets 0.5 to 1.25 Mm. ($\frac{1}{50}$—$\frac{1}{20}$ In.) broad.

So-called "Western Scutellaria," more or less rough gray-hairy and with much larger flowers, in terminal panicles, is not of this species. It is probably derived from different species, but that which we have examined is *S. canescens* Nutt.

Constituents.—Scutellaria contains, as its most important principle, a bitter, crystalline glucoside, which may or may not be identical with that of the European species *S. altissima* L. or of the Japanese species *S. Baicalensis* Georgi (*S. lanceolaria* Miq.), both of which have been called *scutellarin*. Molisch and Goldschmeidt give to that from the last-named plant the formula $C_{21}H_{20}O_{12}$ and name its derivative *scutellarein*. The volatile oil of skull-cap, unlike those of most members of the family, is small in amount and apparently unimportant. Tannin is apparently present, though its presence has been denied by those who have examined the plant chemically. The genus contains about

100 species, and quite a number have been employed. Lloyd gives *S. versicolor* Nutt. as one of the important substitutes for skull-cap.

Pharmaceutical Preparation.—Fluidextract of Scutellaria, U. S. P.

Action and Uses.—Scutellaria is devoid of properties which entitle it to be classed among official drugs. It has been recommended in a variety of diseases, viz., epilepsy, chorea, nervous exhaustion, intermittent fever, incontinence of urine, etc. Its dose is 1 to 2 drachms (4–8 Gm.), given in decoction or fluidextract.

SENEGA, *U. S.*—Senega.

Senegæ radix, Br.; *Radix senegæ*, G.; *Radix polygalæ Virginianæ.*—*Senega* or *Seneca root* or *snakeroot*, *Rattlesnake root*, *Mountain flax*, E.; *Senegawurzel*, G.; *Polygala de Virginie*, Fr.; *P. de Virginia*, Port.; *Poligala de V.* Sp.; *Poligala Virginiana*, It.

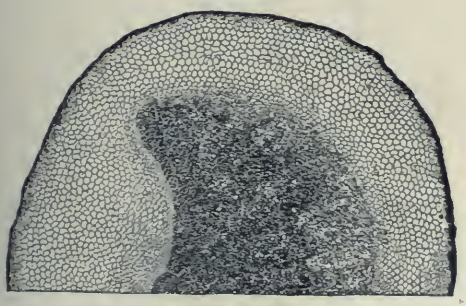
The dried root of *Polygala Senega* L. (Fam. *Polygalaceæ*).

Senega is official in all pharmacopœias. The Swiss requires that if the filtrate from its maceration in ether have the ether removed with warm water, ferric chloride will impart a violet color to the residue, and that the ethereal extraction of 10 Gm. should leave, on evaporation, at least 1.4 Gm. of fat and resin.

Origin.—The Senega plant is a perennial herb of eastern and central North America, as far south as North Carolina. The root sends up a cluster of erect, slender, simple, or little branched stems about a foot in height. The leaves are alternate, sessile, lanceolate or oblong-lanceolate, rough on the margin, otherwise smooth, and narrowed to both ends. The flowers are nearly sessile, in slender terminal spikes, and have 5 sepals, of which the 2 lateral ones are round, petaloid, and rose-colored; the 3 petals are whitish. Senega flowers in May and June, and ripens its small 2-celled and 2-seeded capsule in July. The large, broad-leaved form, growing mostly in the north-central States, has been called *var. latifolia* T. et G. The root should be collected in the autumn. Our principal supply now comes from Minnesota and northward.

Description.—Mostly 7 to 15 Cm. (3 to 6 In.) long and 4 to 8 Mm. ($\frac{1}{6}$ to $\frac{1}{3}$ In.) thick, exclusive of the large, knotty, many-headed crown, occasionally reaching several times this size; tortuous, tapering, and bearing several similar horizontal branches, and a few rootlets, and for a variable distance below the crown a more or less sharp keel, varying greatly in prominence, and usually taking a spiral direction, often nearly absent; externally yellow-brown to dark-gray-brown, longitudinally wrinkled; fracture rather tough, but short and sharp, the bark thick, yellow or brownish, of a waxy or resinous, faintly fine-radiate appearance, enclosing a yellowish-white wood, from which a larger or smaller radial segment is usually wanting; odor slight, disagreeable; taste sweetish, then acrid; starch is wanting.

Fig. 385.



Senega root: section showing one-sided growth of wood and inner bark (× 18).

Fig. 386.

Transverse sections of Senega root.

Senega often exhales a slight odor of oil of wintergreen. We have found the same odor strong in growing plants of other species of Polygala.

Of commercial senega, several geographical varieties are recognized, all presenting minor differences in their appearance. Southern senega is smaller and usually paler. Manitoba senega is very large and stout, often dark-colored and with purple discolorations about the crown.

Adulteration.—Senega has been much subjected to adulteration. *Triosteum root*, and all other adulterants, excepting other species of Polygala, are readily recognized by the presence in them of starch. Several other species of Polygala have been thus used. "White" or "Texas" Senega is said to be derived from *P. Boykinii* Nutt., of the Southern States; but all that we have encountered in the market was from *P. alba*. The

Fig. 387.

False Senega: transverse section (× 10).

latter averages smaller than the genuine, is paler, and is (at least usually) wanting in the keel. Various other species have been mentioned in this connection, but the roots of all are apparently too small to prove deceptive.

Constituents.—The acrid constituents of Senega are about 5 or 6 per cent. of a saponin-like mixture which is divisible into *polygalic acid* (about three-fourths of the

Fig. 388.

Manitoba Senega: a small root (¾ Nat.).

Fig. 389.

Polygala alba: a large root (¾ Nat.).

whole) and *senegin*, the two bearing much the same relations as quillajic acid and quillajasopotoxin of quillaja bark. Senegin is precipitated by basic lead acetate, polygalic acid by both the neutral and basic substances and also by ammonium sulphate. Neither starch nor tannin is present, but there is a very small amount of methyl-salicylate, also resin, fat, sugars, etc. The ash should not exceed 7 per cent. The methyl-salicylate seems to be a decomposition-product, increasing as the drug is kept. When Senega is confined closely for a long time, this odor may become very strong.

Pharmaceutical Preparations.—Infusion of Senega, B. P.; Fluidextract of Senega, Syrup of Senega, U. S. P.

Action and Uses.—The study of the action of senega, or its active principle senegin, fails to establish a rational basis for its employment as a stimulating expectorant and diuretic. It is used in acute bronchitis after the subsidence of the early inflammation,

when the mucus is scanty and tenacious and a stimulating expectorant is indicated. In a like manner if given in spasmodic croup it does more good after the stage of spasm, when the condition is that of a simple catarrhal laryngitis. It is useful in chronic bronchitis with bronchorrhœa. Its diuretic effect is neither pronounced nor certain and is of no avail as a remedy in dropsy. The dose of senega in substance is from 10 to 20 grains (0.60–1.30 Gm.), of the fluidextract from 10 to 20 minims (0.60–1.30 Cc.). The syrup is given in the dose of ½ to 2 drachms (2–8 Cc.).

Allied Products.—The genus *Polygala* contains nearly 500 species, many of them, in the tropics, being shrubs, and some, of great beauty, cultivated for ornament. Some 40 have been recorded as used medicinally, most of them like Senega, and, so far as known, because of similar constituents.

The drug *Polygala*, as commonly understood (*Bitter Polygala*, E.; *Kreuzblume*, *Milchwürz*, G.: *Polygala*, *Laitier*, Fr.; *Polygala amarga*, Sp.), is the herb, or more especially the root, of *P. polygama* Walt. (including *P. rubella* Muhl.). It is a biennial herb growing in dry fields and pastures from Canada southward to the Gulf of Mexico. It has a fusiform root and numerous glabrous nearly simple stems which are 15–20 Cm. (6 to 8 In.) high, and bear a terminal narrow raceme of about 15 to 25 purple, finally pendulous flowers. The leaves are alternate, linear-oblong or oblanceolate, narrowed below, obtuse, and somewhat mucronate. The flowers are showy and conspicuously crested. Racemes of inconspicuous flowers are produced on procumbent stems, and usually are fertilized in the bud. The plant is without odor and has a bitter taste.

P. Siberica L. yields the Chinese drug *Yuen-chi*, the root used in cataplasms. *P. angulata* DC. (*P. Poaya* Mart.) is the Brazilian *Poaya do Campo*, used like ipecac. *P. glandulosa* Kunth is the Chinese *Yan-foo*. *P. thesioides* Willd. and *P. grindioides* Willd., of Chili, are much used diuretics, under the names *Chinchin* and *Quelenquelen*. A number of East Indian species are used as expectorants, *P. Chinensis* L. being used under the names *Merádú* and *Negli*. *P. theœzans* L., of Java and Japan, is used as a tea-substitute, and *P. venenosa* Juss., *Katu-tutun*, and several others are very poisonous. The seed of *P. Javana* DC. is a tænicide. In the Soudan, *P. micrantha* Guill. et Per. is used as a purgative.

P. butyracea yields to the African natives an oil-seed from which they extract the butter-like fat *Malonkang* or *Ankalaki*, used as a food. Its composition is olein 30.5 per cent., palmitin 57.54, myristin 6.16, and free palmitic acid 4.799 per cent.

SENNA, *U. S.*—Senna.

Folia sennæ, P. G.; *Senna Alexandrina* and *S. Indica*, Br.; *Folia Cassiarum*, Nor. —*Senna-leaves*, E.; *Sennesblätter*, G.; *Feuilles de sêné*, Fr.; *Sena*, It.; *Sen*, Sp.; *Senna*, Port.

The dried leaflets of *Cassia acutifolia* Delile (*C. Senna* L. [in part]; *C. lanceolata* Nect.; *C. orientalis* Pers.; *C. lenitiva* Bisch.; *Senna acutifolia* Link), the *Alexandria* variety, or of *C. angustifolia* Vahl. (*C. elongata* Lem.; *C. lanceolata* W. et A.; *C. acutifolia* Nees; *C. medica* Forsk.; *C. medicinalis* Bisch.; *Senna officinalis* Roxb.; *S. angustifolia* Batka), the *Indian* or *Tinnevelly* variety (Fam. *Leguminosæ*).

Senna is official in all pharmacopœias, both varieties being in nearly all cases named. The German recognizes only the Indian, and the Danish gives the same preference. Many use for the Alexandrian variety the synonym "C. lenitiva." The Italian, Spanish, and Portuguese name *C. obovata* Coll., once official in the B. P. A number authorize the deresinating of senna by extraction with 90 per cent. alcohol and drying. Most refer to *Argel leaves*, from *Solenostemma Argel* (Delile) Hayne (*Cynanchum A.*—Del.; *C. oleifolium* Nect.; *C. fruticosa* R. Br.—Fam. *Asclepiadaceæ*), either entirely excluding them or fixing a limit (up to 10 per cent.). Such a mixture is called *Sen de la Palta* by the Spanish. Some exclude Coriaria leaves (see *Adulterants*).

Origin.—The senna plants are small, soft-wooded shrubs, with unequally pinnate leaves, which are commonly collected entire, the leaflets being separated after drying. A part of the Alexandrian variety is collected by cutting down the entire plant. In all cases the crude product is more or less admixed with sticks, stalks, flowers, pods, other leaves, dust and dirt, and even stones. The larger impurities are removed by hand, the finer ones by sifting. By sifting, also, broken leaves are removed, and the entire ones are separated into several sizes, the larger being respectively higher priced, though not at all superior. These processes still leave remaining any spurious, diseased or discolored leaves, so that hand-picking alone produces a perfect article. Alexandria senna is quite widely distributed through central Africa, but is collected chiefly in the

country about the middle and upper Nile River, and the crop is mostly accumulated in Suakim and Cairo. India senna is native of Arabia. Some of this wild product is collected and marketed as *Mecca* or *Arabian senna*, but the genuine commercial article is the product of plants cultivated in British India, and is very carefully gathered, selected, and prepared. The Mecca senna, here referred to, is occasionally marketed as *Bombay senna*, the genuine Bombay senna being a small and poor grade of the cultivated India senna.

Description.—Alexandria senna consists of leaflets with extremely short, stout petiolules, about 2.5 Cm. (1 In.) long and 1 Cm. ($\frac{2}{5}$ In.) broad, inequilaterally lanceolate or lance-ovate, acutely cuspidate, entire, sub-coriaceous, brittle, pale green, or slightly yellowish or grayish green, sparsely and obscurely hairy, more so underneath, the hairs appressed; odor peculiar, tea-like; taste mucilaginous, tea-like, bitterish.

It is frequently contaminated with the one-nerved, thick, wrinkled, glaucous, equilateral Argel leaves.

India senna leaflets average nearly twice as long, though but little broader, are more abruptly pointed, usually more yellowish, and the hairiness is even more obscure.

FIG. 390.

Tinnivelly senna.

FIG. 391.

Alexandria senna.

FIG. 392.

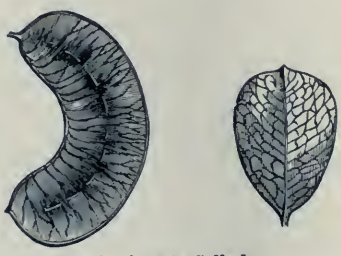
Tripoli senna: leaflets and legumes.

The leaflets of India senna vary considerably in their relative thinness, breadth, and acumination, and various attempts have been made to distinguish forms or varieties; but the differences appear to be insignificant.

The powder shows rosettes of crystals and single rhomboidal crystals, and the peculiar thick-walled, one-celled epidermal hairs are characteristic. In that of Alexandria senna the hairs are 2 or 3 times as numerous as in the Indian. A larger portion of the hairs of the Indian are curved than those of the Alexandrian.

Inferior Products, Substitutes, Adulterants, etc.—A long list of adulterants of senna in the entire condition has been recorded, and the effect has been to create an

FIG. 393.



Cassia obovata Colladon.

FIG. 394.

Solenostemma argel Hayne.

exaggerated idea of the extent to which adulteration is practiced. The retention of diseased, discolored or musty leaves through imperfect cleaning is common in the poorer grades of Alexandria senna, such as the "Tripoli senna," and constitutes the principal defect found in this drug. Small and broken leaflets of India senna are often sold for Alexandria senna, or mixed with that variety. The presence of Argel leaves

(see above) is also very common. These leaves are thick, have a heavy midrib, but indistinct, pinnate veins, a wrinkled surface, an equal base, and their hairs are three-celled and thin-walled. They occur far less commonly than in former times. *Cassia oborata* (*Senna baladi* of the Arabians), being still official in some countries, are naturally apt to be offered. They are easily distinguished by their obovate form, with narrowed base, and the cells of the lower epidermis are pappillose. Holmes has tested the *Aden senna*, from *C. holosericea* Fres., offered as a substitute, and found it efficient. These leaflets are smaller, relatively broader, less acute, and more hairy. Coriaria leaves, or *Curriers' sumac* (*Gerberstrauch*, G.; *Redoul, Sumac des corroyenes*, Fr.), the leaves of *Coriaria myrtifolia* L. (Fam. *Coriariaceæ*), formerly common, now rare, constitute a serious danger, since they are poisonous. They are thickish and distinctly 3-nerved, bitter, strongly astringent, and somewhat acrid. They contain tannin and the glucoside *coriamyrtin* ($C_{30}H_{36}O_{10}$), which occurs in prisms, melting at 220° C. (428° F.) and soluble in water, alcohol, and ether. It is an irritant and convulsant poison, resembling picrotoxin in action. Other species are also poisonous, one or more yielding the New Zealand *foot-poison*. The fruits, consisting of (usually 5) blackish, obliquely ovoid nutlets surrounded by scales, have been mistaken for blackberries, with poisonous results. *Cracca* (*Tiphrosia*) leaflets, here figured, and also somewhat poisonous, have also been found in senna.

Constituents.—The active constituents of senna have been shown, chiefly by Tschirch, to be partly, at least, very close relatives of those of ALOES, RHAMNUS, and RHEUM—namely, one or more glucosides of the *oxymethylanthraquinone* group, yielding emodin. Although it has not been shown, nor is it probable, that these substances are capable of producing the same, nor equally desirable purgative effects as a preparation of senna, yet they are probably the most important factor in the result. Tschirch described *anthraglucosennin*, the emodin ("senna-emodin") from it melting at 223° C. (433.4° F.), and its chrysophanic acid ("senna-chrysophanic acid") melting at 171° to 172° C. (339.8°–341.6° F.). Under the action of alkalies, anthraglucosennin yielded senna-nigrin ("sennigrin"), an amorphous blackish body which also yielded emodin and chrysophanic acid. An *isoemodin* was extracted, but its source was not established; also a *rhamnotin* and the yellow glucoside *glucosennin*. The percentage of emodin obtained ranged from 0.8 per cent. (in Tinnevelly) to 1 per cent. (in good Alexandrian), and was only 0.6 per cent. from deresinated senna. The extractive substance "cathartic acid," elsewhere described, is yielded abundantly by senna. Tschirch's method of obtaining the above substances was as follows: The anthraglucosennin is obtained by percolating the senna with water rendered slightly ammoniacal. It is then extracted with ether, this extract is boiled in toluene, and the solution poured into petroleum spirit, when the emodin is precipitated. Isoemodin remains undissolved by the ether. Glucosennin ($C_{22}H_{18}O_8$) remains in the ether-extract, not being dissolved by the toluene. Chrysophanic acid remains dissolved in the petroleum spirit and toluene mixture.

FIG. 395. FIG. 396.

Cassia acutifolia. Cassia augustifolia.

Other constituents of senna are a large amount of gum, resin, the non-fermentable sugar catharto-mannit, isomeric with quercit, the bitter substance sennapicrin, oxalic, malic, and tartaric acids, combined with calcium and a little volatile oil, which seems to be a decomposition-product developing after drying.

Pharmaceutical Preparations.—COMPOUND INFUSION OF SENNA, COMPOUND LICORICE POWDER, FLUIDEXTRACT OF SENNA, SYRUP OF SENNA, U. S. P.; CONCENTRATED SOLUTION OF SENNA, B. P.

Action and Uses.—Senna is one of the best laxatives in the materia medica, and would be more generally employed were it not for its unpleasant taste and its tendency to gripe when used alone. To obviate the griping produced by it, it is usually given in combination with aromatics, as fennel and coriander, or with other purgatives, as Epsom and Rochelle Salt. Simple bitters, as gentian and colombo, increase its activity, and form with it a particularly efficient combination for constipation due to intestinal atony. Senna operates in about 4 hours, producing liquid stools. Notwithstanding the griping

it does not cause hypercatharsis, and its action is not followed by intestinal torpor or constipation. Some of its principles are absorbed and eliminated in the milk of nursing women and may purge the nursling. The chrysophanic acid when excreted in an alkaline urine will stain that fluid carmine, and be cause for alarm unless this fact be remembered. In the treatment of the constipation of pregnancy and the puerperium senna is administered usually in the form of compound licorice powder, in the dose of 1 to 2 drachms (4–8 Gm.). For the relief of habitual constipation it is frequently combined with bitter tonics, or, as used by the laity, in infusion with manna, fennel, and Epsom Salt, as the popularly known "Black Draught" (Infusum sennæ compositum). The most agreeable preparation of senna to be given to children is the confection in the dose of ½ to 1 drachm (2–4 Gm.). The dose of the fluidextract is 1 to 2 drachms (4–8 Cc.).

Allied Drugs and Products.—*Senna pods*, here figured, are said to be preferred to the leaves in the country where they are gathered, and they are more or less used in all countries. No exact study of their constituents, as compared with the leaves, has been made, though it is known that they yield more "cathartic acid" and more emodin than the latter, and are nearly free from resin and volatile oil. The constituents of the seeds, frequently so active in this family, require investigation. Some physicians have declared the action of the pods superior to that of the leaves, but the pods have not retained a high place in practice.

The genus *Cassia* contains about 400 species, and purgative properties have been found to exist very widely among them, though especially so in the sub-genus *Senna*, comprising upward of 40 species of herbs, shrubs, and trees, distinguished by the absence of glands from the common petiole, and by the broad, papyraceous legumes which do not dehisce, but merely become cleft at the margin at maturity, and contain the small triangulate seeds near the middle, attached to long funiculi.

Cassia Marilandica L. yields the *American* or *Maryland Senna* (*Folia Sennæ Americanæ; Americanische Senna*, G.; *Séné Americaine*, Fr.), official in the U. S. P. of 1870. The plant is a perennial herb belonging to the section *Chamæsenna*, and growing in low grounds throughout the eastern and central United States. It produces erect branching stems 0.9 to 1.5 M. (3–5 Ft.) high, and has pinnate leaves on petioles 25 to 50 Mm. (1–2 In.) long and with a nearly sessile gland near the base on the upper side, 6 to 9 pairs of leaflets, numerous pedunculate erect racemes near the top of the branches, showy yellow or whitish flowers with dark veins, and legumes which are finally smooth, linear, compressed, often curved, and somewhat sinuate on the raised edges; the ovate-oblong seeds are separated by transverse dissepiments. It flowers in August and ripens its fruit in October. The leaflets are 25 or 50 Mm. (1 or 2 In.) long, about 12 Mm. (½ In.) wide, on short foot-stalks, smooth, ovate-oblong to elliptic, uneven at the base, green above and paler beneath. Collected in summer, the leaflets have an herbaceous odor, but if collected in September or the beginning of October, after the plant is out of bloom, they acquire a distinct senna odor. They are thinner in texture and larger than Alexandria senna, and lose on drying about 70 per cent. of moisture. Their constituents are not definitely known, but are probably the same as those of senna, and in very much smaller amount, since the action is many times weaker.

More than half a hundred species of Cassia are recorded as being used medicinally, of which the following may be mentioned: The seeds of *C. Sieberiana* DC. are used for purging in the Soudan. The seeds of *C. Javanica* L. and some other species are employed for fish-poisoning, those of *C. occidentalis* L. as a substitute for coffee, under the name "Mogdad-coffee." Many species are used as antidotes to snake-bites and to relieve the stings of bees, some as applications to ring-worm and other parasitic diseases. The bark of *C. speciosa* Schrad, of Brazil, is sold under the name *Fedegosa*. The herbage of several is cooked as a vegetable, and some are used for poultices, while two or three present indefinite claims as antisyphilitics.

Colutea or *Bladder-senna* (*Falsche Senna*, G.; *Séné indigène, Baguenaudier*, Fr.; *Espantalobos*, Sp.) is the leaves of *Colutea arborescens* L. (Fam. *Leguminosæ*), a large shrub of southern Europe. The leaflets are in 4 or 5 pairs, oval or elliptic, obtuse or emarginate at the apex, regular at the base, thin, smooth, and dark green above, pale green beneath, and clothed with appressed hairs. They have a feeble odor and a nauseous and bitter taste. The constituents are unknown. Besides having been occasionally used as an adulterant of senna, these leaves, and the seeds also, have had some individual medicinal use as purgatives. The seeds are also regarded as emetic. The drug has been used chiefly as a domestic purgative in some parts of Europe, in an infusion prepared with 1 ounce to 1 pint (32–500 Gm.), with the addition of liquorice-root and anise-seed, and taken in divided doses in the morning, fasting. The powder and the extract have also been used, but the former is not tolerated, owing to its offensive taste, and the same objection lies against the infusion. The smoke of the dried leaves is said to act powerfully as an *errhine*. Colutea is employed in the same cases as senna.

Globularia leaves, from *G. Alypum* L. (Fam. *Globulariaceæ*), a shrub of southern Europe, have occasionally been used as a substitute for senna. They are nearly sessile, obovate-oblong, entire or slightly toothed, finely granular, and on the lower side bluish-green. Walz found in the leaves a peculiar tannin and an amorphous bitter principle, *globularin*, which is precipitated by tannin, is soluble in water, alcohol, ether, and chloroform, and is a glucoside. Heckel and Schlagdenhauffen (1882) found its composition to be $C_{15}H_{20}O_8$, and that of its decomposition-product, globularetin, C_9H_6O; the latter, heated with alkalies, yields cinnamic acid, which also exists in the leaves, together with mannit, wax, etc.

SERPENTARIA, *U. S.*—Serpentaria.

Serpentariæ rhizoma, Br.; *Serpentaria* (*Vipèrine*) *de Virginie*, Fr. Cod.; *Radix colubrina*; *R. viperina.*—*Virginia snakeroot, Serpentary, Sangree*, E.; *Virginische Schlangenwurzel*, G.; *Serpentaria de Virginia*, Sp.

The dried rhizome and roots of *Aristolochia Serpentaria* L. (*Endodeca S.*—Klotsch—*Virginia serpentaria proper*) or of *A. reticulata* Nutt. (*Texas serpentaria*) (Fam. *Aristolochiaceæ*).

Origin.—These plants are slender perennials, a foot or two high, with flexuous, rather tough stems, sparingly branched from near the base; ovate to lance-ovate thickish leaves, with more or less heart-shaped base; peculiar brownish-purple pipe-shaped flowers about an inch in length, on straggling peduncles borne mostly at the ground, without corolla, the calyx-tube sharply constricted near the middle, the limb three-lobed and obliquely expanded, the stamens 6, in pairs, connected with the style, and a 3-celled, tardily dehiscent, many-seeded pod. The Texan species is rather the larger of the two, its foliage coarser and thicker, harsh from its conspicuously reticulate sharp venation, and of a paler or more grayish green. The Virginian species extends almost throughout the eastern United States, though pretty well exterminated in many sections where it was formerly abundant. The drug is chiefly collected in the mountainous districts south of Pennsylvania and the Ohio River.

Fig. 397.

Aristolochia serpentaria, L.

Fig. 398.

Rhizome with roots.

Fig. 399.

Transverse section of rhizome.

Description.—*Virginia Serpentaria.*—Rhizome of oblique growth, 1 to 3 Cm. ($\frac{2}{5}$ to about 1 In.) long and 1 to 2 Mm. ($\frac{1}{25}$ to $\frac{1}{12}$ In.) thick, crooked and somewhat branched, bearing on the upper surface approximate, short stem-bases, and underneath a dense tress of long, thin, branched roots, straightish, except as they are bent and doubled by pressure; dull yellowish brown, internally whitish, the wood-rays of the rhizome longest in the lower side; fracture of both rhizome and roots weak; odor strong, aromatic, and camphoraceous; taste warm, aromatic, bitter.

Texas Serpentaria is larger, coarser, of a more gray color, and the roots are fewer.

Constituents.—As an aromatic bitter, serpentaria depends for its properties upon its volatile oil and bitter principle. It also contains tannin, starch, sugar, gum, and about 5 per cent. of resin, soluble in petroleum ether, with a little which is not so soluble. Of the volatile oil there is from 0.5 to 1 per cent., its important constituent being borneol. In taste it resembles valerian and camphor. The bitter constituents are several. *Aristolochin* is an amaroid ($C_9H_{10}C_6$), which has also been called *clematitin* (from *A. Clematitis* L. and other species) and *serpentarin*, and is poisonous. It is believed that a very small amount of the alkaloid *aristolochine* is present, as well as *aristinic*, *aristidinic*, and *aristolic acids*, all of the last four being found in *A. Argentina* Griseb.

Pharmaceutical Preparations.—Concentrated Solution of Serpentary, Infusion of Serpentary, Br.; Fluidextract of Serpentaria, Tincture of Serpentaria, U. S. P.

Action and Uses.—On account of its warm, pleasant taste and its stimulating effect upon gastric secretion, serpentaria is added to other drugs, as cinchona, to increase their absorption and activity. It has been used as a mild diuretic and diaphoretic in febrile states and to bring out the tardy rash of certain exanthematous diseases. In overdose it produces a sense of fulness in the head, nausea, vomiting, and abdominal griping. The dose of serpentaria in powder is 10 to 30 grains (0.60–2 Gm.). The fluidextract is given in the dose of 10 to 30 minims (0.60–2 Cc.) and the tincture in the dose of ½ to 2 drachms (2–8 Cc.).

Allied Products.—The genus *Aristolochia* comprises nearly 200 species, about a fourth of which are recorded as in medicinal use. The genus is of interest as producing what is probably the largest of known flowers. The constituents and properties of the aristolochias are in general similar to those of the drug above described. Many of them are also used as vulneraries in native practice, and several as emmenagogues. Their use in the treatment of snake-bite is, of course, fanciful. The Brazilian species, *A. cymbifera* Mart. (*A. grandiflora* Gom.), is there called *Raiz Jarinha* or *R. mil-homens*. *A. fœtida* H. B. K. is the Mexican *Hierba del Indio*. *A. pentandra* Jacq. is the Yucatan *Guaco de San Cristobal*. *A. Chilensis* Miers is the Chilian *Herba de la vierge Maria*. *A. fragrantissima* Ruiz is the Peruvian *Bejuca de la estrella*. *A. turbacensis* Kunth, of tropical America, is the *Contracapitana de Mompox* or *Capitana de Corazon*. *A. Pistolochia* L., of southern Europe, is used under the names *Pistolochia* and *Polyrhiza*, and is the "Aristolochia" of Pliny. *A. contorta* Bunge yields the Chinese drug *Fu'-ts'ing-muh-hiang*, and *A. kaempferi* Willd. yields *ona-tan-ling*. The root of *A. antihysterica* Mart., of the American tropics, is used as an emetic and diaphoretic. The East Indian species, *A. bracteata* Retz and *A. Indica* L., the latter bearing many native names, are used as anthelmintics. *A. glaucescens* H. B. K., of Guiana, yields one of the drugs called *Pareira Brava*, and is used as a purgative and diuretic. The root of *A. anguicida* Jacq., of tropical America, is poisonous, as is the rhizome of *A. grandiflora* Sm., the *Poisoned Hog-meat* of Jamaica.

SERUM ANTIDIPHTHERICUM, *U. S., P. G.*—Antidiphtheric Serum.

Diphtheria antitoxin, E.; *Serum antidiphthérique*, Fr.; *Diphtherie-Heilserum*, G.

A fluid separated from the coagulated blood of a horse, Equus caballus L, immunized through the inoculation of diphtheric toxin. It should be kept in sealed glass containers, in a dark place, at temperatures between 4.5° and 15° C. (40° and 59° F.).—U. S.

Preparation.—The immunization of the animals and the preparation of the antitoxin have been described in detail on pages 198–200 under Antitoxins. Although nearly all antidiphtheric serum used in this country is now manufactured here, there are still considerable quantities imported from France and Germany, both in the liquid and dry form.

Properties.—Antidiphtheric serum, as officially recognized, is a yellowish or yellowish-brown, transparent, or slightly turbid liquid, odorless or having a slight odor due to the presence of the antiseptic used as a preservative. Its specific gravity varies from 1.025 to 1.040 at 25° C. (77° F.). It gradually loses its power, the loss in one year varying between 10 per cent. and 30 per cent. Each container should be furnished with a label or statement giving the strength of the antidiphtheric serum, expressed in antitoxic units, the name and percentage by volume of the antiseptic used for the preservation of the liquid (if such be used), the date when the antidiphtheric serum was last tested, and the date beyond which it will not have the strength indicated

on the label or statement. The standard of strength, expressed in units of antitoxic power, should be that approved or established by the United States Public Health and Marine Hospital Service.—U. S.

The German Pharmacopœia gives the following descriptions of the liquid and dry antidiphtheric serums recognized by it: The liquid serum is a yellow, clear fluid having at most a very slight sediment; it has the odor of the preservative used. It is put up in bottles of various form and color, the contents of which contain from 100 to 3000 immunity units. The bottles most frequently used are those containing: No. O = 200 I. U.; No. I = 600 I. U. (or 500 I. U.); No. II = 1000 I. U.; ; No. III = 1500 I. U. Antidiphtheric serum which contains more than 300 immunity units in 1 Cc. is considered a high grade serum. The solid antidiphtheric serum is a dried serum of high grade, and contains at least 5000 immunity units in 1 Gm. It contains no antiseptic or other added substance. It appears as a yellowish-white powder, soluble in 10 parts of water, giving a solution which, in color and appearance, resembles the corresponding liquid serum. Single doses of from 250 to 1000 immunity units are put up in white glass-stoppered vials capable of holding from 2 to 6 Cc. The solution should be made with sterile water in the original bottle, using 1 Cc. for every 250 units, and should be prepared fresh each time.

The immunity unit may be defined as the neutralizing power possessed by an arbitrary quantity of antidiphtheric serum kept under special conditions to prevent deterioration in an authorized laboratory. From a theoretical point of view, it may be defined as that quantity of antidiphtheric serum which will just neutralize 200 minimal lethal doses of a pure poison, the latter being one containing only toxin, and no toxoid, toxone, or other substance capable of uniting with the antibodies. The unit for measuring the strength of diphtheria antitoxin is an arbitrary quantity, just as the units of all systems of weights and measures are fundamentally arbitrary quantities, so that the question of the quantity of immunity units which a particular antidiphtheric serum contains can only be determined by comparing it with the standard serum preserved by Ehrlich at the Royal Institute of Experimental Therapy, at Frankfort-on-the-Main, in Germany. (From Bulletin No. 21 of the Hygienic Laboratory, at Washington, D. C.)

While formerly it was necessary for American manufacturers of antidiphtheric serum to send their products to Germany for standardization, this work is now done by the Public Health and Marine Hospital Service, at its laboratory in Washington, where a standard serum has been prepared based on Ehrlich's immunity unit. Under an act of Congress, approved July 1, 1902, and the regulations framed thereunder, the Director of the Hygienic Laboratory is required to examine all antitoxins for purity and potency. From time to time purchases of antidiphtheric serum are made in the open market by government officials, and these are carefully examined. If found not to conform to the prescribed requirements, the manufacturer is notified and steps are taken to insure the withdrawal of that particular lot from sale. Not only is the serum tested for its potency, but great care is taken to determine its freedom from contamination by foreign bacteria, and finally to insure the absence of chemical poisons, especially tetanus toxin. The law requires all antitoxin serum to be plainly marked with the name of the article, and the name, address, and license number of the manufacturer.

Action and Uses.—These have been treated on p. 201, which see.

SEVUM PRÆPARATUM, *U. S., Br.*—Prepared Suet.

Sebum ovile, P. G.; *Suif de mouton*, Fr. Cod.; *Sevum*, U. S., 1890.—*Prepared mutton tallow*, E.; *Graisse de mouton*, Fr.; *Hammeltalg, Schöpsentalg, Unschlitt*, G.

The internal fat of the abdomen of the sheep, Ovis Aries, L., purified by melting and straining.—U. S., Br.

Preparation.—The fat, having been carefully freed from adhering membrane and blood, is cut into pieces and crushed so as to break up the cells, after which it is melted and strained through cotton or flannel. Mutton-tallow always has a peculiar, rather unpleasant odor and a finer product can be obtained by filtering the melted fat through paper in a hot-water funnel, whereby some minute odorous particles are removed which ordinarily pass through the strainer.

Properties.—Prepared suet is a white, solid fat, nearly inodorous, and having a bland taste when fresh, but becoming rancid on prolonged exposure to air. It is insoluble in water or cold alcohol; soluble in 44 parts of boiling alcohol, in about 60 parts of ether, and slowly in 2 parts of petroleum benzin. From its solution in the latter, when kept in a stoppered flask, it slowly separates in a crystalline form on standing. An alcoholic solution of prepared suet is neutral or has only a slightly acid reaction to litmus-paper moistened with alcohol. Prepared suet melts between 45° and 50° C. (113° and 122° F.) (44.4° and 48.9° C. (112° and 120° F.), Br., 47° and 50° C. (116.6° and 122° F.), P. G.), and congeals between 37° and 40° C. (98.6°–104° F.) (at about 37.8° C. (100° F.), Br.). Prepared suet should be kept in well-closed vessels, impervious to fat. It should not be used after it has become rancid.—U. S. On cooling melted suet it should be stirred while cooling to insure a smooth mass.

Composition.—According to Chevreul, mutton suet consists of 70 to 80 per cent. of stearin and palmitin, and 20 to 30 per cent. of olein, together with a trace of hircin; the latter is the glyceryl ester of hircic acid, which has a strong acid reaction and a peculiar goat-like odor, and is freely soluble in alcohol.

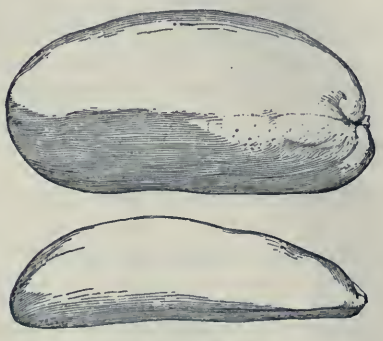
Action and Uses.—Suet when freshly prepared may be used as a soothing application to superficial burns. It enters into some official ointments.

SIMARUBACEÆ.—The Quassia Family.

The *Simarubaceæ*, almost wholly tropical, comprises 28 genera and about 125 species of shrubs and trees. The utilities of the family are restricted almost wholly to medicine, and the active constituents and properties are closely similar to those of Quassia. The fleshy fruit of *Simaba Cedron* Planch. (*Cedron Fruit*) is edible, and the seeds of species of *Irvingia* yield edible fat. That of the African species, *I. Barteri* Hook. (*A. Gaboonensis* Baill.), is used under the names *Dika* and *Gaboon chocolate*. That of *I. Oliverii* Pierre is similarly used in Cochin-China. The following drugs of the family, in addition to the Quassias, are of some importance.

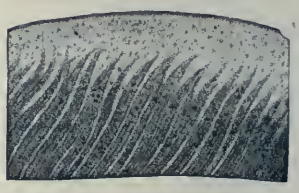
Simaruba (*Simarouba*, Fr.; *Ruhrrinde*, *G.*; *Simaruba*, Sp.) is the root-bark, its outermost layer mostly removed, of *S. amara* Aubl. (*S. officinalis* D.C.; *Quassia simarouba* L. f.), or of *S. glauca* D.C. (*S. medicinalis* Endl.; *S. officinalis* MacF.; *Quassia glauca* Spreng.). These plants are small trees of tropical America. There has been great confusion regarding their synonymy and, partly for this reason, their geographical distribution is imperfectly known. The first named occurs sparingly over a wide area in northern South America, the second in Central America and the West Indies. The bark is usually torn off in long and exceedingly tough strips, a few inches wide and 3 to 6 Mm. (⅛ to ¼ In.) thick, much inclined to be split longitudinally. The outer surface varies from pale ochre yellow to orange brown, is shortly rough-fibrous, and exhibits occasional warts. The inner surface is lighter, long and slen-

Fig. 400.



Cedron seeds (Nat.).

Fig. 401.



Simaruba bark: transverse section.

derly striate, and exhibits more or less partly detached bast-fibers. It splits rather easily, though incompletely, and has an exceedingly tough-fibrous fracture. The cross-section exhibits oblique and wavy bast-wedges, and an outer layer about half as wide, granular from numerous groups of stone-cells. That of *S. glauca* is lighter colored and usually thicker than that of *S. amara*. Simaruba bark is odorless, but exceedingly bitter. The bitter constituent or constituents of Simaruba are unknown. A little tannin and resin are contained.

Cedron Seeds (*Semen simabæ*, *Semen cedronis*, *Rattlesnake Beans*) are the seeds of the

Cedron fruit, produced by *Simaba Cedron* (R. Br.) Planch. (*Quassia C.*—R. Br.), and *S. ferruginea* St. Hil., small slender trees of South America, mostly of the northern sections. The form and size of the seeds are indicated in the accompanying illustration. They are nearly smooth, of a pale brownish-gray color, hard, inodorous, and very bitter. The bitter principle has been called *cedrin*, but its composition is not known. It occurs in yellowish or colorless crystals, soluble in water, alcohol, and chloroform, and somewhat volatile. It has been thought probable that this is identical with *valdivin* ($C_{36}H_{48}O_{20}.5HO$—Tanret), from *Simaba Valdivia* Planch., which, however, foams with water and is emetic, like saponin.

Ailanthus (*Tree-of-Heaven, Chinese Sumac*, E.; *Götterbaum*, G.; *Vernis de Japan*, Fr.) is the bark, also the leaves, of *Ailanthus glandulosus* Desf., a small tree, native of China, and well known in the United States, both in cultivation and escaped into waste places. Its foliage, and more especially the male flowers, exhale a very disagreeable odor. Flies and many other insects, as well as birds, avoid its branches. The leaves are a favorite food of the silk-worm. The *bark* is grayish brown, nearly smooth, internally yellowish, with long, straight and inconspicuous striæ, tough and fibrous, of peculiar odor and bitter taste. The *leaves* are frequently more than a meter (4 Ft.) long, and consist of about 15½ pairs of leaflets, which are short-petioluled, 2 to 3 In. long, a third as wide, ovate, acuminate and acute, at the base truncate or slightly cordate, inequilateral, obscurely few-toothed toward the base, thinnish, smooth, of disagreeable odor and bitter taste. The plant contains resin, a dark green volatile oil and an amaroid, the last most abundant in the bark, the second in the leaves. None of these constituents has been investigated.

The volatile oil, inhaled, has caused intense nausea and dizziness. The bitter principle has the tonic properties of its class and is a gastric irritant. In army hospital practice the powdered leaves, dusted over wounds, have been found very valuable in repelling flies, without affecting the patient. There are 7 species of *Ailanthus*, all Asiatic. The barks of *A. Malabarica* D.C. and *A. excelsa* Roxb. are used as vegetable bitters in India, as is the juice of the leaves and bark of the latter species. By incision the bark of the former is made to yield gum-resin, which is used in dysentery. (For a microchemical examination of the bark of *A. excelsa*, see *Phar. Jour.*, 1870–1871, pp. 154, 175, and 193.)

Samadera Indica Gaertn. (*Niota pentapetala* Lam.), a small East Indian tree, is bitter in all parts. The bark is red brown, smooth, internally whitish dotted, and has a short and finely fibrous fracture. It yields the bitter principle *samaderin*, soluble in water and alcohol, yellow with nitric or hydrochloric acid, violet red with sulphuric acid. It is used as a bitter tonic in the treatment of dysentery.

Various species of *Brucea* are used for their bitter, anthelmintic, and antidysenteric properties. The fruit of *B. sumatrana* Roxb. (*Gonus amarissimus* Lour.) yields the alkaloid *brucamarine*. The bark of *Castela Nicholsonii* Hook. is similarly used.

SINAPIS ALBA, *U. S.*—White (Yellow) Mustard.

Sinapis Albæ Semina, Br.; *Semen Erucæ*, P. G.—*Weisser Senf*, G.; *Moutarde blanche*, Fr.; *Senape Bianca*, It.; *Mostarda Branca*, Port.; *Mostaza Blanca*, Sp.

The ripe seed of *Sinapis alba* L. (*S. foliosa* Willd.; *Leucosinapis a.*—Spach.; *Brassica a.*—Boiss.—Fam. *Cruciferæ*).

White mustard is official in several other pharmacopœias besides those named above.

Origin.—This seed is derived from an annual plant, native of southern Europe and southwestern Asia, and now growing spontaneously in greater or less abundance in nearly all temperate and warm-temperate regions. It is slender, with long and widely spreading branches, the stem retrorsely rough-hairy, the leaves rough, the lower lyrate-pinnatifid, becoming gradually almost entire above. The yellow flowers are borne in terminal racemes. The mature pods are erect on spreading pedicels, are somewhat constricted between the seeds, and end in a long beak. White mustard-leaves are frequently employed in salads and are sometimes made into poultices.

Description.—White mustard-seeds are globoidal, about 2 Mm. ($\frac{1}{12}$ In.) in diameter, weigh about 0.005 Gm., and are marked on one end with a small circular hilum and on the inner side with two shallow grooves. The testa is yellowish or pale grayish brown, very finely pitted and roughish. The kernel consists of an oily embryo which possesses a curved caulicle and 2 conduplicate cotyledons. The seed is inodorous. It becomes mucilaginous in the mouth and, when masticated, has a pungent and acrid taste. The powder should be of a pale yellow or dull gray-yellow color. It should show few or no starch grains, and if 1 gram of it be exhausted by slow percolation with alcohol and the residue be mixed with 200 Cc. of water and heated to boiling, and after cooling be made up to 1000 Cc. by the addition of cold water, the addition of 4 Cc. of tenth-normal iodine solution should not produce in the solution a dark blue color. The ash should not exceed 6 per cent., and is usually less than 5 per cent.

Entire white mustard is scarcely susceptible of adulteration, but the ground or powdered article is not infrequently adulterated with starch or starchy substances. These are readily detected by the test given above. Although the ripe seed contains no starch, traces of this substance are very liable to find their way into the powder. The addition of curcuma is indicated by a bright yellow color to the powder. (For further particulars regarding adulteration, see SINAPIS NIGRA.) The powder of white mustard is readily distinguished from that of the black by its failure to give off pungent fumes when mixed with water, unless heated.

Constituents.—The inner layer of the testa contains much gum. The principal constituents of the kernel are from 20 to 25 per cent. of a bland fixed oil, the glucoside *sinalbin*, and the glucosidal enzyme *myrosin*.

Neither volatile oil nor any other pungent principle is present until after the decomposition of the sinalbin. This glucoside is peculiar in that it contains nitrogen ($C_{30}H_{44}N_2S_2O_{16}$). It is obtained by removing the fixed oil, exhausting the residue with boiling alcohol, and allowing the latter to cool, when the sinalbin separates in glassy, prismatic crystals. These are bitter, soluble in water, with difficulty in alcohol, insoluble in ether, oil of turpentine or carbon disulphide; neutral, not colored by ferric chloride, yielding white precipitates with corrosive sublimate and silver nitrate, and colored yellow by traces of alkalies. Myrosin is soluble in water, but not in alcohol, by which it can be precipitated from the concentrated infusion. If too much alcohol is employed, the myrosin is coagulated and its activity destroyed, the same result occurring from its exposure to a boiling temperature.

Sinalbin, acted upon by myrosin in the presence of water, is decomposed into white mustard oil, dextrose, and sinapine sulphate. White mustard contains more myrosin than is necessary to convert the glucoside present. This oil is *Para-hydroxy-benzyl-isothiocyanate* or "acrinyl sulphocyanide," and has the formula C_7H_7ONCS. It is a yellow, pungent liquid, powerfully irritant, but blistering more slowly than oil of black mustard. Its odor, when cold, is faint and anise-like, but, when heated, it is somewhat volatile and gives off pungent fumes similar to those of black mustard oil. It is soluble in dilute alkalies. *Acid sinapine sulphate* is $C_{16}H_{24}NO_5HSO_4$. *Sinapine* is the ester of choline, "Sinkaline," and *sinapic acid* ($C_{11}H_{12}O_5$), these separating when the yellowish mixture of the salt is boiled with alkalies.

Action and Uses.—Mustard seed may be swallowed whole in the dose of 1 or 2 teaspoonfuls 2 or 3 times a day for their laxative action, which is thought to be due to increased peristalsis brought about by mechanical irritation of the bowel wall. In powder, mustard is used as a condiment, an emetic, and as a counterirritant. Taken in small quantities with food it stimulates the secretion of gastric juice and promotes digestion, but is contraindicated in the presence of acute gastric inflammation. If used constantly in excessive quantity, however, it is apt to cause chronic gastritis. ½ to 1 tablespoonful added to a pint of tepid water will usually, if swallowed promptly, produce vomiting, and is a useful emetic in all cases of narcotic poison. Mustard is most frequently employed as a counterirritant, for which purpose it is well adapted, but should be used with care. As ordinarily used, it is made into a poultice or sinapism by the addition of water or vinegar, then spread upon a piece of linen or gauze. When applied, another piece of gauze or linen should be interposed between the skin and mustard to prevent the latter from adhering. A sinapism thus made will usually produce a good deal of burning and distinct redness of the skin in a few minutes, when it should be removed. If allowed to remain too long it will cause blisters, which may terminate in very slowly healing ulcers or even gangrene. Children and other individuals with tender skins will not tolerate a full strength mustard poultice, so that when used in these cases the action of the mustard should be mitigated by the addition of wheat flour or linseed meal in varying proportions. Mustard poultices are used to relieve the pain of flatulent colic, of acute inflammations of the abdominal and thoracic viscera, of muscular rheumatism, arthritis, neuralgia, headache, dysmenorrhœa, etc. A mustard foot-bath or pediluvium made by adding 1 or 2 tablespoonfuls of mustard to an ordinary foot-bath is popularly employed to abort forming colds. The volatile oil of mustard is a decided irritant, occasionally used as a rubefacient in place of a mustard poultice. For this purpose it is diluted with about 20 parts of alcohol or 10 parts of almond oil. It is sometimes given in the dose of ¼ to ½ minim (0.015–0.025 Cc.) to relieve the gastric atony of drunkards. In overdose it acts as a powerful, irritant poison.

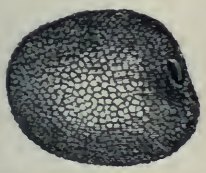
SINAPIS NIGRA, *U. S.*—Black (Red or Brown) Mustard.

Sinapis Nigræ Semina, Br.; *Semen Sinapis*, P. G.; *Semina brassicæ.—Senfsamen, Schwarzer Senf*, G.; *Moutarde noire*, Fr.; *Senape Nera*, It.; *Mostarda, Mostarda Negra*, Port.; *Mostaza, Mostaza Negra*, Sp.

The dried ripe seeds of *Brassica nigra* (L.) Koch (*Sinapis n.*—L.; *B. sinapioides* Roth.; *Melanosinapis communis* Spenn.—Fam. *Cruciferæ*). Black mustard is official in all pharmacopœias, which are divided as to classing the plant in the genus *Brassica* or in *Sinapis*. The Russian refers it to *Brassica juncea* (L.) Coss. (*Sinapis j.*—L.), the Portuguese to "*S. arvensis* L.," which is *Brassica arvensis* (L.) B. S. P., *B. Sinapistrum* Boiss. Several caution against the admixture of related seeds, especially those of rape.

Origin.—The nativity of this plant is practically the same as that of white mustard and, like that, it is widely cultivated and escaped. Both agree closely in habit, the black growing rather taller. On the black, both the pods and their pedicels are

FIG. 402.



Black mustard-seed: entire.

FIG. 403.

Embryo.

FIG. 404.

Transverse section.

erect, so that the former are appressed to the stem. The pods are more slender, more shortly beaked, and are not constricted between the seeds. The foliage is used like that of white mustard.

Description.—From 1 to 5 Mm. ($\frac{1}{25}$ to $\frac{1}{15}$ In.) in diameter, globose, deep red brown, with or without a slight grayish tinge, with a light gray or whitish hilum, the testa finely pitted, hard, mucilaginous; exalbuminous, the embryo oily, free from starch, consisting of a curved caulicle and two cotyledons, the one folded over the other; inodorous when dry, but when triturated with water of a pungent, penetrating, irritating odor; taste pungent and acrid.

Rape seed, which has been substituted or admixed, is larger, exhibits a bluish lustre, and is but slightly or not at all pungent.

The starch-test described under SINAPIS ALBA should also be employed for powdered black mustard. The ash should not exceed 6 per cent.

Although radish, turnip, and other seeds related to black mustard often occur accidentally with it in small numbers, the only admixture, in the entire condition, which need be considered is rape seed (*Brassica campestris* L.). This is larger, and readily distinguishable by its peculiar bluish-red tint. In the ground condition, black mustard is enormously subject to adulteration; more when designed for table use than for medicinal purposes. The admixture is usually flour of some kind, though powdered curcuma is very often employed. In 1891, Baert examined 27 samples purchased in pharmacies and grocery stores in Michigan, and found 19 of them adulterated. In 1 sawdust was used; in all the others the adulterant was a starchy substance, readily detected either by the microscope or by the test given with the above description.

Ground mustard is official in the British Pharmacopœia under the title Sinapis, or Mustard. Its definition calls for the ground seeds of both varieties, mixed, but does not provide for the removal of the integuments, as is done before grinding, nor for the removal of the fixed oil, as is often done by expression after powdering, the resulting cake being then re-ground. Since none of the activity resides in this fixed oil, the resulting flour is more active in proportion to the reduction in weight due to the loss of oil. If, however, a boiling temperature be reached during the process, the activity is decreased, or even destroyed, for reasons explained under S. ALBA, *Constituents.*

Constituents.—These are similar to those of white mustard, with the following exceptions: There is less gum; the fixed oil amounts to from 30 to 35 per cent.; the

glucoside is *sinigrin* instead of sinalbin; the amount of myrosin is scarcely sufficient to convert the glucoside present. Special interest in this drug, therefore, centres in sinigrin and its products. The yield of sinigrin ranges from ⅔ to 1½ per cent. It can be obtained from black mustard exhausted with boiling strong alcohol by treating it with cold water, adding a little barium carbonate to the infusion, evaporating to a syrupy consistence, and boiling this residue repeatedly with 85 per cent. alcohol, and evaporating. It occurs in white, silky, inodorous needles, or, if crystallized from water, in short glass-like prisms, soluble in water, almost insoluble in absolute alcohol, and insoluble in ether, chloroform, and benzene. The substance is lævogyric, and has a melting-point of 126° to 127° C. Sinigrin has a cooling, bitter taste. It is *Potassium myronate* ($C_{10}H_{18}NKS_2O_{10}$), and loses one molecule of water on prolonged drying *in vacuo* at 98.5°C. Its decomposition is effected by myrosin similarly to that of sinalbin (see SINAPIS ALBA), the products being sugar, potassium acid sulphate and volatile oil of mustard, oil of black mustard, or *Allyl isosulphocyanate* (see *Oleum Sinapis Volatile*), together with traces of several related substances. The yield of this oil is from ½ to ¾ of 1 per cent. of the weight of the seeds.

Action and Uses.—The properties and uses of black mustard are the same as of the white (see preceding article).

Allied Products (see also CRUCIFERÆ).—The genus *Brassica* L. is credited with about 50 species, though the precise number is uncertain. They are natives of Europe, northern Africa, and Asia, especially of the Mediterranean region. They include the cabbages, turnips, rapes, and colzas, of which there are more than a hundred distinct forms, mostly the products of cultivation. The most important, in relation to mustard, is *B. juncea* Hooker f. (*Sinapis j.*—L.), the seeds of which are known as *Russian mustard* or *Sarepta*, and are specified by the Russian Pharmacopœia as the source of black mustard. They are very similar to *B. nigra* in every way.

SODII ACETAS, *U. S.*—Sodium Acetate.

Natrium aceticum, P. G.; *Terra foliata tartari crystallisata.*—*Acetate of soda*, E.; *Acétate de soude*, Fr.; *Natriumacetat, Essigsaures Natron*, G.; *Acetato di soda*, It.

Formula, $NaC_2H_3O_2 + 3H_2O$. Molecular weight, 135.1.

It should be kept in well-stoppered bottles, and should contain in an uneffloresced condition not less than 99.5 per cent. of pure salt.—U. S.

Preparation.—Sodium acetate was first prepared by Duhamel (1736) and by J. F. Meyer (1767), and was made by Doerffurt (1793) from sugar of lead by decomposing it with sodium carbonate and sulphate. It may be obtained by neutralizing acetic acid or by decomposing lead acetate with sodium carbonate, in the latter case filtering from the insoluble lead carbonate and evaporating the clear liquids to crystallization. The salt is, however, manufactured on a large scale in the United States in the process for purifying acetic acid from wood vinegar.

Properties.—This salt crystallizes in colorless, transparent, monoclinic prisms which are odorless and have a cooling saline taste, and are somewhat efflorescent on exposure, falling in dry air to a white powder. Soluble at 25° C. (77° F.) in 1 part of water and in 23 parts of alcohol; in all proportions of boiling water and of boiling alcohol. It is about one-third as soluble in water and far less soluble in alcohol than the potassium salt. When heated to 60° C. (140° F.), the salt begins to liquefy. At 123° C. (253.4° F.) it becomes dry and anhydrous; at 315° C. (599° F.) it is decomposed with evolution of inflammable, empyreumatic vapors, leaving a black residue of sodium carbonate and carbon, which imparts to a non-luminous flame an intensely yellow color, gives an alkaline reaction with moistened litmus-paper, and effervesces with acids. The aqueous solution (1 in 20) of the salt colors litmus-paper blue, but does not redden phenolphthalein solution, unless carbonate be present. If a little of the salt be heated with 1 Cc. of sulphuric acid and 1 Cc. of alcohol, acetic ether will be formed, recognizable by its odor.—U. S. The salt is insoluble in ether. Sulphuric acid liberates from it acetic acid, and its aqueous solution becomes deep red with ferric salts, and on boiling yields a brown-red precipitate of ferric hydroxide.

Tests.—Sodium bitartrate test-solution added to a saturated aqueous solution of the salt should produce no turbidity (limit of potassium). The aqueous solution of the salt (1 in 20), slightly acidulated with acetic acid, should not be colored or made turbid

by an equal volume of hydrogen sulphide solution, when kept corked at 35° C. (95° F.) for at least half an hour, either before or after rendering slightly alkaline with ammonia-water (absence of heavy metals). 5 Cc. of the aqueous solution (1 in 10) should not respond to the modified Gutzeit's test for arsenic given under ARSENI TRIOXIDUM. If 1 Gm. of the salt be thoroughly ignited, not above red heat, and the residue extracted with boiling water until the washings cease to react with methyl-orange indicator, the mixed filtrate and washings should require for neutralization not less than 14.74 Cc. of half-normal sulphuric acid, methyl-orange being used as indicator.—U. S. Each Cc. of the sulphuric acid represents 0.06755 Gm. of crystallized sodium acetate, hence 14.74 Cc. represents 0.9956 Gm., or 99.56 per cent. The tests for limit of chloride, sulphate, and calcium have been omitted from the U. S. P., 1900, but are retained in the P. G.

Action and Uses.—Sodium acetate possesses the same medicinal properties as potassium acetate (which see). Its dose is from 10 to 30 grains (0.60–2 Gm.) as a diuretic and from 1 to 2 drachms (4–8 Gm.) as a mild laxative.

Derivative Salt.—*Sodio-theobromine Acetate. Agurin.* $C_7H_7NaN_4O_2 + NaC_2H_3O_2$.—This compound, introduced in 1901 as a diuretic, has since been used with success in doses of 1 Gm. 3 times daily, in solution or in wafers.

SODII ARSENAS, *U. S.*—Sodium Arsenate.

Natrium arsenicum.—Arseniate (arsenate) of soda, E.; *Arséniate de soude,* Fr.; *Natriumarsenat, Arsensaures Natron,* G.

Formula, $Na_2HAsO_4 + 7H_2O$. Molecular weight, 309.84.

It should contain, in an uneffloresced condition, not less than 98 per cent. of pure salt, and be kept in well-stoppered bottles.—U. S.

Preparation.—No pharmacopœia at present gives a method of preparing the salt. The Br. P., 1885, gave the following procedure: Powder finely and mix thoroughly 10 parts of arsenic trioxide, 8.5 parts of sodium nitrate, and 5.5 parts of dried sodium carbonate. Put the mixture into a large clay crucible and cover it with the lid. Expose to a full red heat till all effervescence has ceased and complete fusion has taken place. Pour out the fused salt on a clean flagstone, and as soon as it has solidified, and while it is still warm, put it into 35 parts of boiling water, stirring diligently. When the salt has dissolved filter the solution through paper and set it aside to crystallize. Drain the crystals, and, having dried them rapidly on filtering-paper, enclose them in stoppered bottles.

On fusing arsenic trioxide in the proper proportions with sodium carbonate and nitrate, carbon dioxide, CO_2, and nitrous anhydride, N_2O_3, are given off, and the residue is converted into sodium pyroarsenate, as will be seen from the equation $As_2O_3 + 2NaNO_3 + Na_2CO_3 = Na_4As_2O_7 + N_2O_3 + CO_2$. The pyroarsenate, on being dissolved in water, is converted into orthoarsenate by combining with water; $Na_4As_2O_7 + H_2O$ yields $2Na_2HAsO_4$, and this salt crystallizes with $7H_2O$. The carbonate may be conveniently replaced by an equivalent quantity of solution of caustic soda, in which the arsenic trioxide may be dissolved, and the residue left on evaporation to dryness should then be oxidized by fusion with sodium nitrate; all danger of expelling arsenic by injudicious heating will then be avoided. The same salt is also obtained on oxidizing arsenous to arsenic acid by means of hot nitric acid, dissolving the dry residue in hot water, and adding sodium carbonate as long as effervescence is produced.

Properties.—Sodium arsenate crystals are colorless, transparent, inodorous prisms having a faint alkaline taste, which usually contain $7H_2O$ or 40.4 per cent.; when obtained at a low temperature they contain $12H_2O$ or 53.7 per cent. The crystals are slightly deliquescent in a moist atmosphere, but in dry air are efflorescent and lose $5H_2O$, the white powder which is finally left having the composition $Na_2HAsO_4.2H_2O$, and containing 16.2 per cent. of water of crystallization, which is given off near 148° C. (298.4° F.). At a higher temperature the dried salt fuses, and at a red heat is converted into pyroarsenate. The official salt is soluble in 1.2 parts of water at 25° C. (77° F.), very sparingly soluble in cold, but nearly insoluble in boiling alcohol. It should respond to the tests of identity and purity given under SODII ARSENAS EXSICCATUS that follows.

Action and Uses.—The action of sodium arsenate does not differ essentially from arsenous trioxide, for which it may be substituted. It is given in the dose of $\frac{1}{20}$ to $\frac{1}{8}$

grain (0.003–0.008 Gm.). The dose of the official solution (Liquor sodii arsenatis) is from 3 to 10 minims (0.20–0.60 Cc.).

Other Sodium Arsenates.—If an excess of sodium carbonate is used in the formula given above, the aqueous solution will contain *trisodium arsenate*, and yield crystals having a stronger alkaline reaction and the composition $Na_3AsO_4.12H_2O$. With an excess of arsenic acid crystals of *monosodium arsenate*, $NaH_2AsO_4.H_2O$, may be obtained.

SODII ARSENAS EXSICCATUS, *U. S.*—Exsiccated Sodium Arsenate.

Sodii arsenas, Br.; *Natrium arsenicum exsiccatum.—Dried (anhydrous) arseniate of soda*, E.; *Arseniate de soude desséché*, Fr.; *Getrocknetes Natriumarsenat*, G.

Formula, Na_2HAsO_4. Molecular weight, 184.68.

It should contain not less than 98 per cent. of pure anhydrous salt.—U. S.

According to the temperature at which they form, crystals of sodium arsenate may contain 7, 8, or 12 molecules of water, and are more or less efflorescent, so that the per cent. of arsenic in any specimen is an uncertain quantity. Hence, considering the very poisonous property of this compound, a salt of fixed character such as the anhydrous arsenate, which is readily prepared, has very properly been made official in the Pharmacopœia, 1900, and should be employed instead of the crystallized salt with 7 molecules of water. The anhydrous salt is also official in the Br. P., but under the title SODII ARSENAS.

Preparation.—Break sodium arsenate crystals into small fragments, and allow them to effloresce at a temperature between 40° and 50° C. (104° and 122° F.) until they are completely disintegrated; then gradually increase the temperature to 150° C. (302° F.), and continue the drying until the product ceases to lose weight. Reduce it to a fine powder and transfer to dry, well-stoppered bottles.—U. S.

Properties.—The salt is an amorphous, odorless, white powder, having a mildly alkaline taste (it is very poisonous), and permanent in dry air. It dissolves in 3 (6, Br.) parts of water at 25° C. (77° F.); very sparingly soluble in cold, but nearly insoluble in boiling alcohol. It should not lose weight at 150° C. (302° F.). It imparts an intensely yellow color to a non-luminous flame.

Tests.—The aqueous solution of the salt (1 in 20) gives a precipitate (arsenate) with solutions of barium chloride (white), calcium chloride (white), and silver nitrate (dark red). The precipitate in all cases is soluble in nitric acid. If 0.5 Cc. of an aqueous solution (1 in 20) be mixed with 2 Cc. of hydrochloric acid, and a drop of this mixture be placed upon a bright piece of copper-foil, a dark steel-gray film will be deposited on applying a gentle heat (reduction to metallic arsenic). If to 2 Cc. of an aqueous solution (1 in 20), 5 Cc. of tenth-normal silver nitrate solution be added, and the precipitate redissolved by a slight excess of ammonia-water, no black precipitate of reduced silver should appear on boiling (absence of arsenite). If to 5 Cc. of an aqueous solution (1 in 20), 1 Cc. of ammonium sulphide test-solution be added, no turbidity or dark coloration should appear (absence of lead, copper, iron, etc.).—U. S. 1 Gm. of the salt dissolved in 1 Gm. of glacial acetic acid and 50 Cc. of water should require 2.03 Gm. of lead acetate for complete precipitation.—Br. This test is intended to show the absence of notable quantities of other salts. The method has been criticised by Thos. S. Barrie (*Chemist and Druggist*, 1900, p. 884) as being inaccurate and not suitable for a quantitative determination. He also states that 1 Gm. of the salt would require 3.05 Gm. of lead acetate instead of 2.03 Gm., a neutral lead arsenate being formed, and not an acid salt, as assumed by the Br. Possibly the figure 2.03 is a typographical error.

Action and Uses.—The dose of the exsiccated sodium arsenate is about two-thirds that of the hydrous salt—viz., $\frac{1}{30}$ to $\frac{1}{12}$ grain (0.002–0.005 Gm.).

Allied Compound.—*Sodii cacodylas, Natrium cacodylicum, Sodium cacodylate*, E.; *Natrium-kakodylat, Kakodylsaures Natron*, G. $(CH_3)_2AsO_2Na$.—This salt is obtained by exact neutralization of cacodylic acid, which is dimethyl arsenic acid (see under ACIDA). It contains 46.8 per cent. of arsenic, equivalent to 61.8 per cent. of As_2O_3, is very deliquescent, and contains variable quantities of water, according to the temperature at which crystallization took place and the nature of the solvent. The commercial salt mostly contains 2 to 3 molecules. It forms prismatic crystals, easily soluble in alcohol as well as water. Many commercial samples contain free cacodylic acid, the amount of which may be determined by tenth-normal alkali, using phenolphthalein as indicator.

SODII BENZOAS, *U. S., Br.*—Sodium Benzoate.

Natrium benzoicum.—Benzoate de soude, Fr.; *Natriumbenzoat, Benzoesaures Natron*, G.

Formula $NaC_7H_5O_2$. Molecular weight, 143.01.

It should be kept in well-stoppered bottles, and should contain not less than 99 per cent. of the pure salt.—U. S.

Preparation.—Add to 10 parts of benzoic acid suspended in 20 parts of hot water, gradually, 7 parts of sodium bicarbonate; after the evolution of carbon dioxide has ceased, neutralize the liquid exactly by the addition of a little benzoic acid, or if necessary with sodium bicarbonate; filter and evaporate with frequent stirring until the residue weighs between 13½ and 14 parts. As the salt separates it creeps up on the sides of the dish, and should therefore be frequently scraped off and returned to the liquid portion. When sufficiently concentrated the mass is stirred until cold, when the remaining water will evaporate. The yield is 13¼ parts. This salt being very efflorescent, the U. S. Pharmacopœia requires it to be anhydrous, for which purpose the above solution is evaporated to dryness, when the yield is 11⅘ parts.

Properties.—Sodium benzoate is described as being a white, amorphous or crystalline powder, permanent in the air, odorless, of a sweetly-astringent taste, and having a neutral reaction; soluble in 1.6 parts of water and in 43 parts (24 parts, Br.) of alcohol at 25° C. (77° F.), in 1.3 parts of boiling water, and in 12 parts of boiling alcohol. When heated the salt melts, emits vapors having the odor of benzoic acid, then chars, and finally leaves a blackened residue of an alkaline reaction which imparts to a non-luminous flame an intense yellow color. On mixing an aqueous solution of the salt with a solution of ferric chloride, a flesh-colored precipitate of ferric benzoate is produced.—U. S. According to Hager, the anhydrous salt dissolves in 13.5 parts of 90 per cent. alcohol, in 4.5 parts of 60 per cent. alcohol, in 15 parts of glycerin, and is insoluble in ether, chloroform, and volatile oils; when heated, the salt becomes brown, and afterward melts near 450° C. (842° F.) to a dark-brown mass, which, ignited, burns for a short time only.

Tests.—If 5 Cc. of diluted sulphuric acid be added to a solution of 1 Gm. of the salt in 10 Cc. of water, a white precipitate of benzoic acid will be produced, which, after thorough washing, should conform to the tests of purity mentioned under ACIDUM BENZOICUM. The aqueous solution (1 in 20) of the salt, when acidulated with hydrochloric acid and filtered, should not be colored or rendered turbid by an equal volume of freshly prepared hydrogen sulphide test-solution, after standing well-stoppered in a warm place for at least half an hour, either before or after the addition of ammonia-water to slight alkalinity (absence of metallic impurities). If 1 Gm. of dry sodium benzoate be thoroughly ignited at red heat, and the residue extracted several times with hot water, filtered and thoroughly washed, the combined filtrates should require for complete neutalization not less than 13.85 Cc. of half-normal sulphuric acid, methyl orange being used as indicator.—U. S. Each Cc. of the acid corresponds to 0.071505 Gm. of the salt, after calcination, hence 13.85 Cc. corresponds to 0.9903 Gm. or 99.03 per cent. The Br. demands that 1 Gm. shall require 6.8 to 6.9 Cc. of normal sulphuric acid, that is, 13.6 to 13.8 Cc. of half-normal acid for titration.

The U. S. P., 1900, has dropped tests for chloride, sulphate, potassium carbonate and tartrate. Except the last, these tests are still given in the Br. P.

Action and Uses.—Because of its antiseptic properties resembling those of salicylic and boric acids, sodium benzoate was at one time lauded and extensively employed as a remedy for many infectious febrile diseases, notably diphtheria, scarlet fever, puerperal septic infection, and even pulmonary tuberculosis, but the extravagant claims of its power have not been substantiated, and its use has been abandoned. It is given occasionally in acute rheumatic fever when the stomach will not tolerate the salicylates. It is used with some success in chronic gout and rheumatism, and in the so-called uric acid diathesis. The dose of sodium benzoate is rather large, from 1 to 3 drachms (4–12 Gm.) in 24 hours.

Allied Salts.—POTASSII BENZOAS, *Potassium benzoate*, $KC_7H_5O_2.3H_2O$. This salt may be prepared like sodium benzoate, 10 parts of benzoic acid requiring 8.2 parts of potassium bicarbonate, the yield being 17.5 parts of potassium benzoate of the above composition. It

crystallizes with difficulty in small plates, which effloresce in air and are very soluble in water and alcohol.

SODII BORO-BENZOAS, N. F., *Natrium boro-benzoicum, Sodium boro-benzoate,* 3 parts of powdered borax and 4 parts of sodium benzoate are dissolved in water and the solution evaporated to dryness.

SODIUM BENZOATE WITH BISULPHITE.—A mixture of 41.9 parts of sodium bisulphite and 58.1 parts of sodium benzoate, said to be a powerful antiseptic, non-poisonous, and equal to iodoform.

SODII BICARBONAS, *U. S., Br.*—Sodium Bicarbonate.

Natrium bicarbonicum, P. G.; *Natrium carbonicum acidulum.—Bicarbonate of soda, Sodium hydrocarbonate,* E.; *Bicarbonate de soude, Sel digestif de Vichy,* Fr.; *Natriumbicarbonat, Doppeltkohlensaures Natron,* G.

Formula $NaHCO_3$. Molecular weight, 83.43.

Sodium bicarbonate should be kept in well-closed bottles, in a cool place, and should contain not less than 99 per cent. of the pure salt.—U. S.

Preparation.—This salt is rarely, if ever, prepared by the pharmacist, but is manufactured on a large scale. Crystallized sodium carbonate is treated with carbon dioxide, anhydrous sodium bicarbonate, or acid carbonate, being formed and water eliminated; thus, $(Na_2CO_3 + 10H_2O) + CO_2 = 2NaHCO_3 + 9H_2O$; by using a mixture of anhydrous and crystallized sodium carbonate, a part of the eliminated water is required for converting the former into bicarbonate, the rest being allowed to escape by drainage. Sodium bicarbonate is obtained also as an intermediate product in the manufacture of the normal carbonate by the Solvay ammonia-soda process, wherein concentrated solution of sodium chloride is mixed with ammonia and then saturated with carbon dioxide under pressure. Sodium bicarbonate is precipitated and ammonium chloride remains in solution. In either case the newly formed sodium bicarbonate is washed with small quantities of water for the purpose of removing the more soluble impurities. The product of the Solvay process requires careful purification, owing to contamination with ammonium salts, especially ammonium carbonate; hence sodium carbonate, prepared from normal carbonate, is preferred for medicinal purposes.

Sodium bicarbonate is also made by passing carbon dioxide into a saturated solution of the carbonate, when the much less soluble bicarbonate is precipitated.

It is obviously not essential that the carbon dioxide needed in these operations should be generated from marble; the same gas is largely produced in establishments where saccharine substances are undergoing fermentation, and is obtained as a waste product in many chemical operations. In some manufactories the products of combustion of the fuel used for heating steam-boilers are deprived of their impurities by washing, and subsequently utilized for saturating, at least in part, the sodium carbonate with carbon dioxide. Large quantities of this salt are manufactured in the United States, and its importation has decreased from nearly 7,000,000 pounds in 1875 to about 966,000 pounds in 1897. Two large producers of sodium bicarbonate in this country are the Pennsylvania Salt Manufacturing Company, at Natrona, Pa., and the Solvay Process Company, near Syracuse, N. Y.

Commercial sodium bicarbonate is frequently contaminated with carbonate and chloride; but if a pure salt is wanted, this may be readily obtained by percolating the commercial article with cold distilled water until the washings cease to give a brown-red precipitate with mercuric chloride, and drying the purified residue with moderate heat only.

Properties.—Sodium bicarbonate is a white inodorous powder, has a mildly saline not unpleasant and scarcely alkaline taste, and is of a slight alkaline reaction to litmus, but neutral to phenolphthalein. Permanent in dry, but slowly decomposed in moist, air. It is insoluble in alcohol and ether, and requires at 15° C. (59° F.) 12 parts (U. S., P. G.), 11 parts (Br.), of water. Above 60° C. (140° F.), the solution loses carbon dioxide, and at a boiling heat the salt is entirely converted into normal carbonate. When heated, the salt is decomposed into normal carbonate, water, and carbon dioxide, and finally at 100° C. (212° F.), loses about 36.9 per cent. of its weight. At a bright-red heat it melts. To a non-luminous flame it imparts an intensely yellow color. When freshly prepared with cold, distilled water, without shaking, the solution gives a very

faint alkaline reaction with litmus-paper. The alkalinity increases by standing, agitation, or increase of temperature. Sodium bicarbonate is also soluble in glycerin without change, but in the presence of borax carbon dioxide is given off, and sodium carbonate remains behind; a mixture of sodium bicarbonate and borate is not decomposed by cold water. It dissolves with brisk effervescence in diluted acids, forming solutions in which platinum chloride causes no precipitate. If the salt is treated with a small quantity of water, insufficient for solution, the liquid may react in the cold with a solution of magnesium sulphate, producing a white precipitate, and cause with a solution of corrosive sublimate a dark brown-red precipitate, both reactions being due to sodium carbonate, which may be present in small amount. The formula of sodium bicarbonate given above represents 36.94 per cent. Na_2O, 52.35 per cent. CO_2, and 10.71 per cent. H_2O.

Tests.—If 1 Gm. of the salt be dissolved in 19 Cc. of water, it should yield a perfectly clear and colorless solution, leaving no residue. If 5 Cc. of the aqueous solution (1 in 20) be slightly supersaturated with hydrochloric acid, the liquid should not be colored red by a drop of ferric chloride test-solution (absence of sulphocyanate). If 1 Gm. of the salt be dissolved, without agitation, in 20 Cc. of water at a temperature not above 15° C. (59° F.), and 0.2 Cc. of normal sulphuric acid added, no red color should appear upon the addition of 2 drops of phenolphthalein test-solution (limit of normal carbonate). The aqueous solution (1 in 20), slightly supersaturated with hydrochloric acid, should not be rendered turbid by the addition of an equal volume of hydrogen sulphide test-solution, after standing corked in a warm place for at least half an hour, either before or after the addition of ammonia-water in slight excess (absence of heavy metals). If sodium bicarbonate be heated in a test-tube, no ammoniacal vapor should be emitted. 2 Gm. of the salt should require for complete neutralization not less than 23.74 Cc. of normal sulphuric acid, methyl orange being used as indicator.—U. S. Each Cc. of the acid represents .08343 Gm. of the bicarbonate and 23.74 Cc. represent 1.9806 Gm. or 99.03 per cent. 1 Gm. should require 11.8 to 11.9 Cc. normal sulphuric acid, corresponding to 98.45 to 99.3 per cent.—Br. 100 parts of the salt previously dried over sulphuric acid should leave a residue of not more than 63.8 Gm. when heated to redness.—P. G. A larger residue indicates the presence of carbonate or other contamination.

The tests for limit of chloride, sulphate, thiosulphate, potassium, and calcium have been omitted from the 1900 Pharmacopœia, but are retained in the Br. P. and P. G.

Action and Uses.—The alkaline action of sodium bicarbonate is milder than that of sodium or potassium carbonate. Taken for a short time in moderate doses it is the best antacid to relieve the sour eructations, heartburn, nausea, and headache of acid indigestion, but its habitual use tends to augment the acid secretions of the stomach, and thus defeat the purpose of its administration. When used as an antacid it must be given after meals, for if taken on an empty stomach it increases the acid of the gastric juice, hence taken before meals it is of service in atonic dyspepsia. In the treatment of lithæmia and to lessen the acidity of the urine sodium bicarbonate is not so efficacious as potassium bicarbonate. The alkaline treatment of acute rheumatic fever consisted in the administration of large doses of sodium bicarbonate and its local application, in solution, to the involved joints. It is to-day frequently given with the salicylates with marked success to those cases which do not yield to the salicylates alone. It seems to lessen the frequency of the cardiac complications. Its efficacy is increased if the affected joints be swathed in cloth saturated with a solution of the salt. Diabetes mellitus occurring in obese individuals is sometimes greatly benefited by the prolonged use of sodium bicarbonate. The intravenous injection of a solution of the salt has been used to relieve diabetic coma. The application of a saturated solution to burns of the first or second degree quickly relieves the pain and promotes healing. The dose of sodium bicarbonate is from 5 to 30 grains (0.30–2 Gm.), the larger doses being given in rheumatism.

SODII BISULPHIS, *U. S.*—Sodium Bisulphite.

Natrium bisulfurosum.—Bisulphite de soude, Fr.; *Natriumbisulfit, Doppeltschwefligsaures Natron*, G.

Formula, $NaHSO_3$. Molecular weight, 103.35.

It should contain not less than 90 per cent. of the pure salt and should be kept in a cool place in small, completely filled, well-stoppered bottles.—U. S.

Preparation.—This salt is employed in the arts for bleaching, and was called *leucogene* by Chaudet, who recommended it for this purpose. It is also used as *antichlor* for neutralizing the excess of chlorine after bleaching fabrics or paper-pulp, and has been recommended for the preservation of fermentable liquids and articles of food. It is prepared by saturating a solution of sodium carbonate with sulphur dioxide and crystallizing in a cool place. Warm concentrated solutions treated in this manner usually separate on cooling *sodium pyrosulphite*, $Na_2S_2O_5$.

Properties.—Sodium bisulphite is in opaque, prismatic crystals or a crystalline or granular powder, slowly oxidized and losing sulphur dioxide on exposure to air, having a faint sulphurous odor, a disagreeable sulphurous taste, and an acid reaction; soluble in 3.5 parts of water and in 70 parts of alcohol at 25° C. (77° F.), in 2 parts of boiling water, and in 49 parts of boiling alcohol. When strongly heated the salt decrepitates, and is converted into sulphur and sodium sulphate. A small fragment of the salt imparts to a non-luminous flame an intense yellow color. On adding hydrochloric acid to an aqueous solution of the salt, sulphur dioxide is evolved.—U. S. The salt being easily affected by exposure, it is difficult to keep it unaltered, even in stoppered bottles. Sodium pyrosulphite resembles the pharmacopœial salt in its properties.

Tests.—If 1 Gm. of sodium bisulphite be dissolved in 10 Cc. of diluted hydrochloric acid, with the aid of sufficient heat to expel the sulphur dioxide, the solution should not be turbid (absence of thiosulphate). The salt should not respond to the hydrogen sulphide test when applied as given under SODII SULPHIS. The salt is assayed by adding 0.25 Gm. of the finely powdered crystals to 50 Cc. of tenth-normal iodine solution in a glass-stoppered vial (of about 100 Cc. capacity), and shaking frequently during 1 hour. Tenth-normal sodium thiosulphate solution is then added with constant shaking until the brown color of the iodine disappears. Not more than 6.45 Cc. of the thiosulphate solution should be required, corresponding to not less than 90 per cent. of pure salt.—U. S.

In this titration, iodine is taken in excess, the exact amount required for the bisulphite being $50 - 6.45 = 43.55$ Cc. of tenth-normal solution. The reaction $NaHSO_3 + I_2 + H_2O = NaHSO_4 + 2HI$ shows that 1 Cc. of iodine solution containing 0.012589 Gm. of iodine is equivalent to 0.0051675 Gm. of the bisulphite. Hence 43.55 Cc. of iodine solution represents 0.225 Gm. of pure salt in 0.25 Gm. taken for assay—that is, 90 per cent. The older method of assay by adding iodine solution to the solution of the salt is defective, and has been displaced by the method above in the present Pharmacopœia. From the latter, the tests for limit of chloride and sulphate in the bisulphite have also been omitted.

Action and Uses.—The action and uses of sodium bisulphite are practically those of the other sulphites. Its dose is from 10 to 30 grains (0.60–2 Gm.).

SODII BORAS, *U. S.*—Sodium Borate.

Borax, Br., P. G.; *Natrium biboricum*, (*pyroboricum*).—*Sodium tetra- or pyroborate*, E.; *Borax*, E., Fr., G.; *Borate de soude, Bauracon, Sel de Perse*, Fr.; *Natrium-pyroborat*, G.

Formula, $Na_2B_4O_7 + 10H_2O$. Molecular weight, 379.32.

It should contain, when uneffloresced, not less than 99 per cent. of the pure salt.—U. S.

Origin and Preparation.—It is uncertain whether borax was known to and used by the ancients, and even in the Middle Ages it was frequently confounded with other salts. The observations of Homberg (1702), Geoffroy (1732), and others did not lead to correct views regarding the chemical nature of borax until Baron (1747) showed that the "sedative salt" exists in it combined with soda. The occurrence of boric acid and borax is mentioned at some length under ACIDUM BORICUM, which see. Borax is found native as *tincal* in Persia, Thibet, and other localities, as a saline incrustation on the shores of certain lakes, and as a crystalline deposit at the bottom of the borax lake in California. The incrustation and the deposit are continually renewed by crystallization from the lake waters as fast as the borax is removed. Tincal requires to be washed with a solution of caustic soda for effecting the removal of fatty matter with which the crystals are covered, and on being afterward recrystallized from water yields borax. Borax is also prepared from various native borates which are found in Nevada, in certain

parts of South America, Europe, and Asia, and which are known as the minerals *boracite, borosodocalcite, cryptomorphite,* etc. These consist of boric acid combined in varying proportions with sodium, calcium, and magnesium, and mixed with sulphates, chlorides, and silica, and yield borax on being treated with sodium carbonate, and after recrystallization from water.

Most of the borax is at present prepared from commercial crude boric acid, which is either boiled with a solution of soda, or, more generally, is fused together with calcined sodium carbonate; the impure Italian boric acid yields besides carbon dioxide also ammonia, which is also utilized. The fused mass is then dissolved in water, and this solution separated from the ferric hydroxide and other impurities suspended in the liquor, and evaporated sufficiently, when it is permitted to cool slowly, so that large crystals are obtained, from which the mother-liquor is rapidly withdrawn.

Properties.—Borax forms large, colorless, monoclinic prisms, which are transparent, inodorous, have a mild sweetish, cooling, and afterward alkaline taste, and in dry air effloresce superficially and become opaque. When heated it melts in its water of crystallization, and is converted into a light white spongy mass, which at a red heat fuses, and on cooling forms a transparent glass. Borax has the specific gravity 1.72, has a weak alkaline reaction, is insoluble in alcohol, but dissolves at 80° C. (176° F.) in 1 part of glycerin and at 25° C. (77° F.) in 20.4 parts (U. S.), 25 parts (Br.), 17 parts (P. G.) of water. The glycerin solution imparts a green color to flame (Senier and Lowe, 1878). According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 4.65 parts, at 20° C. (68° F.) 7.88 parts, at 30° C. (84° F.) 11.90 parts, at 40° C. (104° F.) 17.90 parts, and at 100° C. (212° F.) 201.43 parts, of crystallized borax. If a saturated solution of borax is prepared at an elevated temperature and kept at a temperature exceeding 56° C. (133° F.), sodium borate containing $5H_2O$ will crystallize in octahedral crystals which are harder than borax. A cold solution of borax absorbs considerable quantities of carbon dioxide and hydrogen sulphide, both gases being again expelled on heating and evaporating the liquid. The aqueous solution (1 in 20) colors red litmus-paper blue, and yellow turmeric-paper reddish brown. After being acidulated with hydrochloric acid the solution colors blue litmus-paper red; yellow turmeric-paper remains unchanged at first, but on drying becomes brownish red, and this color is temporarily changed to a bluish black by moistening with ammonia-water. If a slight excess of sulphuric acid be added to a hot, saturated aqueous solution of the salt, shining, scaly crystals of boric acid will separate on cooling, which impart a green color to the flame of alcohol. Borax held in a non-luminous flame imparts to it an intense yellow color.

Borax is of special interest in pharmacy on account of its peculiar behavior with other substances. It is incompatible with mucilage of acacia, causing gelatinization, which can, however, be prevented by the presence of sugar; it precipitates many alkaloids from their solution, such as cocaine, morphine, atropine, quinine, etc., except in the presence of glycerin; it forms a damp, almost moist, mixture when triturated with alum; in the presence of glycerin it decomposes alkali bicarbonates with effervescence; and, lastly, while an aqueous solution of borax shows an alkaline reaction toward litmus, a solution in glycerin has a decided acid reaction, which is changed to alkaline upon large dilution with water. This last behavior is also observed with other bodies resembling glycerin, such as mannitol, glucose, etc. (see Acidum Boricum).

Composition.—The water of crystallization amounts to 47.13 per cent., Na_2O to 16.25, and B_2O_3 to 36.62 per cent. The crystallized and the anhydrous salt, $Na_2B_4O_7$, are compounds of tetra- or pyroboric acid.

Tests.—With 21 Cc. of water 1 Gm. of the salt should yield a perfectly clear and colorless solution, leaving no residue. The aqueous solution (1 in 20) should not effervesce with acids (absence of carbonate). The aqueous solution (1 in 20), slightly acidulated with hydrochloric acid, and mixed with an equal volume of hydrogen sulphide solution, should not give a turbidity or coloration after standing corked at 35° C. (95° F.) for half an hour, either before or after adding ammonia-water to slight alkalinity (absence of heavy metals). The aqueous solution (1 in 20) should not be rendered turbid by magnesia mixture (absence of phosphate). If 1 Gm. of the salt be dissolved in 20 Cc. of diluted sulphuric acid by the aid of heat, and 3 drops of indigo test-solution be added, the blue color should not be discharged after heating for 10 minutes on a water-bath (absence of nitrate).—U. S. The tests for limit of chloride

and sulphate, and absence of calcium have been dropped from the 1900 Pharmacopœia, since they are innocuous and in small quantities of no consequence medicinally. These tests are retained in the Br. P. and P. G. The time limit of heating in the test for nitrate has been added to make the test more delicate.

A solution of 1 Gm. of borax in 200 Cc. of water should require 5.2 Cc. of normal sulphuric acid for neutralization, with methyl orange as indicator.—Br. In this assay the boric acid, like carbonic acid, has no action on methyl-orange, which is affected only after this reaction is completed, $Na_2B_4O_7.10H_2O + H_2SO_4 = Na_2SO_4 + 4H_3BO_3 + 5H_2O$. Hence each Cc. of the acid represents 0.18966 Gm. of borax, and 5.2 Cc. represents 0.9862 Gm. or 98.62 per cent.

Action and Uses.—The influence of borax upon the human organism is very slight, except in large doses, which produce vomiting and purging, general depression, an enfeebled circulation, and a diffuse erythematous eruption accompanied by great swelling followed by exfoliation. Death has occurred from its use. Taken in moderate quantity it is too rapidly absorbed to exercise an influence in the alimentary canal. It is excreted almost unchanged, largely in the urine. Borax has some antiseptic power. Two per cent. solutions inhibit the growth of microörganisms, but saturated solutions fail to be destructive to any but the more delicate bacteria, hence it is only a weak germicide. On account of its antiseptic and detergent properties borax is used as a mouth-wash and gargle in aphthous stomatitis, diphtheria, thrush, and other affections of the mouth and fauces. For a like reason it is employed as an application to irritations and ulcerations occurring in the region of the anus and vulva, particularly if pruritis exists. In solution or ointment borax is sometimes efficacious in removing freckles and chloasma from the face, and may be applied with good effect in pityriasis versicolor and some other cutaneous eruptions. Leucorrhœa, especially that due to erosions of the cervix, is, as a rule, greatly benefited by copious, hot, vaginal douches of borax solutions. A saturated solution is a very efficient irrigant in subacute and chronic cystitis and urethritis. For acute or chronic conjunctivitis 1 to 2 per cent. solutions of borax are very serviceable. Given internally it has held an unmerited reputation as an emmenagogue. Gowers recommends its administration in 10- to 20-grain (0.60–2 Gm.) doses in obstinate cases of epilepsy and claims to have seen marked improvement follow its use, but the experience of other clinicians does not coincide with his, and the drug is rarely prescribed. Borax is sometimes added to food as a preservative, and this use of it has provoked much discussion as to its effect upon health. It is generally conceded that while foods thus preserved are not injurious to individuals in ordinary health, they should not be eaten by delicate persons or children. The dose of borax is from 5 to 30 grains (0.30–2 Gm.) well diluted in water.

Antipyonin.—A fine, white, argillaceous, non-caustic powder, soluble in water and said to consist of sodium polyborates. Recommended in corneal and conjunctival inflammation.

SODII BROMIDUM, *U. S., Br.*—Sodium Bromide.

Natrium bromatum, P. G.; *Bromure de sodium*, Fr.; *Bromnatrium, Natriumbromid*, G.

Formula, NaBr. Molecular weight, 102.24.

It should be kept in well-stoppered bottles, and should contain, when dried, not less than 97 per cent. of the pure salt.—U. S.

Preparation.—Sodium bromide may be prepared in a manner similar to that of potassium bromide. A solution of ferrous bromide, boiled with a solution of sodium carbonate, yields a precipitate, the filtrate from which is evaporated and crystallized.

Properties.—At a temperature of about 20° C. (68° F.) and below, colorless, transparent, oblique-rhombic prisms are obtained having the composition $NaBr.2H_2O$ (molecular weight, 138), which when heated melt and give off the water of crystallization. But when the solution is kept at a temperature above 30° C. (86° F.), anhydrous cubes of sodium bromide are obtained, which have a saline, somewhat alkaline, and slightly bitterish taste, and a neutral or faint alkaline reaction. The salt is usually met with in the form of a white crystalline, inodorous powder which is permanent in dry air, but attracts moisture from damp air without deliquescing, and is stated to be soluble in 0.8 part of boiling water, in 11 parts of boiling alcohol (U. S.), and at 25° C. (77° F.) in 1.7 (U. S.) parts of water, and in 12.5 (U. S.) or 5 (P. G.) parts of alcohol. According to

Hager, the anhydrous salt is soluble in 10 (16 Br.) parts of 90 per cent. alcohol and in 3 parts of 60 per cent. alcohol, while the hydrated salt requires 7 parts of the former and 2.25 parts of the latter for solution. The hydrated salt melts in its water of crystallization, but the anhydrous salt requires a red heat for fusion, and then volatilizes slowly without decomposition. The salt imparts to a non-luminous flame an intense yellow color, which, when observed through a blue glass, should not appear permanently red (P. G.).

Tests.—The aqueous solution (1 in 20) of the salt, slightly acidulated with hydrochloric acid and mixed with an equal volume of hydrogen sulphide solution, should not become colored or turbid after standing corked at 35° C. (95° F.) for a half hour, either before or after addition of ammonia to slight alkalinity (absence of heavy metals). Tests for calcium, sulphate, and limit of potassium have been dropped from the U. S. P., 1900. If diluted sulphuric acid be dropped upon some of the powdered salt, no yellow color should appear at once (absence of bromate). If 1 Gm. of the salt be dissolved in 10 Cc. of water and 0.1 Cc. (2 drops) of tenth-normal sulphuric acid be added, no color should be produced by the subsequent addition of a drop of phenolphthalein test-solution, even after heating (limit of alkali). 10 Cc. of the aqueous solution (1 in 20) of the salt, when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate test-solution (absence of barium). If 1 Cc. of chloroform be poured into 10 Cc. of the aqueous solution (1 in 20), then chlorine-water, which has been diluted with an equal volume of water, added drop by drop, and the mixture agitated, the liberated bromine will dissolve in the chloroform, imparting to it a yellow or brownish-yellow color, without a violet tint (absence of iodine). 1 Gm. of the salt, when completely precipitated by silver nitrate, yields, if perfectly pure, 1.824 Gm. of dry silver bromide; in the presence of sodium chloride the precipitate will weigh more. A 5 per cent. solution should not be colored red with test-solution of ferric chloride (absence of thiocyanates), Br., nor blue with 0.5 Cc. of potassium ferrocyanide solution (absence of iron), P. G. If 0.3 Gm. of the well-dried salt be dissolved in about 50 Cc. of water, and 2 or 3 drops of potassium chromate test-solution be added, it should require not less than 28.5 nor more than 30 Cc. of tenth-normal silver nitrate solution to produce a permanent red color.—U. S. Each Cc. of the silver solution represents 0.010224 Gm. of pure NaBr, hence 0.3 Gm. of pure NaBr would require 29.34 Cc. of silver solution for titration. The lower limit, 28.5 Cc., allowed in the titration, represents 0.2914 Gm. of pure bromide, or 97.13 per cent. The presence of chloride, which is the only impurity likely to be present having an action on silver solution, would tend to throw the titration figure higher than the theoretical quantity of silver solution required for the pure salt. Each 0.223 Cc. of silver solution used in excess of the theoretical quantity represents 1 per cent. of chloride present, hence 0.66 (30–29.34) Cc. excess represents 2.96 per cent. of chloride as impurity. The comments made under POTASSII IODIDUM as to the errors involved in this method of assay, apply likewise in the case of sodium bromide.

The P. G., by allowing the use of only 29.3 Cc. of tenth-normal silver solution to titrate 0.3 Gm., requires sodium bromide to be 99.5 per cent. pure. The Br. allows practically no impurities; "only the slightest reactions with the tests for chlorides, iodides, or sulphates" are allowed. The only foreign material that may be present, consequently, is water, of which a limit of 2.06 per cent. is allowed, as is shown by the titration with tenth-normal silver nitrate, of which not less than 95.8 Cc. nor more than 97.8 should be required for 1 Gm. of the salt, corresponding to 97.94 and 100 per cent. respectively.

Action and Uses.—The action and uses of sodium bromide are similar to that of potassium bromide. The sodium radicle is, however, less depressing to the human organism than is the potassium radicle. The dose is from 10 grains to 2 drachms (0.60–8 Gm.).

SODII CARBONAS, *Br.*—Sodium Carbonate.

Natrium carbonicum, P. G.; *Sal sodæ depuratus.—Pure carbonate of sodium*, E.; *Carbonate de soude*, Fr.; *Natriumcarbonat, Kohlensaures Natron*, G.

Formula, $Na_2CO_3 + 10H_2O$. Molecular weight, 284.11.

It should be kept in well-closed vessels. This form of sodium carbonate is no longer official, having been displaced by the monohydrated salt in the U. S., 1900.

Origin and Preparation.—Both sodium and potassium carbonate were known at a very remote period, and by the ancients were called *nitron* and *nitrum*, which names were afterward applied to other salts. A distinction between the alkali carbonates was not made until after Duhamel's observation (1736) had shown table-salt to be the compound of an alkali, and until Marggraf (1759) had proved this alkali to differ from the alkali procured from the ashes of plants.

Sodium carbonate exists in a large number of mineral waters, mostly, however, as bicarbonate. It is contained in the waters of certain lakes in India, Egypt, Central Africa, Mexico, and South America, and is found in the ashes of many plants growing near the seashore, such as Salsola, Statice, Salicornia, Atriplex, Mesembryanthemum, and others. These ashes are known in commerce as *barilla*, *salicor*, etc., the former containing nearly 30 per cent., the latter about 14 per cent. of sodium carbonate. *Kelp* and *varec*, the ashes of various marine algæ, contain much less soda, and are at present not employed for obtaining this salt. Egyptian *trona*, a native sodium carbonate, contains both carbonate and sesquicarbonate. In Hungary and some other countries sodium carbonate effloresces from the earth.

Natural soda is the residue obtained by the evaporation of natural alkaline waters. It is composed of sodium carbonate and bicarbonate in varying proportions, mixed with other salts, mainly sodium sulphate and chloride. In no country does it occur in such enormous quantities as in the region lying east of the Sierra Nevadas. The principal waters containing natural soda are Albart Lake, in southeastern Oregon, Mona Lake and Owen's Lake, in Mono and Inyo counties, California. By spontaneous evaporation the carbonate and bicarbonate of sodium unite to form a compound less soluble than the former but more soluble than the latter, which is called urao, or more commonly "summer soda," and has the composition $Na_2CO_3 + 2NaHCO_3 + 3H_2O$. This salt is known chemically as *sodium sesquicarbonate*. The carbonate obtainable from the above three lakes would suffice to supply the entire world demand for generations, but at present, owing to the cost of transportation, only a relatively small quantity of carbonate is produced. In reference to the production of carbonate from these lakes, a statement of Prof. G. Lunge, an eminent authority, is noteworthy. He says "there can be no doubt that the immense quantities of 'natural soda' will not be allowed to lie dormant any longer. If these lakes are once worked with the energy which is otherwise not wanting in America, the days are numbered when Liverpool soda will rule in the New York market" (*Mineral Industry*, 1892, p. 64).

The most important sources of material for the artificial preparation of sodium carbonate are cryolite and sodium sulphate and chloride. Cryolite is a mineral found almost exclusively at present in southwest Greenland, and consists of sodium and aluminum fluorides, $AlF_3.3NaF$. It is imported in immense quantities by the Pennsylvania Salt Manufacturing Company, and is also used in Denmark and Germany for the preparation of sodium carbonate and alum. Another use for cryolite is in preparing aluminum (vide). When a mixture of cryolite and chalk is cautiously heated to redness, but not to fusion, calcium fluoride and sodium aluminate are produced, this last compound being soluble in water and decomposed by carbon dioxide, which precipitates aluminum hydroxide, retaining a little sodium carbonate, while pure sodium carbonate remains in solution. The changes taking place are expressed thus: $Na_3AlF_3 + 3CaCO_3 = Na_3AlO_3 + 3CaF_2 + 3CO_2$ and $2Na_3AlO_3 + 3CO_2 + 3H_2O = 3Na_2CO_3 + 2Al(OH)_3$.

The oldest method for making sodium carbonate on the large scale is the *Le Blanc* process, devised in 1794, which was the outgrowth of necessity due to an embargo placed upon France by the rest of Europe during the French Revolution, by which the supply of potash was cut off. The French government offered a prize for a practical method for the manufacture of the carbonate from sodium chloride, which resulted in the Le Blanc process. The stronghold of this method at present is in England, but its very existence is now threatened by the Solvay process and the electrolytic process. In the Le Blanc method, common salt is first converted into sodium sulphate by sulphuric acid, whereby great quantities of hydrochloric acid are obtained as a by-product. The sulphate or *salt cake* is then mixed with ground limestone and coal in proper proportions and heated in a furnace, whereby the sulphate is reduced to sulphide by the coal, and the sulphide, acting on the limestone, forms sodium carbonate and calcium sulphide. The changes are: $Na_2SO_4 + 4C = Na_2S + 4CO$, and $Na_2S + CaCO_3 = Na_2CO_3 + CaS$.

The black mass from the furnace is known as *black-ash*, *soda ball*, or *British barilla*. The transformations are never perfect, and black-ash contains from 36 to 45 per cent. of alkali, the rest consisting of sodium chloride and sulphate, calcium sulphite, coal, calcium sulphide, and oxide. The black-ash is next leached with water, which takes up the alkali and other soluble matter and leaves an insoluble residue, called *soda waste* or *alkali waste*, which now serves to a large extent for the preparation of sodium hyposulphite. The solution is evaporated to dryness and the residue calcined, often with saw-dust, to convert any caustic alkali to carbonate; there is thus obtained a grayish mass, known as soda-ash, containing about 50 per cent. of carbonate. This is next further purified by bringing it into solution and allowing the carbonate to crystallize, thus forming the crude soda of commerce. By repeated crystallization or by conversion of the carbonate into the less soluble bicarbonate, by means of carbon dioxide passed into a solution of the carbonate, a pure product is finally obtained.

The importations of soda-ash and sal soda have fallen off greatly, owing to the increased manufacture in this country. There were imported of soda-ash, in 1893, 388,910,183 pounds, valued at $4,855,098, and in 1900, 78,571,870 pounds, valued at $648,450; of sal soda, in 1893, 27,531,554 pounds, valued at $238,029, and in 1900, 6,624,314 pounds, valued at $31,072.

The Solvay or ammonia-soda process, by which common salt is converted directly into sodium bicarbonate, is a dangerous competitor of the Le Blanc process. About 75 per cent. of the German, 60 per cent. of the French, 47 per cent. of the Austrian, and 50 per cent. of the English sodium carbonate is produced by the Solvay process. The production of soda directly from sodium chloride led to numerous investigations, and as early as 1838 it was accomplished by H. Dyar and J. Hemming; but the process, and more particularly the apparatus for the successful working of it, attained greater perfection since E. Solvay began to use it in 1865 on an extensive scale. It consists in conducting, under pressure, into a cold concentrated solution of sodium chloride, first ammonia gas and afterward carbon dioxide, when sodium bicarbonate and ammonium chloride are formed; most of the former salt is deposited, and after being heated to redness requires to be dissolved in water and crystallized in order to obtain sodium carbonate. In the first part of this process the reaction takes place between ammonium bicarbonate and sodium chloride, but the conversion of the latter salt into bicarbonate is never complete, as there is a point of equilibrium beyond which a reverse action takes place, by which sodium bicarbonate and ammonium chloride react to form sodium chloride and ammonium bicarbonate. This kind of reciprocal action is discussed in chemistry under the so-called Law of Mass Action. The changes are expressed thus: $NH_3 + H_2O + CO_2 = NH_4HCO_3$ and $NaCl + NH_4HCO_3 = NaHCO_3 + NH_4Cl$. The bicarbonate is collected, dried, and heated, whereby one-half of the carbon dioxide is recovered for subsequent use. From the mother liquors containing ammonium chloride, ammonia is recovered by heating with lime. Thus the process is made very economical, and, in addition, less labor, fuel, etc., is needed and a purer product is obtained than in the Le Blanc method.

Properties.—Sodium carbonate is in colorless, oblique-rhombic crystals, or in granular crystalline condition, inodorous, and with a harsh alkaline taste and a decided alkaline reaction. On exposure it loses water of crystallization, and ultimately falls into a soft white powder; the amount of this loss depends upon the temperature, and is in ordinary dry air of 12.5° C. (54.5° F.) 31 per cent., and at about 35° C. (95° F.) 56.6 per cent.; the last molecule of water is expelled below the boiling-point of water. The salt is soluble in 1.6 parts of water at 15° C. (59° F.), in 0.09 part at 38° C. (100.4° F.), and in 0.2 part of boiling water; insoluble in alcohol and in ether; soluble in 1.02 parts of glycerin. When heated to 34° C. (93.2° F.), the crystals fuse in their water of crystallization. At a higher temperature, the salt continues to lose water, until at last an anhydrous residue is left, corresponding to 37.07 per cent. of the weight of the crystals. At a bright-red heat the anhydrous salt fuses. To a non-luminous flame it imparts an intensely yellow color. It effervesces strongly on the addition of an acid.

Sodii carbonas venalis, *Natrium carbonicum crudum*, P. G.; *Sal sodæ*, *Soda cruda*.—*Sal soda*, *Washing soda*, E.; *Sel de soude*, Fr.; *Soda*, G.—This is the salt generally met with in commerce. It is used for preparing the pure salt by recrystallizing from hot water until the crystals respond to appropriate tests of purity, and it is advisable to agitate the cooling solution, so as to obtain small crystals or a crystalline powder, which is readily

freed from the mother liquor by draining and washing with a little cold water. The pure salt should be kept in a well-stoppered bottle in a cool place. 20 grains of it neutralize 9.7 grains of citric acid or 10½ grains of tartaric acid.

Tests.—Commercial sodium carbonate contains small but variable quantities of sulphate and chloride, and its solution in water acidulated with nitric acid therefore produces precipitates with barium chloride and with silver nitrate. Cryolite is the source of an impurity which is sometimes met with, and which consists of alumina rendered soluble in water by the soda; it is best detected by acidulating its solution in water with hydrochloric acid, heating to boiling, and then supersaturating with ammonia, when gelatinous aluminum hydroxide will be precipitated. The pure salt with 10 molecules of water of crystallization is official in the Br. P. and P. G., but not in the U. S., 1900. The Br. P. has tests for sulphocyanate, calcium, and potassium, and for limit of chloride, sulphate, thiosulphate, sulphite, while the P. G. has tests only for sulphate, chloride, and ammonia, in addition to the test for heavy metals which is common to all pharmacopœias. These tests are practically the same as those given in the U. S., 1890, which are as follows: A 5 per cent. aqueous solution of the salt should be perfectly clear and colorless, leaving no insoluble residue. If 5 Cc. of the aqueous solution (1 in 20) be slightly supersaturated with hydrochloric acid, the liquid should not be colored red by a drop of ferric chloride test-solution (absence of sulphocyanate). If to the aqueous solution (1 in 20), slightly supersaturated with hydrochloric acid, an equal volume of hydrogen sulphide test-solution be added, no turbidity or coloration should be produced after standing corked in a warm place for half an hour, either before or after the addition of ammonia-water in slight excess (absence of arsenic, lead, iron, aluminum, etc.). If 5 Cc. of the aqueous solution be slightly supersaturated with acetic acid, the addition of 0.5 Cc. of ammonium oxalate test-solution should produce no turbidity (absence of calcium). If 5 Cc. of the aqueous solution be slightly supersaturated with acetic acid, the addition of 0.5 Cc. of sodium cobaltic nitrite test-solution should not render it turbid within one hour (limit of potassium). If 1.2 Gm. of the salt be dissolved in 10 Cc. of diluted nitric acid, then 0.5 Cc. of tenth-normal silver nitrate solution added, and the precipitate, if any, be removed by filtration, the clear filtrate should remain unaffected by the addition of more silver nitrate test-solution (limit of chloride). If 2.5 Gm. of the salt be dissolved in 10 Cc. of diluted hydrochloric acid, then 0.1 Cc. of nitric acid and 0.1 Cc. of barium chloride test-solution added, and the precipitate, if any, be removed by filtration, the clear filtrate should remain unaffected by the further addition of barium chloride test-solution (limit of sulphate, sulphite, and thiosulphate). If the crystallized salt be heated in a test-tube, the vapor of ammonia should not be evolved. 1 Gm. of salt should require not less than 6.9 Cc. (Br.), 7 Cc. (P. G.), of normal sulphuric acid for titration. Each Cc. of the acid represents 0.14205 Gm. of the crystallized salt. Hence the Br. requires 98 per cent. and the P. G. 99.44 (99.5) per cent.

Composition.—Pure crystallized sodium carbonate contains 62.93 per cent. of water, 21.7 per cent. of Na_2O, and 15.37 per cent. of CO_2. When boiled with a little water a salt is deposited containing only 14.5 per cent. of water $= 1H_2O$. Several other salts are obtainable, which crystallize with 3, 5, and $7H_2O$.

Action and Uses.—Sodium carbonate may be given internally in doses of 10 to 30 grains (0.60–2 Gm.) for the same conditions for which the bicarbonate is administered, but because its action is much more irritating than the latter salt it is rarely used. Solutions varying in strength from 10 to 20 grains to the ounce (0.60–1.30 Gm., 30 Cc.) are applied with great benefit to dry, chronic skin eruptions, as psoriasis, lichen, pityriasis, prurigo, etc., while pustular and vesicular affections are unsuited for its use. A frequent method of its employment for diseases of the skin is to add from 4 to 6 ounces (16–24 Gm.) of the salt to a general bath, which should last about ½ hour.

SODII CARBONAS EXSICCATUS, *Br.*—Dried Sodium Carbonate.

Natrium carbonicum siccum, P. G.—*Dried carbonate of soda, Exsiccated sodium carbonate*, E.; *Carbonate de soude sec*, Fr.; *Entwässerte Soda, Getrocknetes Natriumcarbonat*, G.

Formula, Na_2CO_3, Br.; $Na_2CO_3 + 2H_2O$, P. G. Molecular weight, 105.31, Br.; 141.07, P. G.

This salt has been dropped from the U. S., 1900. The monohydrated salt, $Na_2CO_3.H_2O$, which is the only form official now, stands very close to it in percentage composition.

Preparation.—Sodium carbonate, 200 Gm.; to make 100 Gm. Break the salt into small fragments, allow it to effloresce by exposure to warm air at a temperature not exceeding 25° C. (77° F.) for several days, then expose it to a temperature of about 45° C. (113° F.) until it has been converted into a white powder weighing 100 Gm. Pass the powder through a sieve and preserve it in well-stoppered bottles.—P. G.

This salt is intended to facilitate the dispensing of sodium carbonate. The warm air to which the crystallized salt is to be exposed in the beginning should be of a lower temperature than the melting-point (34° C.) of the salt, when a light and voluminous powder will be obtained. Working strictly according to the directions, the salt will have the composition given above, and probably is a mixture of the mono- and terhydrated carbonate. Near and above 40° C. (104° F.) a salt of the formula $Na_2CO_3.H_2O$ is readily obtained, weighing $1\frac{3}{8}$ ounces, from 4 ounces of the crystallized salt. The product of the British Pharmacopœia is denser, the salt being at first fused in its water of crystallization, and afterward rendered anhydrous.

Properties.—Dried sodium carbonate is a soft white powder which answers to the tests and reactions of the crystallized salt. It is permanent at a temperature of 30° or 35° C. (86° or 95° F.), but at low temperatures absorbs moisture. 1 Gm. should require not less than 14 Cc. of normal hydrochloric acid for titration, showing at least 73.7 per cent. of anhydrous carbonate, Na_2CO_3.—P. G.

Action and Uses.—Dried sodium carbonate was used as a more stable form of sodium carbonate, but is displaced in the 1900 revision of the Pharmacopœia by the monohydrated salt.

SODII CARBONAS MONOHYDRATUS, *U. S.*—Monohydrated Sodium Carbonate.

Formula, $Na_2CO_3 + H_2O$. Molecular weight, 123.19.

It should contain not less than 85 per cent. of the anhydrous salt, Na_2CO_3, corresponding to not less than 99.5 per cent. of the crystallized monohydrated salt.—U. S.

It is prepared by crystallizing ordinary sodium carbonate above 35° C. (95° F.) and possesses the advantage of being comparatively stable in the air. In a test made on a sample exposed in an open beaker, 0.14 per cent. of moisture was taken up during the first week and only 0.02 per cent. more during the second. In view of its purity and convenience in handling, the salt is to be preferred to the efflorescent salt containing 10 molecules of water of crystallization, and is the only form recognized in the U. S., 1900.

Properties.—It is a white, crystalline, granular powder, quite stable under ordinary conditions, but in dry air, at or above 50° C. (122° F.), the salt effloresces, and at 100° C. (212° F.) it loses all of its water (14.52 per cent.). It is soluble in 2.9 parts of water at 25° C. (77° F.), in 1.8 parts of boiling water, and 1.02 parts of glycerin. In other respects it is like ordinary sodium carbonate. The Pharmacopœia has omitted all tests for impurities except that for heavy metals, which is described under Sodii Carbonas (which see). To neutralize 1 Gm. of the salt, or 0.855 Gm. of the anhydrous salt, dissolved in 10 Cc. of distilled water, should require not less than 32.3 Cc. of half-normal sulphuric acid solution, 3 drops of methyl-orange test-solution being used as indicator.—U. S. Each Cc. of the acid represents 0.0308 Gm. of the monohydrated, or 0.02633 Gm. of the anhydrous salt; hence 32.3 Cc. of the acid represents 0.9948 Gm. of the former, or 0.8504 Gm. of the latter salt, each corresponding to 99.48 per cent.

Action and Uses.—The uses of monohydrated sodium carbonate differ in no respect from those described under sodium carbonate. The dose of the monohydrated salt is about ½ that of the ordinary carbonate containing 10 molecules of water, or from 2 to 10 grains (0.12–0.60 Gm.).

SODII CHLORAS, *U. S.*—Sodium Chlorate.

Natrium chloricum.—Chlorate de soude, Fr.; *Natriumchlorat, Chlorsaures Natron*, G.

Formula, $NaClO_3$. Molecular weight, 105.7.

Sodium chlorate should be kept in glass-stoppered-bottles, and *great caution* should

be observed in handling the salt, as dangerous explosions are liable to occur when it is mixed with organic matters (cork, tannic acid, sugar, etc.), or with sulphur, antimony sulphide, phosphorus, or other easily oxidizable substances, and either heated directly or subjected to trituration or concussion. It should contain not less than 99 per cent. of pure salt.—U. S.

Preparation.—This salt is most conveniently obtained, according to Wittstein, by preparing sodium bitartrate from 9 parts of crystallized sodium carbonate and 9.5 parts of tartaric acid, and adding the hot solution to one containing 8 parts of potassium chlorate. The cold liquid is filtered from the precipitated potassium bitartrate, evaporated and crystallized. The last traces of bitartrate may be removed by recrystallization from alcohol. The yield is about 7.5 parts. The salt is also formed, like the corresponding potassium salt, by passing chlorine into solution of soda and boiling; the resulting chlorate requires to be freed from chloride by repeated crystallization, involving considerable loss, owing to the ready solubility of both salts.

Hager recommends the following: Dissolve 100 parts of potassium chlorate and 60 parts of official dry sodium carbonate in 600 parts of warm water; allow to cool, add 300 parts of alcohol, set aside in a cool place for two days, decant the solution, distil off the alcohol, evaporate to crystallization, and purify by recrystallization. The yield is about 85 parts.

Properties.—Sodium chlorate crystallizes in the form of regular cubes, combined with the dodecahedron and tetrahedron. The crystals are colorless and transparent, or the salt is seen in a white crystalline powder, and is permanent in the air, inodorous, and has a cooling saline taste; it is soluble at 25° C. (77° F.) in 1 part of water, and in about 100 parts of alcohol; in 0.5 part of boiling water, and in about 40 parts of boiling alcohol; also soluble in 5 parts of glycerin. When heated, the salt melts, then gives off oxygen (about 45 per cent. of its weight), and finally leaves a residue of sodium chloride readily soluble in water, and yielding, with silver nitrate test-solution, a white, curdy precipitate, insoluble in nitric acid. To a non-luminous flame it imparts an intensely yellow color. The aqueous solution is neutral to litmus-paper. When a crystal of the salt is dropped into hydrochloric acid, the liquid assumes a deep greenish-yellow color and emits the odor of chlorine.

Tests.—A saturated aqueous solution should not be rendered turbid by sodium bitartrate test-solution (limit of potassium). The aqueous solution (1 in 20) of the salt, upon the addition of 1 Cc. of ammonium sulphide test-solution, should not develop a dark coloration (absence of lead, copper, etc.). Tests for chloride, sulphate, calcium, and magnesium have been dropped from the U. S. P., 1900. The salt is produced in such high degree of purity that the tests are scarcely called for.

Action and Uses.—The action and uses of sodium chlorate correspond closely to those of potassium chlorate. Its greater solubility is an advantage when stronger solutions are desired. Its dose is from 5 to 20 grains (0.30–1.30 Gm.).

SODII CHLORIDUM, *U. S., Br.*—Sodium Chloride.

Natrium chloratum, P. G.; *Sal commune, s. culinare.—Common salt, Table-salt, Sodium chloride*, E.; *Chlorure de sodium, Sel commun, Sel de cuisine*, Fr.; *Chlornatrium, Kochsalz*, G.

Formula, NaCl. Molecular weight, 58.06.

It should contain when dried not less than 99 per cent. of the pure salt.—U. S.

Origin and Preparation.—Sodium chloride is found native in extensive beds and in different geological formations, though mostly associated with clay and calcium sulphate, and constitutes rock-salt or sal gemmæ if very pure and transparent. This is mined, mechanically freed from the adhering impurities, and sold as rock-salt or purified by recrystallization. In some places holes are dug into the rock and filled with water, which is pumped up when nearly saturated with salt and evaporated.

Most saline springs contain sodium chloride. If the salt is present in sufficiently large proportion, it is recovered by evaporation; but if present in the solution only in limited proportion, the spring water is first concentrated, in some parts of France and Germany, by pumping it up on a high scaffolding and causing it to trickle over layers of brushwood, whereby, from the largely-extended surface exposed to the air, much water is evaporated, and a brine is obtained which may be economically concentrated by artificial heat. Some-

times the brine contains also considerable proportions of gypsum and sodium sulphate, which salts are deposited from the boiling brine and raked out; when nearly free from these salts and sufficiently concentrated, the liquor is no longer mixed with fresh portions of the brine, but is maintained at an elevated temperature and the salt removed as it crystallizes. The size of the crystals, called grain of the salt, varies with the heat, and increases as the temperature falls.

Sea-water is a solution of various salts, prominent among which is sodium chloride, which is contained in the waters of the large oceans to the amount of from 2.6 to 2.9 per cent., but is much less in the large bays and seas which are surrounded by land, and sinks—for instance, in the water of the Baltic Sea—to ½ per cent. The extraction of the salt from sea-water depends upon the climate, the water being removed either by freezing or by evaporation. When frozen, sea-water yields pure ice and leaves a more concentrated saline solution. In warmer countries the concentration is effected by spontaneous evaporation in shallow pits, the brine as it concentrates being conducted into other pits, and finally into reservoirs, where the salt is deposited.

The mother-liquors which are obtained in the several processes described are solutions of various salts, usually sulphates and chlorides, in some cases also of sodium, potassium, calcium, and magnesium bromides, and they frequently yield salts or double salts of definite composition by being concentrated and exposed to either a low or an elevated temperature; they are used up in the preparation of sodium sulphate, magnesium sulphate, and bromine.

In addition to the large quantities of salt obtained in the United States, about 750,000,000 pounds of it are annually imported.

Properties.—When crystallized by spontaneous evaporation sodium chloride forms transparent cubes; but when the solution is evaporated at an elevated temperature, the crystals aggregate on the surface of the liquid in the form of white or translucent hollow pyramids. It is very frequently kept in the form of a white, granular, crystalline powder, which is inodorous and permanent in the air, unless contaminated with magnesium chloride, when it becomes moist in a damp atmosphere. On the application of heat sodium chloride usually decrepitates, and at a red heat it melts and is slowly volatilized. It has a neutral reaction to test-paper, a density of 2.16, and a purely saline taste. It is very sparingly soluble in strong alcohol, and requires a little less than 3 parts of hot or cold water for solution. 100 parts of water dissolve at 0° C. (32° F.) 35.52 parts, at 14° C. (57.2° F.) 35.87 parts, at 25° C. (77° F.) 36.13 parts, at 60° C. (140° F.) 37.25 parts, and at 100° C. (212° F.) 39.61 parts, of sodium chloride (Poggiale). On cooling the saturated aqueous solution to below the freezing-point of water, transparent colorless prisms, $NaCl.2H_2O$, are obtained, which melt above 0° C. (32° F.) and deposit a granular powder of the anhydrous salt. Dilute aqueous solutions of sodium chloride produce at a low temperature ice which is free from the salt, and concentrated solutions deposit crystals of the salt before they freeze. When a saturated solution of sodium chloride is mixed with a large volume of concentrated hydrochloric acid, or is saturated with hydrochloric acid gas, the pure salt is precipitated. A fragment of the salt imparts to a non-luminous flame an intense yellow color; the aqueous solution, acidulated with nitric acid, yields with test-solution of silver nitrate a white precipitate soluble in ammonia.

Composition.—Sodium chloride contains 60.59 per cent. of chlorine and 39.41 per cent. of sodium. Heated with sulphuric acid, hydrochloric acid is given off.

Tests.—The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not be colored or rendered turbid when mixed with an equal volume of hydrogen sulphide solution and allowed to stand corked at 35° C. (95° F.) for ½ hour, either before or after addition of ammonia-water in slight excess (absence of heavy metals). If 2 Gm. of the salt be digested for some hours with 25 Cc. of warm alcohol, the cold and filtered alcoholic solution evaporated to dryness, the residue dissolved in 5 Cc. of water, 1 Cc. of chloroform added, then chlorine-water previously diluted with twice its volume of water, drop by drop, with constant agitation, the chloroform should be free from any yellow to orange or violet color (absence of bromide or iodide). Tests for calcium, magnesium, potassium, and sulphate have been omitted from the U. S. P., 1900, but are retained in the Br. P. and P. G. If 1 Gm. of well-dried sodium chloride be dissolved in distilled water to 100 Cc., 10 Cc. of the solution should require not less than 17 Cc. of tenth-normal silver nitrate solution for titration, using a few drops of potassium chromate test-solution as indicator.—U. S. Each Cc. of silver

solution represents 0.005806 Gm. of NaCl, hence 17 Cc. represents 0.0987 Gm., or 98.7 per cent.

Action and Uses.—Sodium chloride is one of the most important natural constituents of the body, occurring in all of the fluid and solid tissues except the enamel of the teeth. When introduced into the stomach in moderate amounts it exerts no demonstrably active effect, but appears to aid the digestion of certain foods, probably by increasing their solubility and by stimulating the secretion of gastric juice. In overdose it causes vomiting and diarrhœa. Its long-continued use in excessive amounts may result in scurvy. Sodium chloride gives relief in that form of dyspepsia in which decomposition of food in the stomach causes acid eructations, heartburn, and flatulence. It has been proposed and employed as a remedy in intermittent fever, although its effect upon the malarial parasite has not been thoroughly studied. Its antiperiodic action is greatly inferior to that of quinine. Teaspoonful doses of dry salt repeated every fifteen minutes are said to be frequently successful in controlling hæmoptysis. The intravenous or hypodermic injection of "normal salt solution," called also "physiological saline solution," constitutes one of the most important therapeutic applications of sodium chloride. The saline strength of these solutions is supposed to be the same as of the blood serum, and varies, according to different authorities, from $\frac{6}{10}$ to $\frac{9}{10}$ per cent., or, as it is roughly calculated, 1 teaspoonful of sodium chloride to 1 pint of water. The solution must be thoroughly sterilized, and at a temperature of about 105° F., before its introduction into the vein. There is no more efficient measure at our command than this to aid a patient in profound shock, whether it be due to injury, drug narcosis, or the intoxication of acute infectious diseases. It is also of value in conjunction with the hot pack to aid in the elimination from the blood of poisons which cause uræmic and diabetic coma. The quantity infused varies from 1 to 4 pints. A tepid solution of common salt acts as a prompt and useful emetic to empty an overloadad stomach or one containing narcotic poisons. Sodium chloride is to be remembered as a chemical antidote to silver nitrate. Enemas of salt water are serviceable for the removal of hardened fecal masses and round and thread worms from the rectum. Weak salt solutions (20 to 60 grains (1.30–4 Gm.) to the pint [480 Cc.]) applied by an atomizer or nasal douche are useful in subacute and chronic inflammations of the nares, pharynx, and larynx. Salt and water may be employed as a vaginal injection in leucorrhœa, and as a wash for pruritis vulvæ and to relieve the pain of insect stings. Salt water baths are somewhat stimulating, and are useful in depraved conditions of the body, and in chronic, sluggish skin diseases.

SODII CITRAS, *U. S.*—Sodium Citrate.

Natrium citricum.—*Citrate de soude*, Fr.; *Natriumcitrat, Citronensaures Natron*, G.

Formula, $2Na_3C_6H_5O_7 + 11H_2O$. Molecular weight, 709.20.

It should contain not less than 97 per cent. of pure salt $[C_3H_4(OH).(COONa)_3 + 11H_2O]$, and should be kept in well-stoppered bottles.—U. S.

Preparation.—Citric acid, being tribasic, is capable of forming three different salts with sodium, but the normal salt, or trisodium citrate, is the one recognized in the Pharmacopœia. No official method of preparation is given, but the following process may be employed: A solution of citric acid is neutralized with sodium carbonate or bicarbonate, concentrated, and allowed to crystallize. The crystals are filtered off, drained, removed to bibulous paper or porous plates, and dried. To make 100 parts of the salt requires 58.8 parts of citric acid and 121.5 parts of crystallized sodium carbonate, 52.7 parts of monohydrated sodium carbonate, or 71.6 parts of sodium bicarbonate.

Properties.—The salt occurs as a white, odorless, granular powder, having a cooling saline taste and a slightly alkaline reaction to litmus-paper. It effloresces slowly when exposed to dry air. At 150° C. (302° F.) it loses all of its water of crystallization (27.73 per cent.), and at red heat it decomposes, leaving a black residue of sodium carbonate and carbon, which is strongly alkaline and effervesces with an acid. The salt is soluble in 1.1 parts of water at 25° C. (77° F.) and in 0.4 part of boiling water, but only slightly soluble in alcohol. It imparts an intense yellow color to a non-luminous flame, and 10 Cc. of its aqueous solution (1 in 20) with 2 Cc. of calcium chloride test-solution yields a clear mixture, which upon boiling deposits a white granular precipitate (citrate).

Tests.—The aqueous solution (1 in 20) should not produce a red color with a drop

of phenolphthalein test-solution, nor effervesce on addition of an acid (absence of carbonate). The U. S. P., 1900, has omitted tests for sulphate and chloride. The aqueous solution (1 in 20), slightly acidulated with acetic acid, should give no turbidity or coloration when mixed with an equal volume of hydrogen sulphide solution and kept corked at 35° C. (95° F.) for at least ½ hour, either before or after addition of ammonia-water to slight alkalinity (absence of heavy metals). If 1 Gm. of the salt be thoroughly ignited at a temperature not above red heat, and the residue extracted with boiling water until the washings cease to react with methyl-orange as indicator, the mixed liquids should require not less than 16.4 Cc. of tenth-normal sulphuric acid solution for neutralization, with methyl-orange as indicator.—U. S. Each Cc. of the acid represents 0.0591 Gm. of the salt that has been converted into carbonate, hence 16.4 Cc. of the acid represents 0.9697 Gm. of the salt, or 96.97 (97) per cent.

Action and Uses.—In small doses, 10 to 40 grains (0.60–2.60 Gm.), sodium citrate possesses diuretic and antilithic properties similar to those of potassium citrate. In doses of from 6 to 10 drachms (24–40 Gm.) it is a mild laxative, resembling magnesium citrate in its action.

SODII CITRO-TARTRAS EFFERVESCENS, *Br.*—Effervescent Sodium Citro-tartrate.

Preparation.—Take, in fine powder, sodium bicarbonate, 17 ounces; tartaric acid, 9 ounces; citric acid, 6 ounces; refined sugar, 5 ounces. Mix the powders thoroughly, place them in a dish or pan of suitable form heated to between 93.3° to 104.4° C. (200°–220° F.), and when the particles of the powder begin to aggregate stir them assiduously until they assume a granular form; then by means of suitable sieves separate the granules of uniform and most convenient size, and preserve the preparation in well-closed bottles.—Br.

If kept dry, this citro-tartrate is preferable to a mixture of the powdered ingredients, which soon undergoes decomposition. Thrown into water, it dissolves with brisk effervescence.

Action and Uses.—This preparation presents a means of obtaining the diaphoretic, diuretic, and laxative effects of sodium citrate and tartrate under peculiarly favorable conditions. The carbonic acid gas liberated on the addition of water enhances the acceptability of the salts to the stomach and tends to allay nausea and vomiting. It is given in mild febrile attacks and acute rheumatic fever. The dose is from 1 to 2 drachms (4–8 Gm.), in a wineglassful or more of water, to be drunk during effervescence.

SODII HYDROXIDUM, *U. S.*—Sodium Hydroxide.

Soda, U. S., 1890, *Soda caustica*, *Natrium causticum*, *Natrium hydricum*.—*Caustic soda*, *Sodium hydrate*, E.; *Soude caustique*, Fr.; *Natron*, *Aetznatron*, G.

Formula, NaOH. Molecular weight, 39.76.

It should be kept in well-stoppered bottles made of hard glass, and should contain not less than 90 per cent. of pure anhydrous sodium hydroxide, and not more than 2 per cent. of other inorganic substances, with the exception of water.—U. S.

Preparation.—Sodium hydroxide is prepared by the same methods as have been described under Potassium Hydroxide (which see), in which corresponding sodium compounds are used in place of those of potassium. The article commonly found on the market is known as *soda by lime*, which is formed by the action of slaked lime on sodium carbonate in solution, $Na_2CO_3 + Ca(OH)_2 = CaCO_3 + 2NaOH$. The clear supernatant liquid is evaporated to dryness, fused, and cast in molds. *Soda by baryta* and *soda by alcohol* are very pure, but the purest product is obtained by the action of pure metallic sodium on water. Large quantities of solution of sodium hydroxide are now made electrolytically (see Potassium Hydroxide) from sodium chloride, in England, the Continent of Europe, and at Niagara Falls. While many electrolytic processes have been devised, those in active operation are the Castner-Kellner, the Le Sueur, and the Dow process. Large manufacturers of sodium hydroxide in this country are the Solvay Process Company, of Syracuse, N. Y., and Detroit, Mich., the Michigan Alkali Company, of Wyandotte, Mich., and the Matthiessen Alkali Company, of Niagara Falls.

Properties.—Sodium hydroxide is white, hard, opaque, inodorous, very alkaline in reaction, strongly corrosive, and of an intensely acrid and caustic taste. It is usually seen in irregular fragments having a fibrous appearance, or in cylindrical sticks which are crystalline upon a fresh fracture. On exposure to the atmosphere it absorbs water and is liquefied, and subsequently it solidifies again and becomes efflorescent, in consequence of the absorption of carbon dioxide and the crystallization and efflorescence of sodium carbonate. A concentrated aqueous solution when exposed to a temperature of—10° C. (14° F.) or less, separates thick tabular crystals of the hydrate, $2NaOH.7H_2O$, which melt above 6° C. (42.8° F.). The strong aqueous solution of sodium hydroxide dropped into test-solution of tartaric acid, so that the latter remains in excess, deposits acicular crystals of acid sodium tartrate, which are dissolved on the addition of more sodium hydroxide or of water. It is soluble in 1 part of water at 25° C. (77° F.) and in 0.8 part of boiling water; very soluble in alcohol. When heated to about 525° C. (977° F.) sodium hydroxide melts to a clear, oily liquid, and at a bright red heat it is slowly volatilized unchanged. When introduced into a non-luminous flame it imparts to it an intensely yellow color. A solution of sodium hydroxide, even when greatly diluted, gives an intensely alkaline reaction with litmus-paper.—U. S.

Tests.—Alcohol dissolves sodium hydroxide, but leaves most of the salts behind which are likely to be present. The aqueous solution (1 in 20) should be perfectly clear and colorless (absence of organic matter), and after being acidulated with acetic acid, should yield no precipitate on the addition of an excess of tartaric acid test-solution (limit of potassium). If 1 Gm. of sodium hydroxide be dissolved in 20 Cc. of water and the solution slightly supersaturated with hydrochloric acid, the solution should not be colored or rendered turbid by the addition of an equal volume of hydrogen sulphide test-solution, after standing corked at 35° C. (95° F.) for at least ½ hour, either before or after making slightly alkaline with ammonia-water (absence of arsenic, copper, lead, etc.). If 0.7 Gm. of sodium hydroxide be dissolved in 1.5 Cc. of water and the solution added to 10 Cc. of alcohol, not more than a slight white precipitate should occur within 10 minutes (limit of silicate, etc.). On adding a slight excess of diluted sulphuric acid to 10 Cc. of a 10 per cent. aqueous solution of sodium hydroxide, no distinct effervescence should occur (limit of carbonate). About 1 Gm. of sodium hydroxide, weighed accurately in a stoppered weighing-bottle, is dissolved in about 50 Cc. of water, and titrated with normal sulphuric acid-solution, with methyl-orange solution as indicator; multiply the number of Cc. of acid consumed by 3.976, and divide this product by the weight of sodium hydroxide taken; the quotient represents the percentage of pure NaOH present.—U. S. Each Cc. of normal sulphuric acid neutralizes 0.03976 Gm. of NaOH. If n Cc. of acid are required for g Gm. of hydroxide titrated, the weight of pure NaOH in 100 Gm. of the hydroxide will be $\frac{0.03976 \times n}{g} \times 100 = \frac{3.976\ n}{g}$. Hence the rule as stated above. The quotient should not be less than 90.

Commercial sodium hydroxide sometimes contains sodium aluminate, which is soluble in water, but insoluble in alcohol; on treating with excess of ammonium chloride, it will separate as a white gelatinous precipitate, which is dissolved again by excess of hydrochloric acid. Sulphide, if present, will cause the precipitate with a lead salt to be more or less brown, instead of white, and cyanide will produce Prussian blue on adding to the solution a little ferrous and ferric salt and acidulating with hydrochloric acid. The tests for limit of chloride, sulphate and nitrate, and the test for calcium have been dropped from the 1900 Pharmacopœia, since these impurities are innocuous, and the use of caustic soda is more technical than medicinal.

Action and Uses.—The applications of sodium hydroxide in medicine are the same as of Potassium Hydroxide (which see).

SODII HYPOPHOSPHIS, *U. S., Br.*—Sodium Hypophosphite.

Natrium hypophosphorosum. — *Hypophosphite de soude,* Fr.; *Unterphosphorigsaures Natron,* G.

Formula, $NaPH_2O_2 + H_2O$. Molecular weight, 105.29.

It should contain not less than 98 per cent. of the pure salt, and be kept in well-stoppered bottles. Also *caution should be observed* in handling, as explosion is liable to

occur when triturated or heated with nitrates, chlorates, or other oxidizing agents. —U. S.

Preparation.—An aqueous solution of 6 parts of calcium hypophosphite is accurately precipitated by a solution of 10 parts of crystallized sodium carbonate; insoluble calcium carbonate and soluble sodium hypophosphite are produced, and separated by filtration; on evaporating the filtrate, the latter salt is left behind, and if necessary may be freed from sodium carbonate by redissolving it in alcohol, filtering, and evaporating.

Properties.—Sodium hypophosphite is usually obtained in the form of a white granular powder, but by the slow evaporation of its alcoholic solution may be procured in pearly rectangular, tabular crystals, which, when dried over sulphuric acid and afterward heated to about 115° C. (239° F.), lose nearly 17 per cent. of water. Above 200° C. (392° F.) spontaneously inflammable hydrogen phosphide is evolved, and a porous mixture of sodium pyrophosphate and metaphosphate, sometimes mingled with a little red phosphorus, is left. The salt is inodorous, has a peculiar bitterish-sweet saline taste, is deliquescent in the air, though less so than potassium hypophosphite, and is easily soluble in water, slightly in absolute alcohol, but is insoluble in ether. The U. S. P. states it to be soluble in 1 part of water and in 25 parts of alcohol at 25° C. (77° F.), in 0.12 part of boiling water, and in 1 part of boiling alcohol. A fragment of the salt imparts to a non-luminous flame an intense yellow color. The aqueous solution, slightly acidulated with diluted sulphuric acid, yields with test-solution of silver nitrate a white precipitate, which rapidly turns brown and black, owing to the separation of metallic silver; and when acidulated with hydrochloric acid and added to excess of test-solution of mercuric chloride, it first produces a white precipitate of calomel, and on further addition metallic mercury separates. With copper sulphate test-solution, on gentle heating, a reddish-brown precipitate of copper hydride is formed, which readily decomposes with effervescence into copper and hydrogen. When evaporated with dilute nitric acid and finally ignited, a residue is obtained weighing 97 per cent. of the weight of the hypophosphite, and consisting of sodium metaphosphate. Like all hypophosphites, the salt is oxidized on exposure to the air to phosphite and phosphate, and must therefore be preserved in well-stoppered bottles.

The U. S. P. salt is represented as hydrated, while that of the Br. is anhydrous. The salt found in European and American markets is almost anhydrous. According to Jowett (*Pharm. Journ.*, August 13, 1898), sodium hypophosphite can be completely dehydrated without change by heating at 110° C. (230° F.) to constant weight, and it is not altered in any way when boiled in air-free water.

Tests.—The aqueous solution of the salt (1 in 20) should not be colored red by the addition of a drop of phenolphthalein test-solution, nor effervesce on the addition of an acid (absence of caustic alkali or carbonate). In the aqueous solution (1 in 20), acidulated with hydrochloric acid, an equal volume of hydrogen sulphide test-solution should not produce any turbidity or coloration after standing corked at 35° C. (95° F.) for at least half an hour, either before or after the addition of ammonia-water to slight excess (absence of arsenic, lead, etc.), 5 Cc. of the aqueous solution of the salt (1 in 10) when measured into a beaker containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water and evaporated to dryness on a bath of boiling water, should not respond to the modified Gutzeit's test for arsenic, given under Arseni Trioxidum. The U. S. P., 1900, has omitted the assay of the salt, since all volumetric methods are defective and the gravimetric methods, which are alone accurate, are not suitable for pharmacists. The permanganate method of titration of the previous pharmacopœia is defective, and has been criticised by Jowett, who has made a comparative study of various methods (see under Calcium Hypophosphite). Any phosphite present would also react with permanganate, and thus vitiate the result. This may be detected by solution of lead acetate which precipitates lead phosphite. Phosphate would also be precipitated in the same way, but this is not likely to be present, while phosphite is almost always present in the commercial hypophosphites.

The Br. P. requires that a solution of the salt give little or no precipitate with lead acetate (limit of phosphate and phosphite), and that 0.5 Gm. of the salt, boiled 10 minutes with 25 Cc. of water and 1.15 Gm. of potassium permanganate, give a nearly colorless filtrate, showing complete reduction. As 3 molecules of the salt require 4 molecules of the permanganate for reaction, 1.15 Gm. of $KMnO_4$ represents 0.4808 Gm. of hypophosphite, which corresponds to 96.16 per cent. purity. The criticism above also

applies to this method of assay. The U. S. P., 1900, has omitted tests for sulphate, chloride, calcium and limit of phosphate and potassium.

Action and Uses.—The properties of sodium hypophosphite are similar to those possessed by the hypophosphites in general (see CALCII HYPOPHOSPHIS). The dose is from 5 to 20 grains (0.30–1.30 Gm.).

SODII IODIDUM, *U. S., Br.*—Sodium Iodide.

Natrium iodatum, P. G.—*Iodure de sodium*, Fr.; *Jodnatrium*, G.

Formula, NaI. Molecular weight, 148.78.

It should be kept in well-stoppered bottles and should contain not less than 98 per cent. of the pure salt.—U. S.

Preparation.—This salt may be obtained by processes analogous to those which afford potassium iodide, either from iodine and solution of caustic soda or by decomposing a solution of iodide of iron with sodium carbonate. The latter process is the more profitable one, since on the reduction of sodium iodate by charcoal a portion of the salt is converted into sodium carbonate.

Properties.—When crystallized at a temperature above 40° C. (104° F.), anhydrous sodium iodide is obtained in cubes which are deliquescent on exposure and should therefore be kept in well-stoppered bottles. This salt melts at a dull-red heat, and when fused in contact with the air parts with a little iodine, at a higher temperature volatilizes slowly, but more readily than the chloride, and on cooling congeals to a pearly radiating crystalline mass. At ordinary temperatures the solution yields short monoclinic prisms or plates which have the composition $NaI.2H_2O$ and the molecular weight 184.54, effloresce in dry air, on exposure are deliquescent, melt at a moderate heat in the water of crystallization, and become anhydrous. The salt is usually prepared by evaporation to dryness in the form of a white crystalline powder, which is inodorous, of a saline, somewhat sharp and bitterish taste, and has a faint alkaline reaction. According to the U. S. P., 1 part of the official salt dissolves at 25° C. (77° F.) in 0.5 part of water, and in about 3 parts of alcohol; in 0.33 part of boiling water, and in 1.4 parts of boiling alcohol. The salt is also soluble in glycerin. It differs from potassium iodide in not being precipitated from its concentrated aqueous solution by a concentrated solution of sodium bitartrate, and in imparting a yellow color to flame, which on being observed through a blue glass should not, or only transiently, appear red. On adding a little chlorine-water to the aqueous solution and agitating it with chloroform or carbon disulphide, these liquids will acquire a violet color. Sodium iodide, as well as its aqueous solution, gradually undergoes decomposition upon exposure to light, becoming colored from free iodine, hence both should be preserved in dark amber-colored bottles. A very marked development of heat takes place when strong solutions of the anhydrous salt are made, due to a chemical union of the salt with water, whereas similar solutions of potassium iodide produce a decided reduction of temperature.

Tests.—If the salt be in distinct crystals, only few monoclinic prisms (containing 2 molecules of water) should be found among the regular cubes of the anhydrous salt. A solution of 1 Gm. of the salt in 1 Cc. of water should not yield any precipitate with 1 Cc. of sodium bitartrate test-solution (limit of potassium). If 1 Gm. of the salt be dissolved in water, and 0.1 Cc. (2 drops) of tenth-normal sulphuric acid solution be added, no red color should be produced by the addition of a drop of phenolphthalein test-solution, even after heating (limit of alkali). The aqueous solution (1 in 20) of the salt, slightly acidulated with hydrochloric acid, should not be colored or rendered turbid by addition of an equal volume of hydrogen sulphide solution and allowing to stand corked in a warm place for ½ hour, either before or after adding ammonia-water to slight excess (absence of heavy metals). If 0.5 Gm. of the salt be dissolved in 10 Cc. of previously boiled and cooled distilled water, no distinct yellow tint should be visible (absence of free iodine), nor should the solution acquire a yellow color within ½ minute after adding 2 drops of diluted sulphuric acid free from sulphurous or nitrous acid (limit of iodate). If 5 Cc. of the aqueous solution be gently heated with 1 drop of ferrous sulphate test-solution and 0.5 Cc. of potassium hydroxide test-solution, no blue color should appear after acidulating the mixture with hydrochloric acid (absence of cyanide). If 1 Gm. of the salt, 5 Cc. of water, 5 Cc. of potassium hydroxide test-solution, and about 0.2 Gm. of aluminum wire, contained in a 40 Cc. test-tube having a pledget of purified cotton in its

upper part and a piece of moistened red litmus-paper over its mouth, be heated upon a water-bath for 15 minutes, no blue coloration of the paper should be discernible (limit of nitrates and nitrites). 10 Cc. of the aqueous solution (1 in 20), when acidulated with hydrochloric acid, should not be made turbid by the addition of 1 Cc. potassium sulphate test-solution (absence of barium).

0.2 Gm. of the salt in 2 Cc. of ammonia-water, thoroughly shaken with 15 Cc. of tenth-normal silver nitrate solution, should give a filtrate which, upon acidifying with nitric acid, does not become more than slightly turbid (limit of chloride and bromide), nor show any darkening within 10 minutes (absence of thiosulphate). This test is identical with that of the P. G., which also adds that an *opaque* filtrate indicates more than 1 per cent. of sodium chloride. 0.5 Gm. of the well-dried salt dissolved in 10 Cc. of distilled water, to which about 5 drops of potassium chromate test-solution are added, should require not more than 34.6 Cc. nor less than 33 Cc. of tenth-normal silver nitrate solution to produce a red color (corresponding to at least 98 per cent. of pure sodium iodide).—U. S. Each Cc. of the silver solution represents 0.01488 Gm. of pure NaI, hence 0.5 Gm. of pure NaI would require 33.6 Cc. of the silver solution for titration. The lower limit, 33 Cc., allowed, represents 0.49 Gm. of pure bromide, or 98 per cent. Chloride, the most likely impurity present having an effect on silver solution, would tend to throw the titration figure higher than the theoretical quantity of silver solution required for pure sodium bromide. Each 0.525 Cc. of silver solution consumed in excess of the theoretical quantity, represents 1 per cent. of NaCl, assuming this to be the impurity; hence 1 Cc. (34.6–33.6) excess represents 1.9 per cent. of NaCl as impurity. The comments made under Potassii Iodidum as to the errors involved in the titration apply also to sodium iodide.

The Br. P. demands that 1 Gm. of the dried salt require not less than 66.5 Cc. of tenth-normal silver nitrate for titration. The quantity for a pure salt would be 67.21 Cc. The figure 66.5 corresponds to 98.96 per cent. of NaBr.

The U. S. P., 1900, has dropped tests for calcium, limit of sulphate, and for iron by the ferrocyanide method.

Action and Uses.—The indications for the employment of sodium iodide are the same as for potassium iodide. It is claimed that it is less liable to occasion skin eruptions, and is less depressing in large doses than potassium iodide. It is given in the dose of 10 to 40 grains (0.60–2.60 Gm.) or more. (See Potassii Iodidum.)

SODII NITRAS, *U. S.*—Sodium Nitrate.

Natrium nitricum, P. G.; *Nitrum cubicum.*—*Cubic niter, Chile saltpeter*, E.; *Azotate (Nitrate) de soude, Nitre cubique, Nitrate de Chili*, Fr.; *Natriumnitrat, Chilesalpeter*, G.

Formula $NaNO_3$. Molecular weight, 84.45.

It should be kept in well-stoppered bottles and should contain not less than 99 per cent. of the pure salt.—U. S.

A native salt, purified by crystallization from water.

Origin and Preparation.—Sodium nitrate was first observed by Bohn (1683) on distilling a mixture of table-salt and nitric acid, and was prepared by Marggraf (1761) from calcium nitrate and sodium sulphate. In 1820 it became known through Mariano de Rivero that it exists in immense quantities in certain districts of Chile and Peru, where it is imbedded in clay and sand and more or less mixed with sulphates and chlorides of sodium, calcium, and magnesium. The stratum containing this saline mass, which is called *caliche* or *terra salitrosa*, is blasted, the salt extracted by boiling with water, and the decanted solution crystallized. In this condition sodium nitrate is brought into the market in damp crystalline masses, which are more or less colored by intermixed earth and require to be purified by recrystallization.

Properties.—Purified sodium nitrate crystallizes in colorless, transparent rhombohedrons of the hexagonal system, which are permanent in dry, but slightly deliquescent in moist air, having a neutral reaction, and dissolve at 25° C. (77° F.) in 1.1 parts of water and in about 100 parts of alcohol (50 parts, P. G.), in 0.6 part of boiling water, and in 40 parts of boiling alcohol. When heated at 312° C. (593.6° F.) the salt melts without decomposition. At a higher temperature it evolves oxygen, and is reduced to nitrite. On red-hot charcoal it deflagrates, but the action is less intense than in the case of potassium nitrate. To a non-luminous flame it imparts an intensely

yellow color. The aqueous solution is neutral to litmus-paper. If the aqueous solution be mixed in a test-tube with a drop of diphenylamine test-solution, and sulphuric acid be carefully poured in, so as to form a separate layer, a deep blue color will appear at the zone of contact. The salt is inodorous and has a cooling, saline, and somewhat bitter taste. It is of comparatively little interest in pharmacy, but is extensively employed in the manufacture of nitric and sulphuric acids, potassium nitrate, etc. Unlike ordinary saltpeter, it is hygroscopic and more soluble in water and alcohol.

Tests.—The aqueous solution (5 per cent.) should remain unaffected by hydrogen sulphide and ammonium sulphide (absence of metals), also after addition of ammonia-water, by ammonium oxalate (calcium), or sodium phosphate solution (absence of magnesium).—P. G. If to 10 Cc. of the solution (1 in 20) 1 Cc. of chloroform be added, then chlorine-water, previously diluted with an equal volume of water, drop by drop, with agitation, the chloroform should be free from any violet color (absence of iodide). The aqueous solution (1 in 20) slightly acidified with hydrochloric acid, and mixed with an equal volume of hydrogen sulphide solution, should not become colored or turbid within ½ hour on standing corked in a warm place, either before or after adding ammonia-water in slight excess (absence of heavy metals, arsenic, etc.). —U. S. No turbidity should be produced within 5 minutes in the aqueous solution, acidulated with nitric acid, on the addition of either barium chloride test-solution (limit of sulphate) or silver nitrate test-solution (limit of chloride).—P. G. 1 Gm. of the salt, treated with an excess (or about 1 Cc.) of sulphuric acid and afterward heated to redness until vapors cease to be given off, yields a residue weighing .835 Gm. The U. S. P., 1900, has omitted the tests for chloride, sulphate, calcium, and potassium.

Action and Uses.—Sodium nitrate is rarely used in medicine. It has been proposed as a remedy in diarrhœa and dysentery in daily doses of from 1 to 2 ounces (30–60 Gm.).

SODII NITRIS, *U. S., Br.*—Sodium Nitrite.

Nitrite de soude, Fr.; *Salpetrigsaures Natron*, G.

Formula, $NaNO_2$. Molecular weight, 68.57.

It should be kept in well-stoppered bottles and should contain not less than 90 per cent. of the pure salt.—U. S.

Preparation.—When sodium nitrate is heated with charcoal, starch, or similar substances, sodium nitrite is formed, and may be recovered by lixiviation of the mass with water. A better process consists in adding to sodium nitrate, previously fused in shallow iron pans, about two and a half times its weight of lead, free from zinc and antimony, the lead fusing readily and being converted into yellow oxide or litharge. An excess of lead is used, and the fused mass is kept in constant agitation for about 4 hour; the fusion is continued for 3½ hours. After cooling the mass is lixiviated with water in large iron tanks, and when the solution has reached the specific gravity 1.342, it is treated with nitric acid specific gravity 1.029, and then concentrated to 1.414 specific gravity, clarified by rest, and set aside in lead-lined wooden tanks to crystallize. By repeated recrystallization the salt is obtained quite pure (98 per cent. and over).

Properties.—Sodium nitrite occurs in the form of white opaque pencils or colorless, transparent, hexagonal crystals, odorless, and having a mild saline taste. When exposed to the air the salt deliquesces, and is gradually oxidized to sodium nitrate; hence it should be kept in well-stoppered bottles. It is soluble in about 1.4 parts of water at 25° C. (77° F.), and very soluble in boiling water; slightly soluble in alcohol. The aqueous solution gives an alkaline reaction with litmus-paper, and when mixed with solution of ferrous sulphate and acetic acid becomes of a dark-brown color. If the aqueous solution of the salt be mixed with some potassium iodide test-solution and a few drops of an acid added, iodine will be liberated, and nitrogen dioxide gas will escape with effervescence, When heated the salt melts, and at a red heat it is decomposed, yielding oxygen, nitrogen, nitrogen dioxide, and sodium oxide. To a non-luminous flame it imparts an intensely yellow color.

Tests.—The salt should readily form a colorless solution with water, without leaving any insoluble residue. If 1 Gm. of the salt be dissolved in 20 Cc. of diluted hydrochloric acid, and heated sufficiently to expel the gases, the resulting solution, after restoring its original volume, when mixed with an equal volume of hydrogen sulphide

test-solution, should produce no coloration or precipitate after standing corked in a warm place for ½ hour, either before or after addition of ammonia-water to slight excess (absence of heavy metals). If to 30 Cc. of tenth-normal potassium permanganate solution, diluted with about 150 Cc. of distilled water, 5 Cc. of sulphuric acid, and 10 Cc. of a solution of 1 Gm. of sodium nitrite in sufficient water to make 100 Cc. be successively added, the liquid brought to a temperature of 40° C. (140° F.) and allowed to stand 5 minutes, not more than 3.75 Cc. of tenth-normal oxalic acid solution should be required to decolorize the solution (each Cc. of the permanganate solution consumed corresponding to 0.0034285 Gm. of pure $NaNO_2$).—U. S.

From the reaction, $5NaNO_2 + 2KMnO_4 + 3H_2SO_4 = 5NaNO_3 + K_2SO_4 + 2MnSO_4 + 3H_2O$, which takes place in the titration, this proportion is deduced, 2×156.98 Gm. $KMnO_4 : 5 \times 68.57$ Gm. $NaNO_3 :: 0.0031396$ Gm. $KMnO_4 : x$ Gm. $NaNO_2$, or $x =$ 0.0034285 Gm. $NaNO_2$. 1 Cc. of tenth-normal potassium permanganate solution contains 0.0031396 Gm. $KMnO_4$, hence 1 Cc. is equivalent to 0.0034285 Gm. $NaNO_2$. The volume of permanganate actually consumed by the nitrite is 30 Cc. —3.75 Cc. = 26.25 Cc., which represents 0.09 Gm. of pure $NaNO_2$ in 0.1 Gm. of the salt, or 90 per cent.

In the execution of the titration a better procedure is to add the nitrite solution to the permanganate first, and then follow with the sulphuric acid, as the possibility of loss of nitrogen trioxide gas when the nitrite strikes the surface of the acidified permanganate solution in the U. S. P. process is thus diminished.

The Br. P. employs the gasometric methed, which is like that of the U. S. P., 1890. If 0.1 Gm. of the salt be dissolved in 4 Cc. of water and introduced into a nitrometer filled with a concentrated solution of common salt, then followed successively by 0.7 Gm. of potassium iodide in 4 Cc. of water, and 10 Cc. of normal sulphuric acid, the liberated nitrogen dioxide gas should measure not less than 32.5 Cc. at 15.5° C. (60° F.) and 760 Mm. (30 inches) of mercury pressure, and should be almost completely soluble in a strong solution of ferrous sulphate.

The reaction which takes place, $NaNO_2 + KI + 2H_2SO_4 = NO + I + KHSO_4 + H_2O$, shows that 68.57 Gm. of $NaNO_2$ yields 29.81 Gm. of NO. 1 Cc. of NO at 15.5° C. and 760 Mm. of mercury pressure weighs 0.0012637 Gm., which represents 0.002907 Gm. of $NaNO_2$. Hence 32.5 Cc. required in the assay represents 0.09448 Gm. of $NaNO_2$, which is 94.48 (95) per cent. of 0.1 Gm. taken. In this calculation the correction which would be necessary for the pressure exerted by the water vapor in the gas is ignored, as it does not materially alter the results.

If the NO gas be measured at a temperature, t, and pressure, p, different from 15° C. and 760 Mm., the gas volume may be reduced to that which would be occupied under the latter conditions by the following formula, $x = \frac{V \times (273 + 15.5) \times p}{(273 + t) \times 760}$, where $V =$ the volume observed.

Action and Uses.—Sodium nitrite, like potassium nitrite, exerts the same influence upon the human organism as do nitroglycerin and amyl nitrite. On account of the slowness of its absorption and elimination, its effect is more prolonged. It is given in the dose of from 1 to 3 grains (0.06–0.20 Gm.).

SODII PHENOLSULPHONAS, *U. S.*—Sodium Phenolsulphonate.

Sodii sulphocarbolas, Br., U. S., 1890.—*Sodium sulphocarbolate, Sodium paraphenolsulphonate*, E.; *Sulphophénate de soude*, Fr.; *Phenolsulfosaures Natrium*, G.

Formula, $C_6H_4(OH)SO_3Na + 2H_2O$. Molecular weight, 230.45.

It should contain not less than 99 per cent. of pure Sodium Paraphenolsulphonate, and should be kept in well-stoppered bottles.—U. S.

Origin and Preparation.—If crystallized phenol is mixed with an equal weight of strong sulphuric acid, a new compound is formed, which was first noticed by Laurent (1841), and by him named phenylsulphuric acid, with the formula $C_6H_5HSO_4$. The true constitution of the new compound was shown by Kekulé to be phenolsulphonic acid, $HSO_3C_6H_4(OH)$, the group HSO_3 displacing an atom of H in the benzene nucleus, and not in the hydroxyl group, as formerly supposed. If the mixture of phenol and sulphuric acid be set aside in the cold for some time until it yields a clear solution with water, orthophenolsulphonic acid will be formed, but if the temperature be allowed to

rise or increase, various mixtures of the isomeric ortho- and para- varieties of the acid are obtained. In order to produce only the paraphenolsulphonic acid, the mixture is preferably heated on a boiling water-bath for 6 hours, when it will be found to yield a clear solution with water. After mixing the new acid compound with ten times its weight of water, an excess of barium carbonate is added, and the mixture kept at 100° C. (212° F.) until the acid has been neutralized; it is then filtered, and the solution of barium phenolsulphonate concentrated and mixed with sodium carbonate for mutual decomposition. $Ba(SO_3C_6H_4(OH))_2 + Na_2CO_3 = 2NaSO_3C_6H_4(OH) + BaCO_3$. The solution after filtration (to remove $BaCO_3$) is concentrated, and set aside to crystallize. In place of barium carbonate, lead carbonate may likewise be employed to neutralize the newly formed phenolsulphonic acid, as lead phenolsulphonate is also soluble in water.

Properties.—Sodium phenolsulphonate is in colorless, transparent, rhombic prisms, slightly efflorescent in dry air, odorless or nearly so, having a cooling, saline, somewhat bitter taste, and a neutral reaction; soluble in 4.8 parts of water and in about 130 parts of alcohol at 25° C. (77° F.), in 0.7 part of boiling water, and in 10 parts of boiling alcohol. When heated a little above 100° C. (212° F.) the salt loses its water (15.5 per cent.) and becomes white. At a higher temperature it emits inflammable vapors having the odor of phenol, and leaves a residue of sodium sulphate amounting to 30.6 per cent. of the original weight, the filtered solution of which, acidulated with nitric acid, produces a white precipitate with test-solution of barium chloride. A fragment of the salt imparts an intense yellow color to a non-luminous flame. The dilute, aqueous solution (1 in 100) of the salt is colored violet by test-solution of ferric chloride.—U. S. When fused together with potassium hydroxide, pyrocatechin is obtained.

Tests.—The aqueous solution (1 in 20), slightly acidulated and mixed with an equal volume of hydrogen sulphide solution, should not become colored or turbid when kept corked at 35° C. (95° F.) for ½ hour, either before or after adding ammonia-water in slight excess (absence of heavy metals, arsenic, etc.). The solution should remain clear with solution of barium chloride (absence of sulphate).—U. S. It does not give a yellowish-brown precipitate with uranium nitrate solution (distinction from salicylate).—Br.

Action and Uses.—The phenolsulphonates were introduced into medicine with the idea that when taken they would be decomposed in the body into phenol and sulphates, but experience has demonstrated the fallacy of this assumption. Even in massive doses they fail to produce the changes in the urine characteristic of phenol. Sodium phenolsulphonate in solution (3 to 5 grains (0.20–0.30 Gm.) to an ounce [30 Cc.]) forms a mildly antiseptic and astringent application for inflamed mucous membranes, and may be used with benefit in subacute and chronic urethritis, vaginitis, tonsillitis, otorrhœa, and rhinitis. Its employment as an intestinal antiseptic in fermentative indigestion and diarrhœa is rarely resorted to. Sodium phenolsulphonate is given in the dose of 3 to 15 grains (0.20–1 Gm.).

SODII PHOSPHAS, *U. S.*, *Br.*—Sodium Phosphate.

Natrium phosphoricum, P. G.—*Sodium orthophosphate, Disodium hydrogen phosphate*, E.; *Phosphate de soude*, Fr.; *Natriumphosphat, Phosphorsaures Natron*, G.

Formula, $Na_2HPO_4 + 12H_2O$. Molecular weight, 355.61.

It should contain, in an uneffloresced condition, not less than 99 per cent. of the pure salt, and should be kept in well-stoppered bottles, in a cool place.—U. S.

Origin.—Sodium phosphate exists in the urine of carnivorous animals and in other animal liquids. It was probably known to the ancients since the *chrysocolla* used for soldering (see Sodii Boras) was at least partly obtained from urine. Hellot (1735) recognized it as distinct from the ammoniacal salts of urine, and Haupt (1740) named it *sal mirabile perlatum*, because it melts before the blowpipe to an opaque pearly bead. Proust (1775) stated it to be a compound of soda, and Klaproth and Sheele (1785) proved also the presence of phosphoric acid. The salt was employed medicinally by Pearson (1787), and was usually prepared by neutralizing phosphoric acid with sodium carbonate; but at present it is exclusively prepared from bone phosphate.

Preparation.—There is no official method given in any of the pharmacopœias, and it is not practicable for the pharmacist to prepare the salt on a small scale. The mate-

rial that serves as the starting point for the manufacture of the salt is bone ash, or the ash obtained by calcining bones, which is principally tricalcium phosphate, together with small quantities of calcium carbonate, sodium chloride, magnesia, and silica. 10 parts of bone ash are digested with 8½ parts (6.66 parts, Berzelius) of concentrated sulphuric acid, diluted with 50 parts of water, for several days. $Ca_3(PO_4)_2 + 2H_2SO_4 = CaSO_4 + Ca(H_2PO_4)_2$. Insoluble calcium sulphate is formed, and soluble mono-calcium phosphate. The mass is thrown on a filter and washed with hot water. The filtrate is concentrated and set aside to allow the small quantity of calcium sulphate which separates to subside, refiltered, diluted, and heated. The hot solution is treated with a solution of sodium carbonate until precipitation ceases, set aside for a day in a warm place, filtered and concentrated to a point where crystals will form when nearly cold. The salt is further purified by recrystallization, and it should be borne in mind that the crystals formed in a warm solution, 35° C. (95° F.), or above, have not the same amount of water of crystallization as the official salt, but have the composition $Na_2HPO_4.7H_2O$. Moreover, the salt crystallizes best from a solution which is slightly alkaline, to secure which it is well to add a little sodium carbonate. The reaction taking place on adding sodium carbonate above is, $Ca(H_2PO_4)_2 + Na_2CO_3 = CaHPO_4 + Na_2HPO_4 + CO_2 + H_2O$. Part of the phosphoric acid is reprecipitated as insoluble secondary calcium phosphate, while sodium phosphate remains in solution, together with a little sulphate and chloride, which latter are gotten rid of by crystallization.

Properties.—The official sodium phosphate contains 60.3 per cent. of water of crystallization, a portion of which, 5 molecules or 25.1 per cent., is lost by efflorescence upon exposure to air; moreover, carbon dioxide is gradually absorbed, the salt being converted into monosodium phosphate and acid sodium carbonate; hence it must be preserved in well-stoppered bottles, in a cool place. At the temperature of boiling water the salt can be made anhydrous; but when exposed in this condition it again absorbs water, gradually forming a salt of the composition $Na_2HPO_4 + 7H_2O$, containing about 47 per cent. of water, which is permanent. Dried, granulated sodium phosphate occurs as an article of commerce, and is adopted in the U. S. P., 1900; it contains, weight for weight, a much larger proportion of Na_2HPO_4 than the official salt.

It crystallizes in colorless, transparent, obliquely four-sided, monoclinic prisms, which have the specific gravity 1.55, react slighly alkaline upon litmus-paper and phenolphthalein paper, are inodorous, and have a cooling saline taste. The crystals melt to a colorless liquid at 35° C. (95° F.) (Kopp), 40° C. (104° F.) (U. S., P. G.), and congeal on cooling to a crystalline mass. At a red heat the basylous water is expelled and sodium pyrophosphate is left. Crystallized sodium phosphate requires for solution 5.5 parts of water at 25° C. (77° F.) and less than 1.5 parts of boiling water. Sodium phosphate is insoluble in alcohol, and imparts a yellow color to flame, which, if observed through a blue glass, is not red, or only transiently so. The aqueous solution gives with silver nitrate a yellow precipitate, Ag_3PO_4, soluble in nitric acid and in ammonia; with magnesia mixture, a white precipitate soluble in acetic acid; and with ferric chloride, a white precipitate insoluble in acetic acid. If 0.5 Cc. of the aqueous solution be mixed with 1 Cc. of ammonium molybdate test-solution, the mixture will at once assume a yellow color, and, after a few minutes, yield a yellow precipitate of ammonium phospho-molybdate, the appearance of which is hastened by a gentle heat.

Tests.—No residue should be left on dissolving the salt in water (absence of calcium, etc.). No turbidity or coloration should be produced in the aqueous solution (1 in 20) by the addition of a small quantity of ammonium sulphide test-solution, or of an equal volume of hydrogen sulphide test-solution after addition of a few drops of hydrochloric acid and allowing to stand corked in a warm place for ½ hour (absence of metallic impurities). If 1 Gm. of the powdered anhydrous salt be shaken with 3 Cc. of stannous chloride test-solution, no brown coloration should appear within 1 hour (limit of arsenic).—P. G. No effervescence should occur on the addition of hydrochloric or nitric acid to a solution of the salt (absence of carbonate). On adding to 5 Cc. of the aqueous solution (1 in 20) 0.5 Cc. of silver nitrate test-solution, a pure yellow precipitate will be formed, which should not become dark colored by heating (absence of thiosulphate, etc.). 5 Cc. of the aqueous solution (1 in 10) should not respond to the modified Gutzeit's test for arsenic, described under ARSENI TRIOXIDUM. The U. S. P., 1900, has omitted the tests for chloride and sulphate. The Br. P. and P. G. permit only traces of these impurities.

Action and Uses.—Sodium phosphate in moderate doses is laxative, and in large doses a mild saline purge, resembling magnesium sulphate in its action. Rutherford and Vignal ascribe to it a stimulant effect upon the liver cells, and Bartholow considered it the best remedy in hepatic cirrhosis and catarrhal jaundice. The good that results from its administration in the latter condition is probably due to its action upon the catarrhal inflammation of the duodenum. Taken in quantity too small to loosen the bowels, it is absorbed into the blood, the alkalinity of which it slightly increases, and is supposed by some to combine with any excess of uric acid present and form soluble urates, which are readily eliminated. Sodium phosphate may be employed whenever a gentle laxative effect is desired. On account of its not unpleasant saline taste it is readily taken by children. It is particularly useful in those cases of alternate diarrhœa and constipation in bottle-fed infants, dependent upon a deficient flow of bile into the intestine. 2 to 4 grains (0.12–0.25 Gm.) of the salt should be dissolved in the milk at each feeding. Sodium phosphate is sometimes used on theoretical grounds in rickets and scrofulosis. The laxative dose ranges from ½ to 2 drachms (2–8 Gm.) 1 to 3 times a day. 1 to 2 ounces (30–60 Gm.) will produce purgation.

Allied Salt.—Sodii et Ammonii Phosphas, $NH_4NaHPO_4 + 4H_2O$. Molecular weight, 207.62. This is the *microcosmic salt* of the alchemists, and was formerly prepared from urine. It is obtained by dissolving 5 parts of crystallized sodium phosphate and 2 parts of ammonium phosphate in 20 parts of hot water, adding a little ammonia until the liquid is alkaline, and crystallizing. The salt crystallizes in colorless, transparent, monoclinic prisms which are inodorous and have a cooling saline taste, and a neutral or faint alkaline reaction. It effloresces superficially on exposure, losing a little ammonia, melts readily to a colorless liquid in its water of crystallization, and at a red heat forms a colorless glass of sodium metaphosphate, which is used in blowpipe analysis.

SODII PHOSPHAS EFFERVESCENS, *U. S.*, *Br.*—Effervescent Sodium Phosphate.

Natrium phosphoricum effervescens.—Phosphate de soude effervescent, Fr.; *Brausendes Natriumphosphat*, G.

Preparation.—Exsiccated sodium phosphate, in fine powder, 200 Gm.; sodium bicarbonate, dried and powdered, 477 Gm.; tartaric acid, dried and powdered, 252 Gm.; citric acid, uneffloresced crystals, 162 Gm. To make about 1000 Gm. Powder the citric acid and mix it intimately with the exsiccated sodium phosphate and tartaric acid, then thoroughly incorporate the sodium bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. (199.4° and 219.2° F.). When the mixture, by the aid of careful manipulation with a wooden spatula, has acquired a moist consistence, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles.—U. S.

The formula of the Br. P. is as follows: Dry 25 ounces of crystallized sodium phosphate until it has lost 60 per cent. of its weight; powder the product, and mix with sodium bicarbonate 25 ounces, tartaric acid, in powder, 13½ ounces, and citric acid, in powder, 9 ounces. Place the mixture in a dish heated to 93.3° to 104.4° C. (200°–220° F.), and when the particles of the powder begin to aggregate, stir them assiduously until they assume a granular form; by means of sieves separate the granules of uniform size, and dry them at a temperature not exceeding 54.4° C. (130° F.). The final product should weigh about 50 ounces. Keep in well-closed bottles. The Br. preparation contains the same per cent. of phosphate as that of the U. S., but employs 4.82 per cent. more of sodium bicarbonate, 7.14 per cent. more of tartaric acid, and 11.11 per cent. more of citric acid, the quantities being in the order given, 500, 500, 270, 180 Gm.

Action and Uses.—Although an elegant pharmaceutical preparation, effervescent sodium phosphate presents no advantage over the salt in substance. It is largely used by the laity as a laxative in the dose of 1 to 4 drachms (4–16 Gm.), taken in about 4 ounces (160 Cc.) of water, usually before breakfast.

SODII PHOSPHAS EXSICCATUS, *U. S.*—Exsiccated Sodium Phosphate.

Natrium phosphoricum exsiccatum. — *Dried (anhydrous) sodium phosphate,* E.; *Phosphate de soude desséché,* Fr.; *Getrocknetes Natriumphosphat,* G.

It should contain not less than 99 per cent. of pure anhydrous sodium phosphate, Na_2HPO_4, and should be kept in well-stoppered bottles.—U. S.

Preparation.—Allow a convenient quantity of crystallized sodium phosphate to effloresce for several days in warm air, at a temperature of from 25° to 30° C. (77°–86° F.), then continue the drying in an oven, raising the temperature very gradually until 100° C. (212° F.) has been reached, and maintaining it until the salt ceases to lose weight. Powder and sift the residue and keep in bottles.—U. S.

The dried salt represents practically 40 (39.7) per cent. of the weight of the crystallized salt employed. It was introduced in the U. S., 1900, being a white powder which absorbs moisture readily, and conforms to the reactions and tests given under SODII PHOSPHAS.

Action and Uses.—The uses of exsiccated sodium phosphate are the same as of the hydrous salt. Since it is about 2½ times stronger than the ordinary phosphate, its dose is proportionately smaller. 10 to 60 grains (0.60–4 Gm.) will produce a laxative effect.

SODII PYROPHOSPHAS, *U. S.*—Sodium Pyrophosphate.

Natrium pyrophosphoricum.—*Pyrophosphate de soude,* Fr.; *Natriumpyrophosphat,* G.

Formula, $Na_4P_2O_7 + 10H_2O$. Molecular weight, 443.02.

It should contain in an uneffloresced condition not less than 99 per cent. of the pure salt, and be kept in well-stoppered bottles.—U. S.

Preparation.—10 ounces of crystallized sodium phosphate are exposed to a warm atmosphere until effloresced, and then heated to dull redness until a small portion of the mass, dissolved in water, causes with silver nitrate a white precipitate free from yellow tint. The white salt is dissolved in 5 pints of boiling water and the solution filtered if necessary and crystallized. The total yield will be 6 ounces.

When sodium phosphate is heated to a gradually increased temperature, it first undergoes fusion at about 44° C. (111.2° F.), at 100° C. (212° F.) loses all of its water of crystallization (60.31 per cent.), and finally at 300° C. (572° F.) is converted into sodium pyrophosphate, two molecules of the official phosphate yielding one molecule of anhydrous pyrophosphate, thus $2Na_2HPO_4.12H_2O = Na_4P_2O_7 + 25H_2O$.

Properties.—The salt crystallizes in colorless or whitish transparent or translucent monoclinic prisms or plates which are inodorous and have a cooling saline and feebly alkaline taste. It is permanent in cool air, slightly efflorescent in warm air. Soluble in 11.5 parts of water at 25° C. (77° F.), and in 1.1 parts of boiling water; insoluble in alcohol. When heated to 100° C. (212° F.), the salt loses its water of crystallization (40.35 per cent.) without previous fusion. At a higher temperature it fuses, forming a transparent liquid, which, on cooling, solidifies to a crystalline mass. To a non-luminous flame it imparts an intensely yellow color. Its aqueous solution is feebly alkaline to litmus and to phenolphthalein paper. A 5 per cent. aqueous solution of the salt yields, with magnesia mixture, a white precipitate; with silver nitrate test-solution it yields a precipitate of a pure white color (distinction from orthophosphate), soluble in ammonia water, and in nitric acid without effervescence (absence of carbonate). With ammonium molybdate test-solution no precipitate is formed within 15 or 20 minutes, even when a gentle heat is applied (distinction from orthophosphate). On boiling the aqueous solution with free mineral acids the salt is gradually converted into orthophosphate.

Tests.—The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid and mixed with an equal volume of hydrogen sulphide solution, should not become colored or turbid on standing corked at 35° C. (95° F.) for half an hour, either before or after addition of ammonia water in slight excess (absence of heavy metals). 5 Cc. of the aqueous solution (1 in 10) should not respond to the modified Gutzeit test for arsenic given under ARSENI TRIOXIDUM. The U. S. P., 1900, has dropped the tests for chloride, sulphate, and potassium in this salt.

Uses.—It is said that the action and uses of this salt are the same as those of sodium phosphate, but that it should be given in doses one-third less. Its pharmaceutical uses give it its chief value. The crystals are difficult to reduce to fine powder, and are far less soluble in water than those of the orthophosphate.

SODII SALICYLAS, *U. S., Br.*—Sodium Salicylate.

Natrium salicylicum, P. G.—*Salicylate de soude*, Fr.; *Natriumsalicylat, Salicylsaures Natrium*, G.

Formula, $NaC_7H_5O_3$. Molecular weight, 158.89.

It should be kept in well-stoppered bottles, protected from heat and light, and should contain not less than 99.5 per cent. of the pure salt.—U. S.

Preparation.—Sodium bicarbonate 10 parts and salicylic acid 16.5 parts are mixed in a porcelain or glass vessel, and 10 parts of pure water are gradually added: as the reaction progresses carbon dioxide is rapidly evolved, the newly formed salt remaining in solution, which latter should have a slightly acid reaction to ensure a product free from color. If necessary, the solution may receive a slight addition of salicylic acid, as alkali salicylates in the presence of an excess of alkali absorb oxygen from the air and become colored. The solution is heated on a water-bath to expel all carbon dioxide, and then evaporated at about 60° C. (140° F.) to dryness; the residue may be recrystallized from a solution in 120 parts of 95 per cent. alcohol if desired. Owing to the delicate reaction of salicylic acid with iron salts, all contact with metals must be avoided; moreover, the salicylic acid must be free from creosotic (homosalicylic) acid, and the alkali free from iron.

Although not a bibasic acid, salicylic acid is capable of forming two classes of salts, primary and secondary salicylates; the former are obtained when the acid is neutralized by means of alkali carbonates or bicarbonates, whereas the use of alkali hydroxides results in the formation of the secondary salts, which are less soluble and less stable.

The official sodium salicylate of the U. S., G., and Br. Pharmacopœias is the primary salt, the first two named recognizing the anhydrous salt, while the latter admits 5.3 per cent. of water, the salt having the composition $2NaC_7H_5O_3 + H_2O$.

Properties.—Sodium salicylate is a white micro-crystalline powder or forms small white crystalline scales, is permanent in the air, inodorous or nearly so, and has a sweetish saline and mildly alkaline taste and a feebly acid reaction. It dissolves at 25° C. (77° F.) in 0.8 part of water and in 5.5 parts of alcohol, and is more freely soluble in boiling water and boiling alcohol; also soluble in glycerin. By heat the salt is decomposed, inflammable vapors and an odor of phenol are given off, and a carbonaceous residue of sodium carbonate is left, weighing about 33 per cent. of the salt used, and imparting to a non-luminous flame an intense yellow color. If copper sulphate test-solution be added to the aqueous solution (1 in 20), a green color will be produced. On adding to a small portion of the salt, in a test-tube, about 1 Cc. of concentrated sulphuric acid, and then, cautiously, about 1 Cc. of methylic alcohol in drops, on heating the mixture to boiling the odor of methyl salicylate will be evolved. Ferric chloride added to the concentrated aqueous solution of the salt produces a violet precipitate, but a very diluted solution (1 in 100) is colored violet. The rather concentrated aqueous solution, when strongly acidulated with hydrochloric or sulphuric acid, gives a white crystalline precipitate, which is soluble in ether and in hot water and has all the properties of salicylic acid (which see).

Tests.—The aqueous solution should be colorless, and should slightly redden blue litmus-paper (absence of carbonate). Agitated with about 15 parts of concentrated sulphuric acid, the salt should not impart color to the acid (absence of foreign organic matter).—Br., P. G. If a solution of 1 Gm. of the salt in a mixture of 50 Cc. of alcohol and 25 Cc. of water be acidulated with nitric acid, the filtered solution should yield no precipitate, nor be rendered turbid on the addition of a few drops of test-solution of barium chloride (absence of sulphate) or of silver nitrate (absence of chloride). —Br. P., P. G. In the last test the addition of alcohol is made for the purpose of keeping in solution the salicylic acid liberated by the nitric acid, whereby filtration is avoided. The salt should not have the odor of phenol. If to an aqueous solution of the salt (1 in 20) 3 drops of iodine solution and a slight excess of hydrochloric acid be added, the filtrate should not yield a precipitate upon adding barium chloride solution (absence of sulphite). If sulphite were present, the iodine would oxidize it to sulphate. If the aqueous solution (1 in 20) be acidulated with hydrochloric acid and the precipitated salicylic acid filtered off, the filtrate, mixed with an equal volume of hydrogen sulphide solution, should not become colored or turbid on standing corked at 35° C. (95° F.) for half an hour, before or after addition of ammonia in slight excess (absence of heavy

metals, arsenic, etc.). If 1 Gm. of the dry salt be thoroughly ignited at red heat, and the residue be repeatedly extracted with hot water, filtered, and well washed, the cold filtrate should require for complete neutralization not less than 12.52 Cc. of half-normal sulphuric acid, methyl orange being the indicator, corresponding to 99.5 per cent. purity. Each Cc. of the acid is equivalent to 0.079445 Gm. of the salt when incinerated and converted into carbonate.—U. S. In a solution of the salt containing not less than 1 per cent., uranium nitrate solution produces a yellowish-brown precipitate (distinction from carbolates and sulphocarbolates).—Br.

Action and Uses.—The uses of sodium salicylate are identical with those of salicylic acid. On account of its greater solubility and less irritating action upon the stomach it is preferable to salicylic acid for internal administration. It is given in the dose of 5 to 30 grains (0.30–2 Gm.) every 3 or 4 hours. (See ACIDUM SALICYLICUM.)

Allied Salts.—SODIUM DIIODOSALICYLATE. $NaC_6H_2I_2(OH)CO_2 + 2.5H_2O$.—When an alcoholic solution of salicylic acid is treated with iodine and iodic acid, diiodosalicylic acid is formed by substitution of 2 atoms of iodine for 2 of hydrogen, which may be neutralized with sodium carbonate, and then yields white laminæ or long, flat, needle-shaped crystals which are soluble in 50 parts of water at 20° C. (68° F.). The salt possesses analgesic and antiseptic properties.

SODIUM DITHIOSALICYLATE.—*Dithion.* $[S.C_6H_3(OH)CO_2Na]_2$.—If a mixture of equal molecular weights of sulphur chloride (bromide or iodide) and salicylic acid is heated for some time to 120°–150° C. (248°–302° F.), a lively reaction ensues, hydrogen chloride (bromide or iodide) escaping, and dithiosalicylic acid remaining in the form of a yellowish resinous mass. The residue, which is soluble in alcohol, is a mixture of two isomeric acids, designated respectively as No. 1 and No. 2. When the acid is treated with solution of sodium carbonate, the two sodium salts are formed, and may be separated by means of sodium chloride, which precipitates the No. 1 salt, while the No. 2 salt remains in solution; or the dried mixture of the two salts may be exhausted with boiling alcohol, which dissolves only the No. 2 salt. This latter salt is preferred; it occurs as a grayish-white amorphous powder, very hygroscopic, and readily soluble in water, forming a brownish-black solution of alkaline reaction. Its antiseptic activity is superior to sodium salicylate, and it has been successfully employed in rheumatic fever, gonorrhœic rheumatism, and similar cases. The dose is from 4 to 10 Gm. daily in doses of 0.5 to 1 Gm. Sodium dithiosalicylate No. 1 is a yellowish amorphous powder, somewhat hygroscopic, and of alkaline reaction; it forms with water a clear brownish solution. The salt has been chiefly employed in veterinary practice, in the form of a 5 per cent. solution.

SODIUM SULPHOSALICYLATE. $C_6H_3(OH)CO_2HSO_3Na$. This salt, obtained by neutralizing sulphosalicylic acid with sodium carbonate, occurs in colorless crystals, soluble in 25 to 30 parts of water; the aqueous solution has an acid reaction, and is not affected by barium chloride or silver nitrate. The salt has been recommended as a substitute for sodium salicylate in the treatment of articular rheumatism.

SODIO-THEOBROMINE SALICYLATE.—*Diuretin.* $C_7H_7NaN_4O_2 + NaC_7H_5O_3$. This compound is obtained by mixing aqueous solutions of equal molecules of sodium theobromine and sodium salicylate and evaporating to dryness; a definite compound appears to be formed, containing theoretically 49.7 per cent. of theobromine and 38.1 per cent. of salicylic acid. Diuretin occurs as a white powder, odorless, of a saline, alkaline taste, and soluble in half its weight of warm water, the solution remaining perfect on cooling. It should be preserved in well-stoppered bottles, as it is readily affected by the air, theobromine separating by action of carbon dioxide, whereby it then fails to form a clear solution in water. Such a milky solution is easily cleared by adding a few drops of caustic soda solution. It has proved to be a reliable diuretic, free from poisonous properties and unpleasant after-effects. The daily dose of diuretin is 60 to 120 grains (4–8 Gm.) in divided portions of 15 grains (1 Gm.) each; it is best administered in solution with aromatic waters, and should not be dispensed in powder form, owing to liability to change upon exposure.

LITHIUM DIURETIN, *Uropherin*, is a corresponding lithium theobromine salicylate, made like the previous salt, but substituting lithium for sodium. It is a white powder, soluble in 5 parts of water, and given in doses of 15 grains (1 Gm.).

SODII SULPHAS, *U. S., Br.*—Sodium Sulphate.

Natrium sulphuricum, P. G.—*Glauber's Salt*, E.; *Sulfate de soude, Sel de Glauber*, Fr.; *Glaubersalz, Natriumsulfat*, G.

Formula, $Na_2SO_4 + 10H_2O$. Molecular weight, 319.91.

It should be kept in well-closed vessels, in a cool place, and should contain, in an uneffloresced condition, not less than 99 per cent. of the pure salt.—U. S.

Origin.—Sodium sulphate is found native in the anhydrous state and crystallized, and also in combination with calcium sulphate. It is present in the water of many mineral springs and in that of certain lakes in Russia and in the western part of the United States. It is stated to have been known in Saxony for a century before it was obtained artificially by Glauber (1658) from the saline residue left in the preparation of hydrochloric acid, and was named after him *Sal mirabile Glauberi.* The same salt, prepared from the mineral spring at Friedrichshall, became known in 1767 as *Sal. aperitivum Fridericianum.* It is largely manufactured in the United States, but small and variable quantities of it are also imported.

Preparation.—This salt is largely obtained in many chemical processes, either as an intermediate or a secondary product, as in the preparation of soda by Leblanc's process; from the mother-liquors of the Stassfurt potash-works; in the preparation of magnesium carbonate; in the manufacture of hydrochloric and nitric acids from sodium chloride and nitrate; in the preparation of table-salt from many saline springs; in the manufacture of sal ammoniac from ammonium sulphate and sodium chloride; in preparing carbon dioxide for the manufacture of mineral waters from sodium bicarbonate and sulphuric acid; and in several other processes. Sodium sulphate as thus obtained is purified by crystallizing it repeatedly from water, if necessary, after neutralization with sodium carbonate. Crystallized from water at or above 33° C. (91.4° F.), it has the composition $Na_2SO_4.7H_2O$.

Properties.—Sodium sulphate crystallizes in large, transparnt, ecolorless, monoclinic prisms, which are inodorous, have a cooling, saline, and distinctly bitter taste, and rapidly effloresce on exposure to the air, leaving a white powder. The crystallized salt must therefore be kept in well-stoppered bottles, and, on account of its low melting-point, in a cool place. It is soluble at 15° C. (59° F.) in 2.8 parts of water. The solubility increases up to 34° C. (93.2° F.), when its maximum is attained, 1 part of the salt then dissolving in 0.25 part of water; from thence it gradually decreases with rising temperature, until 1 part requires 0.47 part of boiling water for solution. Insoluble in alcohol; soluble in glycerin. When heated to 33° C. (91.4° F.), the salt fuses, and, on being heated to 100° C. (212° F.), loses all of its water (55.9 per cent.). At a red heat the anhydrous salt fuses without decomposition. To a non-luminous flame it imparts an intensely yellow color. The aqueous solution is neutral to litmus-paper. A 5 per cent. aqueous solution of the salt yields with barium chloride a white precipitate insoluble in nitric acid.

Tests.—If to 5 Cc. of the aqueous solution (1 in 20) 1 Cc. of sodium phosphate test-solution and 0.5 Cc. of ammonia water be added, no turbidity or precipitate should be produced, even after agitation (absence of magnesium). The aqueous solution (1 in 20), slightly acidulated and mixed with an equal volume of hydrogen sulphide solution, should not become colored or turbid on standing corked at 35° C. (95° F.) for half an hour, before or after adding ammonia water in slight excess (absence of heavy metals). 5 Cc. of the aqueous solution (1 in 10) should not respond to the modified Gutzeit's test for arsenic given under ARSENI TRIOXIDUM. 20 Cc. of the 5 per cent. solution should not be changed by addition of 0.5 Cc. of potassium ferrocyanide solution (absence of iron).—P. G. 100 grains of it, dissolved in distilled water and acidulated with hydrochloric acid, give, by the addition of barium chloride, a white precipitate which, after washing and drying, weighs 72.3 grains, or 1 Gm. yields 0.723 Gm. of $BaSO_4$ (0.725 Gm., Br.). The U. S. P., 1900, has omitted the tests for carbonate, calcium, magnesium, ammonium salt, and chloride, all of which are retained in the Br. P. The Br. P. and P. G. allow only mere traces of chloride.

SODII SULPHAS EXSICCATUS, s. *Natrium sulfuricum siccum,* P. G.—*Dried sodium sulphate,* E.; *Getrocknetes Natriumsulfat,* G. It is obtained by exposing the crystallized salt to a moderate heat until its weight has been reduced to one-half, when the white powder is passed through a sieve and preserved in well-stoppered bottles. This form is convenient in dispensing, and represents double the weight of the crystallized salt.

Action and Uses.—Sodium sulphate is a hydrogogue cathartic, resembling in its action other members of this group, and, like them, is more efficacious when given in concentrated solution. Because of its nauseous taste and drastic action it has been supplanted in this country and England by magnesium sulphate. It is the principal ingredient of many natural purgative waters, as Hunyadi, Carlsbad, Apenta, etc. Sodium sulphate and these waters are useful to overcome acute constipation from any cause, and

produces good results in the chronic form due to hepatic torpor and intestinal indigestion. Its purgative effect is of advantage in many febrile affections. The purgative dose of sodium sulphate is from ½ to 1 ounce (16–30 Gm.) dissolved in from 3 to 6 ounces (90–180 Cc.) of hot water, and taken, as a rule, ½ hour before breakfast. Its disagreeable taste may be partially masked by the addition of lemon juice or aromatic sulphuric acid.

SODII SULPHAS EFFERVESCENS, *Br.*—Effervescent Sodium Sulphate.

Natrium sulfuricum effervescence.—Brausendes Natriumsulfat, G.

Preparation.—Dry 25 ounces of crystallized sodium sulphate until it has lost 56 per cent. of its weight; powder the product and mix it with sodium bicarbonate 25 ounces, tartaric acid 13½ ounces, and citric acid, in powder, 9 ounces. Place the mixture in a dish heated to 93.3° to 104.4° C. (200°–220° F.), and when the particles of the powder begin to aggregate, stir them assiduously until they assume a granular form; by means of sieves separate the granules of uniform size, dry at a temperature not above 54.4° C. (130° F.), and preserve in well-closed bottles. The final product should weigh about 50 ounces, and contains about 22 per cent. anhydrous sulphate.

SODII SULPHIS, *U. S., Br.*—Sodium Sulphite.

Natrium sulfurosum.—Sulfite de soude, Fr.; *Natriumsulfit, Schwefligsaures Natron*, G.

Formula, $Na_2SO_3 + 7H_2O$. Molecular weight, 250.39.

It should be kept in well-stoppered bottles in a cool place, and should contain, in the uneffloresced and air-dried condition, not less than 96 per cent. of the pure salt.—U. S.

Preparation.—This salt is formed on passing sulphur dioxide into a solution of sodium carbonate until the color of blue litmus-paper is changed to red, or the solution of a known quantity of sodium carbonate is completely saturated with sulphur dioxide, whereby sodium bisulphite is produced; an equal weight of sodium carbonate is dissolved in the liquid, and the solution evaporated to crystallization. The sulphur dioxide decomposes the sodium carbonate, replacing the carbon dioxide which is evolved: $Na_2CO_3 + SO_2$ yields $Na_2SO_3 + CO_2$.

Properties.—Sodium sulphite crystallizes in colorless, transparent, monoclinic prisms, which are inodorous, and have a slight alkaline reaction to test-paper, and a cooling, saline, and sulphurous taste. The salt effloresces on exposure, and becomes opaque from the loss of water and from oxidation to sulphate, and therefore requires to be kept in well-stoppered bottles. The solution is more rapidly oxidized than the salt, but does not separate sulphur; likewise, not on the addition of hydrochloric acid (difference from thiosulphate). When heated to 100° C. (212° F.) the crystals lose all their water of crystallization (50 per cent.) without fusing or changing their shape, but at a red heat the salt fuses into an orange-red mixture of sodium sulphide and sulphate. The salt is nearly insoluble in alcohol, but dissolves readily in water. On heating the aqueous solution, saturated in the cold, anhydrous salt is deposited (Rammelsberg). The dry, anhydrous salt Na_2SO_3 (molecular weight 125.23) is nearly permanent in the air, and when immersed in a little water combines with it and forms a solid mass. The crystallized salt is soluble in 2 parts of water at 25° C. (77° F.) and in 1.4 parts of boiling water (U. S.). Diluted sulphuric or hydrochloric acid, added to the salt or its solution, liberates sulphur dioxide, which is recognized by its odor and by its turning black a strip of paper wet with mercurous nitrate solution. If held in a non-luminous flame an intense yellow color is imparted to the latter.

Tests.—If 1 Gm. of the salt be dissolved in 10 Cc. of diluted nitric acid and the solution heated sufficiently to expel the gases, the liquid should not become turbid (absence of thiosulphate). If 1 Gm. of the salt be dissolved in 20 Cc. of diluted hydrochloric acid and heated sufficiently to expel the sulphur dioxide, the remaining solution after restoring its original volume, should not be colored or rendered turbid by an equal volume of freshly prepared hydrogen sulphide test-solution, after standing well-stoppered at 35° C. (95° F.) for at least half an hour, either before or after the addition of ammonia water to slight alkalinity (absence of heavy metals). The salt is assayed by the method given under Sodii Bisulphis, page 1395, using 50 Cc. of tenth-normal iodine solution and 0.5 Gm. of the finely powdered salt. Not more than 11.66 Cc. of tenth-normal sodium thiosulphate should be required to titrate the excess of iodine, leaving

(50–11.66) 38.34 Cc. of iodine solution required by the sulphite, and corresponding to not less than 96 per cent. of pure salt. $Na_2SO_3.7H_2O + I_2 = Na_2SO_4 + 2HI + 6H_2O$. Each Cc. of iodine solution, containing 0.012589 Gm. of iodine, is equivalent to 0.01252 Gm. of crystallized sulphite, and 38.34 Cc. of iodine solution is equivalent to 0.47999 Gm. of pure sulphite, which is 96 per cent. of 0.5 Gm. taken for titration. The present titration method is the reverse of the former method, in which the iodine solution was added gradually *to* the solution of the salt, whereby error occurred by escape of sulphur dioxide. This is still the method in the Br., which demands that 1 Gm. of the salt shall require not less than 77.7 Cc. nor more than 81.7 Cc. of tenth-normal iodine solution. The theoretically required quantity is 79.88 Cc. of iodine solution. The lower limit, 77.7 Cc., correspouds to 97.27 per cent., while the higher limit can only be reached by the salt that has effloresced The U. S. P. of 1900 has dropped the tests for limit of sulphate and chloride, as these are innocuous and of no medicinal effect.

Action and Uses.—Sodium sulphite, in common with the other sulphites and sulphurous acid, possesses mild antiseptic and germicidal properties. In the acid secretion of the stomach it undergoes partial decomposition, which results in the liberation of sulphurous acid and the formation of sodium sulphate. It is absorbed and eliminated as sodium sulphate. In indigestion due to fermentation of the starchy and saccharine elements of food, producing pyrosis and vomiting of an acid, yeasty material, the administration of from 20 to 60 grains (1.30–4 Gm.) of sodium sulphite $\frac{1}{2}$ to 2 hours after meals will frequently give prompt relief. Applied in solution, 1 drachm to 1 ounce (4 Gm. : 30 Cc.) of water, it is curative to ulcers of the tonsils, aphthous stomatitis, mucous patches, and some parasitic skin diseases, as scabies and favus. The dose of sodium sulphite is from 20 to 60 grains (1.30–4 Gm.).

SODII THIOSULPHAS, *U. S.*—Sodium Thiosulphate.

Sodii Hyposulphis, U. S., 1890.—*Natrium thiosulfuricum*, P. G. ; *Natrium subsulfurosum* (*hyposulfurosum*). *Sodium hyposulphite*, E. ; *Hyposulphite de soude, Sulfite sulfuré de soude*, Fr. ; *Natriumthiosulfat*, G.

Formula, $Na_2S_2O_3 + 5H_2O$. Molecular weight, 246.46.

It should be kept in well-closed bottles, and should contain not less than 98 per cent. of the pure salt.—U. S.

The correct chemical name of this salt is sodium thiosulphate, as now recognized in the Pharmacopœia. Hyposulphites are entirely different salts, being derived from an acid having probably the composition $H_2S_2O_4$, while thiosulphates are derived from the acid $H_2S_2O_3$, which is sulphuric acid in which an atom of sulphur plays the part of an atom of oxygen, hence the name thiosulphuric acid. A salt of the true hyposulphurous acid is obtained by the action of zinc on sulphurous acid, zinc sulphite being formed and the liberated hydrogen reducing sulphurous to hyposulphurous acid, with the formation of water. The acid, known only in solution of its salts, which have a deep-yellow color, is a strong reducing agent. True sodium hyposulphite may be prepared by treating a solution of acid sodium sulphite (bisulphite) with metallic zinc, whereby sodium hyposulphite and sulphite, together with zinc sulphite, are formed. The salt is used by dyers and calico-printers for the reduction of indigo blue to indigo white.

Thiosulphuric acid, $H_2S_2O_3$, the acid present in the official salt, has never been obtained in a free state, but a series of stable salts (thiosulphates) has been prepared by boiling the respective sulphites in solution with sulphur ; thus, $Na_2SO_3 + S = Na_2S_2O_3$; they may also be obtained by adding iodine to a mixture of sulphite and sulphide, thus, $Na_2SO_3 + Na_2S + I_2 = Na_2S_2O_3 + 2NaI$, or by the action of sulphur on alkali hydroxide, when alkali pentasulphide is simultaneously formed. The fact that thiosulphates show a great tendency to form double salts, as well as their decomposition, when heated, into sulphates and sulphides, readily distinguishes them from true hyposulphites, which latter, when heated, break up into thiosulphates and water.

Preparation.—The salt is best prepared on the large scale. In the purification by dry lime of illuminating gas prepared from coal, the gas-lime contains calcium carbonate, thiosulphate, and pentasulphide, and is utilized for the manufacture of sodium thiosulphate by a process proposed by Graham. The gas-lime is exposed to the air so as to convert the sulphide into thiosulphate ; $2CaS_5 + 3O_2$ yields $2CaS_2O_3 + 2S_2$. It is then

treated with its weight of cold water, and the filtrate, which contains the calcium thiosulphate, is converted into the sodium salt by double decomposition with sodium carbonate, whereby insoluble calcium carbonate is produced and a solution of sodium thiosulphate obtained, which is concentrated and crystallized; $CaS_2O_3 + Na_2CO_3$ yields $CaCO_3 + Na_2S_2O_3$. The residue left in the preparation of soda, called soda waste, contains calcium sulphide, and is converted into sodium thiosulphate by a process nearly identical with the one just described. In decomposing calcium thiosulphate the sodium carbonate may be replaced by sodium sulphate, in which case calcium sulphate is precipitated.

Properties.—Sodium thiosulphate is in large, transparent, colorless, monoclinic prisms, which have the specific gravity 1.74, are neutral or faintly alkaline, are inodorous, and have a cooling, bitter, slightly alkaline, and sulphurous taste. It is permanent in the air, but over sulphuric acid it slowly parts with most of its water of crystallization, and in the atmosphere begins to effloresce at about 30° C. (91.4° F.). When slowly heated it parts with all its water of crystallization (36.3 per cent.) at 100° C. (U. S.), but if rapidly heated not below 215° C. (419° F.), and at about 225° C. (437° F.), it is decomposed, with the separation of sulphur (Pape); at a red heat it forms a black (after cooling brown-yellow) mass of sodium sulphate and sulphide, and some sulphur is also liberated. A non-luminous flame is colored intensely yellow by the salt. The crystallized salt dissolves at 25° C. (77° F.) in 0.35 part of water, readily forms supersaturated solutions, and at boiling heat the solution is rapidly decomposed; it is slowly soluble in oil of turpentine, the odor of the latter being modified (Edison, 1876), but it is insoluble in alcohol, and is precipitated by the latter from its concentrated solution as an oily liquid. The aqueous solution is gradually, or in the presence of free alkali more rapidly, decomposed into sulphur and sulphite. According to F. H. Alcock, a small quantity of carbon disulphide prevents this change. In the presence of zinc and free acid hydrogen sulphide is formed; on acidulating the solution of the salt, thiosulphuric acid is liberated, and at once decomposed into sulphurous acid and sulphur, which forms a white precipitate (difference from sulphites).

Sodium thiosulphate dissolves chloride, iodide, and other compounds of silver readily, and is employed for this purpose by photographers, and such a solution may be used for silvering copper and brass. Iodine is decolorized by a solution of sodium thiosulphate, sodium iodide and tetrathionate being formed, according to the equation $2Na_2S_2O_3.5H_2O + I_2 = 2NaI + Na_2S_4O_6 + 10H_2O$. This reaction affords a convenient method for the estimation of iodine, 125.9 parts of which are decolorized by 246.46 parts of the thiosulphate. A similar reaction takes place with chlorine, and makes the salt a useful and cheap *antichlor* for the removal of chlorine retained by fabrics and other substances which have been bleached by chlorine. Sodium thiosulphate is also a solvent for the insoluble salts of lead and other metals. It affords a white precipitate in a concentrated solution of barium chloride, which is soluble in much water (difference from sulphate).

Impurities.—If ferric chloride test-solution be dropped into the aqueous solution (1 in 20) of the salt, a dark-violet color will be produced, which disappears rapidly on agitation. If to 5 Cc. of the aqueous solution (1 in 10) 3 Cc. of nitric acid be added and the solution cautiously evaporated to dryness on a water-bath, and the residue, treated with distilled water, be filtered and washed, and the filtrate and washings evaporated to dryness, it should not respond to the modified Gutzeit's test for arsenic given under ARSENI TRIOXIDUM. The residue from 20 Cc. of the solution (1 in 20) treated in like manner, when dissolved in 20 Cc. of water and slightly acidulated with hydrochloric acid, and mixed with an equal volume of hydrogen sulphide solution, should not become colored or turbid on standing corked at 35° C. (95° F.) for half an hour, either before or after addition of ammonia water in slight excess (absence of heavy metals). The aqueous solution (1 in 20) should not be rendered turbid by the addition of ammonium oxalate test-solution (absence of calcium). The aqueous solution of the salt (1 in 20) should not be colored red by a drop of phenolphthalein test-solution (absence of caustic alkali or carbonate); nor should a drop of silver nitrate test-solution produce a brown or black precipitate in 5 Cc. of this solution (absence of sulphide). If 1 Gm. of sodium thiosulphate be dissolved in 20 Cc. of water, it should require not less than 39.75 Cc. of tenth-normal iodine solution to produce a distinct yellow tint (corresponding to at least 97.97 (98) per cent. of the pure salt).—U. S.

From the equation given above, explaining the reaction between sodium thiosulphate

and iodine, we learn that 492.92 parts of the former will decolorize 251.8 parts of the latter, and hence each Cc. of tenth-normal iodine solution (containing 0.01259 Gm. of iodine) so decolorized will represent 0.024646 Gm. of crystallized sodium thiosulphate, or 39.75 Cc. are equal to 0.9797 Gm., which is 97.97 (98) per cent. of 1 Gm.

Action and Uses.—The properties of sodium thiosulphate are similar to those of the sulphites. It is occasionally used for its antizymotic action to prevent fermentation due to the growth of sarcinæ and yeast fungi in the alimentary canal. Its chief use is in the treatment of parasitic skin diseases, especially pityriasis versicolor, to which it is applied in aqueous solution or ointment of the strength 1 drachm to the ounce (4 Gm. : 30 Cc.). Its administration for the relief of malarial hæmaturia is entirely empirical, but frequently successful. The dose of sodium thiosulphate is from 10 to 60 grains (0.60–4 Gm.).

SODIUM, *Br.*—Sodium.

Sodium, Fr. ; *Natrium*, G.

Symbol, Na. Atomic weight, 22.88. Valence, one in nearly all cases.

It was admitted in the Br. P. for preparing solution of sodium ethylate.

Sodium is a member of the family of alkali metals of which the characteristics have been mentioned under Cæsium, Lithium, and Potassium. It occurs in native rocks to nearly as great an extent as does the very similar metal potassium ; but while the potassium salts resulting from the decomposition of the rocks is taken up readily by plants, sodium finds its way, chiefly as chloride, through the medium of streams and rivers to the ocean, where it has accumulated for ages. The ashes of land plants are rich in potassium salts, while those of plants growing on shores and in the sea are richest in sodium salts. In the animal kingdom, sodium salts are abundant and in greater quantity than potassium salts. Sodium also occurs in great quantity as solid deposits in sodium chloride and sodium nitrate beds, and in Greenland as cryolite, a double fluoride of aluminum and sodium, $AlF_3.3NaF$.

Preparation.—Sodium, like potassium, was first isolated in 1807 by Sir H. Davy, of England, by electrolyzing molten sodium hydroxide. It was formerly made on a large scale by reduction of sodium carbonate with carbon in furnaces, but more recent and better methods are now used. As in the case of potassium, the method of electrolysis of molten sodium hydroxide or sodium chloride is used to a large extent. Castner introduced a successful method for the manufacture of sodium, which consists in the reduction of sodium hydroxide by heating it with an intimate mixture of finely divided iron and carbon. The mass is prepared by mixing the iron with molten pitch, allowing it to cool, breaking it into pieces, and heating to a comparatively high temperature without access of air. The reduction is said to take place at a temperature of 825°, instead of 1400°, as in the older method. The main reaction is represented by this equation: $6NaOH + FeC_2 = 2Na_2CO_3 + 6H + 2Na + Fe$.

Properties.—Sodium is like potassium in nearly all of its properties. It is silver gray, has a strong metallic lustre, and at ordinary temperatures may be cut like wax. It melts at 95.6° C. (204.08° F.), and at a red heat volatilizes. Its density is 0.974. In contact with air it is oxidized, and therefore requires to be kept under petroleum naphtha, or should be protected by being coated with a layer of paraffin, as proposed by Wagner (1863).

It decomposes water, forming sodium hydroxide and hydrogen, but the latter does not inflame as in the case of potassium. Sodium comes into the market in bars, while potassium is found mostly in spheres. The principal applications of sodium are: preparation of technical potassium cyanide (potassium and sodium cyanide mixture), used in gold extraction, also of sodium amalgam, which is used for the same purpose, in addition to its use in the laboratory as a reducing agent; preparation of sodium peroxide, for bleaching and oxidizing purposes; synthetic preparation of organic compounds, for example, acetoacetic ether and antipyrine.

The salts of sodium are colorless unless the acid is colored, have a neutral reaction except those with weak acids, and are not volatilized at a low red heat, and somewhat less readily than potassium salts at a higher temperature. They impart to flame an intense yellow color, which is not visible if examined through a blue glass. They are mostly readily soluble in water, and these solutions yield with hydrofluosilicic acid

gelatinous precipitates, and, when neutral or alkaline, afford with potassium metantimonate white crystalline precipitates. Similar precipitates are obtained with most other metallic salts, which must therefore be removed by the proper reagents, with the exception of those of potassium, before the test for sodium be applied.

Sodii Peroxidum, *Natrium superoxydatum s. peroxydatum. Sodium peroxide,* E.; *Natrium-superoxyd,* G. $NaO(Na_2O_2)$. This is the only oxide of sodium known with certainty. The oxide Na_2O, mentioned in nearly all text-books, cannot be made (Forcrand). The peroxide is made on a large scale by heating at 400° C. (752° F.) metallic sodium in shallow aluminum pans placed in long ovens through which air freed from moisture and carbon dioxide is passed. It is an almost white powder, more difficultly fusible than the hydroxide, very soluble in water with foaming and a great rise of temperature, the foaming being due to the decomposition of hydrogen peroxide which is first formed. Its chief use is as a bleaching agent, through the hydrogen peroxide generated when the powder is added to ice-cold dilute mineral acids, $Na_2O_2 + 2HCl = 2NaCl + H_2O_2$. It is also used in analytical chemistry as an oxidizer in place of nitrate and chlorate.

UNOFFICIAL SODIUM SALTS.

Sodii Caffeino-sulphonas.—*Sodium caffein-sulphonate,* E.; *Koffeinsulfosaures Natrium,* G. Symphorol-Na. Symphorol, $C_8H_9N_4O_2.SO_3Na$. Prepared by heating 100 parts of chlorocaffeine or an equivalent of bromocaffeine with 75 parts of anhydrous sodium sulphite and 1000 parts of water in an autoclave to 150° C. (302° F.) for 8 hours, the sodium caffeinsulphonate crystallizing out on cooling. A white crystalline powder having a bitter taste, and soluble in about 20 parts of water. This salt is recommended as a diuretic in dropsy and obesity. Its dose is from 15 to 60 grains (1–4 Gm.) a day.

Symphorol-L and Symphorol-Sr are the respective lithium and strontium salts.

Sodii Ethylas.—*Natrium æthylicum, sodium ethylate,* C_2H_5ONa. Obtained by action of sodium on absolute alcohol, hydrogen escaping. By evaporation, a pale reddish-yellow powder is obtained, having a caustic taste and soluble in water and alcohol. Used externally as a caustic of milder action than that of sodium hydroxide. Water decomposes it into alcohol and sodium hydroxide. Liquor sodii ethylatis is official in the Br. P., and is made by dissolving 1 Gm. of sodium in 20 Cc. of absolute alcohol. Sodium ethylate is applied in 10 per cent. aqueous solution in the treatment of lupus, psoriasis, and other skin diseases.

Sodii Ethylsulphas *s.* Sulphovinas.—*Sodium ethylsulphate* or *sulphovinate,* E.; *Sulfovinate de soude,* Fr. Cod.; *Aethylschwefelsaures Natrium,* G. $C_2H_5SO_4Na.H_2O$.—Sulphovinic acid is formed by mixing equal weights of alcohol and sulphuric acid, the mixture becomes hot and combination takes place thus, $C_2H_5OH + H_2SO_4 = C_2H_5HSO_4 + H_2O$. The mixture is treated with $BaCO_3$ (or $CaCO_3$), which forms soluble barium sulphovinate and precipitates any excess of free sulphuric acid. The mixture is filtered and the filtrate treated with sodium carbonate, which gives sodium sulphovinate and insoluble barium (or calcium) carbonate. The liquid is then evaporated at moderate heat and crystallized. Sodium sulphovinate crystallizes in shining, transparent, flat, six-sided tables, which effloresce on exposure to dry air. When obtained by spontaneous evaporation, the salt is granular and forms white opaque crystalline aggregations; and if crystallized from an alcoholic solution it contains alcohol in the place of water of crystallization. Heated to about 80° C. (176° F.), the crystals melt and rapidly part with their water, amounting to 10.8 per cent.; and if the heat is increased to 100° C. (212° F.) or a little above this point, the salt is decomposed, with the formation of sodium sulphate, charcoal, heavy oil of wine, and of sulphurous acid, ethylene, and other gases. The aqueous solution of the salt, when heated to boiling, is decomposed, in the same manner as all sulphovinates, into alcohol, which distils off, and acid sodium sulphate: this decomposition takes place more rapidly in concentrated than in diluted solutions. Crystallized sodium sulphovinate dissolves at ordinary temperatures in a little more than half its weight of water, and is soluble in glycerin and ordinary alcohol, sparingly soluble in absolute alcohol, and insoluble in ether. Its solution is neutral to test-paper and has a slightly bitter, afterward sweetish, taste. The aqueous solution of the salt should yield only a slight precipitate with barium chloride (sulphate), should not be colored by hydrogen sulphide (absence of lead), and should not be rendered turbid by sodium carbonate (absence of lead, barium, and calcium).

Sodii Fluoridum.—*Sodium fluoride,* E.; *Fluorwasserstoffsaures Natrium,* G.; *Fluorol,* NaF.—This is obtained by neutralizing hydrofluoric acid with sodium hydroxide. It is a white crystalline powder, soluble in 25 parts of water, and has a saline taste. It attacks glass, and should be kept in rubber bottles. Given in epilepsy, malaria, skin diseases, tuberculosis, in doses of $\frac{1}{12}$ to $\frac{1}{6}$ grain (0.005–.01 Gm.). Externally as antiseptic in aqueous solution, 0.5 to 10 to 1000. Technically to prevent lactic and butyric fermentation in the manufacture of alcohol, 10 to 15 Gm. NaF to 1000 liters of mash.

Sodii Formas.—*Sodium formate. Ameisensaures Natrium*, G. $HCO_2Na.H_2O$.—It is prepared by neutralizing formic acid with pure sodium carbonate or bicarbonate. It crystallizes in colorless rhombic plates or prisms, which are inodorous, have a saline bitter taste, melt in their water of crystallization, are deliquescent in moist air, and dissolve freely in water.

Sodii Glycerophosphas.—*Sodium glycerophosphate.* $C_3H_7O_3PO_3Na_2.H_2O$.—Obtained by neutralizing glycerophosphoric acid (which see). It occurs in the market as a 50 per cent. solution of a clear, light-yellow color. Used in convalescence, nervous asthma, and when the system needs phosphorus, in dose of 3 to 4 grains (0.2–0.25 Gm.) a day subcutaneously. As a substitute for jaborandi, when the latter is objectionable, injections on each side of the lumbar region are given in dose of 5 to 8 grains (0.3–0.5 Gm.) a day.

Sodii Methylsulphas.—*Sodium methylsulphate.* $CH_3SO_4Na.H_2O$. Prepared precisely like the ethylsulphate, except that methylic alcohol is substituted for ordinary alcohol. It resembles the sulphovinate in properties, and has been recommended for similar purposes.

Sodii Nitroferricyanidum.—*Sodium nitroferricyanide* or *nitroprusside.* $Na_2Fe(CN)_5NO.2H_2O$.—This is a salt of nitroferrocyanic acid, which is obtained by the action of nitric acid on potassium ferrocyanide. Potassium nitrate is crystallized out by concentrating and cooling the solution, which is then neutralized by sodium carbonate, and the sodium salt crystallized. Addition of alcohol increases the separation of potassium nitrate. The salt forms large ruby-red crystals, soluble in 2.5 parts of water and in alcohol. The aqueous solution decomposes on standing. It serves as a delicate test for soluble sulphides (but not free H_2S), giving a purple color which quickly passes into violet. It is also used as a test for acetone (Legal's test).

Sodii Oleas.—*Sodium oleate, Eunatrol.*—This preparation is supposed to be pure sodium oleate, but, according to B. Fischer, consists of 70 per cent. of the oleate and 30 per cent. of free oleic acid. It is made by saponifying 100 parts of oleic acid with 10 parts of pure dry caustic soda in alcoholic solution and evaporating to dryness. It is a white, soft, soapy mass, weakly alkaline to litmus, and forms a murky solution. It is used in pill form, in dose of 15 grains (1 Gm.), twice daily as a cholagogue.

Sodii Silicas.—*Sodium silicate.* Na_2SiO_3.—This is made by fusing at high heat 100 parts of anhydrous sodium carbonate and 56.6 parts of powdered quartz (SiO_2). By dissolving the mass in water and concentrating, crystals of the salt may be obtained, which, when redissolved in water, give a solution of so-called water glass, which has been given internally for gout, in dose of 5 to 15 grains (0.3–1 Gm.) of a $33\frac{1}{3}$ per cent. solution, diluted with much water, 3 or 4 times daily. Externally it is used to impregnate paper, linen, gauze, etc., for bandages; when used for this purpose it should be free from excess of alkali, which would corrode the skin. It is also used technically for making objects fireproof, manufacturing artificial stone, cements, etc. Its solution, official in the U. S. P., 1890, is used in making splints for fractures, dislocations, etc.

Sodii Sulphoricinas.—*Sodium sulphoricinate, Solvin, Polysolve.*—A brownish, thick liquid, soluble in alcohol and water, and used as a solvent for phosphorus, iodine, iodoform, naphthalene, phenol, resorcin, etc., for antiseptic purposes. Concentrated sulphuric acid, acting on fats or fatty acids, gives sulphoricinic acid, from which the sodium salt is obtained by neutralization.

Sodii Valerianas.—*Sodium valerianate, Valérianate de soude*, Fr.; *Baldriansaures Natrium, Natriumvalerianat*, G. $C_5H_9O_2Na$.—Obtained by neutralization of valerianic acid (which see) with sodium hydroxide and crystallizing. It forms a white crystalline mass, which is rather unctuous to the touch, and has a neutral or slight alkaline reaction, a weak odor of valerian when perfectly dry, and a sweet and valerian-like taste. It melts at 140° C. (284° F.) without decomposition to a colorless liquid, and on cooling congeals crystalline; at a higher heat it gives off pungent acid vapors and inflammable gas, and leaves 42.75 per cent. of sodium carbonate. The salt is freely soluble in alcohol and water, and on exposure to the atmosphere liquefies from the absorption of water. On the addition of diluted sulphuric acid a strong odor of valerianic acid is given off. The solution of sodium valerianate in water should not be colored by hydrogen sulphide and ammonium sulphide (absence of metals), and should yield no precipitate with barium chloride (absence of sulphate). Sodium valerianate may be used interchangeably with ammonium valerianate. Its dose is from 5 to 20 grains (0.30–1.30 Gm.).

Phenol Sodium Sulphoricinate is the only preparation of importance, and occurs in the market in two forms, containing respectively 25 and 30 per cent. of phenol. It is used as a local caustic in nasal and laryngeal papilloma and ulcers and chronic inflammations.

SOLANACEÆ.—The Potato Family.

The potato family, most largely represented in tropical and almost wanting in cool-temperate regions, comprises some 75 genera and probably not far from 2000 species, though only about 1600 are admitted by Wettstein.

FOOD-PLANTS.

As represented by the potato, tomato, egg-plant, pepper, physalis, and less well-known tropical fruits, it is one of the great food-families of plants.

The *tomato* (*Lycopersicum esculentum* L.), at first regarded as poisonous, later suspected of causing cancer and, not so very long ago, condemned by the British army as unwholesome, has now proved itself one of the most wholesome of juicy vegetables. Abundant, cheap, and readily preserved, it has come to be of the greatest value as an addition to the winter diet, and to the bill of fare of soldiers, sailors, and others unable to secure fresh food. It has even been credited with medicinal properties, an idea which, in the absence of experimental evidence, can be regarded as probably correct. Davis reported obtaining from the fruit, upon distillation with water, an oil identical with volatile oil of mustard. Briosi and Gigli reported from 0.4 to 0.65 per cent. of citric acid and traces of tartaric acid, as well as of an alkaloid, in the juice. Levulose was present, and the coloring-matter was reported as showing resemblances to that of saffron.

Physalis L.—A number of the 45 species of this genus produce delicious edible fruits, some varieties of which are important articles of trade in the West Indies, Mexico, and other Andean countries, under the name *Tomatillo*. *Alkekengi* (*Fructus* or *Baccæ Alkekengi* or *halicacabi*.—*Strawberry-tomato*, *Winter-cherry*, *Ground-cherry*, *Bladder-fruit*, E.; *Indenkirsche*, *Blasenkirschen*, *Schluta*, G.; *Coqueret*, Fr.; *Alkekenges*, Sp.) is the fruit of *P. Alkekengi* L. (*Alkekengi officinarum* Moench.), a European species, extensively cultivated. Other species, especially *P. Peruviana* L. (*Alkekengi pubescens* Moench.), and the Mexican *P. ixocarpa* Bert. (*P. æquata* Jacq.), bear similar names. Alkekengi is borne upon a low-spreading, softly-hairy herb. The fruit is spherical, of the size of a cherry, scarlet red, shining, and remains enclosed in the inflated orange-colored permanent calyx. It is 2-celled, and contains numerous white flattish ovate seeds attached to a central placenta. In the fresh state the fruit is very juicy and has a sweet and acidulous taste; it shrivels considerably on drying. The fruit has a composition similar to that of the tomato, though more sugary. The herbage contains an amorphous bitter principle *physalin*, $C_{14}H_{16}O_5$, which is obtained as a whitish powder on agitating the cold aqueous infusion with chloroform, and is soluble in chloroform and alcohol, but sparingly so in ether, cold water, and diluted acids.

MEDICINAL PLANTS.

Although several of the plants referred to above have more or less medicinal repute, they are to be regarded rather as food-plants than distinctly medicinal, as are those which follow. The most important, as well as the most common, medicinal properties of this family reside in the so-called mydriatic or solanaceous alkaloids which have been discussed separately and in connection with Belladonna, *Duboisia*, Dulcamara, and other solanums, Hyoscyamus, Scopola, and Stramonium. Very different properties, exceptions in the family, are represented in *Nicotiana*, *Fabiana*, and Capsicum. The family contains many secondary drugs possessing mydriatic, and a few possessing special properties, the most important of which are considered below:

Mandragora, the *European Mandrake*, *Mandrake Apple* or *Devil's Apple* (*Alraunwurzel*, *Schlafapfel*, G.), is the plant, more especially its root, *M. officinarum* L. (*M. officinalis* Mill.; *M. vernalis* Bertol.; *Atropa Mandragora* L.), and is a most ancient narcotic drug, the mandrake of the Bible. It was probably due to the peculiar form of the root, which often bears a fancied resemblance to that of the human body, that aphrodisiac properties were attributed to it. Its real properties, which are pronounced, are due to its mydriatic alkaloids, originally called *mandragorine*, now known to be practically identical with those of stramonium and hyoscyamus. Wentzel isolated a little alpha-methoxy-methylpiperidine, myristic acid, phytosterin, chrysatropic acid ($C_{10}H_8O_4$), and glucose.

There are 3 or 4 species in this genus, and the others probably share in the properties of that above described.

Lycium L. is a genus of some 70 species, several of which have been used for their mydriatic and diuretic properties, notwithstanding that the fruits of some are edible, and the young herbage of others cooked as a table vegetable. *L. vulgare* (Ait. f.) Duval (*L. Barbarum vulgare* Ait. f.), the *Matrimony Vine*, *Bastard jasmine* or *Box Thorn*, native of Europe and cultivated as an ornamental shrub, has been used as a mydriatic, though it is said that its alkaloid is only *betaine*, and this artificially derived by chemical manipulation. The facts may be considered as not yet established.

Manaca, Manacan, Mercurio Vegetal, Camganiba, or *Geratacaca,* is the root of *Brunfelsia Hopeana* Benth. (*Franciscea uniflora* Pohl), a large shrub of the Amazon valley. The drug is a crooked, branching, hard and tough woody root, the outer surface purplish red, either smooth or somewhat fissured and scaling, the wood yellowish white. The bark has a not strong narcotic and nauseous taste. Its most important constituent appears to be resin, though a crystalline powder of alkaloidal character has been imperfectly described under the name *manacine.*

The fruit of *Nicandra physaloides* Gaertn., of Peru, sparingly naturalized elsewhere, is used as a diuretic. The leaves of *Cestrum Parqui* L'Her., the *Parqui* or *Palqui* of Chili, are highly narcotic, poisonous, and both they and the wood are employed medicinally, as are a dozen others of the 159 species of this genus, and several of the similar plants *Sessea* and *Vestia.* In all, some 250 members of the *Solanaceæ* are recorded as being used medicinally.

Lachnanthes.—Although this drug, also called *Red-* or *Paint-root, Spirit-weed* or *Wool-flower,* is not at all related to the *Solanaceæ,* it is mentioned here because the effects of overdoses are said to resemble those of mild poisoning by belladonna and other solanaceous drugs. It is the entire plant, but especially the rhizome and roots, of *Gyrotheca capitata* (Walt.) Morong (*Anonymos c.* Walt.; *Lachnanthes tinctoria* Ell.; *Gyrotheca t.* Salisb.), growing in damp soil in the pine barren regions, along the Atlantic coast and in Cuba. The plant is a perennial herb about 4 to 6 Dm. (1½ to 2 Ft.) high, the upper portions white-woolly. The rhizome is about an inch in length and of nearly equal thickness and bears a large number of long, coarse, somewhat waxy, deep-red roots. The leaves are mostly borne in basal rosette and somewhat succulent, falcate, 5 to 15 Mm. (⅕ to ⅗ In.) wide, and reduced to bracts upward upon the stem. The flowers are in a close, woolly cyme, the ovary inferior, the perianth six-parted, the sepals narrower than the petals, the stamens 3, alternating with the petals, on long filaments; the style is solitary, filiform, and declined, its stigma slightly 2-lobed; the fruit a 3-celled, many-seeded, rounded, and truncate capsule. The constituents of the plant are entirely unknown, but are quite active, producing a peculiar form of cerebral stimulation or narcosis. In the country where it grows, there is a legend that it is fatally poisonous to white pigs, but not injurious to black ones. Aside from its narcotic use among the Indians, it has been used for dyeing purposes. The drug is used by the Eclectics and Homœopaths in the usual unscientific and indefinite manner for various nervous disorders.

SPARTEINÆ SULPHAS, *U. S.*—Sparteine Sulphate.

Sulfate de spartéine, Fr. Cod.; *Sparteinum sulfuricum.*—*Sparteinsulfat, Schwefelsaures Spartein,* G.

Formula, $C_{15}H_{26}N_2.H_2SO_4 + 5H_2O$. Molecular weight, 419.26.

The sulphate of an alkaloid obtained from Scoparius. It should be kept in well-stoppered amber-colored vials.—U. S.

Preparation.—Sparteine sulphate may be prepared by dissolving the alkaloid sparteine (see p. 1371), preferably recently distilled, 10 parts, in 40 parts of diluted (10 per cent.) sulphuric acid and allowing the solution to crystallize in a warm place.

Properties and Tests.—Sparteine sulphate occurs as colorless, rhombohedral crystals, or as a crystalline powder, which are odorless and have a slightly saline and somewhat bitter taste. It crystallizes with varying amounts of water of crystallization, but when recrystallized from a solution in diluted alcohol it contains 5 molecules of water. It is soluble in 1.1 parts of water, and in 2.4 parts of alcohol at 25° C. (77° F.); insoluble in ether and chloroform. When heated to 110° C. (230° F.), the salt loses all of its water of crystallization (21.3 per cent.), and when anhydrous, melts at 136° C. (276.8° F.). It is hygroscopic, and its aqueous solution has an acid reaction upon blue litmus-paper. If 25 Cc. of ether be added to about 0.1 Gm. of sparteine sulphate in a test-tube, followed by a few drops of diluted ammonia-water, avoiding an excess, and if an ethereal solution of iodine (1 in 50) be afterwards added until the liquid, when shaken, turns from an orange to a dark reddish-brown color, the bottom and sides of the test-tube will, after a short time, be coated with minute, dark greenish-brown crystals. Barium chloride test-solution, in an aqueous solution of sparteine sulphate, produces a white precipitate insoluble in hydrochloric acid. If a solution of potassium ferrocyanide (1 in 20) be added to a solution of the salt a yellow precipitate is produced. Sulphuric acid, when added to sparteine sulphate, should not become colored (absence of sugar and other readily carbonizable organic impurities). On shaking 0.05 Gm. of sparteine sulphate in a test-tube, with 5 Cc. of potassium hydroxide test-solution, the liquid will at first be turbid, and small drops of sparteine will gradually

collect on the surface. If a strip of moistened red litmus-paper be suspended in the mouth of the test-tube, and a gentle heat then applied, the test-paper will gradually acquire a blue color, but no odor of ammonia should be perceptible (absence of ammonium salts).—U. S.

Action and Uses.—The properties and uses of sparteine sulphate are considered under SCOPARIUS. Its dose varies, is from ½ to 2 grains (0.008–0.12 Gm.).

SPECIES AROMATICÆ, *P. G.*—Aromatic Herbs.

Espèces aromatiques, Fr.; *Gewürzhafte Kräuter*, G.

Preparation.—Peppermint (leaves), wild thyme (herb), thyme (herb), lavender (flowers), of each 2 parts; cloves, 1 part. Having cut these drugs into fine particles, add 1 part of coarsely-powdered cubebs and mix the whole thoroughly.—P. G.

SPECIES DIURETICÆ, *P. G.*—Diuretic Tea.

Espèces diuretiques, Fr.; *Harntreibender Thee*, G.

Preparation.—Lovage (root), rest-harrow (root), licorice (root), of each 1 part. Having cut these drugs into coarse particles, add 1 part of juniper berries, previously crushed, and mix thoroughly.—P. G.

SPECIES EMOLLIENTES, *P. G.*—Emollient Herb-mixture.

Espèces emollientes, Fr.; *Erweichende Kräuter*, G.

Preparation.—Marshmallow (leaves), mallow (leaves), melilot (herb), German chamomile (flowers), flaxseed, of each 1 part. Having ground the drugs to a coarse powder, they are thoroughly mixed.—P. G.

SPECIES LAXANTES, *P. G.*—Purgative Tea.

Espèces purgatives, Fr.; *Abführender Thee*, G.

Preparation.—Senna, in very coarse powder, 160 parts; elder flowers, 100 parts; fennel, crushed, 50 parts; anise, crushed, 50 parts; potassium tartrate, 25 parts; tartaric acid, 15 parts. Dissolve the potassium tartrate in 50 parts of water and moisten the fennel and anise uniformly with the solution; after 30 minutes dissolve the tartaric acid in 15 parts of water and add this solution to the previous mixture and dry the whole with the aid of gentle heat. Finally add the senna and elder flowers and mix thoroughly.—P. G.

SPECIES LIGNORUM, *P. G.*—Wood Tea.

Species ad decoctum lignorum.—Espèces sudorifiques, Fr.; *Holzthee*, G.

Preparation.—Guaiac (wood), 5 parts; rest-harrow (root), 3 parts; licorice (root), 1 part; sassafras (bark), 1 part. Having coarsely cut or crushed the drugs, they are thoroughly mixed.—P. G.

SPECIES PECTORALES, *P. G.*—Pectoral Tea.

Espèces pectorales, Fr.; *Brustthee*, G.

Preparation.—Marshmallow (root), 8 parts; licorice (root), 3 parts; orris (root), 1 part; colt's foot (leaves), 4 parts; mullein (flowers), 2 parts; anise, crushed, 2 parts. Reduce the marshmallow, licorice, orris, colt's foot, and mullein to a very coarse powder and mix with the anise.—P. G.

SPIGELIA, *U. S.*—Spigelia.

Pinkroot, Maryland, Carolina or Indian Pink, Worm-grass or *Worm-weed, Starbloom*, E.; *Marylandische Spigelia*, G.; *Spigélie du Maryland, Spigélie anthelmintique*, Fr.; *Cravo do Carolina*, Port.

The dried rhizome and roots of *Spigelia Marilandica* L. (Fam. *Loganiaceæ*).

Spigelia is official in several other pharmacopœias, most of which name *S. Anthelmia* L. ("*S. anthelmintica*," Ph. Belg.), and specify the flowering plant.

Origin.—The Maryland pink is a simple-stemmed, nearly smooth, perennial herb, a foot or two high, of the habit shown in the accompanying illustration. The flowers are scarlet red externally reddish, yellow within. It occurs sparingly north of Maryland and southern Ohio, extending as far as Wisconsin and New Jersey. South of these points it was formerly very abundant, but has been largely destroyed by collection. Owing to a similarity of name, the rhizome and roots of *Ruellia* (Fam. *Acanthaceæ*) have been very extensively mixed with and sold for it.

Description.—The rhizome of oblique and sharply flexuous growth, somewhat branched, mostly 2.5 to 5 Cm. (1–2 In.) long and 2 to 4 Mm. ($\frac{1}{12}$–$\frac{1}{6}$ In.) thick, knotty from the approximate stem-bases of the upper surface, which bear cup-shaped scars, dark brown or blackish, thickly clothed underneath and at the sides with long, rather coarse, finely branched, lighter-brown roots, which are usually broken shortly, not leaving a long, bare, woody central portion; brittle, showing a whitish wood and a dark or decayed pith; somewhat aromatic; taste sweetish, bitter, and somewhat pungent.

The larger, lighter colored rhizome of *Ruellia*, Sp., with fewer coarse roots, from which the bark readily separates, is frequently substituted or admixed.

Fig. 405. Fig. 406.

Spigelia: flowering-top (½ Nat.); rhizome with roots (enlarged ⅕).

The powder is dark brown and is characterized by the presence of numerous rounded and oblong stone-cells, the latter blunt to nearly square at the ends, by cells containing single quadrangular crystals of calcium oxalate, occasional acicular raphides, and rather few starch-grains.

Adulterants and Substitutes.—Spigelia is so far subject to sophistication that an absolutely genuine and pure article is probably the exception. Besides the ruellia referred to above, the rhizome and roots of *Phlox glaberrima* L. are said to be used in some localities. It is somewhat darker and less ridged than ruellia and more closely resembles spigelia. The drug, and still more the adulterant, are very apt to retain an undue amount of earthy matter.

Constituents.—The active constituent of spigelia appears to be the volatile, crystallizable alkaloid *spigeline*, obtained by distillation with milk of lime. The constitution of this alkaloid has not been investigated. It is soluble in both alcohol and water, yields with iodine a brownish-red precipitate, with metatungstic acid a white flocculent precipitate, and with Mayer's reagent a white crystalline precipitate, soluble in alcohol and ether, and differing from the precipitates of other alkaloids produced in this way in being soluble in acids. There is also present in spigelia a small amount of volatile oil, fat,

wax, tannin, and a tasteless resin. Whether there is a specific bitter principle in addition to spigeline is uncertain.

Pharmaceutical Preparation.—Fluidextract of Spigelia, U. S. P.

Action and Uses.—The anthelmintic properties of spigelia have been known to the medical profession of America since 1754, when its employment was recommended by three South Carolina physicians, Drs. Lining, Garden, and Chalmers, who learned of its virtues from the aborigines. The symptoms produced by toxic doses of the drug upon the human organism were described by Dr. Chalmers, and correspond closely to those observed by Dr. H. A. Hare in his experiments with spigelia upon dogs. They consist in a hot, dry skin and fauces, an accelerated circulation, dilated pupils, internal strabismus, exophthalmus, general motor paralysis, drowsiness deepening into coma, slowed respiration, and death from paralysis of the respiratory centre. In the proper dose, spigelia is a safe and efficient anthelmintic, particularly if it be followed by a rapidly acting purge, as magnesium sulphate. The dose of spigelia is from 10 to 20 grains (0.60–1.30 Gm.) to a child under 5 years of age, and from ½ to 2 drachms (2–8 Gm.) to an adult. It is commonly given in infusion in combination with purgative and aromatic drugs, as senna, manna, and fennel. The fluidextract of spigelia and senna formerly official is a convenient and efficient preparation, given in the dose of ½ drachm (2 Cc.) to a child, and as much as ½ ounce (16 Cc.) to an adult. The dose of the fluidextract is the same as of the drug in substance.

Other Spigelias.—The genus *Spigelia* L. comprises some 30 species, all American, mostly tropical, and several of them are employed like the official. This is especially true of *S. Anthelmia* L., native of the West Indies and northern South America, where it is very abundant. It has a similar habit to Pinkroot, but the lance-ovate acuminate leaves are mostly in whorls of 4, the light-reddish flowers are only half an inch long, the rhizome is short, blackish externally, whitish internally, and bears numerous long, thin roots. The drug has a stronger narcotic and bitter taste than the official. It has been introduced to use in Europe, and the Belgian Pharmacopœia specifically states that it is more active than our official species.

SPIRITUS.—Spirits.

Alcoolats, Fr.; *Geiste*, G.

Spirits were formerly prepared almost exclusively by distilling odorous substances with alcohol; at present, however, both the United States and British Pharmacopœias direct most of them to be prepared simply by dissolving the volatile oils and other volatile compounds in alcohol. Whenever volatile oils are used in the preparation of spirits, only the very best should be selected, as the value of the finished product depends entirely upon the quality of the oil; particular attention should be paid to those oils likely to have acquired a terebinthinate odor, such as the oils of juniper, lemon, nutmeg, and orange peel. Since odorous principles volatilize only sparingly with the vapors of alcohol, but more freely with the vapors of water, distilled spirits are made with alcohol sufficiently diluted with water, so that a portion of the latter remains in the still on the completion of the process. The German Pharmacopœia usually directs alcohol and water in the proportion of 3 parts of the former to 3 or 5 parts of the latter; after due maceration with the bruised drug 4 parts by weight of distillate are recovered. The alcoolats of the French Codex are generally made with 60 or 80 per cent. alcohol, the fresh drugs being used whenever practicable. In all cases the alcohol employed should be free from fusel oil, and the drugs should be well bruised and macerated with the alcohol for one or several days before distillation is commenced. In distilling spirits the same precaution should be adopted as in the distillation of medicated waters, with this addition, that ample provision be made for the complete condensation of the vapors. Heat is best applied by means of steam or on a small scale by means of a salt-water bath.

SPIRITUS ÆTHERIS, *U. S., Br.*—Spirit of Ether.

Spiritus œthereus, P. G.; *Liquor anodynus mineralis Hoffmanni, Æther sulfuricus alcoolisatus, Éther officinal alcoolisé*, Fr. Cod.—*Éther sulfurique alcoolisé, Liqueur d'Hoffmann*, Fr.; *Hoffmannstropfen*, G.

Preparation.—Ether, 325 Cc.; alcohol, 675 Cc.; to make 1000 Cc. Mix them.—U. S. Ether, 10 fluidounces; alcohol (90 per cent.), 20 fluidounces.—Br. Ether and alcohol, of each equal weight.—Fr. Cod. Ether, 1 part; alcohol, 3 parts.—P. G.

This preparation is used in Europe as a simplified form of *Hoffmann's anodyne* and for similar purposes.

Uses.—Spirit of ether may be used in all cases for which ether is prescribed internally. Its dose is from 1 to 3 drachms (4–12 Cc.).

SPIRITUS ÆTHERIS COMPOSITUS, *U. S., Br.*—Compound Spirit of Ether.

Hoffmann's anodyne, E.; *Liquor nervine de Bang*, Fr.; *Zusammengesetzter Ätherweingeist*, G.

Preparation.—Ether, 325 Cc.; alcohol, 650 Cc.; ethereal oil, 25 Cc.; to make 1000 Cc. Mix them.—U. S.

To prepare 10 fluidounces of compound spirit of ether, mix 3¼ fluidounces of ether, 2 fluidrachms of ethereal oil, and 6½ fluidounces of alcohol.

Take of ether 5½ fluidounces; alcohol (90 per cent.), 78 fluidounces; sulphuric acid, 36 fluidounces; distilled water, 1½ fluidounces; sodium bicarbonate, a sufficient quantity. Gradually mix the sulphuric acid with 40 fluidounces of the alcohol; let the mixture stand for 24 hours. Then distil slowly until the thermometer, the bulb of which is within the liquid, indicates a temperature of 171.6° C. (341° F.). Pour the distillate into a separator, and, after separation is complete, remove the lower layer. Add the distilled water to the upper layer, and also, gradually, sodium bicarbonate, until after agitation the liquid is nearly neutral to litmus-paper. Separate the ethereal liquid, and add to it the ether and 38 fluidounces of the alcohol. Filter.—Br.

Properties.—Compound spirit of ether is a colorless, inflammable liquid, entirely volatilized by heat, but when ignited on glass or porcelain it leaves an almost invisible residue having an acid taste and reddening blue litmus-paper. The spirit is neutral to test-paper, or has only a very slight acid reaction. It has an aromatic ethereal odor and a pungent, slightly sweetish taste. When mixed with water a whitish turbidity is produced from the separation of oil of wine, and a slight opalescence is still observed if 40 drops of the spirit are mixed with a pint of water. If adulterated with a fixed oil, this will separate from the water as a thin film, which, when absorbed by bibulous paper, produces a permanent greasy stain, not disappearing by heat. On evaporating some of the spirit with an excess of aqueous solution of barium chloride, a white precipitate of barium sulphate is produced.

While an assay method for determination of the ethyl sulphate content of a compound spirit of ether would be desirable, the U. S. P. names neither properties nor tests for the preparation. The Brit. Pharm. makes the following statements: "A colorless mobile liquid, with characteristic ethereal odor and taste. Specific gravity, 0.808 to 0.812. It gives an opalescent solution when mixed with twice its volume of water. 2 or 3 Cc. evaporated spontaneously on a watch-glass should not yield a residue having an unpleasant odor (absence of empyreumatic impurities)."

The preparations of the two pharmacopœias resemble each other in composition, that of the U. S. P. being more definite and containing a larger proportion of ether. Unfortunately much of the commercial article sold under the name of Hoffmann's Anodyne fails to correspond to the official spirit, and care is necessary in the purchase and use of the same. It is rarely made by the official formula, but is obtained in the manufacture and rectification of ether as a by-product, the last fraction of the distillate, consisting of a mixture of alcohol and ether containing small proportions of light and heavy oil of wine being collected. This is variously diluted with alcohol, ether, and water, so as to bring the product up to an arbitrary standard fixed by the manufacturer and somewhat resembling the official spirit. These inferior products can be readily distinguished from the official by a markedly decreased turbidity upon admixture with water, and also in producing only a slight precipitate with barium chloride solution. They should never be dispensed when compound spirit of ether is prescribed.

Action and Uses.—Compound spirit of ether is stimulant, antispasmodic, and anodyne. From experiments with heavy oil of wine, Dr. H. A. Hare concludes that it does not possess the sedative action ascribed to it, and that the calmative effect of Hoffman's anodyne depends largely upon the ether. It is an excellent carminative, acting promptly and thoroughly. Given by rectal injection in the dose of ½ ounce (16 Cc.), diluted with water or milk of asafetida, it is the best remedy to relieve tympanites occur-

ring in typhoid fever and peritonitis. For the acute cardiac palpitation, nausea, and depression due to excessive use of tobacco, no other drug is quite so efficacious. It gives prompt relief in many cases of hiccough. Attacks of angina pectoris, induced by gaseous distention of the stomach, soon yield to full doses of Hoffman's anodyne. It may be employed to allay the restlessness and insomnia of nervous irritation and hysteria. The dose of compound spirit of ether is from ½ to 2 drachms (2–8 Cc.). It should always be diluted with cold water before it is taken.

SPIRITUS ÆTHERIS NITROSI, *U. S., Br., P. G.*—Spirit of Nitrous Ether.

Spiritus nitri dulcis; Spiritus nitrico-æthereus.—Sweet spirit of nitre, E.; *Éther azoteux alcoolisé, Liqueur anodine nitreuse,* Fr.; *Versüsster Salpetergeist, Salpeteræther-weingeist,* G.

An alcoholic solution of ethyl nitrite ($NO.OC_2H_5$), yielding, when freshly prepared and tested by the process given below, not less than 4 per cent. of ethyl nitrite.—U. S.

An alcoholic solution containing ethyl nitrite, aldehyde, and other substances.—Br.

Preparation.—Sodium nitrite, 100 Gm.; sulphuric acid, 40 Cc.; monohydrated sodium carbonate, 0.6 Gm.; potassium carbonate, completely deprived of water by drying, 3 Gm.; alcohol, water, of each a sufficient quantity. Mix the sulphuric acid with 120 Cc. of water, cool the liquid, add 85 Cc. of alcohol previously diluted with an equal volume of water, and introduce the solution into a 1000 Cc. flask, surrounded by a mixture of ice and water. Dissolve the sodium nitrite in 280 Cc. of water, filter, and, having poured the filtrate into a separatory funnel, allow the liquid to slowly drop into the flask containing the acid mixture. When all has been added and the reaction is complete, allow any crystals which may have formed to settle at the bottom of the flask, and decant the cold mixture of ethyl nitrite and aqueous solution quickly to the previously cleaned separatory funnel, and draw off and discard the aqueous liquid. Wash the separated ethyl nitrite, first, with 20 Cc. of ice-cold water, and then remove any traces of acid by washing it with 15 Cc. of ice-cold water, in which the monohydrated sodium carbonate has previously been dissolved. Carefully separate the ethyl nitrite from the aqueous liquid, and agitate it in a well-stopped vial with the potassium carbonate to remove traces of water. Then cool the liquid, decant, and pour the ethyl nitrite immediately into a tared bottle containing 500 Gm. of alcohol. Ascertain the weight of the ethyl nitrite poured into the alcohol by noting the increase in weight of the tared bottle and contents, and then add enough alcohol to make the mixture weigh 22 times the weight of the ethyl nitrite added. Lastly, transfer the product to small, well-stoppered, dark amber-colored vials, and keep these in a cool place, remote from lights or fire. —U. S.

Take of nitric acid 3 fluidounces; sulphuric acid, 2 fluidounces; copper, 2 ounces; alcohol (90 per cent.), a sufficient quantity. To 1 pint of the alcohol add gradually the sulphuric acid, stirring them together; then add in the same way 2½ fluidounces of the nitric acid. Put the mixture into a retort or other suitable apparatus into which the copper has been introduced and to which a thermometer is fitted. Attach now an efficient condenser and receiver, the latter containing 20 fluidounces of the alcohol, and applying a gentle heat, let the alcohol distil at a temperature commencing at 170° F., but not exceeding 180° F., until the volume of liquid in the receiver has been increased to 32 fluidounces, the receiver and condenser being kept cool with ice-cold water; then withdraw the heat, and having allowed the contents of the retort to cool, introduce the remaining ½ ounce of nitric acid, and resume the distillation as before until the liquid in the receiver has been increased to 34 fluidounces. Mix this liquid with 1 pint of the alcohol, or as much as will make the product contain 2½ per cent. of ethyl nitrite when tested as described below. Preserve it in well-closed vessels.—Br.

In the process of the U. S. P., which is based on the suggestions of Dunstan and Short, sodium nitrite is decomposed by sulphuric acid, and the nitrous acid, in its nascent state, attacks the alcohol, forming ethyl nitrite and water, as shown by the following equation: $NaNO_2 + H_2SO_4 = HNO_2 + NaHSO_4$; $C_2H_5OH + HNO_2 = C_2H_5NO_2 + H_2O$. The newly-formed ethyl nitrite rises as an oily layer to the surface. In order that a large yield of ethyl nitrite may be insured, it is essential that the tube of the separator be allowed to reach nearly to the bottom of the flask containing the alcohol

and sulphuric acid mixture, and that the solution of sodium nitrite be allowed to flow into the flask very slowly in drops, the flask being kept thoroughly cold during the reaction. From the above equation it will be seen that 68.57 Gm. of absolute sodium nitrite are capable of yielding 74.51 Gm. of ethyl nitrite, and if the official salt (containing at least 90 per cent. of $NaNO_2$) be used, the 100 Gm. ordered in the official formula should be able to produce at least 97.79 Gm. of ethyl nitrite, which would yield 2151.38 Gm. of the official spirit. In practice there is always some loss, the full theoretical yield being never obtainable, and hence the necessity of ascertaining the exact weight of the purified ethyl nitrite in order to determine the final weight of alcohol to be added. In our experience the process is easy of execution, and with a little care very satisfactory results are obtained. The amount of pure ethyl nitrite recovered may vary from 70 to 80 Gm. from 100 Gm. of sodium nitrite, and, using such apparatus as are generally found in laboratories, with ordinary precaution we have obtained 78 Gm.

The second formula gives the process of Prof. Redwood (1867), and yields good results if proper attention be paid to the strength of the acids and the alcohol, and to the temperature; it is, however, best adapted for being worked on a small scale. The sulphuric acid, in the presence of nitric acid, dissolves the copper, forming sulphate of copper and setting nitrous acid free, which in its nascent state acts upon the alcohol, producing nitrous ether and water. The reaction is explained by the equation $C_2H_5OH + HNO_3 + H_2SO_4 + Cu = C_2H_5NO_2 + CuSO_4 + 2H_2O$.

Older formulas differ from Redwood's either in acting upon alcohol directly by nitric acid or in generating nitric acid from potassium nitrate and sulphuric acid in the presence of alcohol. In either case the result is much influenced by the strength of the acid and by the temperature, and a larger quantity of aldehyde is always thus produced than in the presence of copper. The action of nitric acid upon alcohol and the production of aldehyde are explained by the equation $2C_2H_5OH + HNO_3 = C_2H_4O + C_2H_5NO_2 + 2H_2O$. The German Pharmacopœia directs a mixture of 5 parts of alcohol and 3 of nitric acid to be set aside for 12 hours, and then distilled into 5 parts of alcohol. The resulting solution is neutralized with calcined magnesia, and after 24 hours again distilled, the distillate being collected in a flask containing 2 parts of alcohol, and the distillation being continued until the contents of the flask have increased to 8 parts. No requirement for a definite ethyl nitrite content is made, but it is stated that 10 Cc. of the finished product, after addition of 0.2 Cc. normal alkali solution, shall not show an acid reaction.

For some time manufacturing chemists have been offering ethyl nitrite in suitable tubes to be diluted with the necessary quantity of alcohol, so as to make spirit of nitrous ether in small quantities. While this plan is very convenient, and no doubt gives better results than much of the commercial article sold in bulk, it should be remembered that ethyl nitrite, unless absolutely free from alcohol and water, is likely to undergo decomposition. Pure ethyl nitrite is a thin, pale-yellow liquid, having a pungent, ethereal, apple-like odor. Since it boils at 16° C. (60.8° F.), it should be kept in a cool place, and the containers opened with care.

Properties and Tests.—Spirit of nitrous ether is a clear, mobile, volatile, and inflammable liquid of a pale yellowish or faintly greenish-yellow tint, having a fragrant, ethereal, and pungent odor, free from acidity, and a sharp, burning taste. Specific gravity: about 0.823 at 25° C. (77° F.). When freshly prepared, or even after being kept for some time with but little exposure to light and air, it is neutral to litmus paper. When long kept, or after having been freely exposed to air and light, it acquires an acid reaction, but it should not effervesce when a crystal of potassium bicarbonate is dropped into it. If a test-tube be half filled with the spirit, and put into a water-bath heated to 65° C. (149° F.) until it has acquired this temperature, the spirit should boil distinctly upon the addition of a few pieces of broken glass. If 10 Cc. of the spirit be mixed with 5 Cc. of potassium hydroxide test-solution, previously diluted with 5 Cc. of water, the mixture will assume a yellow color, which should not turn decidedly brown within 12 hours (limit of aldehyde).—U. S.

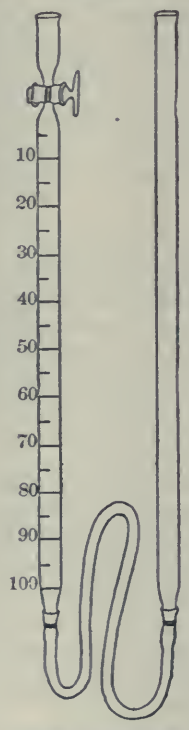
It should not effervesce, or only very feebly, when shaken with sodium bicarbonate (limit of acid); 1 volume agitated briskly at intervals during five minutes in a brine-charged nitrometer, with 1 volume of solution of potassium iodide and 1 volume of diluted sulphuric acid, should yield, at the normal temperature 15.6° C. (60° F.) and pressure (30 In. or 760 Mm. of mercury), and when freshly prepared, at least $6\frac{1}{4}$,

but not more than 7, volumes of nitric oxide gas, corresponding to at least 2½ parts by weight of ethyl nitrite in 100 parts by weight of the spirit; and even after it has been kept for some time, and the vessel containing it has occasionally been opened, it should yield not much less than 5 times its volume of the gas, corresponding to nearly 2 per cent. by weight of ethyl nitrite or a minimum of 1¾ per cent.—Br.

Assay for Ethyl Nitrite.—Transfer about 30 Gm. of the spirit of nitrous ether, which has been previously shaken with 0.5 Gm. of potassium bicarbonate, to a tared 100 Cc. measuring flask, and weigh it accurately. Add sufficient alcohol to bring the volume to exactly 100 Cc., and mix thoroughly. Introduce into a nitrometer exactly 10 Cc. of the alcohol solution, followed by 10 Cc. of potassium iodide test-solution, and afterwards by 10 Cc. of normal sulphuric acid solution. When the volume of gas has become constant (within 30 to 60 minutes), note the volume of gas collected. Multiply this volume in Cc. by 0.307, and divide the product by the original weight of the spirit of nitrous ether. At standard temperature and pressure, the quotient will represent the percentage of ethyl nitrite in the liquid. The temperature correction is ⅓ of 1 per cent. of the total percentage just found for each degree, additive if temperature is below, subtractive if above, 25° C. (77° F.). The barometric correction is $\frac{4}{30}$ of 1 per cent. for each millimeter, additive if above, subtractive if below, 760. When assayed according to the above method, spirit of nitrous ether should yield not less than 4 per cent. of ethyl nitrite.—U. S.

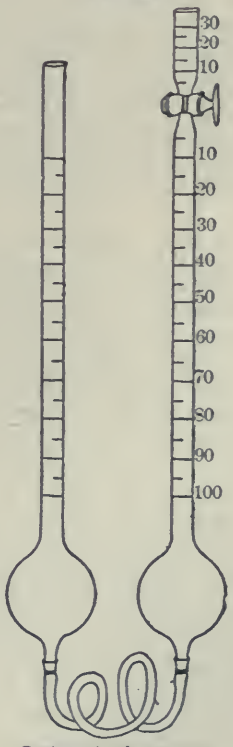
The official assay method is based on the suggestions of the late A. H. Allen (1885), and is much simpler than other methods in use prior to that time. The nitrometer (see Figs. 407 and 408) is completely filled with saturated solution of sodium chloride,

Fig. 407.



Lunge's nitrometer.

Fig. 408.



Curtman's nitrometer.

including the bore of the glass stopcock, and care must be observed that no air enter while the different liquids are allowed to flow from the cup into the nitrometer; this is best avoided by washing the cup with a few Cc. of alcohol or salt solution after the other liquids have been run into the tube, and allowing 0.2 or 0.3 Cc. of fluid to remain in the cup.

The reaction which takes place in the official assay may be shown by the following equation: $C_2H_5NO_2 + KI + H_2SO_4 = C_2H_5OH + KHSO_4 + I + NO$, from which it

appears that 29.81 Gm. of NO gas correspond to 74.51 Gm. of ethyl nitrite. At 0° C. (32° F.) and 760 Mm. pressure, 1 Cc. of NO gas weighs 0.0013355 Gm., but under the conditions mentioned in the assay method, 25° C. (77° F.) and 760 Mm. pressure it weighs 0.0012297 Gm., and hence the amount of ethyl nitrite corresponding to 1 Cc. of NO gas at the temperature and pressure last mentioned will be found to be 0.0030736 Gm., as shown by the following proportion: 29.81 : 74.51 :: 0.0012297 : x (x = 0.0030736). Hence if we let *W* represent the original weight of spirit of nitrous ether involved in the assay (which must be $\frac{1}{10}$ of the weight of the spirit before dilution to 100 Cc.), and *N* the number of Cc. of NO gas obtained in the assay, then ($N \times 0.0030736$) ÷ W represents the weight of absolute ethyl nitrite contained in 1 Gm. of the sample. The amount in 100 Gm. of the spirit or the percentage will be ($N \times 0.0030736 \times 100$) ÷ *W* or ($N \times 0.30736$) ÷ W, which is the rule given in the Pharmacopœia, where the factor 0.30736 has been abbreviated to 0.307.

If the volume of NO gas had a temperature above or below that given in the Pharmacopœia, 25° C. (77° F.), a correction is necessary in the results obtained by the above calculation, the latter applying only to the official temperature. Above 25° C. the volume of NO gas as read is larger than it would be at 25° C., and therefore the per cent. of ethyl nitrite appears greater than is actually true, and a fraction must be subtracted corresponding to the excess of volume of the NO gas over the volume it would have at 25° C. By similar reasoning it follows that when the temperature is below 25° C. a correction must be added corresponding to the deficiency of volume of the NO gas as compared with the volume it would have at 25° C. From Gay-Lussac's law of the relation of gas volumes to their absolute temperatures, the difference between the volume of the NO gas as actually read and what it would be at 25° C. may be calculated. Let t = the temperature at which the NO gas was actually read. Then by the law of expansion 1 Cc. of NO gas at t : *x* Cc. at 25° C. :: 273 + t : 273 + 25 or $x = \frac{273 + 25}{273 + t}$; that is, 1 Cc. of NO gas at t° C. would become $\frac{273 + 25}{273 + t}$ Cc. at 25° C. The correction in volume for each Cc. of NO gas as read at t° C., thus becomes $\left(1 - \frac{273 + 25}{273 + t}\right)$ Cc. $= \left(\frac{t - 25}{273 + t}\right)$ Cc. when it is greater than 25°C., or $\left(\frac{273 + 25}{273 + t} - 1\right)$ Cc. $= \left(\frac{25 - t}{273 + t}\right)$ Cc. when it is less than 25° C. When the temperature t is only a few degrees above or below 25° C. the denominator of these fractions is approximately 300, so that they become $\frac{1}{300}$, $\frac{2}{300}$, $\frac{3}{300}$, etc., according as the difference between temperature t of measurement of the NO gas and 25° C. is 1, 2, 3, etc., degrees. As each Cc. of NO gas measured in the assay is too great or too small by $\frac{1}{300}$ part for each degree of temperature above or below the official temperature, fixed at 25° C., it follows that the per cent. as first calculated must be corrected by $\frac{1}{300}$ (*i. e.*, $\frac{1}{3}$ of 1 per cent.), as given in the Pharmacopœia. This correction deviates more and more from the truth as the temperature difference becomes greater.

If the pressure under which the NO gas is measured is not 760 Mm. of mercury, which is the one assumed in the assay formula for calculation, the volume is either too large or too small, and therefore the per cent. of ethyl nitrite found also. If we let *p* = pressure in Mm. of mercury under which the NO gas is measured, then, according to Boyle's law—namely, that the product of the volume and pressure of a gas is always constant, 1 Cc. NO gas × *p* = x Cc. NO × 760, or x = (1 Cc. × *p*) ÷ 760—that is, 1 Cc. NO measured at any other pressure, *p*, would be $\frac{p}{760}$ Cc. at normal barometric pressure, 760 Mm. The correction in volume for each Cc. NO gas measured at pressure *p* is $\left(1 - \frac{p}{760}\right)$ Cc. or $\frac{760 - p}{760}$ Cc., when *p* is less than 760, or $\frac{p - 760}{760}$ Cc. when *p* is greater than 760. When *p* is greater than 760 the gas is under too great a pressure, that is, the volume is less than it should be, hence a correction should be added to the calculated per cent. as first found in the official method of calculation. When *p* is less than 760 the correction must be subtracted. According as the pressure is 1, 2, 3, etc., Mm. of mercury above or below the normal, 760 Mm., the correction for each Cc. of NO gas will amount to 1, 2, 3, etc., times $\frac{1}{760}$, and the correction of the per cent. must be the same number of times $\frac{1}{760}$ of that first found. $\frac{1}{760}$ is sufficiently close to

$\frac{1}{750}$ or $\frac{4}{3}\frac{1}{0}$ of $\frac{1}{100}$, which means $\frac{4}{3}\frac{1}{0}$ of 1 per cent., as given in the Pharmacopœia. This correction, as in the case of temperature, is only a close approximation, and must not be construed as absolute.

Preservation.—Spirit of nitrous ether should never be kept in large or partially filled bottles, nor exposed to light, as it thus rapidly undergoes oxidation and becomes worthless; neither should it be purchased in bulk, as it is impossible to preserve the quality of it when kept in carboys or large bottles which are frequently opened and rarely securely stoppered. We have frequently examined samples of spirit of nitrous ether drawn from carboys in the cellar of wholesale drug-houses, and found them far below the official requirements, often as low as $\frac{1}{4}$ or $\frac{1}{2}$ per cent. of ethyl nitrite. Even if carefully protected against air and light, the solution slowly decomposes and becomes gradually weaker.

Action and Uses.—Spirit of nitrous ether possesses valuable diuretic and diaphoretic properties, and is, in addition, a sedative to the circulation and nervous system. If its vapor be inhaled in sufficient quantity it produces flushing of the face, giddiness, severe throbbing headache, nausea, muscular relaxation, a rapid, irregular pulse, and dyspnœa. The symptoms resemble those which follow the inhalation of amyl nitrite. In febrile affections, especially of a milder type in children, no remedy at our command so readily cools the skin, quiets nervous excitement, and produces a sense of well-being than sweet spirit of nitre. Because of these excellent properties it is popular as a household medicine. A full dose, followed by a drink of hot lemonade, will frequently abort a forming "cold." When given the patient should be in bed and well-blanketed to promote free diaphorsesis. As a diuretic, spirit of nitre is applicable to the early stage of acute renal inflammation, and to relieve irritation of the urinary tract and bladder due to concentrated urine from any cause. Its diuretic effect is enhanced by the addition of the alkaline salts of vegetable acids, as citrates, acetates, and tartrates. It may be given in full doses for angina pectoris when other nitrites cannot be easily obtained. The dose of spirit of nitrous ether in febrile affections is 20 to 30 minims (1.30–2 Cc.) every 1 or 3 hours. As a diuretic, 30 to 60 minims (2–4 Cc.) should be given every 2 to 4 hours in cold water. Given in hot water its diaphoretic effect is more pronounced.

SPIRITUS AMMONIÆ, *U. S.*—Spirit of Ammonia.

Liquor ammonii caustici spirituosus; Spiritus ammoniaci caustici Dzondii.—Ammoniated alcohol, E.; *Alcoolat ammoniacal, Liqueur d'ammoniaque vineuse*, Fr.; *Weingeistiges Ammoniak*, G.

An alcoholic solution of ammonia ($NH_3 = 16.93$) containing 10 per cent. by weight of the gas. This solution deteriorates on keeping, and should be tested frequently. It must not be dispensed for medicinal purposes if it contains less than 10 per cent. of gaseous ammonia.—U. S.

Preparation.—Stronger ammonia-water 250 Cc.; alcohol, recently distilled and which has been kept in glass vessels, a sufficient quantity. Pour the stronger water ammonia into a flask provided with a safety funnel, and connected by means of a glass condenser with a well-cooled receiver, containing 500 Cc. of alcohol, the delivery tube of the condenser reaching nearly to the bottom of the receiver. Heat the flask carefully and very gradually to a temperature not exceeding 60° C. (140° F.), and maintain it at that temperature until ammonia ceases to be evolved. Then disconnect the receiver, and, having ascertained the strength of a portion of the contents by the method of assay given below, add enough alcohol to make the product contain 10 per cent. by weight of ammonia gas. Keep the product in glass-stoppered bottles in a cool place.—U. S.

250 Cc. of stronger ammonia-water of full strength, weighing 225.25 Gm., contain 56.3 Gm. of ammonia, one-half of which is readily given off at a temperature not exceeding 45° C. (113° F.); but 41 Gm. of ammonia being required for 500 Cc. of alcohol, a somewhat higher heat is required, which, however, should not exceed 60° C. (140° F.). After the evolution of ammonia ceases, the ammoniacal alcohol (2 Cc.) is tested with sulphuric acid in the manner directed by the Pharmacopœia, and if more than 19.1 Cc. of the half-normal acid are needed for neutralization, the alcohol required for dilution is readily calculated; but if the liquid becomes neutral with a smaller

quantity of the volumetric solution, the alcohol should be further charged with ammonia gas evolved from a fresh portion of strong ammonia-water; increasing the heat is inadmissible, since too large a proportion of water would pass over. Alcohol which has been kept in a barrel is apt to contain more or less organic matter in solution, which would be darkened in color by ammonia; hence the recommendation to use only alcohol which after rectification has been preserved in glass vessels.

Properties.—Spirit of ammonia is a colorless liquid having a strong ammoniacal and at the same time spirituous odor and a specific gravity of about 0.808 at 25° C. (77° F.). When diluted with water it has the same behavior to reagents as ammonia-water, and its purity and identity may be determined in the same manner as for the latter.

Assay of Spirit of Ammonia.—Introduce into a weighing bottle about 2 Cc. of the Spirit, weigh accurately, dilute with 50 Cc. of distilled water, and titrate with half-normal sulphuric acid solution, using litmus test solution as indicator. Multiply the number of Cc. of half-normal sulphuric acid solution consumed by 0.008465, and this product by 100, and divide by the weight in grammes of the spirit taken to obtain the percentage of ammonia gas.—U. S.

Uses.—Spirit of ammonia is stimulant and antispasmodic. It is rarely used, having been supplanted by the more agreeable aromatic spirit. (See SPIRITUS AMMONIÆ AROMATICUS.) Its dose is from 10 to 30 minims (0.60–2 Cc.), well diluted.

SPIRITUS AMMONIÆ AROMATICUS, *U. S., Br.*—Aromatic Spirit of Ammonia.

Alcoolat ammoniacal aromatique, Fr.; *Aromatischer Ammoniakgeist*, G.

Preparation.—Ammonium carbonate, in translucent pieces, 34 Gm.; ammonia-water 90 Cc.; oil of lemon 10 Cc., oil of lavender-flowers 1 Cc.; oil of nutmeg 1 Cc.; alcohol, 700 Cc.; distilled water a sufficient quantity; to make 1000 Cc. To the ammonia-water, contained in a flask, add 140 Cc. of distilled water, and afterward the ammonium carbonate reduced to a moderately fine powder. Close the flask and agitate the contents until the carbonate is dissolved, and allow it to stand for 12 hours. Introduce the alcohol into a graduated bottle of suitable capacity, add the oils, then gradually add the solution of ammonium carbonate, and afterward enough distilled water to make the product measure 1000 Cc. Set the liquid aside during 24 hours in a cool place, occasionally agitating, then filter it through paper in a well-covered funnel. Keep the product in glass-stoppered bottles in a cool place.—U. S.

Oil of nutmeg 4½ fluidrachms, oil of lemon 6½ fluidrachms, alcohol 6 pints, water 3 pints; distil 149 fluidounces. Place the last 9 ounces of distillate in a bottle with ammonium carbonate 4 ounces and strong ammonia solution 8 fluidounces; warm gently to 140° F. until dissolved; filter through cotton and gradually mix with the distillate.—Br.

On adding ammonia-water to official ammonium carbonate, normal ammonium carbonate is formed, which is readily soluble in alcohol. This is the compound aimed at by both Pharmacopœias. If official ammonium carbonate is treated with alcohol, normal ammonium carbonate will be dissolved, and acid ammonium carbonate, being nearly insoluble, will be left behind. An insoluble saline precipitate will therefore indicate either a deficiency in the strength of the ammonia-water or a partial decomposition of the carbonate used. This salt should be employed only in translucent masses, and the effloresced portion, which contains variable proportions of acid ammonium carbonate, should be rejected for this preparation. In order to ensure the complete change of the ammonium salt, we have found it advantageous to allow the mixture of ammonium carbonate, distilled water, and ammonia-water to stand for some time (say 12 hours) before mixing it with the alcoholic solution of the oils. The change effected is readily explained as follows: $NH_4HCO_3.NH_4NH_2CO_2$ (official carbonate) + NH_4OH (ammonia) = $2(NH_4)_2CO_3$ (normal carbonate).

Properties.—This spirit is nearly colorless when freshly prepared, but gradually acquires a somewhat darker tint. It has an aromatic and at the same time pungent ammoniacal odor and taste, effervesces with acids, becomes milky on the addition of water, and has the specific gravity about 0.900 at 25° C. (77° F.) U. S. or 0.888 to 0.893.—Br.

Uses.—Aromatic spirit of ammonia is more agreeable to the taste than the simple spirit, and more generally employed. Its properties are stimulant, antispasmodic, and antacid. It is extensively used for the relief of headache attended with nausea, acid eructations, and flatulence. It may be administered with excellent results in cases of profound shock and sudden failure of the vital functions, and is one of the best diffusible stimulants that we have: The dose is from ½ to 1 drachm (2–4 Cc.), properly diluted with water.

SPIRITUS AMMONIÆ FŒTIDUS, *Br.*—Fetid Spirit of Ammonia.

Alcoolat ammoniacal fétide, Essence antihystérique, Fr.; *Ammoniakalischer Stinkasantgeist*, G.

Preparation.—Take of asafetida 1½ ounces; strong solution of ammonia, 2 fluidounces; alcohol (90 per cent.), a sufficient quantity. Break the asafetida into small pieces and macerate it, in a closed vessel, in 15 fluidounces of the alcohol for 24 hours; distil until alcoholic vapors cease to be condensed; mix the distillate with the solution of ammonia, and add sufficient alcohol to make 1 pint (imperial).—Br.

On distilling the tincture of asafetida prepared as above directed, a portion of the volatile oil of asafetida passes over; the finished preparation is therefore an alcoholic solution of this volatile oil mixed with ammonia-water. *Aqua fœtida antihysterica* (*s. Pragensis*) is a weak distilled spirit free from ammonia, but contains the volatile products of galbanum, myrrh, valerian, zedoary, angelica, peppermint, wild thyme, English chamomile, and castor, in addition to the oil of asafetida.

Uses.—This preparation is designed to exhibit the stimulant and antispasmodic properties of asafetida and ammonia, and is indicated in hysterical conditions and functional nervous disorders. The dose is ½ to 1 drachm (2–4 Cc.).

SPIRITUS AMYGDALÆ AMARÆ, *U. S.*—Spirit of Bitter Almond.

Essence of bitter almond, E.; *Alcoolat (Esprit) d'amandes amères*, Fr.; *Bittermandelgeist*, G.

Preparation.—Oil of bitter almond, 10 Cc.; alcohol, 800 Cc.; distilled water, a sufficient quantity; to make 1000 Cc. Dissolve the oil in the alcohol, and add enough distilled water to make the product measure 1000 Cc.—U. S.

Uses.—Spirit of bitter almond is used as a flavoring agent.

SPIRITUS ANGELICÆ COMPOSITUS, *P. G.*—Compound Spirit of Angelica.

Alcoolat d'angélique composé, Fr.; *Zusammengesetzter Angelikaspiritus*, G.

Preparation.—Take of angelica (root), in moderately fine powder, 16 parts; valerian (root), in moderately fine powder, 4 parts; juniper berries, crushed, 4 parts; alcohol, 75 parts; water, 125 parts. Mix the alcohol and water, add the drugs, and set the mixture aside at a temperature of 15° to 20° C. (59°–68° F.) for 24 hours, with occasional agitation. Then distil 100 parts, and in the distillate dissolve camphor, 2 parts.—P. G.

Compound spirit of angelica is a clear, colorless liquid, having the specific gravity of 0.890 to 0.900.

Uses.—This preparation combines antispasmodic and stimulant properties, and may be given in nervousness of hysterical origin. Its dose is from ½ to 1 drachm (2–4 Cc.).

SPIRITUS ANISI, *U. S., Br.*—Spirit of Anise.

Alcoolat (Esprit) d'anis, Fr.; *Anisgeist*, G.

Preparation.—Oil of anise, 100 Cc.; alcohol, 900 Cc.; to make 1000 Cc. Mix them.—U. S.

The formula of the British Pharmacopœia is identical with the above.

Uses.—Spirit of anise is carminative and antispasmodic in the dose of 1 to 2 drachms (4–8 Cc.). It is also used to flavor mixtures.

SPIRITUS ARMORACIÆ COMPOSITUS, *Br.*—Compound Spirit of Horseradish.

Esprit de raifort composée, Alcoolat antiscorbutique, Fr.; *Meerrettiggeist,* G.

Preparation.—Take of horseradish-root, scraped, bitter orange-peel, well bruised, each 5 ounces; nutmeg, bruised, 55 grains; alcohol (90 per cent.), 1¼ pints; distilled water, 1½ pints. Mix and distil 2 pints (imperial).—Br.

This preparation is an alcoholic solution of the volatile oils of the drugs used.

Uses.—This compound is a useful addition to other diuretic preparations, to be given especially in those cases in which stimulating diuretics are indicated in cases of renal inactivity not due to acute inflammation. Its dose from 1 to 2 drachms (4–8 Cc.) diluted.

SPIRITUS AURANTII COMPOSITUS, *U. S.*—Compound Spirit of Orange.

Esprit d'orange composée, Fr.; *Zusammengesetzter Orangengeist,* G.

Preparation.—Oil of orange-peel, 200 Cc.; oil of lemon, 50 Cc.; oil of coriander, 20 Cc; oil of anise, 5 Cc.; alcohol, a sufficient quantity; to make 1000 Cc. Mix them. Keep the product in completely filled, well-stoppered bottles in a cool and dark place. —U. S.

To make 1 pint of compound spirit of orange dissolve 3 fluidounces and 96 minims of oil of orange-peel, 384 minims of oil of lemon, 154 minims of oil of coriander, and 39 minims of oil of anise, in sufficient alcohol to make 16 fluidounces of solution.

Uses.—Compound spirit of orange is used chiefly for its agreeable taste. It is the principal ingredient of aromatic elixir. It is given in doses of from ½ to 1 drachm (2–4 Cc.) diluted.

SPIRITUS CAJUPUTI, *Br.*—Spirit of Cajuput.

Alcoolat (Esprit) de cajeput, Fr.; *Cajeputgeist,* G.

Preparation.—Take of oil of cajuput 1 fluidouuce; alcohol (90 per cent.), a sufficient quantity to form 10 fluidounces of the spirit. Dissolve.—Br.

Uses.—The uses of this spirit are the same as of the oil of cajuput. The dose is 30 to 60 minims (2–4 Cc.) diluted.

SPIRITUS CAMPHORÆ, *U. S., Br.*—Spirit of Camphor.

Teinture de camphre concentrée, Fr. Cod.; *Spiritus camphoratus,* P. G.; *Tinctura camphoræ.—Tincture of camphor,* E.; *Esprit de camphre, Alcool camphré,* Fr.; *Kampherspiritus,* G.

Preparation.—Camphor, 100 Gm.; alcohol, a sufficient quantity; to make 1000 Cc. Dissolve the camphor in 800 Cc. of alcohol, filter through paper, and pass enough alcohol through the filter to make the product measure 1000 Cc.—U. S.

To make 1 pint of spirit of camphor dissolve 1¾ avoirdupois ounces of camphor in 12 fluidounces of alcohol, and add to the solution sufficient alcohol to bring the volume up to 16 fluidounces.

Take of camphor 1 ounce; alcohol (90 per cent.) sufficient to make 10 fluidounces. Dissolve.—Br.

Dissolve 1 part of camphor in 9 parts of alcohol.—Fr. Cod.

Dissolve 1 part of camphor in 7 parts of alcohol, and to the solution add 2 parts of water.—P. G.

Uses.—This preparation is useful chiefly when it is desired to apply camphor locally for sprains, bruises, headache, and other painful conditions. It may be used as a local application to wounds and indolent ulcers. Internally administered, it is antispasmodic and sedative. The dose is from 5 to 30 minims (0.30–2 Cc.) diluted.

SPIRITUS CHLOROFORMI, *U. S., Br.*—Spirit of Chloroform.

Chloric ether, Spirit of chloric ether, E.; *Alcoolat de chloroforme,* Fr.; *Chloroformspiritus,* G.

Preparation.—Chloroform, 60 Cc.; alcohol, 940 Cc.; to make 1000 Cc. Mix them.—U. S.

To make 1 pint of spirit of chloroform mix 461 minims of chloroform with sufficient alcohol to bring the volume up to 16 fluidounces. Each fluidounce contains nearly 30 minims (28.8 +) of chloroform.

Chloroform 1 fluidounce; alcohol (90 per cent.) 19 fluidounces; dissolve.—Br.

Uses.—This is a convenient preparation for administering chloroform by the stomach. It may be given in colic and other painful conditions of the abdomen. The dose is from 20 to 60 minims (1.30–4 Cc.) diluted with water.

SPIRITUS CINNAMOMI, *U. S., Br.*—Spirit of Cinnamon.

Alcoolat de cannelle, Fr.; *Zimmtspiritus*, G.

Preparation.—Oil of cinnamon, 100 Cc.; alcohol, 900 Cc.; to make 1000 Cc. Mix them.—U. S.

Oil of (Ceylon) cinnamon 1 fluidounce; alcohol (90 per cent.) 9 fluidounces.—Br.

Uses.—Spirit of cinnamon may be used to promote digestion, to relieve intestinal colic, and to flavor various mixtures. Its dose is from 10 to 20 minims (0.60–1.30.).

SPIRITUS COCHLEARIÆ, P. G.—Spirit of Scurvy-grass.

Alcoolat de cochléaria, F.; *Löffelkrautspiritus*, G.

Preparation.—Take of cochlearia (herb) 4 parts; white mustard seed, ground, 1 part. Place the drugs into a retort, add water 40 parts, and macerate for 3 hours; then add alcohol 15 parts, mix and distil 20 parts.—P. G.

Properties and Tests.—Spirit of scurvy-grass is a clear, colorless liquid, having a characteristic odor and a pungent taste. Its specific gravity ranges from 0.908 to 0.910. If 50 Cc. of the spirit be added to 10 Cc. of tenth-normal silver nitrate solution and 5 Cc. of ammonia-water in a 100 Cc. measuring cylinder, covered and set aside for twenty-four hours with frequent agitation, and after bringing the volume up to 100 Cc. by addition of water, filtered, 50 Cc. of the clear filtrate, after addition of 3 Cc. of nitric acid and 1 Cc. of ammonium ferric sulphate solution, should require 2.2 to 2.5 Cc. of tenth-normal ammonium sulphocyanate solution to produce a red coloration.—P. G.

Uses.—This preparation may be used as a stimulating application to painful joints. Internally it is stimulant and diuretic. The dose is from 20 to 40 minims (1.30–2.60 Cc.).

SPIRITUS FRUMENTI, *U. S.*—Whisky.

Eau de vie de grains, Fr.; *Kornbranntwein*, G.

An alcoholic liquid obtained by the distillation of the mash of fermented grain—such as Indian corn, rye, wheat, and barley, or their mixtures.

Origin and Preparation.—The term "whisky" is supposed to be derived from *usque*, the first two syllables of *usquebaugh*, the original name in Ireland—itself from Irish *uisge* and *beatha*, "life," *Uisge beatha, Aqua vitæ*, "Water of Life" (Dunglison's *Dictionary*). In Europe whisky is often made by fermenting potatoes, but likewise from different kinds of grain; in Great Britain principally from barley, oats, and rye. In the United States rye, maize, and wheat are mostly employed for the manufacture of whisky either in the raw state or after having been previously malted, when it furnishes a product of better flavor. The fermenting mixture is called the *mash*. During the fermentation the starch is converted into sugar, and finally into alcohol and carbon dioxide. The mixture is now subjected to distillation, and the weak spirit, called *low wine*, is rectified, and thus obtained stronger and less charged with fusel oil, which comes over chiefly in the last portions of the distillate. The *raw whisky* is kept in barrels or tanks for several years, during which time it acquires mellowness and is improved in flavor, doubtless in consequence of the formation of various compound ethers.

Properties.—Whisky is a spirituous liquid, usually of a yellowish or amber color, due to coloring matter and to a trace of tannin derived from the tanks in which it has been kept, and to a trace of sugar which has probably been added in the form of caramel. The density of whisky depends on the percentage of alcohol, and is to a slight extent influenced by the amount of the coloring and extractive matters; it should be

not above 0.945, nor less than 0.924 at 15.6° C. (60° F.), corresponding, approximately, to an alcoholic strength of 37 to 47.5 per cent. by weight or 44 to 55 per cent. by volume of absolute alcohol. The disagreeable odor of raw whisky is mainly owing to a small quantity of amylic alcohol, which on keeping is changed into an ether, and perhaps partly into valerianic acid; œnanthylic and other allied acids are likewise present to a slight extent. Old whisky has a slight acid reaction, due to the formation of a minute quantity of acetic and, according to Kappel (1859), of valerianic acid. For neutralizing the acidity of good whisky 20 Cc. require usually between 0.8 and 1.0 Cc. of tenth-normal solution of alkali, indicating between 0.113 and 0.142 Gm. of acetic acid or its equivalent. The acidity slowly increases with age up to a certain degree; in one case 2.25 Cc. of tenth-normal alkali were required for 20 Cc. of whisky.

Tests.—On evaporating whisky by a moderate heat nearly to dryness, the residue which is left should have a slightly aromatic and rather insipid, but not an acrid, taste. The most convenient test for recognizing the origin of whisky is that proposed by Molnar. A small quantity of it is heated with a slight excess of potassium hydroxide until the alcohol has been completely evaporated; the compound ethers are thereby decomposed, and on adding an excess of sulphuric acid the volatile acids are liberated, and from their odor the source is recognized. *Apple whisky* distilled from cider gives off a decided fruit odor; the odors of whiskies of different kinds of grain are sufficiently distinct from one another, but to readily recognize them considerable experience is required. "If 100 Cc. of whisky be very slowly evaporated in a weighed capsule on a water-bath, the last portions volatilized should not have a harsh or disagreeable odor (absence of more than traces of fusel oil from grain). The remaining residue, fully dried at 100° C. (212° F.), should weigh not more than 0.25 Gm. This residue should have no sweet or distinctly spicy taste (absence of added sugar, glycerin, or spices). It should nearly all dissolve in 10 Cc. of cold water, forming a solution which is colored not deeper than light-green by a few drops of ferric chloride test-solution diluted with 10 volumes of water (absence of more than traces of oak tannin from casks). If 50 Cc. of whisky be shaken vigorously in a stoppered flask with 25 Gm. of kaolin, and, after standing half an hour, be filtered, the color of the filtrate should not be lighter than that of the whisky before treatment (absence of caramel coloring). 100 Cc. of whisky should be rendered distinctly alkaline to litmus by 1.2 Cc. of normal potassium hydroxide solution (limit of free acid)."—U. S.

Uses.—The physiological action of whisky is considered under Alcohol. Whisky is more easily obtained unadulterated than is brandy, and for this reason is preferred for most medicinal purposes. The dose is from 1 to 4 ounces (30–120 Cc.).

SPIRITUS GAULTHERIÆ, *U. S.*—Spirit of Gaultheria.

Alcoolat (Esprit) de gaulthérie, Fr.; *Bergtheespiritus (geist)*, G.

Preparation.—Oil of gaultheria: 50 Cc.; alcohol, 950 Cc.; to make 1000 Cc. Mix them.—U. S.

"Essence of wintergreen" has been in use for a long time, but was prepared of varying strength. The pharmacopœial formula is intended to accomplish uniformity.

Uses.—Spirit of gaultheria is used chiefly to impart its agreeable odor and taste to mixtures. Its dose is from 10 to 20 minims (0.60–1.30 Cc.) diluted.

SPIRITUS GLYCERYLIS NITRATIS, *U. S.*—Spirit of Glyceryl Trinitrate.

Spiritus glonoini, U. S., 1890.—*Spirit of glonoin, Spirit of nitroglycerin, Solution of nitroglycerin*, E.; *Nitroglyceringeist, Glycerintrinitratlösung*, G.

An alcoholic solution containing 1 per cent., by weight, of glyceryl trinitrate ($C_3H_5(O.NO_2)_3 = 225.44$). Spirit of glyceryl trinitrate should be kept and transported in well-stoppered tin cans, and should be stored in a cool place, remote from lights or fire. Great care should be exercised in handling, packing, transporting, or storing the spirit, since a dangerous explosion may result if any considerable quantity of it be spilled and the alcohol be partly or wholly lost by evaporation. If, through accident, it be spilled, a solution of potassium hydroxide should be at once poured over it to effect decomposition.—U. S.

Properties and Tests.—"A clear, colorless liquid, possessing the odor and taste of alcohol. Caution should be exercised in tasting it, since even a small quantity of it is liable to produce a violent headache. The same effect is produced when it is freely applied to the skin. It is neutral to litmus-paper. Specific gravity 0.814 to 0.820 at 25° C. (77° F.). On diluting 10 Cc. of the spirit with 15 Cc. of water, both liquids, as well as the mixture, being brought to 15° C. (59° F.), the liquid will exhibit at most a faint cloudiness, but the addition of a further portion of 5 Cc. of water should produce a white turbidity. If the specific gravity of the spirit be higher than 0.830 at 25° C. (77° F.), or if 10 Cc. of it are rendered turbid by less than 10 Cc. of water, the spirit should be rejected.—U. S.

Preparation of Glyceryl Trinitrate.—This compound, generally, but wrongly, called nitroglycerin and also known as trinitrin, glonoin, and propenyl trinitrate, was discovered by Sobrero (1847), and may be prepared either by gradually adding 7 parts of dehydrated glycerin to a well-cooled solution of 20 parts of sodium nitrate in 40 parts of sulphuric acid, specific gravity 1.840, the mixture being kept cool, or 1 part of glycerin may be slowly added, with frequent stirring, to 7 parts of a mixture composed of 1 part of nitric acid, specific gravity 1.47, and 2 parts of strong sulphuric acid, the temperature being carefully kept below 26.6° C. (80° F.). The reaction taking place by either process, between the nitric acid and glycerin, results in the production of propenyl or glyceryl trinitrate: thus $C_3H_5(OH)_3 + 3HNO_3 = C_3H_5(NO_3)_3 + 3H_2O$. In either case the glyceryl trinitrate separates in the form of an oily layer, and is then washed with water, and finally with very dilute soda solution, until all acid reaction ceases. The product amounts to about two and one-third times the weight of glycerin employed. It is a colorless or pale-yellowish oily liquid of 1.60 specific gravity, and crystallizes when cooled to —20° C. (—4° F.). It may be freed from water by treatment with 10 per cent. of glycerin, in which the ester is insoluble, although it is miscible in all proportions with ether, chloroform, phenol, and glacial acetic acid. 1 Gm. of glyceryl trinitrate requires for solution 3.5 Cc. absolute alcohol, 10 Cc. alcohol, specific gravity 0.830, 18 Cc. methyl or amyl alcohol, 120 Cc. carbon disulphide or 800 Cc. water. It is without odor, but its vapors produce intense headache; its taste is sweet and pungently aromatic. When ignited in the open air it burns quietly and incompletely, but when heated in closed vessels or by percussion, it explodes with great violence; sometimes it explodes spontaneously. Nitroglycerin forms the basis of various blasting compounds known as *dynamite, giant-powder, glyoxylin, dualin,* etc. According to A. Nobel, 1 volume yields upon explosion about 10,400 volumes of gas.

Action and Uses.—Although a nitrate, the physiological action of nitroglycerin closely resembles that of the nitrites. The explanation given for this phenomenon seems to be that the glyceryl trinitrate is broken up, either in the alkaline secretion of the intestine or in the blood, into a mixture of nitrites and nitrates, the former of which exercises the dominant influence. As regards the rapidity of its action, it is intermediate to amyl nitrite and the nitrites of sodium and potassium. Its effect, which lasts 3 or 4 hours, is not as violent or fleeting as that of amyl nitrite, nor as persistent as of the alkaline nitrites. Glyceryl trinitrate may be employed in nearly all cases in which amyl nitrite is indicated, especially in angina pectoris accompanied by marked arterial spasm, and in asthma dependent upon spasm and enlargement of the bronchial tubes. Its most important application is to relieve the cardiac embarrassment consequent to the high arterial tension found in many cases of chronic interstitial nephritis. It was recommended by J. M. DaCosta as a remedy to decrease the excretion of albumin in chronic parenchymatous nephritis. Because nitroglycerin relaxes arterial tension and thus relieves the heart of a certain amount of labor in cases characterized by high vascular tension, and allows it to beat more forcibly and regularly, it has been considered a cardiac stimulant, but this employment of nitroglycerin as a cardiac stimulant in shock or collapse is not justified by a knowledge of its action on the heart or bloodvessels, it being a depressant rather than a stimulant. Nitroglycerin is claimed to be a valuable drug in many cases of vomiting. Given in the dose of $\frac{1}{200}$ grain (0.0003 Gm.) hypodermically, with morphine, it will prevent the nausea usually produced by that drug. The dose of the spirit of glyceryl trinitrate is ordinarily 1 to 2 minims (0.05–0.10 Cc.), but in interstitial nephritis it is commonly given in ascending doses until the desired result is obtained or untoward symptoms appear. More than 1 drachm (4 Cc.) has been taken 3 times a day with no ill effects.

SPIRITUS JUNIPERI, *U. S., Br.*—Spirit of Juniper.

Alcoolat (Esprit) de genièvre, Fr.; *Wachholderspiritus*, G.

Preparation.—Oil of juniper, 50 Cc.; alcohol, 950 Cc. to make 1000 Cc. Mix them.—U. S.

Oil of juniper, 1 fluidounce; alcohol (90 per cent.), 19 fluidounces; dissolve.—Br.

Macerate for twenty-four hours 1 part of bruised juniper-berries with 3 parts each alcohol and water, and distil 4 parts.—P. G.

The spirit made from the volatile oil distilled from juniper-berries is much more agreeable than if the common oil of juniper is used. Age improves the flavor.

Uses.—This preparation is added to diuretic mixtures used in the treatment of dropsy. Its dose is from 30 to 60 minims (2–4 Cc.).

SPIRITUS JUNIPERI COMPOSITUS, *U. S.*—Compound Spirit of Juniper.

Alcoolat de genièvre composé, Fr.; *Zusammengesetzter Wachholderspiritus*, G.

Preparation.—Oil of juniper, 8 Cc.; oil of caraway, 1 Cc.; oil of fennel, 1 Cc.; alcohol, 1400 Cc.; water, a sufficient quantity to make 2000 Cc. Dissolve the oils in the alcohol, and gradually add enough water to make the product measure 2000 Cc.—U. S.

To make 1 pint of compound spirit of juniper dissolve 30 minims of oil of juniper and 4 minims each of oil of fennel and oil of caraway in 11¼ fluidounces of alcohol, and gradually add enough water to bring the volume up to 16 fluidounces.

This spirit is an official substitute for *gin*, a spirit distilled in some parts of Europe from juniper-berries, to which sometimes other aromatics are added. It has the advantage of uniformity of composition over the commercial article, and if good volatile oils are used the flavor is agreeable and will improve by age.

Uses.—This preparation resembles Holland gin. It is given in dropsy of both cardiac and renal origin, and is usually combined with other diuretics. The dose is 1 to 4 drachms (4–16 Cc.) diluted with water.

SPIRITUS LAVANDULÆ, *U. S., Br., P. G.*—Spirit of Lavender.

Alcoolat (Esprit, Eau) de Lavande, Fr.; *Lavendelspiritus*, G.

Preparation.—Oil of lavender-flowers, 50 Cc.; alcohol, 950 Cc. to make 1000 Cc. Mix them.—U. S.

Oil of lavender, 1 fluidounce; alcohol (90 per cent.), 9 fluidounces; dissolve.—Br.

Macerate for twenty-four hours lavender-flowers 1 part, with alcohol and water each 3 parts, and distil 4 parts.—P. G.

For use as a perfume a small quantity of oil of bergamot, tincture of musk, or tincture of ambergris is sometimes added, the addition of the tincture being made to the distilled spirit.

Uses.—Spirit of lavender is used more for its pleasant odor than for its carminative effect. It corresponds to the popular perfume, lavender water, which is employed by the laity to bathe the forehead in cases of headache and fever. It may be given internally in the dose of from ½ to 1 drachm (2–4 Cc.).

SPIRITUS MELISSÆ COMPOSITUS, *P. G.*—Compound Spirit of Balm.

Alcoolat de mélisse composé, Fr. Cod.—*Eau de mélisse des Carmes, Eau des Carmes*, Fr.; *Zusammengesetzter Melissengeist, Karmelitergeist*, G.

Preparation.—Take of balm (leaves), 14 parts; lemon peel, 12 parts; nutmeg, 6 parts; cassia bark, 3 parts; cloves, 3 parts. Reduce the drugs to a coarse powder, and add alcohol, 150 parts; water, 250 parts. Place the mixture in a still and distil 200 parts.—P. G.

The formula of the French Codex is very similar to the above, and directs for the same quantity of spirit 2 parts each of angelica and coriander in addition to the above-named drugs.

Compound spirit of balm, also known as Carmelite spirit, is a clear, colorless liquid, having an aromatic odor and taste. The specific gravity varies from 0.900 to 0.910.

Uses.—This preparation is a pleasant carminative and stimulant given in the dose of from ½ to 2 drachms (2–8 Cc.).

SPIRITUS MENTHÆ PIPERITÆ, *U. S., Br., P. G.*—Spirit of Peppermint.

Essence of peppermint, E.; *Alcoolat (Essence) de menthe poivrée*, Fr.; *Englische Pfefferminzessenz*, G.

Preparation.—Oil of peppermint, 100 Cc.; peppermint, bruised, 10 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Dissolve the oil of peppermint in 900 Cc. of alcohol, add the peppermint, and allow it to macerate for 24 hours; then filter through paper, adding through the filter enough alcohol to make the spirit measure 1000 Cc.—U. S.

Oil of peppermint, 1 fluidounce; alcohol (90 per cent.), 9 fluidounces; dissolve.—Br.

The formula of the P. G. agrees with that of the U. S. P., except that the spirit is made by weight and is not colored.

Uses.—This spirit is the most convenient form for the ordinary administration of peppermint. It is given in the dose of 5 to 30 minims (0.30–2 Cc.), on sugar or in sweetened water.

SPIRITUS MENTHÆ VIRIDIS, *U. S.*—Spirit of Spearmint.

Essence of spearmint, E.

Preparation.—Oil of spearmint, 100 Cc.; spearmint, bruised, 10 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Dissolve the oil of spearmint in 900 Cc. of alcohol, add the spearmint, and allow it to macerate for 24 hours; then filter through paper, adding through the filter enough alcohol to make the spirit measure 1000 Cc.—U. S.

The analogous preparation used in France is distilled from fresh crisped mint, and that used in Germany as *Englische Krauseminzessenz* is made by dissolving 1 part of oil of crisped mint in 9 parts (by weight) of alcohol.

Uses.—The uses of this preparation are the same as of the spirit of peppermint. Its dose is somewhat larger, 20 to 40 minims (1.30–2.60 Cc.).

SPIRITUS MYRCIÆ.—Spirit of Myrcia.

Bay-rum, E.

Preparation.—Oil of myrcia, 16 Cc.; oil of orange-peel, 1 Cc.; oil of pimenta, 1 Cc.; alcohol, 1220 Cc.; water, a sufficient quantity to make 2000 Cc. Mix the oils with the alcohol, and gradually add water until the solution measures 2000 Cc. Set the mixture aside, in a well-stoppered bottle, for eight days; then filter through paper in a well-covered funnel.—U. S., 1890.

To make 1 pint of bay-rum dissolve 60 minims of oil of myrcia and 4 minims each of oil of orange-peel and oil of pimenta in 10 fluidounces of alcohol, and gradually add enough water to bring the volume of the mixture up to 16 fluidounces.

On diluting an alcoholic solution of volatile oils rapidly with water a milkiness is apt to be produced, which is subsequently not readily removed by agitation; it is therefore directed to add the water gradually, so that the appearance of a permanent milkiness may be avoided as much as possible. If after a week the spirit cannot be decanted or filtered clear, it may be treated with paper-pulp or other material (except cotton-fibres) usually used in the preparation of medicated waters.

Bay-rum is distilled in several of the West Indian islands from the fresh leaves of Myrcia acris, to which a certain proportion of the fruit is added, St. Croix rum being used for the best quality; its flavor is affected by the employment of the leaves of different varieties of the plant, or probably of different closely-allied species of myrtles. (See paper by A. H. Riise in *Amer. Jour. Phar.*, 1882, p. 278.) However, most of the bay-rum consumed in the United States is now manufactured here, a small portion being distilled from the dried leaves. The above formula furnishes a preparation of agreeable fragrance and of a pale-yellowish color or nearly colorless.

Uses.—Bay rum is used as a refreshing application for headache, and to impart its pleasant odor to many toilet preparations and "hair tonics."

SPIRITUS MYRISTICÆ, *Br.*—Spirit of Nutmeg.

Alcoolat (Esprit) de muscade, Fr.; *Muskatspiritus*, G.

Preparation.—Take of volatile oil of nutmeg, 1 fluidounce; alcohol (90 per cent.), 9 fluidounces; dissolve. If the solution be not clear, agitate with a little powdered talc, and filter.—Br.

In France this spirit is prepared by macerating for four days 500 parts of bruised nutmeg with 4000 parts (by weight) of 80 per cent. alcohol, and distilling as long as alcohol passes over.

Uses.—Spirit of nutmeg is used as a flavoring agent. Its dose is from ½ to 1 drachm (2–4 Cc.).

SPIRITUS ROSMARINI, *Br.*—Spirit of Rosemary.

Spiritus anthos.—Alcoolat (Esprit) de romarin, Fr.; *Rosmarinspiritus*, G.

Preparation.—Take of oil of rosemary, 1 fluidounce; alcohol (90 per cent.), 9 fluidounces; dissolve.—Br.

The preparation known in Europe, and formerly much employed, as *Aqua Reginæ Hungariæ* (Eau de la reine de Hongrie, Fr.), is a compound spirit of rosemary, usually containing a little lavender, sage, or other aromatic oil.

Uses.—This spirit is used as a perfume, and is frequently added to lotions and liniments.

SPIRITUS SINAPIS, *P. G.*—Spirit of Mustard.

Alcoolat de moutarde, Esprit de moutarde, Fr.; *Senfspiritus*, G.

Preparation.—Take of volatile oil of mustard, 1 part; alcohol, 49 parts. Mix.—P. G.

Spirit of mustard is a clear, colorless liquid, having a pungent odor reminding strongly of oil of mustard. Its specific gravity at 15° C. (59° F.) is from 0.833 to 0.837.

Uses.—Spirit of mustard is employed as an addition to liniments intended to produce a distinct local reddening.

SPIRITUS VINI GALLICI, *U. S., Br.*—Brandy.

Spirit of French wine, E.; *Eau de vie, Cognac*, Fr.; *Franzbranntwein*, G.

An alcoholic liquid obtained by the distillation of the fermented unmodified juice of fresh grapes.—U. S.

A spirituous liquid distilled from wine and matured by age, and containing not less than 36½ per cent. by weight or 43½ per cent. by volume of ethyl hydroxide.—Br.

Origin and Preparation.—Brandy is made in France by distilling different kinds of wine. The colorless spirit (white brandy) thus obtained is kept for some time in new oak casks, where it gradually acquires a light-amber tint (pale brandy). The darker-colored varieties have their color deepened by the addition of caramel. The brandies obtained in different districts of France are not esteemed alike, those of Cognac and Armagnac being deemed the best, owing to the agreeable mildness of their flavor; next in order are those from Bordeaux and Rochelle. The lees of wines and the marc of grapes are also distilled, and furnish a spirituous liquid called in France *eau de vie de marc*, which is highly charged with odorous principles, and is used as an addition to other brandies and for imitating brandy by mixing the liquid with pure rectified spirit. The odorous constituents separated from all or most of the alcohol are sometimes met with in commerce as oil of grapes. Large quantities of brandy are also distilled in Spain and Portugal, and of recent years in Germany.

Considerable brandy is now made in the United States, and is usually distinguished as Catawba and California brandy. Catawba brandy is made in the vine-growing districts of the Ohio and Mississippi Valley, according to E. S. Wayne (1855), from the lees and from the marc. That made from the lees is the best, and has the flavor of Catawba wine. When distilled from the marc it has an unpleasant taste, and contains a large amount of fusel oil, but is mellowed down by age. California brandy is made from the lees and

marc, which are thrown together with poor wines and distilled, the distillate being tinged by the addition of caramel (*Proc. Amer. Phar. Assoc.*, 1866, p. 64).

Properties.—Brandy is a spirituous, amber-colored liquid having a peculiar flavor, which is improved by age; hence the U. S. P. directs it to be used only when at least four years old. The flavor depends upon the variety of grapes used, upon their ripeness, upon the care bestowed upon fermentation and distillation, and upon the age of the wine, an older wine yielding a more fragrant distillate. The specific gravity of brandy is required to be between .925 and .941 (U. S.), corresponding, approximately, to an alcoholic strength of 39 to 47 per cent. by weight, or 46 to 55 per cent. by volume, of absolute alcohol. It has a slight acid reaction, which is, at least in part, due to the presence of acetic acid. The odor is due to minute quantities of œnanthic, acetic, and perhaps propylic and allied ethers; its quality is best ascertained by pouring some of the brandy into a wine-glass, then emptying the latter, and, without washing or wiping it, setting it aside; the peculiar fragrance becomes then more apparent, and is still noticable after a day, while the odor of brandy which had been diluted with deodorized spirit becomes weak and disappears in the course of a few hours, during which time also the odor of whisky or similar spirits becomes apparent. Brandy assumes a dark-greenish color on the addition of ferric chloride, owing to the presence of tannin derived from the casks or from catechu, etc., purposely added. Sugar can usually be detected in the extract by Trommer's test, and is derived from caramel.

Tests.—The addition of grains of paradise, Cayenne pepper, and similar substances, sometimes used for imparting artificial strength to brandy, is detected by the sharp or burning taste of the extract left on evaporation. With sufficient practical experience the origin of brandy may be recognized by Molnar's method (see SPIRITUS FRUMENTI), but it is more difficult to distinguish by their odors the ethers and fusel oils of the French wines used for making brandy than the fusel oils of different kinds of grain. "If 100 Cc. of brandy be very slowly evaporated in a weighed capsule on a water-bath, the last portion volatilized should have an agreeable odor, free from harshness (absence of fusel oil from grain or potato spirit). The residue, dried at 100° C. (212° F.), should weigh not more than 0.25 Gm. This residue should have no sweet or distinctly spicy taste (absence of added sugar, glycerin, or spices). It should nearly all dissolve in 10 Cc. of cold water, forming a solution which is colored not deeper than light-green by a few drops of ferric chloride test-solution diluted with 10 volumes of water (absence of more than traces of oak tannin from casks). 100 Cc, of brandy should be rendered distinctly alkaline to litmus by 1 Cc. of the normal volumetric solution of potassium hydroxide (limit of free acid). If 50 Cc. of brandy be shaken vigorously in a stoppered flask with 25 Gm. of kaolin, and, after standing ½ an hour, be filtered, the color of the filtrate should not be lighter than that of the brandy before treatment (absence of caramel coloring."—U. S.

Uses.—Brandy when pure and of at least 4 years of age is perhaps the most agreeable form in which to administer alcohol to fever patients. The difficulty in obtaining an unadulterated article has caused it to be largely replaced by whisky. A few drops of brandy on cracked ice will frequently allay nausea after other remedies have failed.

SPONGIÆ.—Sponges.

Éponges, Fr.; *Schwämme, Badeschwämme*, G.; *Esponjas*, Sp.

Spongia officinalis L. (Ord. *Ceratospongiæ*).

Origin and Description.—Although sponges have for many years been recognized by naturalists as animals, they are still regarded by some persons as plants. They belong to the order of metazoa, characterized by multitudes of cells, each performing its own part in the economy of the individual, and while reproduction by division is frequent in certain groups, all have recourse to specialized cells or eggs for the perpetuation of the species.

Sponges are aquatic, are found in the water of every part of the globe, and may be exceedingly abundant in suitable locations. So far as known they are all sedentary animals, compelled, with few exceptions, to pass all but the earliest stages of existence fastened to the same submerged object to which they became attached in their early youth. The young possess powers of locomotion, and can seek out new places of abode, but the adults must remain in one place and take whatever of food and fortune the

passing currents may bring them. Thus they can only live and flourish where there are floating clouds of microscopical plants and animals and their spores. These form their staples of subsistence, and must come to them as the rain comes to the plant. In their natural state, sponges somewhat resemble in appearance a jelly-fish or a mass of liver, the entire surface being covered with a thin, slimy skin, usually of a dark color, and perforated to correspond with the apertures of the canals, commonly called "holes of the sponge."

Commercial sponge is, in reality, only the skeleton of the animal. The composition of this skeleton varies in the different kinds of sponges, but in the commercial grades it consists of interwoven horny fibres, among and supporting which are spiculæ of silicious matter in greater or less numbers, and having a variety of forms. The fibres consists of a network of fibrils, whose softness and elasticity determines the commercial quality of a given sponge. The horny framework is perforated externally by very minute pores and by a less number of larger openings. These are parts of an interesting double, external and internal, canal system. At the smaller openings on the sponge's surface channels begin, which lead into dilated spaces. In these, in turn, channels arise, which eventually terminate in the large openings. Through these channels or canals definite currents are constantly maintained, which are essential to the existence of the sponge. The currents enter through the small apertures and emerge through the large ones.

The active part of the sponge—that is, the part concerned in nutrition and growth—is a soft, fleshy mass partly filling the meshes and lining the canals. It consists largely of cells having different functions; some utilized in the formation of the framework, some in digestion, and others in reproduction. Lining the dilated spaces into which afferent canals lead are cells surmounted by whip-like processes. The motion of these processes produces and maintains the water currents, which carry the minute food products to the digestive cells in the same cavities. Sponges multiply by the union of sexual products. Certain cells of the fleshy pulp assume the character of ova, and others that of spermatozoa. Fertilization takes place within the sponge. The fertilized eggs, which are called larvæ, pass out into the currents of the water, and in the course of 24 to 48 hours they settle and become attached to rocks and other hard substances, and in time develop into mature sponges. The depth of the water in which sponge grows varies from 10 to 50 feet in Florida, but considerably more in the Mediterranean Sea, the finer grades being found in the deepest water, having a surface temperature of 50° to 57° F. in winter.

The method of obtaining sponges in the Mediterranean is by means of divers, with and without apparatus, although the use of apparatus was prohibited by the Turkish Government many years ago, owing to the excessive fishing, thus deteriorating the sponge beds, which require about three years to properly develop. As a consequence these goods became scarce and greatly enhanced in value. A diver usually stays below the water ½ to 1 minute, gathering what he can in the meantime, though, with apparatus, he can remain below the surface considerably longer. His work is very hard, owing to the pressure of the water. He is trained to his work when very young, and seldom lives more than thirty years. In the Florida and West Indian waters the fishing is done in flat-bottom boats, called dinghys. A special apparatus, known as a sponge glass, is used to help locate the sponges. It is made from an ordinary wooden bucket, the wooden bottom being replaced by one of ordinary window glass, securely fastened by cement. In using a sponge glass, it is placed upright on the surface of the water; the handle of the bucket is placed on the back of the neck of the fisherman, with his head thrust down in the bucket. In this way the fisherman can distinctly see very small objects in very deep water, and he can even distinguish good sponges from those of an inferior grade. When suitable sponges are located, they are brought up by means of a long pole, about 30 feet in length, with a sharp curved double hook, and placed in the boat. The sponge hooks are made of iron with 3 curved prongs, measuring about 5 or 6 inches in width. The entire length of the hook is about 8 inches, the upper end being made into a very strong socket for the insertion of the pole. As soon as the fisherman collects a sufficient quantity of sponges, he takes them to the vessel, where they are spread carefully on the deck, in their natural upright position, so as to allow the slimy matter, called "gurry" by the fisherman, to run off easily. During the first stages of decomposition they have a very unpleasant odor, something like decayed fishy matter. After the dinghys collect sufficient sponges to make a vessel load, they are

taken to what is called a sponge kraal, which is an enclosure of about 10 to 12 feet, made generally by placing stakes in the beach where the water is from 2 to 3 feet deep.

Sponges, after being kept on the decks of the vessel from 1 to 2 days, will generally be sufficiently cured to be taken to the kraals, where they are kept for a few days, and then thoroughly washed and pounded with a flat stick. They are then placed upon strings of about 6 feet in length and taken to the markets, where they are sold at auction. They are generally sold in lots, and then carefully trimmed and packed in bales weighing from 15 to 100 pounds each, according to quality, the cheaper grades being generally packed in the larger bales.

Varieties of Sponge.—In commerce there are found many different varieties of sponges, namely: Sheepwool, Velvet, Yellow Grass, Glove, Reed, Hardhead, and Wire, emanating from Florida and the West Indies, each variety having several different grades. The Mediterranean gives us "Honeycomb" sponges, commonly called "Mediterranean Bath" or "Turkish Bath," "Silk or Surgeon" sponges, "Elephant's Ear" or "Washrag" sponges, there also being several different grades of each variety. Varieties of Sheepwool are named Rock Island, Key, and Matacomby, obtained from Florida; Abaco, Cuba, and Nassau from the West Indies, their names being given in order as to quality, the most valuable being Rock Islands, which are of a strong fibre and best form, being most valuable for carriage washing and heavy work. This grade also makes fine bath sponges, when bleached, after having been treated with diluted hydrochloric acid to dissolve out calcareous matter, with potassium permanganate and oxalic acid, which gives them a white color, and then washed in a bath of sal-soda, thus neutralizing the acid and changing the color to yellow or lemon. This method, however, greatly weakens the fibre of the sponge, thus ruining it as regards durability. A better method, though not so pleasing to the eye, is to wash the natural sponge in a weak solution of oil of vitriol, say 1 part to 20 of water, allowing them to remain in until the dark color is taken out of the sponge, then thoroughly washing in water. This process does not injure the sponge, makes it look cleaner, and removes all calcareous matter contained therein.

Key Sheepwool is of good form, soft, and close fibre, lacking strength owing to the iron in the sponge, which is signified by a bright red color at the root and running entirely through the structure of the sponge. It is extensively bleached and looks nice, but wears badly, owing to the excessive use of acids, necessary to extract the iron from the sponge.

Abaco Sheepwool resembles the Rock Island, though lacking its strength.

The Cuba Sheepwool somewhat resembles the Key variety, and is used for carriage purposes.

The Nassau, being the coarsest grade, and irregular as regards the horny fibre and firmness, also shape, is the cheapest grade of Sheepwool Carriage Sponges.

The Velvet Sponges, of which there are several varieties (*i. e.*, Abaco, Cuba, and Cay, from the West Indies, also a hard variety from Florida), are much used as cheap carriage sponges and for general purposes, being moderate in price. The Abaco and Cuba Velvet are the best and much resemble Sheepwool. A large hole at the top of this sponge spoils its utility. The Cay variety is the one largely used, being more abundant. The Florida Velvet is coarse and hard, and is not generally liked, except for certain manufacturing purposes. Owing to a hole in the top of this grade of sponge, many people prefer the Coupe-sponges (*i. e.*, the large sponges cut up and trimmed), thus obtaining a nice solid sponge minus the holes. The Yellow Sponge has also several varieties: Nassau and the West Indies, Key and Matacomby from Florida. They have a good shape, but are rather brittle, and used chiefly among painters and bricklayers, and for household purposes. The best of these are the Matacomby and Key. There is also a species of Yellow Sponge, called "Hard Head," and this is what its name implies, a hard sponge. One variety, however, from Cuba, is of fine texture and soft, though somewhat weak, and is bleached, to take the place of a Surgeon Sponge.

The Grass Sponge is a very poor specie and is very low in price. It is chiefly used for manufacturing purposes, by painters, stone-masons, bricklayers, etc. The best quality and nicest shapes are bleached and sold on the market for a cheap bath sponge, and look as good in appearance as the higher grades, but give no satisfaction in wear.

The Reef Sponges, usually called "Slate Sponges," are fine in texture, but lack

strength, are extensively bleached for toilet purposes and used by manufacturers, engravers, and in surgery.

Sponges from the Mediterranean Sea are superior in quality to those from either Florida or West Indies. The horny fibres are far less pronounced, and they do not develop to the same thickness. They are finer in texture, more pliable, and grow in deep water, having a surface temperature of 50° to 70° F. in winter, which is clearer and more free from impurities, and the more difficult to obtain. The various grades are called White Turkey—*i. e.*, Silk Surgeon Sponges; Brown Turkey—*i. e.*, Zimocha, being similar, only coarser and darker in color, than the White Turkey; Leather Sponges—*i. e.*, Washrag or Elephant's Ear; Honeycomb Sponges, all of which have several different varieties. The best varieties are Mandruka Turkish Cup, deriving their name from their formation, similar to a cup; Turkey Solids, which are the same variety, only solid, as the name implies. The Leather Sponges are thin, flat, and fine in texture, used formerly in surgical intestinal work, but now chiefly for manufacturing purposes, and used considerably in Europe by veterinary surgeons. Brown Turkey—*i. e.*, Zimocha Sponges—are similar in texture to a Silk Sponge, but brittle. It is chiefly used in Europe for a horse sponge, and also for manufacturing purposes. Honeycomb Sponges are various in quality, those being known as Mandruka are found in deep water, have perfect forms and a close fibre, with no horny fibres protruding from the surface, and are specially known for their small root. This latter fact should be borne in mind in selling sponges. Many people object to large holes in the sponge, whereas the root is the chief factor in determining its strength. The "catch" of this grade is diminishing yearly, thereby enhancing their value; consequently only a few dealers import them. In commerce the "Mandruka" is a comparatively recent variety.

Next in quality comes the Bengaza, a sponge similar to the Mandruka, though somewhat coarser, but of nice shape and strong, and usually sold as a "Mandruka." This sponge grows in deep water. The cheaper varieties of Honeycomb—*i. e.*, Turkish Bath—are found in shallow water and are numerous in variety, quality varying according to depth at which they are found. They are chiefly bleached, only the finest selected being used in their natural color.

The question of propagating sponges has been discussed both as regards Florida and Mediterranean sponges, and the idea is believed to be feasible. The method is as follows: Sponges cut into small pieces will live and grow if properly attached in suitable water (clear and free from impurities). They can be cut on a moistened board with a knife or fine saw. Care must be taken not to express the soft matter. The preferred size of the cutting is about 1 inch broad and similar in height. The outer skin should be retained as far as practicable. In cutting, the lines of the circulating canals should probably be considered, although pieces cut without any reference to the directions of the canals have lived and grown. Exposure is not injurious, unless exposed too long or in very warm weather. The clippings must then be made fast, care being taken to use material that is not injurious to the sponge, and will not distort its growth. They must be fastened on the bottom in an upright position that can be maintained and not smothered by mud, sand, or sediment. The use of bamboo pegs seem to have given much satisfaction and good results attained in as short a time as a year.

Owing to the great advance in the cost of sponges during the last few years, due to the scarcity and the results of over-fishing and increased demand, of which the European market has been a factor, the packers in Florida have resorted to loading sponges that are sold by weight, to keep down the price, so as to appear to continue asking the former prices, whereas in reality the cost is 20 to 25 per cent. higher. There are several methods of accomplishing this, such as injecting in the sponge sand or marble dust, also by washing the sponges in a salt solution, and by injecting glucose and heavy syrups. To compare the difference between a pure and loaded sponge take a 2-ounce sponge of each grade, wetting them both, and it will be found that the pure article will measure about 19 inches in circumference, or thereabouts. The loaded article in comparison will only measure about 16 inches in circumference and less. Of course, this will largely depend upon the amount of foreign matter contained therein, the average herein given being taken from a bale of each kind and measured. Take a sponge of equal weight, say 2 ounces, costing $4 a pound, and pure, and a loaded sponge at $3 per pound, and it will be seen that by washing them out you are getting a larger sponge in the 2-ounce pure than in the 2-ounce loaded, and therefore the cost is practically equal,

despite the fact of there being $1 difference per pound in the price. A bale of pure sponges averaging 8 to the pound at $4 per pound will be as large, if not larger, than a loaded bale about 6 to the pound at $3 per pound. The cost of these per sponge is 50 cents. The purchasing of loaded sponges should therefore be avoided, it being illustrated that as good value, if not better, can be obtained by paying the higher price.

Many dealers are now offering Sheepwool sponges by the piece, a stated number of sponges being packed in a bale, and this method is commended, saving the retailer the trouble of figuring the individual cost of each sponge, and sometimes unconsciously losing their profits by not taking into consideration the difference of gross weight at which the sponges are usually purchased, and the net weight, and even a possible loss from the sponges drying out. In this connection we would say that sponges in bales absorb humidity in the summer time and are usually more or less damp, whereas in the winter time they lose in weight, owing to the dryness of the air.

(The above is largely from an article by Albert Hart in the *Amer. Journ. Pharm.* for 1901.)

Composition.—The organic matter of sponge is a proteid called *spongin*, which was formerly supposed to be closely allied to, or identical with, *fibroin* or *sericin* of silk, but was proved by Schlossberger (1858) and Staedeler (1859) to be entirely distinct, in being insoluble or very slowly soluble in ammoniacal solutions of the oxides of nickel and copper, and in the behavior to hot diluted sulphuric acid, with which it yields *leucin* and *glycocoll*, while sericin yields by this treatment tyrosin and serin, and is readily dissolved by solutions of nickel and copper in ammonia. Spongin is soluble in hot solution of caustic potassa and in hot mineral acids.

Action and Uses.—Before the discovery of iodine, roasted or so-called "burnt" sponge was generally used in the treatment of *goitre*, both internally and externally, and certainly with excellent results in appropriate cases; but it is now wholly superseded by the preparations of iodine. Sponge is familiarly employed for countless domestic purposes which require the use of a porous, compressible, and elastic substance capable of holding liquids, and, among others, for partial or general baths, which are of great hygienic importance. Its use in medicine and surgery for absorbing blood, pus, and other animal liquids was at one time common, but aseptic surgery now considers its employment an unmitigated evil.

Derivatives and Allied Product.—*Spongia usta*, Fr. Cod.; *Burnt sponge*, E.; *Éponge torrifiée*, Fr.—Heat clean sponge, cut into small pieces, in a coffee-roaster until about ¼ its weight has been given off. The residue consists mainly of charcoal, with 25 to 30 per cent. of calcium sulphate, 10 per cent. of silica, 9 per cent. of ferrous oxide, the remainder being magnesium carbonate, potassium chloride, and calcium phosphate, and about ½ to 1 per cent. of sodium iodide (Herberger). Some irregular practitioners use burnt sponge in the treatment of spasmodic croup. It has little if any value.

Spongia Cerata.—*Sponge tent*, E; *Éponge préparée à la cire*, Fr.; *Wachsschwämme*, G.—Sponge is freed from foreign matters by beating and washing, then dried, cut into proper shape, dipped into yellow melted wax, pressed between hot iron plates, and when cold freed from the excess of wax.

Spongia Compressa.—*Compressed sponge*, E.; *Funiculo pressa*, F. Cod.; *Éponge préparée à la ficelle*, Fr. Cod.; *Pressschwamm*, G.; *Esponja preparada*, Sp.—Perfectly clean, fine sponge is cut into elongated pieces while moist, securely tied by means of twine into cylindrical pieces, and then dried.

Vegetable Sponge or Gourd Towel.—The fibrous network of the fruit of Luffa ægyptiaca, *Miller* (Momordica Luffa, *Linné*, Fam. *Cucurbitaceæ*), has been used to some extent, under these and similar names, like a sponge and flesh-brush. Luffa petola, *Seringe*, and L. fœtida, *Cavanilles*, yield similar products. The fleshy portion of these fruits is edible, though not very palatable; several other species are violently purgative and emetic.

STANNUM.—Tin.

Etain, Fr.; *Zinn*, G.

Symbol, Sn. Atomicity bivalent and quadrivalent. Atomic weight, 118.1.

Tin is rarely found in the metallic state. Its most important ore is a binoxide, SnO_2, known as *tinstone*, which is usually imbedded in granite, quartz, or slate, and often associated with iron pyrites, and with tungstate of iron and manganese, known as the mineral *wolfram*. It is rarely met with as silicate, and is present in *columbite*, *tan-*

talite, and allied minerals, and in minute proportions in the mineral waters of Saidschütz and other places. The most important tin-mines are in Devonshire and Cornwall in Great Britain, and in Malacca and Banca, but tin is likewise obtained in Australia, Bohemia, Saxony, and some parts of the United States. Australian tin sometimes contains gold. The tinstone is stamped into a coarse powder, freed from lighter minerals by washing with a stream of water, roasted to expel arsenic and sulphur, again washed with water, mixed with powdered coal and a little lime or fluor-spar for the purpose of forming a fusible slag, and then reduced on the hearth of a reverberatory furnace.

Tin is a bluish-white metal of the specific gravity 7.3, softer than gold, but harder than lead, and when bent emitting a crackling sound. It may be rolled or hammered into *foil*, at 100° C. (212° F.), drawn into wire, and at 200° C. (392° F.) is so brittle that it may be readily reduced to powder. It melts near 230° C. (446° F.), and, according to Nies and Winkelmann (1882), on congealing increases in volume 0.7 per cent. While cooling it is readily converted into powder by trituration in a hot iron mortar; after sifting it constitutes *Stanni pulvis*, which was formerly employed. It is but superficially oxidized in moist air, and will effectually protect iron from rusting as long as the coating is perfect. Its alloy with lead forms *pewter*, *Britannia metal*, and *solder;* alloyed with copper it constitutes *gun-metal* and *bronze;* and by combining 4 parts of tin with 3 of cadmium, 8 of lead, and 15 of bismuth a fusible alloy is obtained, melting at 60° C. (140° F.).

Tin forms two series of compounds, the *stannous* and the *stannic*, in which it is bivalent and tetravalent respectively. These may be considered as being derived from stannous oxide, SnO, and stannic oxide, SnO_2. Tin, like aluminum and zinc, has both acidic and basic properties, for the oxides or hydroxides with acids give salts, and with strong alkalies they give stannites and stannates. Stannous salts are easily oxidized to stannic salts, and stannites easily pass to the stannates. There are two forms of stannic hydroxide, known as stannic acid, H_2SnO_3, and metastannic acid, $H_2Sn_5O_{11}$. The former is obtained by precipitation of stannous salts with caustic alkali, the latter by the action of concentrated nitric acid on tin. Stannic acid is soluble in acids and alkalies, while metastannic acid is not soluble in acids, but may be dissolved in hot alkalies, giving, for example, sodium metastannate, $Na_2S_5O_{11}$.

Metallic tin dissolves in hot, strong sulphuric acid to stannic sulphate, evolving sulphur dioxide. Strong hydrochloric acid dissolves it to stannous chloride, and nitro-muriatic acid yields with it stannic chloride. *Stannous salts* are precipitated brown by hydrogen sulphide, the precipitate being soluble in ammonium sulphide. Gold chloride produces a deep-purple precipitate (*purple of Cassius*), and mercuric chloride is reduced either to calomel or to a gray powder of metallic mercury. This reaction explains the value of stannous chloride as a test for salts of mercury. *Stannic salts*, of which the chloride, $SnCl_4$, is used by dyers, do not react with the chlorides of gold and mercury, but yield with hydrogen sulphide a yellow precipitate which is soluble in ammonium sulphide. Both stannous and stannic salts are precipitated white by potassium hydroxide; the precipitates are soluble in an excess of the reagent, and the alkaline solution, when obtained from stannous salts, yields on boiling a black precipitate of stannous oxide. Of the sulphides, *stannic sulphide*, SnS_2, is of interest; it is made by heating a mixture of tin amalgam, sulphur, and sal ammoniac, when it remains behind in golden-yellow scales, ammonium chloride and sulphide and chloride of mercury subliming; when ground, stannic sulphide is known as *mosaic gold* and *bronze powder*.

Sodii Stannas, *Natrium stannicum, Sodium stannate.—Preparing salt.* $Na_2SnO_3.3H_2O$. This is used by calico printers as a mordant, and is prepared on the large scale by fusing tin ore with soda and sodium nitrate or by boiling it with strong caustic soda. The salt forms pearly crystals and comes into the market mostly as colorless masses. It is easily soluble in water, and is decomposed by acids, even carbonic, as well as by boiling with ammonium chloride, with precipitation of stannic acid. This behavior is utilized to precipitate the acid on fibres in the dyeing industry, which then have the power of combining with color bodies. This process is known as mordanting.

Action and Uses.—Neither tin nor its salts are employed in modern medicine. Tin in filings and powder was formerly recommended and used as a tæniacide, the destruction of the worm being due to the mechanical action of the foreign substance. From 1 to 4 drachms (4–16 Gm.) were administered, suspended in syrup or made into an electuary, and followed in from 3 to 6 hours by a brisk cathartic. Some of the salts of tin, chiefly

the chloride, are credited with vermicidal properties. The effect of poisonous quantities of tin upon the organism is said to be similar to that of lead. In the dose of $\frac{1}{16}$ to $\frac{1}{2}$ grain (0.004–0.03 Gm.) chloride of tin has been employed as an antispasmodic in chorea, epilepsy, and other convulsive diseases. Externally it is astringent and irritant, and has been applied to slowly healing ulcers.

SALTS OF TIN.

Stanni Chloridum.—*Stannous chloride*, E.; *Stannochlorid, Zinnchlorür*, G. Tin salt. $SnCl_2.2H_2O$. This is formed by dissolving tin in strong hydrochloric acid and crystallizing from acid solution. It is known commercially as *tin salt*, and is used extensively as a mordant. It is soluble in acidified water or alcohol. Much water decomposes it into basic chloride, Sn(OH)Cl. Air oxidizes it to stannic oxychloride, $SnOCl_2$, and stannic chloride, $SnCl_4$.

Bettendorf's Reagent.—This is a saturated solution of stannous chloride in strong hydrochloric acid, used in testing for arsenic. The reactions are $As_2O_3 + 3SnCl_2 + 6HCl = As_2 + 3SnCl_4 + 3H_2O$, and $As_2O_5 + 5SnCl_2 + 10HCl = As_2 + 5SnCl_4 + 5H_2O$.

Stannic Chloride. $SnCl_4.5H_2O$.—This is formed when tin is dissolved in aqua regia, or by passing chlorine into a solution of stannous chloride. It is used in the dyeing industries. When tin is treated with chlorine, anhydrous stannic chloride is formed, a colorless fuming liquid, boiling at 114° C. (237.2° F.), and long known as *spiritus fumans Libavii*. A solution of the chloride, when boiled, yields stannic and hydrochloric acids. Stannic chloride forms combinations with other chlorides, such as $SnCl_4.2NH_4Cl$, which is known in commerce as *pink salt*, and is used in cotton-printing. $SnCl_4.2NaCl.5H_2O$ is the so-called *crystallized tin chloride*.

STAPHISAGRIA, *U. S.*—Staphisagria; Stavesacre.

Staphisagriæ semina, Br.; *Semen staphisagriæ, staphidis agriæ*, or *pedicularis*.—*Stephanskörner, Läusekörner*, G.; *Staphisagrie*, Fr.; *Astaphysagria, Paparraz*, Port.; *Estafisagria, Albarraz*, Sp.

The dried ripe seed of *Delphinium Staphisagria* L. (Fam. *Ranunculaceæ*).

Staphisagria is official in most European pharmacopœias.

Origin.—The plant yielding these seeds is a tall, stout, hairy biennial larkspur, native of southern Europe and adjacent Asia, and somewhat cultivated for its seeds. Holmes has shown that the species formerly grown in gardens, and figured under this name, is distinct.

FIG. 409.

Stavesacre seeds (× 2).

Description.—About 5 to 7 Mm. ($\frac{1}{5}$–$\frac{1}{4}$ In.) long and nearly as broad, flattish-tetrahedral, one side convex, another small and opposite to a pointed extremity, the edges rather acute; brown, gray brown or sometimes blackish, strongly and coarsely reticulate-wrinkled, containing a whitish, or becoming gray brown, oily perisperm and a small, straight embryo; nearly inodorous, taste very bitter, acrid, and somewhat biting. The yield of ash is from 3 to 4 per cent.

The seed of *Delphinium Consolida* L., of similar shape and structure, but several times smaller, black, and with sharper angles and ridges, may be substituted for external use.

Constituents.—Staphisagria contains, besides about 25 to 30 per cent. of a non-drying fixed oil, a little volatile oil, several resins, and unimportant substances, a total of about 1 per cent. of three, or possibly more, alkaloids, to which its properties are due. Most of the alkaloidal matter is retained in the fixed oil when the latter is extracted by solvents, so that this has been used for the same purposes as the seeds. The most important alkaloid is *delphinine* ($C_{31}H_{49}NO_7$), of which Katz obtained 30 grammes from 50 kilos of seeds by the following method: The seeds were extracted by ether, the solution precipitated by ethereal solution of oxalic acid and by shaking out with tartaric acid, precipitating the acid solution with sodium cyanide, shaking out the remaining liquid with ammonia and ether, evaporating the ether, and recrystallizing from alcohol, when the delphinine was obtained in shining colorless crystals. The portion remaining in the cyanide precipitate was then recovered by the use of acetone. Delphinine is soluble in alcohol, ether, and chloroform, melts at 191° C. (375.8° F.). Its double platinum salt is soluble in water, as well as in alcohol and chloroform, crystallizing from the last in acicular yellow crystals. *Delphisine* he regards as a decomposition-product of delphinine. It occurs in needles and contains one more atom of hydrogen, and Katz converted

it into delphinine by simple recrystallization. Delphinine acts much like aconitine. *Delphinoidine* ($C_{25}H_{42}NO_4$), accepted by most authors, not biting and then numbing, and more narcotic than delphinine, Katz regards as a decomposition-product. Other alkaloids which have been reported are *staphisagrine*, now generally regarded as a mixture, *staphisagroine* (Ahrens), which Katz regards as the only naturally existing alkaloid other than delphinine, and *calcitrapine*, of which nothing definite is known.

Pharmaceutical Preparation.—Fluidextract of Staphisagria, U. S. P.

Action and Uses.—Staphisagria is employed in medicine solely as a local application for the destruction of lice and the itch-mite. For this purpose it may be applied in ointment or in a lotion composed of equal parts of the fluidextract and ether. Applied to an abraded surface, it will cause much irritation. Internally it is decidedly irritant to the gastro-intestinal mucous membrane, and its administration in full doses results in violent vomiting and purging. Delphinine has been used with reputed success in the local treatment of neuralgia by applying it in ointment (10 to 40 grains (0.60–2.60 Gm.) to the ounce [30 Gm.]) over the painful nerve.

Other Species.—*Delphinium*, or *Larkspur* (*Staggerweed*, *King's Consonud*, E.; *Ritter-sporn*, *Lerchenklaue*, *Hornkümmel*, G.; *Pied d' alouetta*, Fr.), the dried ripe seeds of *D. Consolida* L., of central Europe, referred to under *Description*, are used in precisely the same way as staphisagria, and the constituents are doubtless nearly or quite identical. Those of at least a dozen other species are similarly used.

The genus *Delphinium* L. comprises some 120 species, nearly half of them in North America. They are generally poisonous, in the same way as staphisagria, in all their parts, and some of them are among the most serious stock-poisons in grazing regions. *D. brunonianum* Royle is the Indian *Samp-phali*.

STILLINGIA, *U. S.*—Stillingia.

Queen's root or *delight*, *Silver-leaf*, *Yaw-root*, E.; *Stillingie*, G., Fr.

The dried root of *Stillingia sylvatica* L. (*Sapium s.*—Torr.—Fam. *Euphorbiaceæ*).

Stillingia is not official in any other pharmacopœia.

Origin.—The Stillingia plant is a stout, perennial, milky-juiced herb, from 1 to 3 ft. high, inhabiting sandy soil, in exposed locations, throughout the southeastern United States, from Virginia to Texas. The habit of the plant and the appearance of the root are here illustrated. The upper flowers are staminate, diandrous, the lower are pistillate, 3-carpelled. The root is collected in late autumn or early spring.

Fig. 410.

Stillingia: plant and root (½ Nat.); section (Nat.).

Description.—Occurring usually in short transverse sections of very long tapering, slenderly fusiform roots, about 2.5 Cm. (1 In.) or less in thickness, very light, tough and spongy; externally of a deep, or occasionally a light reddish brown, finely, shortly, and crookedly longitudinally wrinkled and incompletely annulate, especially the thicker portions, with constrictions, which frequently become slight fissures; ends of the sections pinkish, very fuzzy with innumerable partly detached fine bast-fibres, the bark very thick, containing scattered fine resin-cells and lactiferous ducts, the wood radiate, fibrous, and porous; odor slight, peculiar; taste pungent, bitter, and acrid.

Constituents.—The activity of stillingia, except for its 10 or 12 per cent. of tannin, is due to 3 or 4 per cent. of a volatile oil, a fixed oil, and a resin which has been called *sylvacrol*. The volatile oil is strongly and unpleasantly odorous. The fixed oil,

which is ether-soluble, shares the acridity of the sylvacrol, which latter can be extracted by alcohol or chloroform. A little gum is associated with the resin. Starch is present in moderate amount, and the ash should not exceed 5 per cent.

Pharmaceutical Preparation.—Fluidextract of Stillingia, U. S. P.

Action and Uses.—Stillingia belongs to that class of drugs to which powerful alterative properties were attributed, but, like the other members of the group, the evidences of its power are not very convincing. It has been used, especially in the Southern States, as a remedy in syphilis, scrofula, sluggish cutaneous diseases, and chronic hepatic affections. In large does it is emetic. It is administered in the dose of ½ to 1 drachm (2–4 Cc.), in decoction or fluidextract.

STRAMONIUM, *U. S.*—Stramonium Leaves.

Thorn-, *Devil's-*, or *Mad-apple*, *Apple of Peru*, *Stink-weed*, *Jamestown* (Jimson) *weed* or *lily*, *Devil's trumpet*, *Derotry*, E.; *Stechapfel*, *Dornapfel*, G.; *Feuille de stramoine* or *de porume épineuse*, Fr.; *Foglie di Stramonio*, It.; *Folha de Estramonia*, *Figuiera do Inferno*, Port.; *Hoja de Estramonio*, or *de Toloache*, Sp.

The dried leaves of *Datura Stramonium* L. (*Stramonium spinosum* Lam.—Fam. *Solanaceæ*) yielding, when assayed by the U. S. P. process, not less than 0.35 per cent. of its alkaloids.

Stramonium leaves are official in all pharmacopœias. Many require that they be renewed annually. The Belgian excludes discolored leaves. The Portuguese directs the use of the entire plant except the root, and allows the substitution of *D. Tatula* D.C. (which should be L.).

Origin.—The stramonium plant, native of Asia, is naturalized in most temperate and sub-tropical countries, and is exceedingly common and abundant in the United States, in rich ground, especially about barn-yards, lumber-yards, docks, and other waste places. It is an annual, and one of our largest and coarsest herbs, reaching a height of 1 to 2 M. (3 to 6 Ft.), and its spreading branches covering an area almost as broad. The root is white, the stems and branches pale green, the leaves dark green, the flowers white. The plant is smooth, except for a slight pubescence on the younger parts, and exhales a rank, very heavy and somewhat nauseating narcotic odor. The leaves and seeds are described below, and the habit is shown in the accompanying illustration. All parts of the plant are exceedingly poisonous. We have seen the pupils widely dilated by accidentally rubbing the eyes with the fingers, after pulling the fresh leaves from a plant. Fatal cases of poisoning are of annual occurrence in and near most

Fig. 411.

Datura stramonium L.: flowering branch (⅓ Nat.).

Fig. 412.

Capsule, mature, with two valves removed, showing partitions and position of seeds (¼ Nat.).

of our large cities, and it is estimated that in India this plant causes more deaths than any other. The leaves should be gathered when the plant is in full bloom and dried carefully in the shade. To how great an extent it is true that the quality deteriorates on being kept is mostly conjectural.

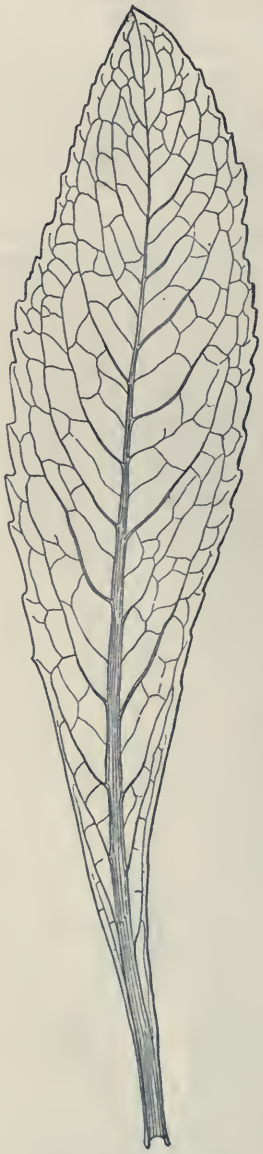
Description.—A much wrinkled, deep- or somewhat grayish-green, rarely very slightly brownish, mass, consisting of petioled leaves, the blades 12 to 25 Cm. (5–10 In.) long and

about two-thirds as broad, inequilaterally ovate, very oblique at the base, acuminate and acute at the apex, very coarsely dentate or sublobed, the large teeth few, acute, with rounded sinuses; thin, smooth, the principal veins few and coarse; odor slight, narcotic when bruised; taste bitter and disagreeable.

The powder is bright green and exhibits stout, conical hairs of 2 or 3 thick-walled cells placed end to end, their surface warty-roughened, much smaller hairs having enlarged, glandular heads of 2 to 4 cells, and numerous stellate or rosette crystals, a few prismatic. Schlotterbeck distinguishes the powders of the 3 closely related leaves, belladonna, stramonium, and hyoscyamus, by these crystals, those of belladonna being mostly in the form of fine crystal-sand or needles, those of hyoscyamus "prismatic" or in twin forms, seldom if ever stellate.

Aside from the accidental substitution of belladonna leaves, stramonium is liable to be adulterated with those of *D. Tatula* L., a species with purple stem and petioles and bluish- or violet-white flowers. The leaves are mostly smaller and have purplish petioles and midribs.

FIG. 413.



Spurious ("French cultivated") stramonium (⅔ Nat.).

In 1900 a large shipment of so-called "French cultivated stramonium" was offered in New York. One of these leaves is here illustrated.

Constituents.—Stramonium-leaves yield 17 to 20 per cent. of ash, are rich in potassium nitrate, to which, doubtless, part of their antispasmodic effects are due, and contain a trace of volatile oil, gum, and other unimportant substances, besides an amount of alkaloid which has been variously estimated at from 0.2 to 0.4 per cent. It is probable that most analyses have given too low results, owing to the large amount of chlorophyll present. Schmidt, who followed a method designed to avoid this error, reported the larger percentage stated above. As to the identity of this alkaloid, we cannot consider information at all sufficient. It was originally called "daturine," but is now known to be identical with other solanaceous alkaloids, hyoscyamine, or atropine, or a mixture of the two in undetermined, and probably very variable, proportions. It is generally regarded as being chiefly hyoscyamine. There is probably, also, a little hyoscine present. All these alkaloids are elsewhere discussed.

Assay of Stramonium.—The method to be employed is identical with that given for Belladonna Leaves, using 10 Gm. of stramonium in No. 60 powder.—U. S. (See page 286.)

Pharmaceutical Preparations.— EXTRACT OF STRAMONIUM, FLUIDEXTRACT OF STRAMONIUM, TINCTURE OF STRAMONIUM, U. S. P.

Action and Uses.—The physiological action of stramonium and its alkaloid, daturine, is almost identical to that of belladonna and atropine. Those specimens which contain a small quantity of hyoscine are slightly more sedative to the central nervous system than is belladonna. In poisonous doses they produce the same symptoms and are subject to the same treatment. (See BELLADONNA.) Stramonium was at one time esteemed as a sedative in epilepsy and in acute mania and other forms of active insanity, but experience has failed to confirm the favorable judgment. It is a useful antispasmodic in dysmenorrhœa, whooping cough, retention of urine due to spasm at the neck of the bladder. Its employment in spasmodic asthma is attended by gratifying results. It may be used by smoking the dried leaves in a pipe or cigarette, either alone or mixed with cubebs, sage, belladonna, and other drugs. The fumes emitted by burning cones made of stramonium, potassium nitrate, and some aromatic are equally efficacious. If possible the smoke should be inhaled into the lungs. Applied locally in ointment, stramonium will palliate the pain of muscular rheumatism, neuralgia, and both the pain

and tenesmus due to hemorrhoids, anal fissure, and other inflammations in the region of the anus. Daturine may be substituted for belladonna and its alkaloid as a mydriatic. Stramonium is given in substance in the dose of 1 to 3 grains (0.06–0.20 Gm.). The dose of the fluidextract is 1 to 3 minims (0.05–0.20 Cc.), of the extract $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.006–0.015 Gm.), and of the tincture 10 to 30 minims (0.60–2 Cc.).

Allied Drugs.—*Stramonium seeds* (*Stramonii semina*, Br.), the dried ripe seeds of the plant discussed above are official in a number of pharmacopœias, and were so in the U. S. P. preceding the edition of 1900. They are about 3.5 Mm. ($\frac{1}{8}$ In.) long and two-thirds as broad, flattened-reniform, the hilum at one side of the concavity; testa dull black or blackish, hard, coarsely and shallowly reticulate-wrinkled, and very finely pitted; perisperm whitish, oily, concealing a cylindrical, curved embryo; odor unpleasant when bruised; taste sweetish and bitter, then somewhat acrid.

Fig. 414.

Stramonium-seed and section (× 3).

Except that they contain about 25 per cent. of fixed oil, and no chlorophyll, their constituents are practically the same as those of the leaves. They have generally been regarded as containing more alkaloid than the leaves, but it appears likely that at least the most of this difference was due to a failure of assayers to detect the full amount contained in the leaves.

The genus *Datura* L. contains from 4 to 15 species, according to whether certain groups are regarded as sub-genera or distinct genera. They are characterized by the same properties as those of the official species, and the alkaloids are doubtless nearly if not quite identical. Hyoscine has been found in the flowers of *D. fastuosa* L. (*D. alba* Nees) of the East Indies, Egypt, etc. This species probably includes the *D. Nilhumatu* Dun., which yields the Indian drug *Nila-humatu*.

STRONTII BROMIDUM, *U. S.*—Strontium Bromide.

Bromure de strontium, Fr.; *Strontiumbromid*, G.

Formula, $SrBr_2 + 6H_2O$. Molecular weight, 352.94.

It should contain not less than 97 per cent. of pure salt, and should be kept in glass-stoppered bottles.—U. S.

Preparation.—Strontium bromide is best made by neutralizing diluted hydrobromic acid with strontium carbonate (free from barium and calcium) in excess, filtering the mixture, and evaporating the clear solution until crystals begin to form. Upon cooling the salt separates in crystals, which are then carefully dried to prevent efflorescence, which takes place at elevated temperature.

Properties.—Strontium bromide occurs in colorless, transparent, hexagonal crystals, odorless, and having a bitter saline taste; they are very deliquescent, and should be kept in well-stoppered vials. The salt is soluble in 1 part of water at 25° C. (77° F.) and in 0.4 part of boiling water, the aqueous solution being neutral to litmus-paper; it is readily soluble in alcohol, and is precipitated from this solution upon the addition of an equal volume of ether, in which it is insoluble. To a non-luminous flame the salt communicates an intensely red color. When heated the crystals first melt, and at 120° C. (248° F.) lose all their water of crystallization (30.4 per cent.); the anhydrous salt fuses at 630° C. (1166° F.). With calcium sulphate the aqueous solution of the salt (1 in 20) slowly forms a white precipitate of strontium sulphate, insoluble in diluted acids; the same reaction occurs more quickly with diluted sulphuric acid, potassium sulphate, and other soluble sulphates. With potassium chromate it forms a yellow precipitate of strontium chromate soluble in acetic acid. With ammonium carbonate or sodium carbonate it forms a white precipitate of strontium carbonate, soluble with effervescence in acetic acid. If 1 Cc. of chloroform be added to 10 Cc. of the solution (1 in 20), then drop by drop chlorine water, which has been diluted with an equal volume of water, and the mixture shaken, the liberated bromine will dissolve in the chloroform, communicating to it a yellow or brownish-yellow color, free from any violet tint (absence of iodine).

Tests.—If 1 Gm. each of strontium bromide and sodium acetate be dissolved in 5 Cc. of distilled water, and the solution be made slightly acid through the addition of from 3 to 5 drops, or a sufficient quantity of diluted acetic acid, the solution should, upon addition of 5 drops of potassium dichromate test-solution and agitating, not become cloudy within 5 minutes (absence of barium). A 5 per cent. solution slightly acidulated with hydrochloric acid should not be affected by an equal volume of hydrogen sulphide solution, when kept corked at 35° C. (95° F.) for at least half an hour, either before or after

adding ammonia-water to slight excess (absence of heavy metals). If 0.5 Gm. of the salt be dissolved in 50 Cc. of distilled water, and a few drops of potassium chromate test-solution be added, it should require not less than 27.48 Cc. nor more than 29 Cc. of tenth-normal silver nitrate solution to produce a permanent red color (corresponding to at least 97 per cent. of pure bromide).—U. S. Each Cc. of the silver solution represents 0.017647 Gm. of pure $SrBr_2.6H_2O$, and 0.5 Gm. of the pure salt would require 28.33 Cc. for precipitation. The lower limit, 27.48 Cc., of silver consumed represents 0.4849 Gm. of the pure salt, or 96.98 (97) per cent. If chloride be present, the quantity of silver solution consumed is increased above that required for the pure salt, and each 0.095 Cc. consumed in excess of 28.33 Cc. represents 1 per cent. of strontium chloride as impurity, provided that is the only one present that acts with silver solution. The excess of (29 Cc.–28.33 Cc.) 0.67 Cc. of silver allowed by the U. S. P. represents 7.05 per cent. of chloride, which is too large. The presence of calcium would also tend to throw the titration figure above the theoretically required amount of silver solution, and it may be that the U. S. P. allows for the presence of such impurity. On the whole, the titration with silver nitrate is unreliable, as it is apt to lead to erroneous results unless care be taken to interpret the titration properly (see remarks under POTASSII BROMIDUM).

The preparation of *pure* strontium carbonate is attended with more or less difficulty, and H. B. Dunham (1893) proposes to use strontium hydroxide instead, which latter can either be dissolved in the respective acids or can be decomposed by the appropriate salts of ammonium. Strontium hydroxide $Sr(OH)_2$, strictly pure, can be rapidly prepared, according to Dunham, by heating strontium nitrate in a capsule for about twenty minutes over a direct fire, which converts it into oxide; the latter is mixed with more than sufficient water to slake it, and after subsiding the clear liquid is poured off, and the residue is again treated with water in the same manner: by this treatment all barium hydroxide is effectually removed, being soluble in 20 parts of water, whereas the strontium hydroxide requires 60 parts of cold water. To free the strontium salt from any calcium possibly present, it is now dissolved in boiling water (requiring 2.4 parts), and the solution then set aside to crystallize: the crystals occur in transparent square prisms with 8 molecules of water.

Action and Uses.—Strontium bromide is used for precisely the same conditions as the other bromides. It possesses advantages over potassium bromide in exerting a nutritive influence upon the system, and in being less apt to produce a rash or unpleasant symptom of bromism. In addition to the ordinary effects of bromides, the strontium salt is useful as a sedative in gastric indigestion of nervous origin. It is given in somewhat larger doses than the other bromides, the average daily quantity being from 1 to 3 drachms (4–12 Gm.).

STRONTII IODIDUM, *U. S.*—Strontium Iodide.

Iodure de strontium, Fr.; *Strontiumjodid*, G.

Formula, $SrI_2 + 6H_2O$. Molecular weight, 446.02.

It should contain not less than 98 per cent. of the pure salt, and should be kept in small glass-stoppered vials, carefully protected from light.—U. S. Deeply colored strontium iodide should not be dispensed, but may be deprived of free iodine by agitation with several portions of carbon disulphide or chloroform and quickly drying on bibulous paper.

Preparation.—Like other strontium salts, the iodide is no doubt best prepared by neutralizing the respective acid with strontium carbonate. Since hydriodic acid is rather unstable, a freshly prepared solution of it should be employed, the excess of strontium carbonate removed by filtration, and the clear solution concentrated by evaporation. When cold, strontium iodide will separate in crystals.

As stated under STRONTIUM BROMIDE, the iodide may also be obtained by neutralizing hydriodic acid with strontium hydroxide and evaporating the solution to the crystallizing point.

Properties.—Strontium iodide occurs in colorless, transparent, hexagonal plates, odorless and having a bitterish, saline taste. The salt is deliquescent, and easily colored yellow by exposure to the air and light. It is soluble in 0.5 part of water at 25° C. (77° F.) and in 0.27 part of boiling water; also soluble in alcohol and slightly in ether;

the aqueous solution is neutral or only very slightly acid to litmus-paper. When cautiously heated the crystals melt, and gradually lose their water of crystallization (24.05 per cent.), becoming anhydrous: at a red heat they are decomposed, losing iodine, and leaving a residue of strontium oxide.—U. S. To a non-luminous flame the salt communicates an intensely red color. If 1 Cc. of chlorine water be added to 5 Cc. of an aqueous solution of the salt, iodine will be liberated and impart to the solution a light reddish-brown color; on agitating the mixture with a few drops of chloroform this will acquire a violet color. Toward calcium or potassium sulphate, potassium chromate, and sodium or ammonium carbonate, strontium iodide behaves precisely like the bromide.

Tests.—It should not respond to the tests for barium and for heavy metals detailed under STRONTII BROMIDUM. If 0.5 Gm. of the salt be dissolved in about 100 Cc. of distilled water, contained in a flask, and 25 Cc. of tenth-normal silver nitrate solution, 5 Cc. of nitric acid, and 5 Cc. of ferric ammonium sulphate test-solution be successively added, the flask stoppered and thoroughly shaken, then it should require not less than 1.7 Cc. nor more than 3.1 Cc. of tenth-normal potassium sulphocyanate solution to produce a permanent red tint (corresponding to 98 per cent. of pure strontium iodide).—U. S. The minimum and maximum limits of silver solution allowed in the titration are 21.9 Cc. and 23.3 Cc. respectively, and the theoretical quantity required for 0.5 Gm. of pure $SrI_2.6H_2O$ is 22.42 Cc. Each Cc. of silver solution represents 0.0223 Gm. of the pure salt, hence the lower limit, 21.9 Cc., corresponds to 0.4884 Gm. of pure iodide in 0.5 Gm. assayed, or 97.68 per cent. The upper limit of silver solution, 23.3 Cc., is (23.3–22.42) 0.88 Cc. in excess of the theoretical quantity, which may be due to the presence of strontium chloride as impurity. Each 0.154 Cc. of silver solution in excess represents 1 per cent. of chloride, provided that is the only impurity reacting with the silver solution, and 0.88 Cc. excess represents 5.7 per cent., which is much larger than the Pharmacopœia allows. As in the case of strontium bromide, the excess of silver solution allowed may be partly attributable to the presence of calcium salt as impurity. It is evident that the results calculated from the titration figures may not represent the true conditions (see remarks under POTASSII BROMIDUM).

Action and Uses.—Strontium iodide may be substituted for the other iodides to produce an iodine effect with less disturbance of digestion or depression of nutrition. Its dose is from 5 to 60 grains (0.30–4 Gm.) or more.

STRONTII SALICYLAS, *U. S.*—Strontium Salicylate.

Strontium salicylicum.—Salicylate de strontium, Fr.; *Salicylsaures Strontium, Strontiumsalicylat*, G.

Formula, $Sr(C_6H_4.OH.COO)_2 + 2H_2O$. Molecular weight, 394.72.

It should contain not less than 98.5 per cent. of the pure salt, and should be kept in well-stoppered bottles, protected from heat and light.—U. S.

Preparation.—Add 10 parts of salicylic acid to 100 parts of hot water, stir into this 5.34 parts of pure strontium carbonate, free from iron, and warm until effervescence ceases. Then filter and evaporate to crystallization.

Properties.—Strontium salicylate is a white, crystalline, odorless powder, having a sweetish, saline taste. It is soluble in 18 parts of water and in 66 parts of alcohol at 25° C. (77° F.), in 3.5 parts of boiling water, and in 10.5 parts of boiling alcohol. The aqueous solution should be slightly alkaline to litmus-paper and should be colorless. It imparts an intensely red color to a non-luminous flame, and when heated in a crucible it is decomposed, yielding inflammable vapors and an odor of phenol, and finally a gray residue of strontium carbonate. When warmed with an excess of concentrated sulphuric acid and a little methyl alcohol, the salt gives the characteristic odor of methyl salicylate.

Tests.—With ferric chloride a concentrated solution of the salt in excess produces a violet precipitate, but a very dilute solution (1 in 100) produces a deep violet-blue color. In an aqueous solution of the salt (1 in 20), copper sulphate solution produces a green color, calcium sulphate solution forms slowly, sulphuric acid quickly, a precipitate of strontium sulphate, potassium chromate forms yellow strontium chromate, soluble in acetic acid, and ammonium carbonate forms white strontium carbonate, soluble in acetic acid with effervescence. A solution of the salt from which the salicylic acid has been removed by acidifying with hydrochloric acid and filtering should not show the

presence of foreign substances when tested as described under STRONTIUM BROMIDE, 2 Gm. of the salt, heated with 10 Cc. of dilute acetic acid, cooled and filtered, should not become cloudy within 3 minutes upon addition of 5 drops of potassium dichromate test-solution (limit of barium). 0.5 Gm. of the salt, cautiously heated with 1 Cc. of sulphuric acid to dryness, moistened with the acid, and again heated to dryness, and finally ignited to constant weight, should leave a residue of not less than 0.227 Gm. of strontium sulphate, corresponding to 98.3 per cent. of pure salt. 394.72 Gm. of the salt will yield 182.29 Gm. of strontium sulphate, or 1 Gm. of the salt will yield 0.46182 Gm. of sulphate.

Action and Uses.—If strontium salicylate possesses any advantage over the other salicylates, it is that it is less irritating to the stomach. Its dose is from 5 to 30 grains (0.30–2 Gm.).

STRONTIUM.—Strontium.

Strontium, Fr., G.

Symbol, Sr. Valence, 2. Atomic weight, 86.94.

Strontium belongs to the family of alkaline earth metals. The general characteristics of these metals and their compounds have been touched on under CALCIUM, and need not be repeated here.

It occurs in nature much less abundantly than barium, the chief minerals being the sulphate, $SrSO_4$, known as celestite, and the carbonate, $SrCO_3$, known as strontianite. The latter is found in large quantities in Westphalia, Germany, and both minerals occur in Pennsylvania and New York; celestite is also found in Put-in-Bay Island, Lake Erie. Small quantities of sulphate and chloride are found in some springs and in the ashes of the bladder-wrack (Fucus vesiculosus) and other plants. It receives its name from strontianite, found near Strontian, in Argyleshire, Scotland. Strontium often accompanies barium and calcium in the carbonate and sulphate.

The metal is obtained from the chloride in the manner described under CALCIUM and BARIUM. It is very similar in its properties to calcium. Some of the differences are the following: Strontium compounds give an intensely red color to a flame; the sulphate is soluble in about 7000 parts of water, thus falling between calcium and barium in this respect; the chloride does not attract water as rapidly as calcium chloride and is soluble in absolute alcohol, thus differing from barium chloride, which is insoluble. Strontium carbonate is much more difficult to reduce to oxide by heat than is calcium carbonate.

Strontium salts are formed by neutralizing the respective acids with strontium carbonate and purifying by crystallization. Strontium sulphate is also employed by first reducing it to sulphide, which is then dissolved in acids. If the natural carbonate or sulphate is accompanied by calcium, barium, iron, magnesium, etc., these must be removed. One method of doing this was proposed by H. B. Dunham (1893) (see under STRONTIUM BROMIDE), another by Barthe and Falières (*Bull. Soc. Chim.*, 1892, p. 104), which consists in making ammoniacal a solution of strontium chloride to precipitate iron and alumina, adding to the filtrate excess of sulphuric acid, and washing the precipitated sulphates frequently with dilute sulphuric acid, then with water to remove calcium and magnesium. The precipitate is then digested for several days with 10 per cent. solution of potassium carbonate, which converts strontium sulphate into carbonate, washed and treated with hydrochloric acid, which dissolves out the strontium carbonate. The filtrate of strontium chloride is strongly acidified with hydrochloric acid and digested with several grammes of precipitated strontium sulphate, which removes the last traces of barium, after which it is filtered and evaporated to dryness. The salt is then dissolved in three times its weight of water, allowed to stand a day, filtered if necessary, and evaporated to crystallization. This yields a pure chloride, from which the carbonate can be obtained by precipitation, which serves as the starting-point for any other salt.

STRONTIUM OXIDE AND HYDROXIDE.—The oxide, SrO, is not easily obtained by heating strontium carbonate, but forms readily by heating the nitrate. It is like calcium oxide, and combines with water to form the hydroxide, which is easily soluble in hot water, and on cooling crystallizes out as $Sr(OH)_2.8H_2O$. These crystals effloresce much more easily than do those of barium hydroxide. For the preparation of pure strontium hydroxide, see under STRONTIUM BROMIDE. Most of the strontium com-

pounds in nature are converted into the hydroxide, which finds great application in the sugar industries, since it combines with cane-sugar to form difficultly soluble crystalline compounds, and thus it is possible to extract sugar from molasses after it can no longer be obtained by crystallization. The saccharine compound is then decomposed by carbon dioxide, which forms strontium carbonate and liberates the sugar.

STRONTII NITRAS.—*Strontium Nitrate*, $Sr(NO_3)_2$.—Colorless octahedral crystals, soluble in 5 parts of cold, 0.5 part of hot water, slightly soluble in alcohol, but not in absolute alcohol. Crystallized from concentrated hot solution, it is anhydrous; but from cold dilute solutions, $Sr(NO_3)_2 + 4H_2O$ or $5H_2O$ is formed. It is manufactured in considerable quantity as a constituent of *red-fire* or *Bengal-fire*, which consists of a mixture of 56 parts of strontium nitrate, 24 parts of flowers of sulphur (or shellac), and 20 parts of potassium chlorate, or 100 of strontium nitrate, 10 of wood charcoal, and 100 of potassium chlorate. Caution in mixing must be observed.

STRONTIUM GLYCEROPHOSPHATE is similar to the calcium salt (which see). It is a white powder, soluble in water, and precipitated from solution on warming and also by various salts. It contains 26 to 27 per cent. of phosphoric acid.

STRONTII LACTAS.—*Strontium lactate*, E.; *Lactate de strontium*, Fr.; *Strontium-lactat, Milchsaures Strontium*, G. $Sr(C_3H_5O_3)_2.3H_2O$.—Strontium lactate is made from the carbonate by dissolving it in lactic acid somewhat diluted with water; if necessary heat is applied to effect solution. After filtration the solution is evaporated with moderate heat to dryness. Like strontium bromide and iodide, the lactate is readily made from the hydroxide by addition to lactic acid until a neutral solution is obtained, and evaporating this to dryness. Strontium lactate occurs as a white granular powder or in crystalline nodules, odorless, and of a slightly bitter, saline taste. The salt is permanent in the air, and soluble in 4 parts of water at 15° C. (59° F.), and in less than 0.5 part of boiling water. The salt is also soluble in alcohol. Its reaction is slightly acid. When heated to 110° C. (230° F.), it loses its water (16.9 per cent.); at a higher temperature it first fuses, then is decomposed, and leaves a residue of strontium carbonate and carbon. If to 5 Cc. of a 5 per cent. aqueous solution of the salt 1 Cc. of sulphuric acid be added, and then 1 Cc. of tenth-normal potassium permanganate solution, the red color will rapidly disappear, while the mixture will effervesce and give off the odor of aldehyde. The salt should respond to the tests of purity given under STRONTIUM BROMIDE. If 0.5 Gm. of the salt be placed upon a watch-glass, and 1 Cc. of sulphuric acid be carefully poured upon it, no effervescence should occur (absence of carbonate, oxalate, etc.); nor should any penetrating odor be perceptible, even after gentle heating (absence of butyrate, propionate, etc.); nor should the acid assume, within ten minutes, a deeper color than a pale straw-yellow (limit of readily carbonizable organic impurities).

Action and Uses.—The belief in the toxicity of strontium and its salts was disproved by Laborde in 1890, who demonstrated that they were not only innocuous, but exercised favorable nutritional influences over the body. He ascribed to them diuretic properties, which are shared most largely by the lactate. From subsequent studies, Seé, Dujardin-Beaumetz, and others conclude that strontium lactate is a valuable remedy to reduce the albuminuria of chronic parenchymatous nephritis, but is less efficient in the interstitial variety. It does not increase urinary flow. The salt has not produced uniformally good results, for its use has been disappointing in the hands of many careful clinicians. The dose of strontium lactate is from 20 to 60 grains (1.30–4 Gm.). Strontium glycerophosphate is used like the calcium salt in the dose of 5 to 10 grains (0.30–0.60 Gm.).

STROPHANTHINUM, *U. S.*—Strophanthin.

Strophantine, Fr. Cod.; *Strophanthin*, G.

Formula, $C_{31}H_{48}O_{12}$ (Fr. Cod.); $C_{30}H_{46}O_{12} + 9H_2O$ (Thoms). Molecular weight, 607.77? or 745.78?

The U. S. Pharmacopœia does not give a chemical formula for strophanthin, and defines the latter to be a glucoside or mixture of glucosides obtained from strophanthus. Since Strophanthus Kombé is the variety officially recognized, the glucoside must be assumed as obtained from it. Considerable confusion and uncertainty exists regarding the character of the strophanthin obtained from different species of strophanthus, and the various data published by different authors must be accepted tentatively, at

least for the present. (See also Constituents under STROPHANTHUS.) H. Thoms has recently (1904) reviewed the work of previous authors, and found the strophanthin obtained by him from *Strophanthus Kombé* to contain small proportions of nitrogen, which he traced to the presence of choline and trigonelline, the latter substances having also subsequently been found in the seed of the same variety. On the other hand, strophanthin obtained from the seed of *Strophanthus hispidus* was free from nitrogen, but it was found impossible to induce crystallization in solutions of the same. The same author, operating with a carefully determined specimen of *Strophanthus gratus*, succeeded in obtaining as much as 3.615 per cent. of crystallized strophanthin, also free from nitrogen, which, after recrystallization, was found to have the composition given in the formula above stated. The high therapeutic value of the *gratus-strophanthin* having been established by numerous pharmacological experiments, Thoms advises the introduction of this variety into medicine in place of the more uncertain and varying strophanthins from other sources, and further suggests that the different strophanthins be distinguished by prefixing the initial letter indicating the source to the name thus: *k-strophanthin*, *h-strophanthin*, *g-strophanthin*, referring to strophanthin from the *Kombé*, *hispidus*, and *gratus* variety of strophanthus seed respectively.

Preparation.—The finely pulverized seeds of strophanthus are exhausted with ether or petroleum benzin to remove fat, and then extracted with 70 per cent. alcohol. From the tincture thus obtained the alcohol is recovered by distillation, and the residuum dissolved in water and filtered. Tannic acid is added to the filtrate, the resulting precipitate washed, mixed with litharge, dried, and then exhausted with alcohol. The addition of ether to the alcoholic solution will cause the strophanthin to be precipitated. This is essentially the process of Fraser, who first extracted strophanthin from the seed in 1886.

Properties and Tests.—A white or faintly yellowish crystalline powder, containing varying amounts of water of crystallization, which it does not lose entirely without decomposition. Taste intensely bitter; great caution should be used in tasting it. Permanent in the air. It is very soluble in water and in diluted alcohol, less soluble in absolute alcohol, but nearly insoluble in ether, chloroform, and benzene. When heated, it begins to fuse at 170° C. (338° F.), and is not completely melted until the temperature of 190° C. (374° F.) is reached. Its solutions are detrogyrate, bitter and neutral to litmus-paper. Sulphuric acid produces with strophanthin an emerald-green color, changing to brown. If to an aqueous solution of strophanthin a trace of ferric chloride test-solution and a few Cc. of sulphuric acid be added, a red-brown precipitate will be produced, turning dark green after one or two hours. Strophanthin should not reduce alkaline cupric tartrate solution; if its solution be heated to 70° C. (158° F.) with a small amount of diluted hydrochloric acid (1 in 20), it will be decomposed into strophanthidin, which precipitates, and a sugar which will remain in solution, and which will reduce alkaline cupric tartrate solution.—U. S.

Strophanthin is extremely toxic. In contact with concentrated acids, it is rapidly decomposed. By heating strophanthin with dilute (10 per cent.) mineral acids, various shades of a green color, changing to violet or blue, are produced, and are more or less characteristic. Strophanthin is precipitated by tannic acid, but not by other alkaloidal reagents. Thoms gives the following properties for the glucoside obtained by him from strophanthus gratus: When anhydrous it melts at 187° to 188° C. (368.6° to 370.4° F.). It requires for solution 100 parts of water, or 30 parts of amyl alcohol, or 30 parts of alcohol, and is very sparingly soluble in ether, chloroform, aud acetic ether. In contact with concentrated sulphuric acid it produces a red color, which, on dilution with water, changes to green with the separation of a greenish-white flocculent deposit.

Action and Uses.—Until some uniformity in the strength of strophanthin be established it would seem an unsatisfactory drug to employ unless the activity and dose of each individual sample be ascertained. It fully represents the crude drug in its action. The average dose is from $\frac{1}{300}$ to $\frac{1}{200}$ grain (0.0002–0.0003 Gm.).

STROPHANTHUS, *U. S.*—Strophanthus.

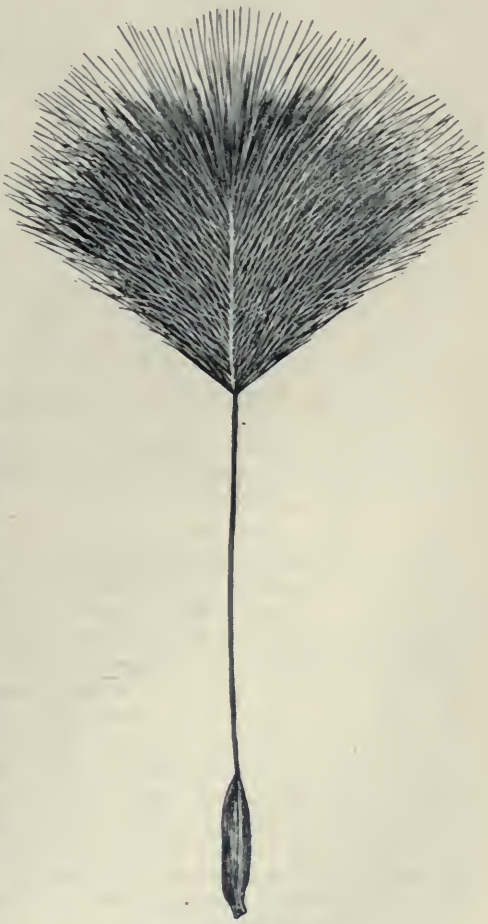
Strophanthi semina, Br.; *Semen strophanthi*, P. G.; *Strophanthus-seed*, E.; *Strophanthussamen*, G.; *Semence de strophanthus*, Fr.; *Semi di strofante*, It.

The dried, ripe seeds of *Strophanthus Kombé* Oliver (*S. hispidus Kombé* Oliver.—Fam. *Apocynaceæ*), deprived of their long awns.

Strophanthus is official in all pharmacopœias, a number of which retain the synonym given the plant when it was not yet recognized as being distinct from that to which the synonym belongs.

Origin.—Strophanthus is the product of a rough-leaved, woody twiner of eastern tropical Africa. Apparently, different species grow in the same vicinity, as is usual with the twiners of this family, this probably accounting in great part for the fact that the commercial seeds are usually contaminated with those of other species. The drug was first made known by the reference to it of samples of an arrow-poison made by the natives of the region where it grows, the sample having been sent to England for examination. The seeds grow in follicles, of which each flower produces two, and which are from 12 to 16 inches in length and an inch in thickness, acuminate, and somewhat acute. The pericarp of the genuine is thin and only slightly fleshy, and contains numerous seeds imbedded in a mass of overlapping, straight, silky, white hairs, which consist of the long plumose awns in which the seeds terminate. The seeds are exported either within the follicles or after removal. The former method is preferable, since it allows of more effective provisions against admixture. In this case the fleshy outer portion is usually first removed. When the seeds alone are exported, the awns are commonly first removed.

Fig. 415.



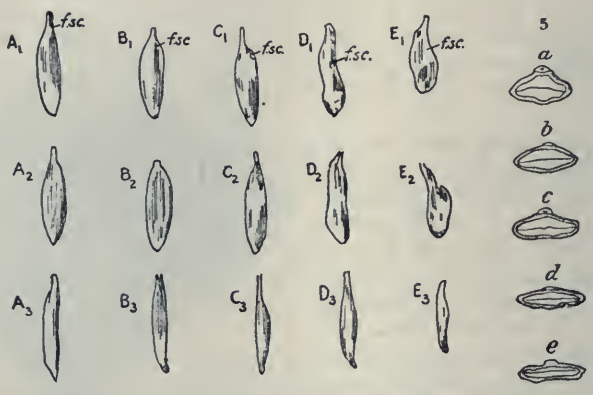
Strophanthus (Nat.).

Description.—Of a light or fawn brown, with a distinct greenish tinge; about 15 Mm. ($\frac{3}{5}$ In.) long and 4 or 5 Mm. ($\frac{1}{6}$–$\frac{1}{5}$ In.) thick in one direction, half as much in the other, lance-oblong, obtuse at the base, acuminate and acutish at the summit, distinctly compressed, usually slightly twisted, bearing a ridge which runs along the upper half or more of one side; silky lustrous from a dense coating of hairs, which mostly lie in longitudinal grooves of the surface, and are closely appressed; fracture short and somewhat soft, the fractured surface whitish and oily; kernel consisting of a thin endosperm enclosing straight cotyledons; odor slight, or heavy when the seeds are crushed; taste very bitter. The endosperm quickly assumes a green color upon treatment with concentrated sulphuric acid, and the cotyledons often do the same, in parts. The powder is pale brown and exhibits numerous hairs of a light greenish-brown color, 1 Mm. ($\frac{1}{25}$ In.) or less in length, consisting of but one cell, its walls thin; starch-grains occur sparingly, mostly compound, 10 mikrons or less in diameter. A decoction prepared with 1 part of the seed and 10 parts of water has a pale-brownish color, and is not changed in appearance on the addition of iodine test-solution, ferric chloride test-solution, or potassium mercuric iodine test-solution.

Adulteration.—To how great an extent the admixture of other seeds with official strophanthus is the result of intentional adulteration cannot be stated. That much of it

is so is certain. The adulterants reported are the seeds of other species of strophanthus and of *Kickxia Africana* Benth., in the same family. The most common and serious adulterant—more often wholly substituted than admixed—is the seed of *S. hispidus* D. C., the so-called *Brown strophanthus.* This grows in West Africa, and there is little excuse for its gaining access to the official drug. The seed is dark brown, averages a third shorter and relatively stouter than the official, and has a shorter and more abruptly contracted point. The hairs are much fewer, shorter, and stouter, and regularly arranged. These seeds, when crushed, give a red coloration on treatment with concentrated sulphuric acid. Another brown seed is that of "*S. gratus,*" readily distinguished by the absence of hairs. "*S. asper*" has a covering of nearly white hairs, which are several times longer than those of *S. Kombé,* and spread somewhat from the surface, giving a

FIG. 416.



Variations in size and form of Strophanthus Kombé seeds (after Perrédès).

semi-shaggy appearance and causing the seed to appear much stouter than it really is. This is known commercially as *White woolly strophanthus,* and is thought to be derived from *S. Nicholsonii* Holmes.

Still another is that of *S. Courmontii Kirkii* Holmes, which is similar to that of *S. hispidus,* has the ventral ridge obscure or wanting, and shows numerous prismatic crystals of calcium oxalate. This plant has smooth leaves and thick pods, usually less than a foot long. It grows with *S. Kombé,* and the seeds are readily mixed. Kickxia seeds are acuminate at both ends, terete, and hairless.

Constituents.—The constituents of minor importance are 25 to 30 per cent. of fixed oil, choline and trigonelline, little starch, proteids, and other ordinary constituents. The active part consists of one or more glucosides, concerning which our information is most indefinite. This indefiniteness unquestionably proceeds from the universal use of contaminated seeds in the examinations made, and we cannot hope that the subject will be cleared up until botanically pure material shall have been secured. The yield of glucoside has been reported variously, from about 1 to nearly 3 per cent. The glucoside of *S. Kombé* appears to be wholly *strophanthin,* which readily decomposes, yielding *strophanthidin,* on which account great care has to be employed in extracting it, acids not being employed in the process. It is this glucoside to which the green reaction of the crushed seeds with sulphuric acid is due, this constituting its best identification test. The best study of it has been by Feist, who assigns the formula, in the anhydrous state, $C_{40}H_{66}O_{19}$, yielding *strophanthidin* ($C_{27}H_{38}O_7 + 2H_2O$) and *strophanthobiose-methyl-ether* ($C_{12}H_{21}O_{10}CH_3$). It melts at 170° to 172° C. (338°–341.6° F.), and has an optical rotation of +10 in 5 per cent. solution. When warmed slowly with a 0.5 per cent. solution of hydrochloric acid, strophanthidin separates suddenly, at 70° to 75° C. (158°–167° F.), in fine needles. Feist's strophanthin is the same as that of Fraser. The source of another glucoside, *pseudo-strophanthin,* cannot be asserted with our present knowledge. It is apparently present in several species, but perhaps not in *S. Kombe.* It is twice as active as strophanthin, though it is by no means certain that the action is the same, and there are indications that it is more irritating to the heart without a corresponding gain in tonic properties. It is said to be present in the brown seeds, but this

is quite indefinite; some brown seeds, certainly, are almost inert. It also appears to be present in the white seeds. This glucoside Feist regards as being the methyl-ether of a substance ($C_{29}H_{33}O_6$) containing one oxygen atom less than strophanthidin. It gives a red coloration with sulphuric acid, melts at 179° C. (354.2° F.), has a slight lævogyre rotation, and hydrolyzes at 100° C. (212° F.) with a 2.4 per cent. solution of hydrochloric acid. Feist is sure that this is the same as the "strophanthin" of Arnaud, but not the same as his ouabain.

The fixed oil of strophanthus is brownish green, of a heavy odor, non-drying, congealing at —6° C. (21.2° F.) and melting again at +2° C. (35.6° F.), specific gravity 0.9249, acid number 24.3, ester number 170.3, saponification number 194.6, iodine number 101.6, Reichert's number 0.9, Hehner's number 94.1. It contains small quantities of volatile oil, phytosterin, formic acid, and one other volatile fatty acid, its primary components being oleates, stearates, and arachinates (*Bjalobestzesky*). It has been thought by some that the irritating properties of some strophanthus seeds were due to their fixed oil.

Pharmaceutical Preparation.—Tincture of Strophanthus, U. S. P.

Action and Uses.—The physiological action of strophanthus is nearly related to that of digitalis in that its use results in an increase in the pulse force and volume, a rise of arterial pressure and a slowing of the pulse. The increased pulse force and volume is due to stimulation of the heart muscle and the use of arterial pressure is also chiefly due to this cause, since strophanthus does not stimulate the muscular coats of the bloodvessels as does digitalis. The moderate slowing of the pulse is not due to stimulation of the vagus nerves. Given in full doses the drug is capable of causing gastro-intestinal inflammation and diarrhœa. When poisonous doses are taken it causes death by arrest of the heart in systole. By reason of its stimulant effect on the heart it indirectly increases urinary flow. The therapeutic uses of strophanthus are identical with those of digitalis (see Digitalis), and its lack of power over the muscular coats of the bloodvessels makes it particularly useful in those cases in which the heart is feeble and the arterial tension high. It also seems to act better in cases of ruptured compensation in valvular disease in children than does digitalis. The dose of powdered strophanthus seeds is ½ to 1 grain (0.03–0.06 Gm.), of the extract ¼ to 1 grain (0.015–0.06 Gm.), and of the tincture 5 to 15 minims (0.3–1 Cc.) three times a day.

STRYCHNINA, *U. S., Br., Fr. Cod.*—Strychnine.

Strychninum.—Strychnine, Fr.; *Strychnin*, G.

An alkaloid obtained from Nux Vomica, and also obtainable from other plants of the Loganianaceæ.—U. S. An alkaloid obtained from the dried ripe seeds of Strychnos Nux Vomica, *L.*, and other species of Strychnos.—Br.

Formula, $C_{21}H_{22}N_2O_2$. Molecular weight, 331.73.

The alkaloid strychnine was discovered by Pelletier and Caventou in 1818.

Preparation.—Very few pharmacopœias give a process for the manufacture of strychnine, but the French Codex gives the following directions: Powdered nux vomica is to be exhausted with boiling alcohol, the alcohol to be subsequently recovered and the residue taken up with very dilute sulphuric acid. After filtration slaked lime is added to the acid liquid, the resulting precipitate collected, dried, and exhausted with hot alcohol. The alcoholic solution is filtered, concentrated, and allowed to cool, when fairly pure strychnine will be deposited. The crude alkaloid is dissolved in water with the aid of diluted nitric acid and the solution allowed to crystallize, any brucine present remaining in the mother-liquor. From the strychnine nitrate thus obtained, the pure alkaloid may be precipitated by adding ammonia-water to its solution in water, and may then be crystallized from boiling alcohol upon cooling.

The following process has been used commercially and differs from the preceding chiefly in extracting the alkaloids as sulphates or hydrochlorides by means of boiling acidulated water instead of exhausting the seed with alcohol.

Powdered nux vomica, or the drug softened by steam and while hot crushed between rollers, is exhausted by boiling with very dilute hydrochloric or sulphuric acid; the decoction contains the alkaloids as hydrochlorides or sulphates, together with the liberated igasuric acid, mucilaginous compounds, coloring matter, and other principles. On

the addition of slaked lime the salts of alkaloids are decomposed, calcium chloride or sulphate is formed, and strychnine and brucine are precipitated, together with the excess of lime employed, and with calcium sulphate On washing this precipitate with water, the foreign principles are mostly removed, and by treatment with cold diluted alcohol the brucine is dissolved. The residue now consists essentially of lime and strychnine, the latter of which is taken up by boiling alcohol, and further purified by converting it into sulphate soluble in water, decolorizing with animal charcoal, and precipitating with an alkali; or, the washed and dried precipitate by lime is at once exhausted with boiling alcohol, and the mixed strychnine and brucine are purified by treatment with sulphuric acid, animal charcoal, and ammonia, and separated by dissolving in hot alcohol, when, on cooling, strychnine will crystallize and brucine remain in the mother-liquor.

Various other processes have been proposed, differing mainly in the manner in which the alkaloids are liberated and afterward separated from each other. Magnesia or sodium carbonate may be substituted for the lime and ammonia in the above processes; and benzene was suggested by Boiraux and Léger (1875) for dissolving strychnine from the mixed alkaloids, brucine, it is stated, being completely insoluble in that menstruum.

Properties and Tests.—Colorless, transparent, prismatic crystals, or a white crystalline powder; odorless, and having an intensely bitter taste, perceptible even in solutions of 1 in 700,000. Permanent in the air. Soluble in 6400 parts of water, 110 parts of alcohol, 5500 parts of ether, 6 parts of chloroform, 150 parts of benzene, and in 180 parts of amyl alcohol at 25° C. (77° F.); soluble in 3000 parts of water at 80° C. (176° F.), and in 28 parts of alcohol at 60° C. (140° F.). Its melting point is 268° C. (514.4° F.). Upon ignition it is consumed, leaving no residue. Its solutions are lævogyrate and alkaline to litmus-paper. Sulphuric acid containing 1 per cent. of ammonium vanadate produces with strychnine a deep violet blue color, changing to a deep purple, and finally to a cherry-red. Sulphuric acid containing a trace of potassium iodate produces a violet color, changing momentarily to reddish purple. If 0.1 Gm. of strychnine dissolved in a few drops of nitric acid be evaporated to dryness, and a few drops of ammonia-water added to the yellow residue, an orange color will be produced, which will turn reddish-purple, and finally brown, on the addition of a small amount of alcoholic potassium hydroxide test-solution. Sulphuric acid should produce no color (absence of sugar and other readily carbonizable organic impurities), but on adding a fragment of potassium dichromate, a deep-blue color is momentarily produced, changing to deep violet, then to purplish red, cherry-red, and finally to orange or yellow. Nitric acid, when added to a crystal of strychnine on a white porcelain surface, should not produce more than a faintly pink color (limit of brucine).—U. S.

Strychnine is soluble at 15° C. (59° F.) in 6700 parts of water; in 207 parts of absolute alcohol; in 150 parts of 90 per cent. alcohol; in 400 parts of common whisky (Wormley); in about 500 parts of alcohol of specific gravity 0.941, and in 2617 parts of specific gravity 0.970 (Prescott and Smith): in 165 parts of benzene; in 1250 parts of commercial ether (Draggendorff); in 12,500 parts of petroleum benzin (Wormley); in 300 parts of glycerin; and also soluble to some extent in volatile and fixed oils and in creosote. It dissolves in 2500 parts of boiling water; in 12 parts of boiling alcohol, and in 40 parts of boiling absolute alcohol. Its solubility in water is not increased by ammonia or caustic alkalies, but dilute acids render it much more soluble with the formation of neutral salts, which are mostly crystallizable, and from the solutions of which the alkaloid is precipitated by alkali hydroxides, alkali carbonates, chromates, and, after some time, by soluble bicarbonates. The solutions of strychnine are lævogyre in their action on polarized light. Chloroform forms a crystalline compound, $C_{21}H_{22}N_2O_2.HCl,CHCl_3$, when a chloroform solution of strychnine is subjected to prolonged heating at 150° C. (302°F.). The chloroform is entirely expelled from the crystals at 100° C. (212° F.). In drying the strychnine obtained from chloroform solution the decrepetation of the residue may be prevented by adding a few Cc. of amyl alcohol to the chloroform solution previous to evaporating. Strychnine combines with iodoform to form the reddish-brown crystalline compound $3C_{21}H_{22}N_2O_2.CHI_3$ (Lextreit, 1881; P. F. Trowbridge, 1899). The salts of strychnine yield precipitates generally in very dilute solutions with the alkaloidal reagents. With phosphomolybdic acid (Sonnenschein's reagent) a yellowish-white amorphous precipitate is obtained, which is soluble in ammonia to a colorless solution. Phosphotungstic acid yields a white precipitate in solutions containing 1 part of strychnine in 200,000 parts of acidulated water. Potassio-iodide of bismuth

gives a brown precipitate in dilutions of 1:250,000; potassio-mercuric iodide, a white precipitate in dilutions of 1:150,000; picric acid, a yellow crystalline precipitate in dilutions 1:20,000; potassium ferrocyanide, a white crystalline precipitate in solutions of 1:100,000. Solution of iodine in potassium iodide gives a reddish-brown precipitate in solutions of 1:100,000. The precipitate is soluble in alcohol from which it may be recovered in characteristic microscopic crystals on slow evaporation of the alcohol. In solutions containing 1 part of a salt of strychnine in 1000 parts of water potassium dichromate precipitates, after some time, characteristic microscopic crystals of strychnine dichromate, $2C_{21}H_{22}N_2O_2.H_2Cr_2O_7$.

When fused with potassium hydroxide strychnine yields quinoline and indole. By electrolytic reduction (J. Tafel, Annalen, 1898, pp. 285–348) strychnine yields according to conditions varying amounts of the toxic bases *tetrahydrostrychnine*, $C_{20}H_{22}NO(NH).CH_2.OH$, and *strychnidine*, $C_{21}H_{22}NO\ (N).CH_2$, the latter being derived from the former by separation of water.

Strychnine dissolves in concentrated sulphuric acid without color. On continued heating of the sulphuric acid solution at 100° C. (212° F.) strychnine-monosulphonic acid $C_{21}H_{21}N_2O_2.HSO_3$ is formed (C. Stoehr). This acid is difficultly soluble in water and alcohol, forms a soluble salt with ammonia, and difficultly or insoluble salts with sodium, potassium, lead, barium, calcium, and copper. Strychnine dissolves in dilute nitric acid without color and without decomposition (distinction from brucine), but in concentrated nitric acid a yellow color results and the strychnine is partly decomposed with the formation of picric acid.

Strychnine is generally identified by the characteristic play of colors, beginning with a deep bluish purple and fading rapidly to an orange shade, varying somewhat for the different oxidizing agents used, when strychnine is dissolved (colorless) in sulphuric acid and treated with a fragment of potassium dichromate, etc. Peroxide of lead produces a blue color, passing into violet, red, and finally into yellow (Marchand). Potassium dichromate produces a blue or a deep violet, fading rapidly to an orange shade. A similar play of colors is produced by potassium ferricyanide, but the colors fade more slowly (Davy). The solution of strychnine in sulphuric acid containing some nitric acid yields on the addition of manganese dioxide a purplish-violet color (Mack, Erdmann), and a similar color, but rapidly fading to yellow, is produced with chloric, chlorius, and iodic acids and their salts, and with manganic sulphate and potassium permanganate. Cerosoceric acid (Sonnenschein) produces a blue color which changes slowly to violet, and finally cherry-red, and is one of the most satisfactory reagents for producing the color reactions. When pure 0.0025 Mgm. of strychnine is readily identified by the above tests. The reaction is, however, interfered with by chlorides, nitrates, organic matter, and particularly sugar, and the alkaloids brucine and morphine. If much contaminated with organic matter, the alkaloid is best purified by dissolving it in dilute acid, so as to free it from fatty and resinous matters, filtering through a wet filter, liberating it by adding ammonia, and dissolving it by agitation with chloroform; if necessary, the process is repeated, and the residue from the evaporation of the chloroform is tested as above.

A mixture of strychnine nitrate and copper nitrate turns violet on the addition of stannous chloride, and becomes green on drying. Strychnine when evaporated with potassium hydroxide yields a dark-blue residue on the addition of stannous chloride. Potassium persulphate and hydrochloric acid give no color reaction with strychnine in the cold, whereas brucine gives a deep-red color (C. Reichard). The peculiar reaction (J. Uri Lloyd) produced by a mixture of hydrastine and morphine when tested with potassium dichromate in sulphuric acid solution is not readily mistaken for the strychnine reaction (Wharton and S. Williams, *Drug. Circ.*, 1901, p. 48).

Action and Uses.—The physiological action and therapeutic application of strychnine are considered under NUX VOMICA (which see). The alkaloid is almost always prescribed in the form of one of its salts. Its dose is from $\frac{1}{160}$ to $\frac{1}{20}$ grain (0.0006–0.003 Gm.).

STRYCHNINÆ HYDROCHLORIDUM, *Br.*—Strychnine Hydrochloride.

Strychninum hydrochloricum.—Chlorhydrate de strychnine, Fr.; *Strychninhydrochlorid, Salzsaures Strychnin*, G.

Formula, $C_{21}H_{22}N_2O_2.HCl + 2H_2O$. Molecular weight, 403.67.

The hydrochloride of an alkaloid obtained from nux vomica and from other species of strychnos.—Br.

Preparation.—Strychnine hydrochloride may be prepared by suspending 5 Gm. of strychnine alkaloid in 50 Cc. of hot distilled water, adding 2.2 Gm. of 25 per cent. hydrochloric acid, or 5.5 Gm. of official diluted hydrochloric acid, and heating until perfect solution is effected. The liquid is then concentrated and allowed to crystallize.

Properties and Tests.—Strychnine hydrochloride occurs in small colorless trimetric prisms which readily effloresce in the air; soluble in 35 parts of water or in 60 parts of alcohol (90 per cent.), forming a solution which is neutral to litmus and intensely bitter to the taste. The salt should afford the reactions characteristic of hydrochlorides, and should respond to the qualitative tests mentioned under "Strychnina," but should not yield any characteristic reaction for sulphates. Dried at a temperature of 100° C. (212° F.) it should lose 7.3 to 8.8 per cent. of moisture.—Br.

Since the salt effloresces readily, it should be kept in well-stoppered bottles in a cool place. The amount of water, 2 molecules, given in the formula above corresponds to 8.85 per cent. Strychnine hydrochloride contains 82.17 per cent. of strychnine.

Action and Uses.—For the action and uses of strychnine see article on Nux Vomica. The hydrochloride is given in the dose of from $\frac{1}{100}$ to $\frac{1}{20}$ grain (0.0006–0.003 Gm.).

STRYCHNINÆ NITRAS, *U. S.*—Strychnine Nitrate.

Azotate de strychnine, Fr. Cod.; *Strychninum nitricum*, P. G.—*Nitrate de strychnine*, Fr.; *Strychninnitrat, Salpetersaures Strychnin*, G.

Formula, $C_{21}H_{22}N_2O_2.HNO_3$. Molecular weight, 394.30.

The nitrate of the alkaloid strychnine.—U. S.

Preparation.—With the exception of the French Codex, the pharmacopœias do not give a process of manufacture. The former simply directs that a convenient quantity of strychnine alkaloid be triturated with nitric acid diluted with 5 times its weight of water, added in small quantities until a neutral solution is obtained. 5 Gm. of strychnine may be suspended in 50 Cc. of hot distilled water and diluted nitric acid be added in sufficient quantity. After a neutral solution has been obtained, it should be concentrated and allowed to crystallize. Theoretically 1 Gm. of the alkaloid requires 1.886 Gm. of the official diluted acid for combination.

Properties and Tests.—Strychnine nitrate occurs in colorless, glistening needles, which are odorless, having an intensely bitter taste, and are permanent in the air. Soluble in 42 parts of water, 120 parts of alcohol, 156 parts of chloroform, and in 60 parts of glycerin at 25° C. (77° F.); soluble in 8 parts of water at 80° C. (176° F.), and in 60 parts of alcohol at 60° C. (140° F.); insoluble in ether. When heated the salt decomposes, but it does not melt, and when ignited it is consumed without leaving a residue. Its aqueous solutions are neutral to litmus-paper, and lævogyrate. A solution of the salt, when poured carefully into a test-tube upon a layer of sulphuric acid containing in solution a little diphenylamine, will develop a blue zone at the juncture of the two liquids. On being heated with hydrochloric acid a bright red color is formed. Sulphuric acid containing 1 per cent. of ammonium vanadate produces with strychnine nitrate a dark violet blue color, changing to purple, and then to red. Sulphuric acid containing a trace of potassium dichromate produces momentarily a blue color, changing to violet, then to purplish red, cherry-red, and finally to orange or yellow. If 0.1 Gm. of the salt, dissolved in a few drops of nitric acid, be evaporated to dryness, and a few drops of ammonia-water added to the residue, an orange color will be produced, which will turn reddish purple, and finally brown, on the addition of a small amount of alcoholic potassium hydroxide test-solution. The addition of sulphuric acid to a crystal of strychnine nitrate on a white porcelain surface should not produce more than a faintly yellow color (limit of brucine).—U. S.

The German Pharmacopœia gives the solubility of strychnine nitrate as 1 part in 90 parts of cold and 3 parts of boiling water, or in 70 parts of cold and 5 parts of boiling alcohol. If the salt be boiled with hydrochloric acid a red color is developed. It dissolves in concentrated nitric acid with a yellow color, but no red color should develop. Strychnine nitrate should dissolve in sulphuric acid without color, and gives the charac-

teristic reaction for nitrates and for strychnine. The salt contains 84.13 per cent. of strychnine.

Action and Uses.—The dose of strychnine nitrate is from $\frac{1}{100}$ to $\frac{1}{20}$ grain (0.0006–0.003 Gm.) (see NUX VOMICA).

STRYCHNINÆ SULPHAS, *U. S.*—Strychnine Sulphate.

Strychninum sulfuricum.—Sulfate de strychnine, Fr. Cod.; *Strychninsulfat, Schwefelsaures Strychnin*, G.

Formula, $(C_{21}H_{22}N_2O_2)_2H_2SO_4 + 5H_2O$. Molecular weight, 850.21.

The sulphate of the alkaloid strychnine.—U. S.

Preparation.—Strychnine sulphate is best prepared by adding strychnine in powder form in slight excess to warm diluted sulphuric acid; the filtrate from the undissolved alkaloid will yield the salt on being evaporated spontaneously to dryness, or the filtrate may be concentrated and then allowed to crystallize. In the latter case it will contain 5 molecules of water. The form of crystal and the amount of water of crystallization may vary with the mode of preparation.

Properties and Tests.—Strychnine sulphate occurs as colorless, or white prismatic crystals, or a white, crystalline powder; odorless, and having an intensely bitter taste, perceptible even in solutions of 1 in 700,000. Efflorescent in dry air. Soluble in 31 parts of water, 65 parts of alcohol, and in 325 parts of chloroform at 25° C. (77° F.), soluble in 6 parts of water at 80° C. (196° F.), and in 20 parts of alcohol at 60° C. (140° F.); insoluble in ether. When heated at 100° C. (212° F.), the salt loses its water of crystallization (10.59 per cent.), and when anhydrous melts at 200° C. (392° F.). Upon ignition it is consumed, leaving no residue. Barium chloride test-solution produces in a solution of the salt a white precipitate, which is insoluble in hydrochloric acid. Sulphuric acid should produce no color with strychnine sulphate, but on adding a fragment of potassium dichromate, a blue color should be formed, changing to deep violet, then to purplish red, cherry-red, and finally to orange or yellow. Sulphuric acid containing 1 per cent. of ammonium vanadate produces a deep violet-blue color, changing to deep purple, and finally to cherry-red. Sulphuric acid containing a trace of potassium iodide produces a violet color, changing to reddish purple. If 0.1 Gm. of the salt be dissolved in a few drops of nitric acid, evaporated to dryness, and a few drops of ammonia-water added to the yellow residue, an orange color will be produced, which will turn momentarily reddish purple, and finally brown, on the addition of a small amount of alcoholic potassium hydroxide test-solution. Nitric acid, when added to a crystal of strychnine sulphate on a white porcelain surface, should not produce more than a faintly yellow color (limit of brucine).—U. S.

The official strychnine sulphate contains 78.03 per cent. of strychnine. At ordinary room temperature a fluidounce of water will dissolve nearly 15 grains of the salt.

Action and Uses.—The sulphate is the salt of strychnine commonly employed. Its properties are considered under NUX VOMICA (which see). It is given in the dose of $\frac{1}{100}$ to $\frac{1}{20}$ grain (0.0006–0.003 Gm.).

STYRAX, *U. S., P. G.*—Storax.

Styrax liquidus, Balsamum styracis, Balsamum styrax liquidus.—Liquid storax, E.; *Styrax liquide*, Fr.; *Flüssiger Storax*, G.; *Stirace, Storace Liquido, Balsamo Storace*, It.; *Estoraque Liquido*, Port., Sp.

A liquid balsam obtained from the wood and the inner bark of *Liquidamber orientalis* Mill. (*Platanus o.* Pecocke, *L. imberbe* Ait.—Fam. *Hamamelidaceæ*).

Purified by solution in alcohol, filtration, and evaporation, it is the *Styrax præparatus* of the Br. P.

Styrax is official in all pharmacopœias. The Belgian names *L. styraciflua* L. as its source.

Origin.—Styrax is obtained by the Yuraks from a forest tree of southwestern Asia Minor, very similar to the North American sweet gum tree. Like other and similar substances, this balsam is not a natural part of the plant, but is produced as a result of the stimulus from wounds in the bark, apparently nature's method to secure antisepsis and to promote healing. To secure the balsam, the outer bark is bruised on one side of the

tree, as a result of which the inner layers become saturated with this pathological exudation. The dead outer bark is later removed and rejected, and the inner is removed and boiled in sea-water, the storax being skimmed off the surface as it rises, and receiving some inorganic additions from the sea-water. An additional quantity is afterward pressed out from the boiled bark. The latter, which is still partly charged with the balsam, is dried and utilized in various ways, especially for burning as incense, and has occasionally found its way into European commerce.

Description.—An opaque, grayish, sticky liquid of the consistency of thick honey, thinner and less opaque when heated, becoming thicker with age and exposure, separating on long standing a thick heavy dark-brown stratum which is transparent in thin layers; of a strong and pleasant balsamic odor, slightly resembling that of vanilla, and a pungently balsamic taste; burning with a bright sooty flame; soluble, excepting the water and other impurities, in alcohol, ether, chloroform, and most volatile oils; yielding, with an equal weight of warm alcohol, a gray-brown, turbid, acid solution which, after cooling, filtering, and evaporating, should leave not less than 70 per cent. of the weight of the styrax as a brown, semi-liquid mass which deposits crystals only after a long time, gives off a bitter almond odor when boiled with potassium bichromate and sulphuric acid, and, with the exception of a few floccules, is completely soluble in ether and in carbon disulphide; insoluble in cold petroleum benzin, but partly soluble in it when hot, the colorless solution depositing crystals of cinnamic acid and cinnamic ethers on cooling. Examined under the microscope, storax is seen to consist of minute globules, intermixed with larger drops of water and with tabular crystals of cinnamic acid, and when left on the object glass feathery crystals of styracin make their appearance. Hager proposed to detect the presence of turpentine by dissolving the storax in a little warm alcohol and exhausting it with petroleum benzin by agitation. On evaporating the benzin solution the residue should have a bluish opalescence and an agreeable odor, while if turpentine be present the color will be yellowish and the odor of turpentine will be apparent.

Constituents.—Storax is a variable mixture of resins, volatile oil, cinnamic acid and its esters, and water. In the commercial article water is sometimes present to the extent of 40 per cent. When distilled with water or steam under pressure, it yields from 0.5 to 1 per cent. of an aromatic oil, of pale-yellow to brown color, and varying in specific gravity from 0.890 to 1.10. The oil from Oriental storax shows an optical rotation of —3° to —38°, while that obtained from American storax is dextrorotatory, having a specific rotation of $[\alpha]_D = 16°33'$. Among the chemical constituents of storax is styrene (styrol, cinnamene, phenylethylene), having the composition C_8H_8 or C_6H_5-$CHCH_2$, a colorless, highly refractive liquid of pleasant odor, optically inactive and boiling, when pure, at 144° to 144.5° C. (291.2°–292.1° F.). Upon long keeping, in contact with acids, or when heated to 200° C. (392° F.), it is polymerized into metastyrene, a transparent, odorless, glass-like body. Cinnamic acid, $HC_9H_7O_2$ or $C_6H_5C.H.$-$CH.COOH$, is present in storax to the extent of 5 to 15 per cent. (23 per cent. Flückiger, Van Italie), chiefly in the free state, and may be extracted by treatment with sodium carbonate solution and subsequent precipitation with hydrochloric acid. There are also present styracin (cinnamyl or styryl cinnamate), $C_9H_9.C_9H_7O_2$, phenyl-propyl cinnamate, $C_6H_5C_3H_5.C_9H_7O_2$, ethyl cinnamate, $C_2H_5.C_9H_7O_2$, vanillin (K. Dieterich), ethylvanillin (von Miller), α and β storesinol, $C_{35}H_{55}(OH)_3$, two amorphous resins of alcoholic character which constitute a large part of the storax. Furthermore, traces of benzoic acid and storesinol cinnamic acid ester have been found. American storax is said not to contain ethyl cinnamate.

Storax of good quality should not contain over 30 per cent. of water, and at least 60 per cent. of its weight should be soluble in alcohol. When dried and incinerated not more than 1 per cent. of ash should be left. Its acid value, ascertained as explained below, should be not less than 55 to 75, its saponification value (see below) 100 to 140, and its ester value, obtained by subtracting the acid value from the saponification value, should be from 35 to 75.

K. Dieterich (*Analyse der Harze, Balsame*, etc., 1900) suggests the following methods for examination of storax:

For determination of the acid value, 1 Gm. of storax is dissolved in 100 Cc. of 96 per cent. alcohol and then titrated with half-normal alcoholic potassium hydroxide solution, using phenolphthalein as indicator. The number of cubic centimeters of alkali solution neutralized, if multiplied by 28.08, will express the acid value. For determination of the saponification value, 1 Gm. of storax is put into a glass-stoppered 250-Cc.

flask, together with 20 Cc. of half-normal alcoholic potassium hydroxide solution and 50 Cc. of benzin of 0.700 specific gravity, and allowed to stand at ordinary room temperature for 24 hours, after which the excess of alkali is titrated with half-normal sulphuric acid, using phenolphthalein as indicator. The number of cubic centimeters of alkali required for saponification, if multiplied by 28.08, will express the saponification value.

Since storax cannot be weighed conveniently, it is rarely possible to weigh exactly 1 Gm. for the above operation, and hence a slight correction must be made when more or less than 1 Gm. of the material is used. Thus, if 1.108 Gm. of storax was used and required 5.57 Cc. of the half-normal alkali solution, then $1.108 : 5.57 :: 1 : x$, and, the value of x having been found equal to 5.027+, the volume of alkali solution necessary for 1 Gm. would correspond to 5.03 Cc., the number in this case to be multiplied by 28.08.

A sample adulterated with tar, which had remained for some time in a glass-stoppered bottle in the Museum of the New York Botanical Garden, imparted to the stopper a fine storax odor, while that of the contents of the bottle was strongly tarry.

Pharmaceutical Preparation.—Compound Tincture of Benzoin, U. S. P.

Action and Uses.—Storax, like copaiba, is a stimulant to nearly all mucous membranes. Although rarely employed, it may be given internally with good effect in the treatment of chronic catarrhs of the lungs and in chronic affections of the genito-urinary organs, as gonorrhœa and atonic amenorrhœa. Combined with 2 or 3 parts of olive oil it forms an efficient parasiticide for scabies; one application followed in a few hours by a bath will usually effect a cure. The dose of storax is from 10 to 20 grains (0.60–1.30 Gm.).

Allied Products.—Cortex Thymiamatis.—This is the bark from which storax has been obtained. It is in brown foliaceous cakes, consisting of thin pieces of bark and having the odor of storax.

Styrax Calamita.—This consists of sawdust mixed with liquid storax, and contains numerous minute crystals of styracin. The drug known by this name in ancient times and during the last century was a solid balsamic resin, most likely obtained from *Styrax officinale* L., which is indigenous to Western Asia and Southeastern Europe. This is no longer an article of commerce.

Liquidamber, or Sweet Gum, is a very similar balsam obtained from *Liquidamber styraciflua* L. (*Sweet*, *Red*, or *Star-leaved Gum-tree*, *Alligator*, *Opossum*, or *Copalm tree*, *Bilsted* or *Satin walnut*), as an exudation resulting from incisions through the bark. The tree grows from Connecticut to Illinois, southward and southwestward into Mexico, but the exudation is collected only in the south. The tree grows to a height of 40 to 60 feet and has widely spreading branches. The trunk-bark is dark gray and deeply fissured, that of the small branches mostly winged with corky projections. The leaves are dark green, round in outline, palmately 5- to 7-lobed, and the lobes serrate. The fruit is capsular, beaked, aggregated in globular heads, together with the indurated scales. The leaves, fruit, and bark, when bruised, have an agreeable odor; the taste of the bark is balsamic and astringent, and that of the other parts mentioned aromatic and acidulous. The balsam, also called *gum wax* (*Balsamo de liquidámbar*, Sp.), exudes in the form of a thick liquid, having the density of syrup and a yellowish color. On standing it thickens, becomes darker in color, and finally hard at the ordinary temperature, and breaks with a resinous fracture, which is of a variegated appearance, the color being brown, with lighter (and even white) spots and streaks. It softens somewhat by the warmth of the hand, and when heated fuses to a yellowish-brown liquid. It has a very pleasant balsamic odor and taste, the latter being followed by pungency. It dissolves completely—fragments of bark excepted—in alcohol, ether, and chloroform, the alcoholic solution having a slight acid reaction.

The composition of sweet gum is closely similar to that of styrax. Harrison found in it 3.5 per cent. of a substance resembling styrene, but not convertible into metastyrene, 5.5 per cent. of cinnamic acid, styracin, a nearly odorless and tasteless dark-brown resin, and 9 per cent. of impurities.

SUCCI.—Juices.

Sucs végétaux, Fr.; *Pflanzensäfte*, G.

These preparations are made by bruising the fresh drugs, expressing them forcibly, and mixing the expressed juice, with a definite proportion of alcohol for preservation. They must necessarily vary in the amount of their active constituents, and perhaps more so than the dried and carefully-preserved drugs. They have been dismissed from the U. S. P., and tinctures of fresh herbs admitted in place thereof.

SUCCUS BELLADONNÆ, *Br.*—Juice of Belladonna.

Suc de belladone, Fr.; *Belladonnasaft*, G.

Preparation.—Bruise fresh leaves and young branches of Atropa Belladonna L., press out the juice, and to every 3 volumes of juice add 1 of alcohol (90 per cent.). Set aside for 7 days, and filter.—Br.

Action and Uses.—This preparation is given in the dose of 5 to 15 minims (0.30–1 Cc.). (See BELLADONNA.)

SUCCUS CONII, *Br.*—Juice of Conium.

Juice of hemlock, E.; *Suc de grande ciguë*, Fr.; *Schierlingsaft*, G.

Preparation.—Bruise the fresh leaves and young branches of Conium maculatum, L., press out the juice, and to every 3 volumes of juice add one of alcohol (90 per cent.). Set aside for 7 days, and filter.—Br.

Action and Uses.—Because of its uncertain strength this is an unsatisfactory preparation of conium to employ. Its dose, usually stated to be from ½ to 1 drachm (2–4 Cc.), has been found to be too small, and must be rapidly increased to produce the desired effect.

SUCCUS HYOSCYAMI, *Br.*—Juice of Hyoscyamus.

Suc de jusquiame, Fr.; *Bilsenkrautsaft*, G.

Preparation.—Bruise fresh leaves, flowering tops, and young branches of Hyoscyamus niger, L., press out the juice, and to every 3 volumes of juice add 1 of alcohol (90 per cent.). Set aside for 7 days, and filter.—Br.

Action and Uses.—The dose of this juice is from ½ to 1 drachm (2–4 Cc.).

SUCCUS SCOPARII, *Br.*—Juice of Broom.

Suc de genêt à balais, Fr.; *Besenginstersaft*, G.

Preparation.—Bruise fresh broom-tops, press out the juice, and to every 3 volumes of juice add 1 of alcohol (90 per cent.). Set aside for 7 days, and filter.—Br.

Action and Uses.—This preparation represents the properties of scoparius. It is given in the dose of 1 to 2 drachms (4–8 Cc.).

SUCCUS TARAXACI, *Br.*—Juice of Dandelion.

Suc de pissenlit, Fr.; *Löwenzahnsaft*, G.

Preparation.—Bruise fresh taraxacum-root, press out the juice, and to every 3 volumes of juice add 1 of alcohol (90 per cent.). Set aside for 7 days, and filter.—Br.

Action and Uses.—This is an efficient preparation of taraxacum. The dose is from 2 to 4 drachms (8–16 Cc.).

SULPHONETHYLMETHANUM, *U. S.*—Sulphonethylmethane.

Trional, Fr. Cod.; *Methylsulfonalum*, P. G.; *Trionalum.—Trional, Diethylsulphonemethylethylmethane*, E.; *Diéthylsulfone-méthyléthylméthane*, Fr.; *Methylsulfonal, Trional*, G.

Formula, $C_8H_{18}S_2O_4$ or $(CH_3)(C_2H_5)C(SO_2C_2H_5)_2$. Molecular weight, 240.46.

Diethylsulphonemethylethylmethane is a product of the oxidation of the mercaptol obtained by the condensation of methylethylketone with ethylmercaptan. It should be preserved in well-stoppered vials.—U. S. The commercial name, trional, by which this compound is better known, was adopted on account of the 3 ethyl groups present.

Preparation.—Sulphonethylmethane is usually prepared on a large scale by saturating a mixture of ethylmercaptan and methylethylketone with hydrochloric acid gas, and oxidizing the resulting condensation product $(CH_3)(C_2H_5)C(SC_2H_5)_2$, known as methylethylketonemercaptol, by means of a weak potassium permanganate solution. The resulting compound is purified by frequent recrystallization from boiling water.

Properties and Tests.—Sulphonethylmethane occurs as colorless, lustrous, odorless, crystalline scales, which have a bitter taste in aqueous solution. It is soluble in

195 parts of water at 25° C. (77° F.), more readily in boiling water, and readily soluble in alcohol and ether. When heated to 76° C. (168.8° F.), it melts, and at a red heat is consumed, evolving sulphur dioxide and leaving no weighable residue. Its aqueous solution is neutral to litmus-paper. If 0.1 Gm. of sulphonethylmethane be heated with 0.1 Gm. of powdered charcoal in a dry test-tube, the characteristic unpleasant odor of mercaptan will be developed. If 0.1 Gm. be gradually heated with dried sodium acetate, hydrogen sulphide will be evolved. 1 Gm. dissolved in 50 Cc. of boiling water should develop no odor. This solution, when cooled and filtered, should show no turbidity on the addition of barium nitrate test-solution or silver nitrate test-solution (absence of sulphates and chlorides). One drop of potassium permanganate test-solution, added to the aqueous solution of sulphonethylmethane should not be immediately decolorized (absence of readily oxidizable organic impurities).—U. S.

The French and German Pharmacopœias both give the solubility of trional in cold water as 1 part in 320 parts.

Action and Uses.—Sulphonethylmethane or trional closely resembles sulphonal in its action. It differs in the time required to produce sleep, being effective usually in 20 to 30 minutes. Its dose is from 15 to 30 grains (1–2 Gm.), and its method of administration like that of sulphonal.

SULPHONMETHANUM, *U. S.*—Sulphonmethane.

Sulphonal, Br.; *Acétone-diéthylsulfone*, Fr. Cod.; *Sulfonalum*, P. G.—*Sulphonal, Diethylsulphone-dimethylmethane*, E.; *Sulfonal, Diéthylsulfone-diméthylméthane*, Fr.; *Sulfonal*, G.

Formula, $C_7H_{16}S_2O_4$ or $(CH_3)_2C(SO_2C_2H_5)_2$. Molecular weight, 226.55.

Diethylsulphonedimethylmethane is a product of the oxidation of the mercaptol obtained by the condensation of acetone with ethylmercaptan. It should be preserved in well-stoppered vials.—U. S.

Preparation.—When dry hydrochloric acid gas is led into a mixture of 2 parts of anhydrous ethyl hydrosulphide (mercaptan, C_2H_5SH) and 1 part of anhydrous acetone, heat is slowly developed; the mixture becomes gradually turbid, and finally separates into two distinct layers, the lower being a dilute hydrochloric acid, while the upper is composed of a new compound, known as dithioethyldimethylmethane or acetone mercaptol $(CH_3)_2C(SC_2H_5)_2$, a condensation-product of the interaction between the mercaptan and acetone. Mercaptol may also be obtained by a process patented in Germany, which consists in first treating sodium thiosulphate with ethyl chloride or bromide, whereby sodium ethylthiosulphate is produced; thus, $Na_2S_2O_3 + C_2H_5Cl = NaC_2H_5S_2O_3 + NaCl$: this salt in the presence of water yields acid sodium sulphate and ethyl hydrosulphide or mercaptan; the latter is not separated, but in its nascent state, in the presence of hydrochloric acid, is allowed to react with acetone, condensing to mercaptol. Obtained by either process, mercaptol is an oily liquid, which is purified by washing with water and afterward with dilute soda solution; it is dried by means of calcium chloride and rectified by distillation; it boils at 190°–191° C. (374°–375.8° F.), is highly refractive, insoluble in water, and has a very disagreeable odor. Upon agitating mercaptol with 5 per cent. potassium permanganate solution until the color of the latter remains, oxidation takes place and the mercaptol is converted into sulphonal; thus, $(CH_3)_2C(SC_2H_5)_2 + O_4 = (CH_3)_2C(SO_2C_2H_5)_2$. Sulphonal may be obtained absolutly pure by recrystallization from water or alcohol.

Properties and Tests.—Sulphonmethane occurs in colorless, inodorous, and nearly tasteless prismatic crystals. It is soluble in 360 parts of water, 47 parts of alcohol, 45 parts of ether, and in 16 parts of chloroform at 25° C. (77° F.); soluble in 15 parts of boiling water, and in 2 parts of boiling alcohol; soluble in benzene. When heated to 125.5° C. (258° F.) it melts, and at a red heat it is consumed, evolving vapors of sulphur dioxide, and leaving no weighable residue. Its aqueous solution is neutral to litmus paper. If 0.1 Gm. of sulphonmethane be heated with 0.1 Gm. of powdered charcoal in a dry test-tube, the characteristic unpleasant odor of mercaptan will be developed. If 0.1 Gm. be gradually heated with dry sodium acetate, hydrogen sulphide will be evolved. Its solution in boiling water should develop no odor. This solution, after cooling and filtering, should show no turbidity upon the addition of either barium nitrate test-solution or silver nitrate test-solution (absence of sulphates and chlorides).

If 1 drop of potassium permanganate test-solution be added to an aqueous solution of sulphonmethane, the liquid should not be immediately decolorized (absence of readily oxidizable organic impurities).—U. S.

Sulphonal is also soluble in 500 parts (P. G.) or 450 parts (Br.) of cold water, 65 parts (P. G.) or 50 parts (Br.) of cold alcohol; in 110 parts of 50 per cent. alcohol; in 11 parts of benzene; in 135 parts of ether; in about 1000 parts of petroleum ether, and to some extent in toluene and acetone. It dissolves in concentrated sulphuric acid, from which water reprecipitates the sulphonal undecomposed. It is a very stable compound, and not attacked by the mineral acids or boiling solutions of the alkalies, nor by oxidizing agents. If a few grains of sulphonal be mixed with an equal weight of potassium cyanide and heated, the odor of mercaptan is evolved, and when to the aqueous solution of the product an excess of hydrochloric acid and a few drops of solution of ferric chloride are added a red color is developed, due to the formation of ferric sulphocyanate (Br.). If a mixture of sulphonal and 3 parts of powdered potassium hydroxide be fused it becomes yellow, then red, and on dilution with water a blue color results, which, upon the addition of an excess of hydrochloric acid, turns a transient violet and sulphur is separated (Vitalli). It is best distinguished from trional and tetronal by its higher melting point and its crystalline form.

Action and Uses.—In the lower animals moderate doses of sulphonal produce sleep and a disturbance in muscular coördination. Large doses cause coma, convulsions, and paresis. It exercises its dominant influence upon the brain, only mildly affecting the peripheral nervous system.

Upon the circulation its effect is slight, and only in large quantities does it depress the respiratory function. When toxic doses are given, death results from paralysis of respiration. Most investigators agree with Kast, who maintains that sulphonal does not cause corpuscular changes in the blood. It is devoid of analgesic and anæsthetic properties. In man sulphonal produces sleep, from which the individual awakes usually refreshed, although mental dulness and bodily sluggishness are apt to follow.

Because of its slow solubility its effect is gradual, 2 to 4 hours elapsing before it is fully developed. Sulphonal may sometimes cause nausea, vomiting, diarrhœa, headache, vertigo, aphasia, hallucinations, tremors, paresis, an unsteady gait resembling that of locomotor ataxia, erythematous eruptions, etc. These symptoms are more apt to occur when the drug is taken for a long period of time than after a single full dose.

Its continuous use will derange digestion and impair the function of the kidneys, the urine becoming scant or entirely arrested and assuming a dark reddish hue from the presence of an unusual substance, hæmatoporphyrine. Any discoloration of the urine, therefore, should be looked upon as a signal to discontinue the use of the drug.

Sulphonal is employed as a hypnotic in insomnia due to functional derangement of the nervous system, and is valueless when pain or advanced disease is the cause of the wakefulness. It is an efficient soporific in cases of insanity characterized by great mental excitement, and has a quieting effect in delirium tremens, but is of little benefit in the delirium of acute febrile diseases.

As a hypnotic sulphonal is intermediate between chloral and paraldehyde, being, perhaps, less powerful than the former and more active than the latter. It is safer than most drugs of its class because it does not depress the heart. Comparatively few deaths from its employment are reported. As much as 120 grains (8 Gm.) have been taken, however, without ill effect, and Neisser has reported one case which recovered after taking about 3 ounces (90 Gm.).

To procure the best results from sulphonal certain peculiarities of its properties must be regarded. Being so slowly absorbed it should be administered from 2 to 4 hours before its effect is desired, and because of its relative insolubility in cold water it should be dissolved in hot water or hot milk and the solution swallowed as soon as it has cooled sufficiently to be drunk. It may be given in fine powder, in capsule or cachet, or suspended in mucilage or syrup. The dose of sulphonal is from 20 to 40 grains (1.30–2.60 Gm.).

Allied Products.—Methonal or Dimethylsulphonedimethylmethane $(CH_3)_2.C(SO_2CH_3)_2$.—This compound, occurring in colorless crystals, is prepared in a manner analogous to that given above for sulphonal, except that methyl hydrosulphide or methylmercaptan is used in place of ethyl hydrosulphide. It has been used as an hypnotic in the same dose as sulphonal.

TETRONAL or DIETHYLSULPHONEDIETHYLMETHANE $(C_2H_5)_2.C(SO_2C_2A_5)_2$.—The name tetronal was given to this compound on account of the 4 ethyl groups present. If diethylketone be used in place of acetone in the process given for the preparation of sulphonal, diethylketonemercaptol will be obtained, which, upon oxidation with potassium permanganate, yields tetronal, a compound analogous to sulphonal, trional, etc. It requires about 450 parts of cold water for solution, but less hot water, and is readily soluble in alcohol. It melts at 85° C. (185° F.). Its action is allied to that of sulphonal. It is given in the dose of 15 to 30 grains (1–2 Gm.).

SULPHUR, *U. S., Br., P. G.*—Sulphur.

Soufre, Fr.; *Schwefel*, G.

Symbol, S. Atomicity, bivalent, quadrivalent, and sexivalent. Atomic weight, 31.83.

Official Forms of Sulphur.—1. SULPHUR LOTUM, U. S.; *Sulfur depuratum*, P. G.—*Washed sulphur*, E.; *Soufre lavé*, Fr.; *Gereinigter Schwefel*, G.

2. SULPHUR (SULFUR) PRÆCIPITATUM, U. S., Br., P. G.; *Lac (Magisterium) sulphuris.*—*Precipitated sulphur, Milk of sulphur*, E.; *Soufre précipité, Magistère (Lait) de soufre*, Fr.; *Schwefelmilch*, G.

3. SULPHUR (SULFUR) SUBLIMATUM, U. S., Br., P. G.; *Flores sulphuris.*—*Sublimed sulphur, Flowers of sulphur*, E.; *Soufre sublimé, Fleur (Crême) de soufre*, Fr.; *Schwefelblumen, Schwefelblüthe*, G.—Sulphur sublimed and condensed to powder.

Washed and precipitated sulphur should contain not less than 99.5 per cent., and sublimed sulphur not less than 99 per cent. of pure sulphur.—U. S.

Origin.—Sulphur occurs most abundantly in the native state in volcanic countries. Beds of native sulphur have been discovered in California, Nevada, Utah, and other parts of the Western United States, in Mexico, the West Indies, etc.; the chief supply of sulphur, however, comes from Italy, where extensive beds are worked near Latera and Scrofano, and from the provinces of Girgenti, Caltanisetta, Catania, and Palermo in the island of Sicily, where nearly 100,000 tons are obtained yearly. Sulphur-beds on the surface of the earth are called *solfatare*, and when they are found underground are known as *solfare*. The latter are the most important, and yield nearly the whole of the commercial sulphur. It is found in many mineral waters as hydrogen sulphide and in the form of sulphates, and is widely distributed in the mineral kingdom in combination with metals, forming iron pyrites, FeS_2, galena, PbS, blende, ZnS, black antimony, Sb_2S_3, cinnabar, HgS, and other sulphides, and as sulphate in gypsum, heavy spar, and many other minerals. Sulphur is a constituent of the volatile oils of mustard, garlic, and asafetida, and of albumin and other proteids.

Sulphur in the free state is sometimes found in sedimentary rocks, occasionally in pure and well-formed crystals. Such deposits are due in great part to the activity of bacteria and algæ, which during life store up so much sulphur that it constitutes from 10 to 25 per cent. of the weight of the living cells. The Beggiatoa bacteria especially have the peculiar power of converting hydrogen sulphide, which arises from gypsum during fermentation of cellulose, into sulphuric acid, during which process, however, a great portion of the sulphur is stored up in the cells in granules as a future food supply.

Extraction and Purification.—Sulphur is obtained in Sicily by melting it from the mineral in semicircular pits called *calcaroni*, which have a diameter of about 30 feet and a depth of about 8 feet, and are internally covered with a layer of gypsum. The bottom is inclined toward one side, which has an opening, closed during the operation with a thin wall of gypsum. The pit is filled with the mineral, and this is heaped up above so as to form an obtuse cone, the whole being covered first with a layer of powdered sulphur ore, and finally with a stratum of spent ore in powder. Fire is now applied to the heap, and after an hour all openings are closed until, after about nine days, the melted sulphur begins to collect on the floor of the pit. Through a small opening made into the gypsum wall the melted sulphur is removed two or three times a day and run into moistened moulds made of poplar wood, where it solidifies in the form of blunt pyramids, in which condition it enters commerce. The *rough sulphur* thus obtained contains from 3 to 4 parts of earthy impurities, which are removed by distilling the sulphur from iron retorts and conducting the vapors into large brick chambers, where they condense in the form of a fine powder, which is from time to time removed before the condensing-chamber becomes too hot, and constitutes *sublimed sulphur*. If,

however, the operation is not interrupted, the brick walls of the chamber become hot enough to melt the sulphur, which is run into wooden moulds. The cylindrical pieces thus obtained enter commerce as *brimstone* or *roll sulphur.*

In Nevada the sulphur ore is placed in upright cast-iron retorts, in shape resembling a blast-furnace; superheated steam is admitted and the pressure raised to about 70 pounds to the square inch; the pressure is slowly reduced to 50 pounds as the melted sulphur flows through a grate into a receiving-pan, where mechanical impurities are allowed to subside, the sulphur being run into large cylindrical moulds, and after cooling broken into irregular lumps before it is refined.

Sulphur is also obtained from pyrites by a process of roasting in heaps or in suitable furnaces built for the purpose, a portion of the sulphur being burned in the operation.

Preparation.—Sublimed Sulphur. The process by which this is procured has been described above. The other official forms of sulphur are prepared as follows:

Washed Sulphur. Sublimed sulphur, 100 Gm.; ammonia water, 10 Cc.; water, a sufficient quantity. Pass the sublimed sulphur through a No. 30 sieve, mix it thoroughly with 100 Cc. of water, add 10 Cc. of ammonia water, and digest for three days, agitating occasionally. Then add 100 Cc. of water, transfer the mixture to a muslin strainer, and wash the sulphur with water until the washings cease to impart a blue color to red litmus-paper. Then allow it to drain, press the residue strongly, dry it rapidly at a moderate heat, and pass it through a No. 30 sieve.—U. S. The P. G. orders for 10 parts of sublimed sulphur 7 parts of water and 1 part of ammonia water, the mixture to be macerated for a day. Prolonged digestion is unnecessary for the removal of the free acid, but it is important that after thorough washing the sulphur be well dried to prevent its slow oxidation.

Precipitated Sulphur. Sublimed sulphur, 100 Gm.; lime, 50 Gm.; hydrochloric acid, water, each a sufficient quantity. Slake the lime, and make it into a uniform mixture with 500 Cc. of water. Add the sulphur, previously sifted, mix well, add 1000 Cc. of water, and heat the mixture to boiling for one hour, stirring constantly and replacing the water lost by evaporation. Then cover the vessel, allow the contents to cool, pour off the clear solution, filter the remainder, and to the united liquids add, gradually, with constant stirring, hydrochloric acid previously diluted with an equal volume of water, until the liquid is nearly neutralized, still retaining, however, an alkaline reaction and a yellow color. Collect the precipitate on a strainer, and wash it with water until the washings are tasteless and cease to give a precipitate with ammonium oxalate test-solution. Then dry it rapidly with a gentle heat, and keep in well-stoppered bottles.—U. S.

In the process described, calcium thiosulphate and pentasulphide are formed in solution, thus: $3Ca(OH)_2 + 12S. = CaS_2O_3 + 2CaS_5 + 3H_2O$. Theoretically 50 parts of quicklime or slaked lime require 115 or 87 parts of sulphur respectively. It is, however, advisable to employ an excess of sulphur, the undissolved portion of which may be used in a subsequent operation. The resulting liquor has a dark orange-red color. Diluted hydrochloric acid should now be added in a thin stream and with continued stirring, when the calcium pentasulphide will be decomposed, calcium chloride remaining in solution, while sulphur is precipitated and hydrogen sulphide is liberated, which should be carried off through a chimney. This reaction occurs according to the equation $2CaS_5 + 4HCl = 2CaCl_2 + 4S_2 + 2H_2S$. If the acid be added with the precaution that the liquid retains its alkaline reaction, calcium hydrosulphide, $Ca(HS)_2$, will remain in solution, and with it any arsenic which may have been present in the sulphur or in the acid; but in the presence of iron black ferrous sulphide will be precipitated with the sulphur, and impart to it a dark-gray color. The latter impurity may be easily removed by washing first with water, followed by dilute hydrochloric acid, and this again by water.

Operating in this manner, as directed by the U. S. P., the calcium thiosulphate will not be decomposed. The further addition of acid will decompose this compound, sulphur being liberated, together with sulphur dioxide, and the latter, by reacting with the hydrogen sulphide, will liberate an additional quantity of sulphur, with the formation of water. The result of the entire complicated reaction is expressed by the equation $2CaS_5 + CaS_2O_3 + 6HCl = 6S_2 + 3CaCl_2 + 3H_2O$. It will be observed that by acidulating the solution of lime and sulphur, as directed by the British Pharmacopœia, a larger amount of precipitated sulphur is obtained; but it was shown by Fordos and Gélis (1851),

and by Berthelot, that that resulting from the thiosulphate is soft and only partially soluble in carbon disulphide. Arsenic, if present in the lime solution, will separate as yellow arsenic sulphide.

Properties.—Sulphur exists in several modifications, and is either crystalline and soluble in carbon disulphide, or amorphous and insoluble in the same liquid. At least six crystallized modifications of sulphur are known, but only two forms are easily obtained—namely, the rhombic and the monoclinic. Rhombic crystals, melting-point 114° C. (237.2° F.), are obtained from solutions of sulphur at ordinary temperature, while monoclinic crystals, melting-point 118° C. (248° F.), result from hot solutions and when molten sulphur cools. The latter crystals readily change to the former. When molten sulphur at a high temperature is suddenly cooled it becomes amorphous and plastic, and is characterized by its softness, insolubility, and low specific gravity (1.957 instead of 2.045). Amorphous sulphur is present in precipitated sulphur in finely divided form, and also in sublimed sulphur. When the latter is shaken with carbon disulphide, about one-third remains undissolved and is amorphous. On gradually heating to near 180° C. (356° F.) sulphur becomes brown, and ultimately black, opaque, and very viscid. If the heat be continued, the mass liquefies again at 260° C. (500° F.), and at about 450° C. (842° F.) is converted into orange-brown vapors. Heated in the air, sulphur ignites at about 150° C. (302° F.), and burns with a blue flame to sulphurous anhydride or sulphur dioxide, SO_2. This gas always contains a small quantity of the trioxide or sulphuric anhydride, SO_3, according to Lunge and Salathé (1883), if the combustion takes place in dry air, the amount being 2.5 or 2.8 per cent., and the quantity being increased in the presence of ferric oxide. The two oxides named are the only oxygen compounds which have been obtained in the isolated state, though several others are known in combination, of which the most important is thiosulphuric acid. (See Sodii Thiosulphas.) The other oxygen compounds of sulphur are as yet only of scientific interest: they are hyposulphurous (also called hydrosulphurous) ($H_2S_2O_4$), dithionic, trithionic, tetrathionic, and pentathionic acids, having the composition $H_2S_2O_6$, $H_2S_3O_6$, $H_2S_4O_6$ and $H_2S_5O_6$ respectively. These four acids, when liberated from their salts, are readily decomposed into sulphuric and sulphurous acids, the last three separating also sulphur. In recent years salts of another oxygen acid of sulphur have been prepared—namely, the persulphates, as $K_2S_2O_8$, which are excellent oxidizers. (See under Acida and also Potassium.)

Sulphur combines also with most of the non-metallic and metallic elements, forming sulphides, the most important of which to the pharmacist are the sulphides of antimony, mercury, iron, potassium, ammonium, and hydrogen. When treated at an elevated temperature with volatile and fixed oils, it dissolves, and forms with the fats compounds which were formerly known as balsams of sulphur. Sulphur is insoluble in water, but dissolves in hot solutions of the fixed alkalies and alkaline earths, forming sulphides, and is somewhat soluble in hot absolute alcohol, ether, chloroform, oil of turpentine, benzin, and benzene, being deposited on cooling in crystals. Carbon disulphide promptly dissolves a portion of it, but leaves a residue of insoluble sulphur, which may be dissolved by a boiling solution of alkali hydroxide.

Sublimed sulphur is a yellow or somewhat greenish-yellow, slightly gritty powder, which is free from odor and taste, or generally has a slight sulphurous odor and a faint acidulous taste, and has a slight acid reaction to litmus. To heat and solvents it shows the behavior described above.

Washed sulphur has the same appearance and behavior as the preceding, except that it is entirely inodorous and nearly tasteless, and does not change the color of litmus-paper, which properties are demanded by the Br. P. for its sulphur sublimatum, but which cannot be met. (E. Merck, *Chemist and Druggist*, 1898, p. 349.)

Precipitated sulphur is a yellowish-white or grayish, very fine powder, free from grittiness and from the odor of hydrogen sulphide, and nearly tasteless. When examined under the microscope it is seen to consist of opaque globules which are free from crystalline matter. It is not altered on exposure to air when kept dry, and on fusion it is converted into ordinary sulphur.

Tests.—Water agitated with washed or precipitated sulphur (U. S.), or these varieties of sulphur moistened with water (P. G.), should not redden blue litmus-paper; the latter is the more delicate test. Pure sulphur should completely evaporate by heat, and when ignited in the air should burn without leaving any fixed residue (clay, gypsum, etc.). The pharmacopœias permit a trace (0.1 to 1 per cent.) of fixed residue for sub-

limed (0.5, U. S.) and washed (0.2, U. S.), but none for precipitated, sulphur. The latter, if precipitated by sulphuric acid, is more readily miscible with water than pure precipitated sulphur, and leaves on ignition a large amount of fixed residue. For the detection of this and other fixed impurities the following additional but unnecessary tests may be employed: If precipitated sulphur be boiled with diluted hydrochloric acid, the liquid filtered, and the filtrate divided into two portions, one portion should not be precipitated by test-solution of barium chloride, and the other portion should not be rendered more than slightly turbid by test-solution of ammonium carbonate with excess of ammonia-water (absence of calcium sulphate). When digested successively with water, hydrochloric acid, and ammonia water, these liquids, after filtration, should leave no residue on evaporation (absence of alkalies, alkaline earths, or sulphide). Sulphur obtained from pyrites usually contains arsenic, which is most conveniently detected, unless present in very minute quantities, by digesting it with 20 parts (P. G.) of ammonia water, filtering, and adding hydrochloric acid, when yellow arsenic sulphide will be precipitated; on the further addition of hydrogen sulphide, arsenous acid, if present, will yield a yellow precipitate of arsenic sulphide. While arsenous acid may be present in sublimed and in washed sulphur, it is obvious from the above explanation of the process that precipitated sulphur may be contaminated with the sulphide, but not with the oxide of arsenic. Very minute quantities of this metal are detected thus: If 0.5 Gm. of washed or precipitated sulphur be digested for several hours with 10 Cc. of ammonia water, the clear filtered liquid evaporated to dryness on a water-bath, then, after adding 1 Cc. of nitric acid and again evaporating, the solution of the residue in 10 Cc. of hydrochloric acid (8 per cent.) should not respond to the modified Gutzeit's test for arsenic (given under ARSENI TRIOXIDUM).—U. S. Selenium, which is sometimes present in sulphur, is detected by boiling 0.5 Gm. of the sample with a solution of 0.5 Gm. of potassium cyanide in 5 Cc. of water, and, if after filtration, the clear liquid be acidulated with hydrochloric acid, it should not assume a reddish color, even after standing an hour (absence of selenium). Precipitated sulphur frequently has a slight odor of hydrogen sulphide, which is more apparent on being warmed; such sulphur acquires a more or less black color when agitated with a solution of lead acetate; the pharmacopœias give no chemical test, almost complete freedom from odor being sufficient.

Action and Uses.—Sulphur has little influence over the general system. Given internally it is absorbed into the blood to some extent, eliminated in the perspiration, milk, urine, etc., and exercises a gentle alterative effect upon the skin and mucous membranes. In the small bowel it undergoes chemical changes resulting in the formation of hydrogen sulphide, to which is due the unpleasant flatus following its use.

It is a mild stimulant to intestinal secretion and acts as a gentle laxative, producing soft, mushy stools. The germicidal properties of sulphur are due to the sulphurous acid gas and sulphides formed from its decomposition. As a laxative, sulphur is of especial value to soften the stools and correct the constipation which occurs in stricture of the bowels, hemorrhoids, and anal fissure.

A combination of sulphur, cream of tartar, and molasses is extensively employed in domestic medicine as a laxative and "blood purifier."

In the treatment of chronic rheumatism, gout, and sciatica sulphur was at one time a highly esteemed remedy, but is rarely employed at present. It was given internally and applied locally in powder, ointment, or bath. Some cases of chronic bronchitis with excessive secretion are greatly benefited by 5 to 10 grains (0.30–0.60 Gm.) of sulphur given 3 times a day.

The most important use of sulphur is in the treatment of various skin diseases. For this purpose it is applied usually in ointment made preferably with precipitated sulphur because of its fine state of comminution. It is a specific in scabies and is beneficial in inveterate cases of acne, eczema, psoriasis, tinea versicolor, and other eruptions when a stimulating application is indicated.

When used in scabies it is important that the skin be thoroughly softened by soaking in hot water and the epidermis removed by brisk rubbing with a rough towel before the ointment is applied. This procedure exposes the female parasite which burrows beneath the skin to the action of the sulphur. The ointment should be allowed to remain on the part all night and be used for 3 or 4 nights consecutively.

Before the advent of formaldehyde the fumes of burning sulphur were extensively employed to disinfect sick rooms from which cases of contagious diseases had been

removed. It is disadvantageous because it destroys the colors of the wall paper, hangings, etc. Sulphur is given in the dose of 1 to 2 drachms (4–8 Gm.) as a laxative, and from 10 to 20 (0.60–1.30 Gm.) as an alterative. For internal use washed sulphur is preferable because it is free from acids to which the griping is due.

SULPHURIS IODIDUM, *U. S., Br.*—Sulphur Iodide.

Sulfur iodatum, Iduretum sulfuris.—Iodure de soufre, Fr.; *Jodschwefel*, G.

Preparation.—Washed sulphur, 20 Gm.; Iodine, 80 Gm. Mix the sulphur and iodine thoroughly by trituration; introduce the mixture into a flask, close the orifice loosely, and by means of a water-bath gradually and with occasional agitation apply a heat not exceeding 60° C. (140° F.) until the ingredients combine, which is indicated by the color becoming uniformly dark throughout the mixture. Then increase the heat to the boiling-point of the water, so as to fuse the mass. By inclining the flask unite any iodine which may have sublimed and condensed on the sides of the flask with the fused mass, and then pour the latter upon a porcelain plate or other suitable cold surface. After cooling, break the product into pieces of suitable size, and keep them in a glass-stoppered bottle in a cool place.—U. S., Br.

Although many consider the substance thus obtained a definite compound with the composition S_2I_2, it lacks entirely the chemical characteristics which analogy with the chloride and bromide of sulphur indicates would be possessed by a true iodide. As far back as 1813 Gay-Lussac stated that any union between the elements must be of a most feeble kind. The melting-point of the substance is 66° C. (150.8° F.), which is much less than that of either constituent. This fact is the only strong point in favor of a chemical compound, while in all other respects the substance acts like a solution of one element in the other. The whole matter is thoroughly discussed by MacIvor in an article in *Chem. News*, vol. 86, p. 5, 1902, which concludes with the remark that the opinion of Sestini (1863) may not be so far from the truth, after all—namely, "there exist a great number of compounds of sulphur and iodine obtained by fusion and solution, all being analogous in character to metallic alloys."

Properties.—Sulphur iodide is a grayish-black mass of a radiated crystalline appearance and with a metallic lustre. It resembles iodine in smell and taste, and on exposure to the air gradually loses iodine. If exposed to a gradually increased heat it sublimes, the first portion of the sublimate consisting of iodine, and the portion subsequently obtained containing sulphur; only a minute trace of fixed residue should be left. Sulphur iodide is insoluble in water, but dissolves in about 60 parts of glycerin, and is very soluble in carbon disulphide, on the spontaneous evaporation of which at a low temperature iodine crystallizes first, and afterward rhombic pyramids of *sulphuric iodide* are obtained, having the formula SI_6 (Vom Rath, 1860), and on exposure to the air leaving sulphur in the form of a delicate crystalline skeleton (Lamers, 1861). Alcohol, ether, volatile oils, and cold solutions of potassium hydroxide and of potassium iodide decompose sulphur iodide by dissolving the iodine. A similar decomposition is effected by boiling the sulphur iodide with water, with the vapors of which the iodine passes off, leaving a residue of sulphur amounting to 20 per cent. of the weight of the sulphur iodide employed; this is recommended as a test of purity by the U. S. P. and Br. P. If 0.5 Gm. of the finely powdered iodide and 1 Gm. of potassium iodide be dissolved in 20 Cc. of water (the sulphur separating), not less than 28 Cc. of tenth-normal sodium thiosulphate solution should be required for complete decolorization of the mixture.—U. S. Each Cc. of the thiosulphate solution represents 0.01259 Gm. of iodine; hence 28 Cc. represent 0.3525 of iodine, or 70.5 per cent.

Action and Uses.—Sulphur iodide has been used as an application in certain chronic skin lesions, as lupus and lepra. It was applied in ointment containing 1 to 3 parts to 10 of lard. According to the strength of the ointment employed it is either a stimulant or caustic.

SUMBUL, *U. S.*—Sumbul Root.

Sumbul radix, Br.—*Musk-root*, E.; *Sumbulwurzel, Moschuswurzel*, G.; *Racine de sumbul*, Fr.; *Sambulus*, Port.

The dried rhizome and roots of an unknown plant of the family *Umbelliferæ*.

Origin.—Accurate nomenclature would require that this article be called "False Sumbul," since the original and genuine Sumbul, with a strong odor of musk, whence

the common name, and which was the dried root of *Ferula Sumbul* Hook. f. (*Euryangium* S.—Kauffm.; *Sumbulus moschatus* Renisch.; *Angelica* m.—Wiggers.—Fam. *Umbelliferæ*), native of Turkestan, has not been imported for many years. The definition of the Pharmacopœia of 1890, naming the latter, did not therefore agree with its description, which was of the former. Holmes, who has grown and studied *F. Sumbul*, has shown clearly that the article at present so called is distinct and unknown, except by its drug, which enters commerce from central and western Asia through Moscow. The thick, annulate portions of the drug are apparently rhizome, but the small, smooth pieces more likely pertain to the roots.

Fig. 417.

Sumbul root (½ Nat.).

Description.—Occurring in very light and spongy transverse cylindrical sections from 0.5 to 12 Cm. (¼–5 In.) in diameter and 2.5 to 5 Cm. (1–2 In.) long; externally the larger pieces are dark brown, roughly wrinkled, and heavily annulate; the smaller successively less rough, some with a silvery-gray, nearly smooth cork, frequently exfoliating; internally yellowish white from the presence of yellowish resin-cells and fibro-vascular bundles distributed irregularly through the white parenchyma; fracture tough, irregular, somewhat starchy; odor strongly aromatic, slightly musky; taste characteristically aromatic, somewhat pungent and bitterish.

The brownish powder shows moderately numerous starch-grains, which are single or few or many united, mostly broadly oval, the hilum usually stellate, and numerous large, thin-walled resin-cells.

Constituents.—Nothing definite can be said to be known on this subject. Scarcely one of the contributions indicate which of the articles called sumbul were under examination. Probably Renisch's work (1843) was done with the original sumbul, and Utech's (1893) and Hahn's (1897) very fragmentary and superficial reports referred to that above described. Utech found more than 6 per cent. of the bitter resin which undoubtedly contained volatile oil, since it was markedly aromatic. It was nearly insoluble in ammonia-water, but soluble in ether, chloroform, and benzol. Hahn extracted with petroleum benzin more than 17 per cent. of a yellow, viscid fixed oil. The drug should not yield more than 6 per cent. of ash.

Pharmaceutical Preparations.—Extract of Sumbul, Fluidextract of Sumbul, U. S. P.

Action and Uses.—Sumbul possesses stimulant and antispasmodic properties similar to but milder than those of valerian. In combination with iron, arsenic, and similar drugs it is employed as a tonic in nervous exhaustion and various functional disorders of females, as hysteria, amenorrhœa, chlorosis, etc.

Its original application as a remedy in cholera, and atonic dysentery and diarrhœa is now rarely resorted to. A resin prepared from it has been found to relieve chronic mucous discharges from the lungs, urethra, and uterus. The dose of the root in powder is from 15 to 60 grains (1–4 Gm.). The fluidextract is given in the dose of 15 to 60 minims (1–4 Cc.), and the extract in the dose of 5 to 15 grains (0.30–1 Gm.).

Allied Products.—Several other roots have been called Sumbul. The genuine Sumbul was a fusiform vertical root, 12 to 25 Cm. (5–10 In.) long and 5 to 10 Cm. (2–4 In.) thick, which came in sections like those of the present false article, but less annulate. It was strongly musky. The East Indian *Jatamanshi Root*, or *Sumbul Hindi*, is from *Nardostachys Jatamansi* D. C. (Fam. *Valerianaceæ*). It is described as a rhizome, about ½ inch thick, of dark gray color, and bearing at the summit a tuft of reddish-brown fibres, the odor a mixture of valerian and patchouli. *Sumbul ekleti* or *ekelti*, *S. Kumi* or *S. Italicus*, is the rhizome of *Valeriana Celtica* L., of Europe. *Bombay Sumbul* or *Boi* is the root of *Dorema ammoniacum* Don. It has been used to adulterate Sumbul, and more nearly resembles the original than the modern drug.

SUPPOSITORIA, *U. S.*, *P. G.*—Suppositories.

Suppositoires, Fr. Cod.—*Suppositorien, Stuhlzäpfchen*, G.

Suppositories are solid bodies of various weights and shapes, adapted for introduction into the different orifices of the human body, and melting readily at blood heat. The

vehicles usually employed are oil of theobroma, glycerinated gelatin, or sodium stearate.—U. S.

The German Pharmacopœia designates oil of theobroma alone as the official vehicle for suppositories, while the French Codex permits them to be made with oil of theobroma, soap, or tallow, but directs the first-named vehicle in all of its official formulas. The British Pharmacopœia gives no general directions for making suppositories, but recognizes 7 official varieties, all of which, with one exception, are made with oil of theobroma.

Preparation.—For suppositories made with oil of theobroma the following general processes may be employed: Take of the medicinal substance the prescribed quantity; oil of theobroma, grated, a sufficient quantity. Reduce the medicinal substance, if dry, to a very fine powder, or, if an extract, soften it with an appropriate liquid, then mix it thoroughly in a mortar with about an equal weight of grated oil of theobroma, and incorporate the remainder of the oil of theobroma until a homogeneous, plastic mass is obtained, adding, if necessary, a small quantity of expressed oil of almond. Roll the mass on a graduated tile until a cylinder of the proper length is formed, divide this into the required number of equal parts, and with a spatula, or other convenient mechanical aid, form them into the desired shape. If the process of fusion is preferred, mix the medicinal substance with about an equal weight of grated oil of theobroma, as above directed, then thoroughly incorporate it with the remainder of the oil of theobroma, previously melted by a gentle heat, in a suitable vessel provided with a lip; then allow it to cool to about 38° C. (100.4° F.), and, when the mixture begins to congeal, pour it immediately into suitable well-cooled molds. Keep the molds at a freezing temperature until the suppositories have hardened and are ready to be removed. For suppositories containing chloral, phenol, their derivatives, or substances which soften the vehicle, raise the melting-point of the oil of theobroma by the addition of from 10 to 15 per cent. of spermaceti, but the melting-point must not be raised above 37° C. (98.6° F.).

For suppositories made with glycerinated gelatin the following process may be used: Take of the medicinal substance the prescribed quantity; glycerinated gelatin, glycerin, water, each a sufficient quantity. Mix the medicinal substance, if solid and soluble in water or glycerin, or if a miscible liquid, with a little water, and add sufficient glycerin to make the weight of the mixture one-half that of the finished mass. Then thoroughly incorporate it with an equal weight of melted glycerinated gelatin, and pour it at once into suitable molds which have been greased with a small quantity of petrolatum. Cool the molds thoroughly before removing the suppositories. Molds for urethral suppositories should be warmed sufficiently before pouring the mass to facilitate the proper filling of the mold. Suppositories having a firmer consistence may be prepared by substituting mucilage of acacia for a portion of the water or glycerin. If the medicinal substance be insoluble in water or glycerin, thoroughly levigate it in a warm mortar with a sufficient quantity of glycerin to make the weight of the mixture one-half that of the finished mass. Then thoroughly incorporate it with an equal weight of melted glycerinated gelatin, and pour it into suitable molds as above directed. With bulky powders about one-half of the glycerin may be replaced with water before levigation. Glycerinated gelatin suppositories should be protected against the effects of heat and moisture and dry air by keeping them in tightly closed containers in a cool place.

Rectal suppositories should be cone-shaped or spindle-shaped, and when made from oil of theobroma should weigh about 2 grammes.

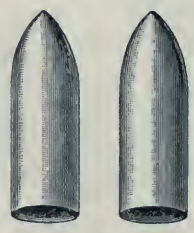
Urethral suppositories (bougies) should be pencil-shaped, pointed at one extremity, and either 7 centimeters in length, weighing about 2 grammes, or 14 centimeters in length, weighing about 4 grammes, when made with glycerinated gelatin. If prepared with oil of theobroma, they should weigh about one-half the above quantities.

Vaginal suppositories should be globular or oviform in shape, and weigh about 10 grammes if made with glycerinated gelatin, and about 4 grammes if made with oil of theobroma.—U. S.

The usual shape of rectal suppositories is that of a cone with a rounded apex (see Figs. 418 and 419), but the difficulty of readily introducing these into the rectum, on account of the resistance offered by contraction of the sphincter muscle, led to the suggestion of a new shape by H. S. Wellcome, of London (1893), as shown in Fig. 420, the great advantages of which become apparent when it is remembered that the bulbous end is inserted into the rectum first, and that as soon as the greatest diameter, which is about ½ inch from the point, has been passed, expulsion of the suppository is

impossible, by reason of the very contractile force of the sphincter, which renders retention of the ordinary conical shape often so difficult.

Fig. 418.



Rectal suppositories (for adults).

Fig. 419.

Rectal suppositories (for children).

Fig. 420.

The Wellcome-shape suppository.

Vaginal suppositories are made either globular or similar to rectal suppositories, as shown in Figs. 421, 422, and 423, while for urethral and nasal bougies the pencil-shape,

Fig. 421.

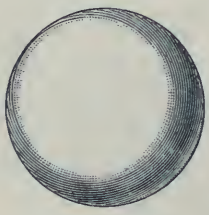


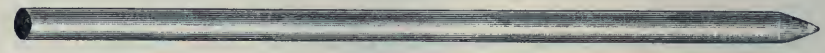
Fig. 422.

Fig. 423.

Vaginal suppositories.

seen in Figs. 424, 425, 426, has been adopted, the last-named being about one-third as long, but twice as thick as the urethral bougies.

Fig. 424.



Urethral bougie.

Suppositories are intended to insure a slow and uniform diffusion of their medicinal constituents to those internal parts to which they may be applied, and the choice of vehicle is made accordingly. The best substance for the preparation of suppositories is undoubtedly cacao butter, or oil of theobroma, first suggested in 1852 by the late A. B.

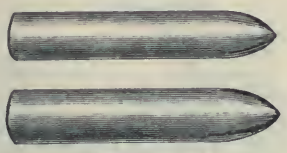
Fig. 425.

The Wellcome-shape urethral bougie.

Taylor, on account of its low fusing-point and bland, non-irritating properties. When medicinal agents, such as volatile oils, and the like, which have a softening effect on the fatty vehicle, are ordered in suppositories, and likewise during the summer season and in warm countries, it will frequently be found impossible to make suppositories with a cacao-butter basis without the addition of spermaceti or wax, which may be used to the extent of 5, 10, or even 20 per cent. of the weight of the fat. At the same time it must be borne in mind that the presence of a considerable quantity of insoluble matter, vegetable or

mineral powders, has the tendency to raise the melting-point of the fat; in some instances the difference has been observed to be as much as 5° or 6° C. (9° or 10.8° F.).

Fig. 426.



Nasal bougies.

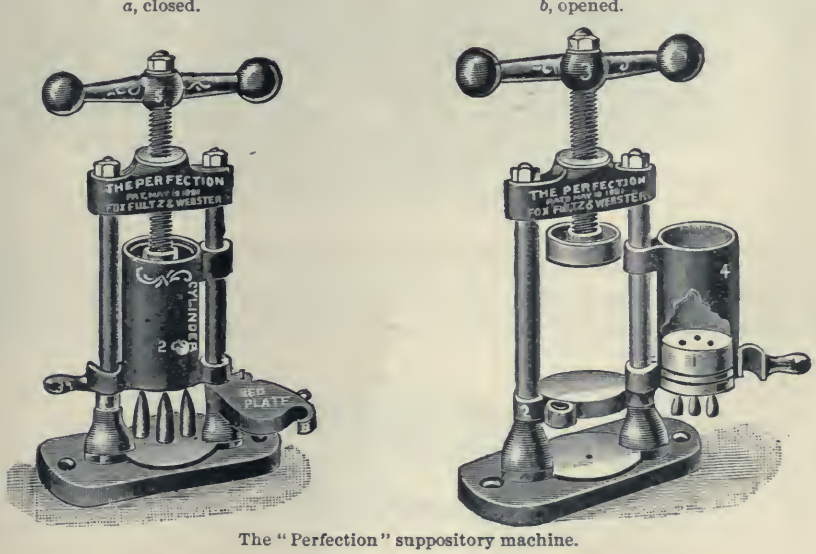
For vaginal suppositories, as well as nasal and urethral bougies, the official glycerinated gelatin, also known as glycerin jelly, is frequently preferred on account of its ready miscibility with water. It is well adapted for the exhibition of solid extracts, as those of belladonna, ergot, and opium, and such substances as boric acid, hydrated chloral, iodine, iodoform, and alkali bromides and iodides, but cannot be used in connection with ichthyol, owing to the fact that ichthyol renders the gelatin insoluble.

Since suppositories are, like ointments, simply mechanical admixtures of the medicinal constituents and a vehicle, the former must always be incorporated in the form of an impalpable powder or in a state of solution, solid extracts being rubbed into a smooth paste with water. On account of the peculiar application of suppositories, it is important that no coarse or gritty particles should ever be contained therein. They are made either entirely by hand, by casting in appropriate molds, or by cold compression in suitable apparatus.

The general official directions given above, if carefully followed, will yield satisfactory results. For hand-made suppositories, which as a rule are not as exact and uniform in shape as those made by fusion, a mixture of oil of theobroma 5 parts, castor oil 1 part, and yellow wax 1 part, melted together and cooled, has been found preferable to oil of theobroma alone, since it is more plastic and yet fuses at about the same temperature; another mixture melting at body-temperature is composed of oil of theobroma 2 parts, lanolin and white wax, of each 1 part. In place of molding suppositories by hand, compression of the finished mass in special molds is largely resorted to, and has proved

Fig. 427.

a, closed. *b*, opened.

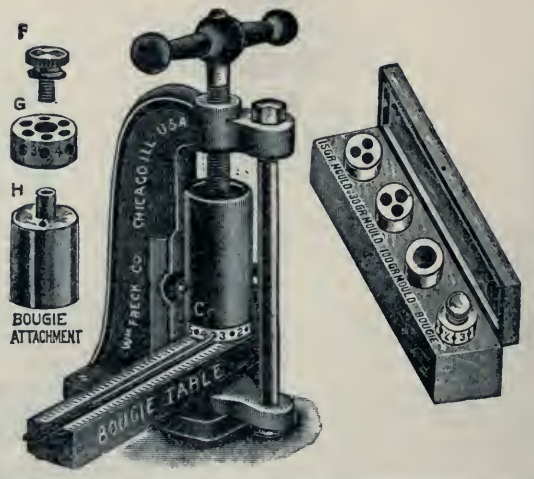


The "Perfection" suppository machine.

very satisfactory. The three molds shown in Figs. 427, 428, and 429 are improvements on the original Archibald compression mold in so far that several rectal suppositories can be compressed at once, while the finished product is easily and quickly removed.

They differ from each other only in the position of the compressor, two being perpendicular and the other horizontal; all, however, require considerable effort to force the

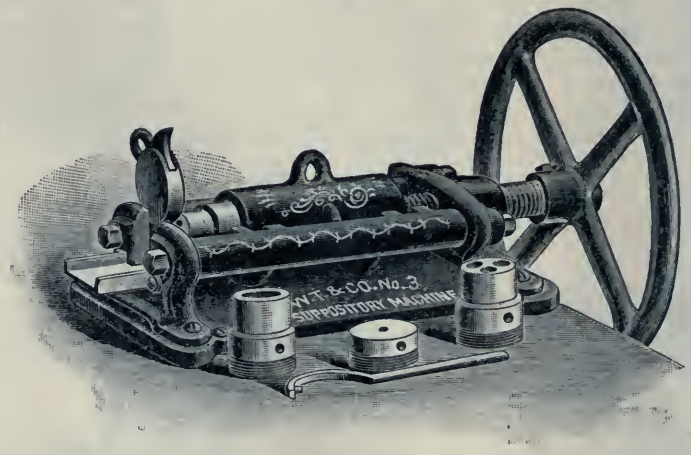
FIG. 428.



Freck's suppository machine with bougie attachment, graduated bougie table, mold-box, and pipe attachment.

mass through the small openings in the top of the molds into the molds proper underneath, which is the only objection that can be urged against them. Bougies, made with

FIG. 429.



Whitall's suppository machine.

glycerin-jelly, are cast in special molds, such as are shown in Figs. 430 and 431; the tubes are usually swabbed with a woolen rag carrying some liquid petrolatum or olive oil, to

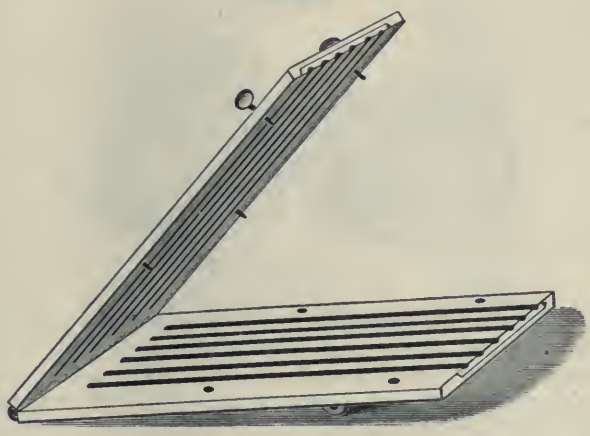
FIG. 430.

Mold for gelatin bougies.

prevent adhesion of the material. When made with cacao-butter or soap and starch they can either be compressed or formed by hand. Nasal bougies should be about 38 millimeters (1½ In.) in length and 6 millimeters (¼ In.) in diameter, while urethral bougies

are usually made 100 millimeters (4 In.) in length and from 3 to 4 millimeters ($\frac{1}{8}$–$\frac{1}{6}$ In.) in diameter. The ends of both are somewhat pointed as shown in Fig. 431.

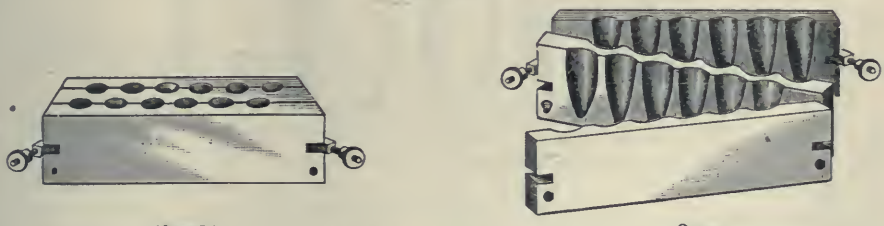
Fig. 431.



Mitchell's urethral bougie mould.

When suppositories are made by fusion, it is important that no heat be applied to the melted vehicle after the addition of the medicinal constituents lest separation occur, particularly in the case of extracts, which cannot afterward be successfully overcome. If perchance the mixture solidifies before it is transferred to the molds, it may again be liquefied by holding the dish or capsule over the steam arising from a hot water-bath and stirring assiduously. The molds must be perfectly clean and dry, having been previously well chilled by placing them on ice; there will then be no occasion whatever for dusting them with lycopodium or other substance. If the fluid mass is of the right con-

Fig. 432.



Closed.' Open

Maris' suppository mold.

sistence and the mold cold, it will immediately congeal and contract on being poured into the molds, but sufficient time should be allowed for the suppository to harden throughout, otherwise trouble may be experienced in removing them; in winter 20 or 30 minutes will suffice, whereas 40 minutes or longer may be necessary in summer, unless the mold,

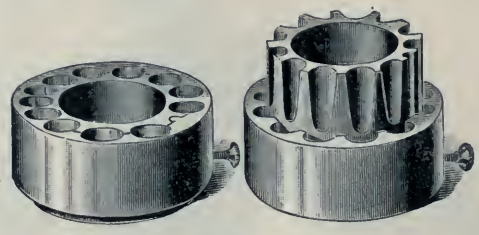
Fig. 433.

Wirz's suppository mold (open).

after having been filled, be placed in an ice-chest. Various styles of molds are in use among pharmacists, those known as divided molds, opening either horizontally or vertically, being preferred on account of the convenience with which they can be taken apart and cleaned. Figs. 432, 433, and 434 represent 3 different styles of molds, from

all of which the suppositories can be quickly removed by bearing slightly with the finger against the conical ends after the molds have been opened.

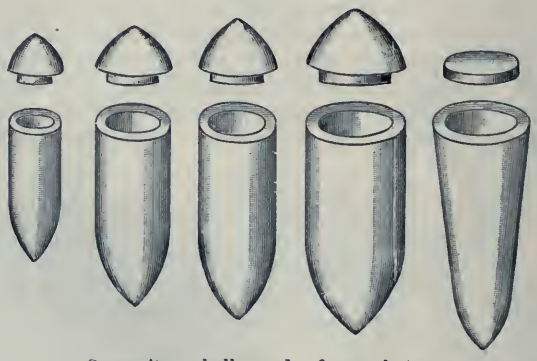
FIG. 434.



See's suppository mold.

Suppository shells made of gelatin or butter of cacao have been introduced for the convenience of the dispenser, but are not used to any extent. The medicinal ingredient is intended to become mixed with the material of the shells as the latter melts, but, as this is uncertain, they should never be used in case of potent remedies or if the direct application of the active agent is likely to cause irritation; for the introduction of boric acid, iodoform, or aristol they are, however, suitable. In the case of butter of cacao shells (see Fig. 435) they are preferably filled with a mixture of the active ingredient

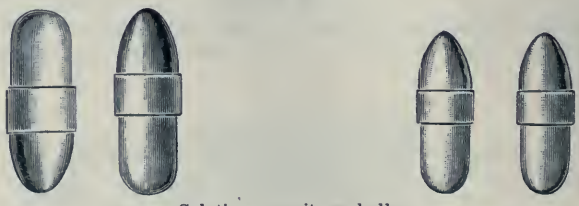
FIG. 435.



Suppository shells, made of cacao-butter.

and grated butter of cacao, and the top sealed either with a warm spatula or a little stiff mucilage of acacia. The gelatin shells (see Fig. 436) may be conveniently sealed

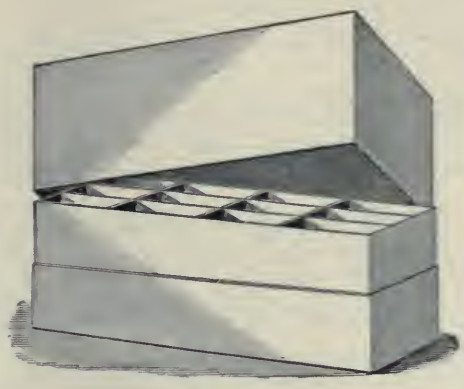
FIG. 436.



Gelatin suppository shells.

by moistening the margin of the lower half with a little water before slipping the upper part over the same. The best method of dispensing suppositories is undoubtedly in partitioned paper boxes (see Fig. 437), the sides and bottom of which should be lined with tinfoil or paraffin paper, the patient always being directed to keep the box in a cool place; in the absence of partitioned boxes, an oblong powder-box may be used, the suppositories being placed between two pieces of sheet-wadding.

FIG. 437.



Suppository box.

SUPPOSITORIA ACIDI CARBOLICI, *Br.*—Phenol Suppositories.

Carbolic acid suppositories, E.; *Suppositoires d'acide phènique*, Fr.; *Phenolsuppositorien*, G.

Preparation.—Take of phenol, 12 grains; white beeswax, 24 grains; oil of theobroma, melted, a sufficient quantity to form, with the phenol and beeswax, a mixture which will fill 12 suitable molds, each capable of holding 15 to 16 grains of oil of theobroma. Dissolve the phenol in the oil of theobroma and beeswax previously melted together at a low temperature, and pour the mixture into the molds; or let the mixture cool, and then divide it into 12 equal parts of a conical or other convenient form for a suppository.—Br.

Uses.—This suppository is disinfectant and locally anæsthetic, and may be used in inflammatory conditions of the rectum attended with purulent and fetid discharge and pain.

SUPPOSITORIA ACIDI TANNICI, *Br.*—Tannic Acid Suppositories.

Suppositoires de tannin, Fr.; *Tanninsuppositorien*, G.

Preparation.—Take of tannic acid, 36 grains; oil of theobroma, a sufficient quantity to form with the tannic acid a mixture which will fill 12 suitable molds, each capable of holding 15 to 16 grains of oil of theobroma. Melt the oil of theobroma; triturate the tannic acid intimately with a little of the oil, and add to the remainder; stir well; as the mixture begins to thicken pour it into the molds; or let the mixture cool and divide it into 12 equal parts of a conical or other convenient form for a suppository.—Br.

Uses.—Tannic acid suppositories are used to diminish local discharges of vagina and rectum, and to constringe the rectal mucous membrane, and thus relieve hemorrhoids and prolapsus.

SUPPOSITORIA BELLADONNÆ, *Br.*—Belladonna Suppositories.

Suppositoires de belladone, Fr.; *Belladonnasuppositorien*, G.

Preparation.—Take of alcoholic extract of belladonna, 18 grains; oil of theobroma, a sufficient quantity for 12 suppositories. Proceed as directed for tannic acid suppositories.—Br.

Each of these suppositories contains 1½ grains of alcoholic extract of belladonna, or approximately $\frac{1}{60}$ grain of the alkaloids of belladonna root.

Uses.—These suppositories are useful to relieve painful conditions of the rectum, bladder, and other pelvic organs. The quantity of extract of belladonna in each is unnecessarily large.

SUPPOSITORIA GLYCERINI, *U. S., Br.*—Glycerin Suppositories.

Suppositoires de glycerin, Fr.; *Glycerinsuppositorien*, G.

Preparation.—Take of glycerin, 30 Gm.; monohydrated sodium carbonate, 0.5 Gm.; stearic acid, 2 Gm.; water, 5 Cc. Dissolve the monohydrated sodium carbonate in the water and add it to the glycerin, contained in a dish, on a water-bath; add the stearic acid, and heat the mixture carefully until the carbon dioxide ceases to be evolved, and the liquid is clear. Then pour the melted mass into suitable molds, remove the suppositories when they are completely cold, and preserve them in tightly stoppered glass vessels.—U. S.

To make a dozen glycerin suppositories use glycerin 556 grains, monohydrated sodium carbonate 10 grains, stearic acid 37 grains, and water 1½ fluidrachms.

Take of gelatin, cut small, ½ ounce, glycerin, by weight, 2½ ounces; distilled water, a sufficiency; place the gelatin in a weighed evaporating dish with sufficient water to cover it; after allowing it to stand for a minute or two, pour away the excess of water; set aside until the gelatin is quite soft, then add the glycerin. Dissolve over a water-bath, and evaporate until the mixture weighs 1563 grains. Pour the product into suppository molds holding 30, 60, or 120 grain-measures, or having other capacities as required. Each suppository contains 70 per cent. by weight of glycerin.—Br.

The two formulas differ somewhat: the mass made by the U. S. P. formula contains about 23 per cent. more of glycerin than that of the Br. P. In the former, sodium stearate is obtained as a result of the reaction between sodium carbonate and stearic acid; thus, $Na_2CO_3.H_2O + 2HC_{18}H_{35}O_2 = 2NaC_{18}H_{35}O_2 + CO_2 + 2H_2O$. Since each molecule of stearic acid is capable of forming one molecule of sodium stearate, 2 Gm. will form 2.155 + Gm. in the U. S. P. process, and if all the water be expelled, the official mass will weigh about 32.155 Gm. and contain about 93 per cent. of glycerin. Each official glycerin suppository will weigh about 50 grains (3.22 Gm.).

Uses.—Glycerin suppositories are extensively employed to relieve constipation. Their action is partly mechanical and in part due to the stimulating action of the glycerin upon the mucous membrane. Their continuous use will result in rectal irritation.

SUPPOSITORIA IODOFORMI, *Br.*—Iodoform Suppositories.

Suppositoires d'iodoforme, Fr.; *Iodoformsuppositorien*, G.

Preparation.—Take of iodoform, 36 grains; oil of theobroma, a sufficient quantity for 12 suppositories. Proceed as directed for tannic acid suppositories.—Br.

Uses.—In addition to the curative influence of iodoform in inflammations of the rectum this suppository is of particular service to allay the pain of hemorrhoids, fissure in ano, ulcerations, etc. It should be inserted a few minutes before defecation when that act is painful.

SUPPOSITORIA MORPHINÆ, *Br.*—Morphine Suppositories.

Suppositoires de morphine, Fr.; *Morphiumsuppositorien*, G.

Preparation.—Take of morphine hydrochloride, 3 grains; oil of theobroma, a sufficient quantity for 12 suppositories. Proceed as directed for tannic acid suppositories.—Br.

Uses.—Besides the employment of this suppository to produce the systemic effect of morphine, it is an useful remedy to relieve the pain, strangury, and tenesmus of inflammations of the rectum and bladder.

SUPPOSITORIA PLUMBI COMPOSITA, *Br.*—Compound Lead Suppositories.

Suppositoires de plomb composès, Fr.; *Zusammengesetzte Bleisuppositorien*, G.

Preparation.—Take of lead acetate, in powder, 36 grains; opium, in powder, 12 grains; oil of theobroma, a sufficient quantity to make 12 suppositories. Proceed as directed for tannic acid suppositories.—Br.

Uses.—The combined astringent and anodyne qualities of this suppository render it appropriate in hemorrhoids, rectal ulceration and hemorrhage, dysentery, diarrhœa, etc.

SYMPHYTUM.—Comfrey Root.

Radix symphyti, R. consolidæ majoris.—Blackwort, Bruisewort, Slippery-root, Gum-plant, Ass-ear, E.; *Schwarzwurz, Beinwurz,* G.; *Grande consoude,* Fr.

The dried root of *Symphytum officinale* L. (Fam. *Boraginaceæ*). The dried leaves are employed almost as extensively as the root.

Origin and Description.—Comfrey is a coarse, bristly-hairy perennial herb, native of Europe, and escaped sparingly in the United States. The leaves are 10 to 25 Cm. (4–10 In.) long, the lowest ovate, the upper successively narrower, acute at the summit, tapering or contracted into a long, broad petiole, pinnately veined, rough, thickish, and mucilaginous. The 5-merous flowers are borne in terminal racemose cymes, the corollas yellowish or purplish white, tubular-campanulate, the throat partly or wholly closed by five linear scales. The root is dug in autumn or early spring and loses about 80 per cent. in drying.

Fig. 438.

Comfrey root (Nat.).

Comfrey-root occurs in pieces from a fraction of an inch to several inches in length, and rarely exceeding 6 Mm. (¼ In.) in thickness, usually much bent, and very deeply, heavily, and roughly wrinkled, and purplish black externally; fracture, when perfectly dry, short, sharp, the fractured surface of a peculiar grayish blue-white color and waxy lustre; bark about one-fourth of the radius, its outer layer blackish; medullary rays broad, wood-wedges narrow; inodorous, very mucilaginous, faintly sweetish, and astringent.

Constituents.—The most important constituent of symphytum is its very large amount of gum. Starch is present in very small amount, giving a brown color with iodine. Graimer reports having isolated the alkaloid *symphyto-cynoglossine* in very small amount, which has a "paralyzing effect on the nerve-centre," and the glucosidal alkaloid *consolidin*, having a similar action to the preceding, and yielding the alkaloid *consolicine*, three times as active as its glucoside. These results would appear to require verifying.

Action and Uses.—Comfrey root is demulcent and mildly astringent. It was used to allay cough and to soothe the irritation of diarrhœa and dysentery, and was given in decoction *ad libitum*.

SYRUPI.—Syrups.

Syrups are concentrated solutions of sugar, the solvent being either water or an aqueous, acetous, or hydroalcoholic solution of some medicinal or aromatic principle. In the United States and British Pharmacopœias the title *Syrupus—Syrup* is used to designate a nearly saturated solution of sugar in water; in practice this solution is usually termed *simple syrup* as a mark of distinction, and this plan is also followed in the French and German pharmacopœias.

Sugar is soluble in half its weight of water at 15° C. (59° F.), and a saturated solution thus prepared has the specific gravity 1.345, or 1.340 if taken at 25° C. (77° F.). Large quantities of sugar dissolved in water very materially increase the bulk of the liquid, a fact which must always be borne in mind in the preparation of syrups; practically, two-thirds of the weight of sugar will equal its bulk in fluid measure, or, in other words, 750 Gm. of sugar, when dissolved in water, will increase the bulk of the liquid by nearly 500 Cc. The proper proportion of sugar to menstruum is of great importance, as upon it depends the stability of the syrup. Should the sugar be deficient in quantity it will not efficiently protect the other organic principles present, and the syrup is liable to ferment. On the other hand, if too much sugar be dissolved by the aid of heat, the excess will crystallize out after cooling and dispose an additional quantity to separate in like manner, thus leaving the syrup weaker in sugar than it should be, and subject to similar alterations as if an insufficient quantity of sugar had been used. As a rule, 65 parts of sugar should require 35 parts of water, but for colder climates a little more water may be used. The British Pharmacopœia directs 50 parts of water for 100 parts of sugar, and the German Pharmacopœia 40 parts of water to 60 parts of sugar, in making simple syrup. If alcohol be present in the menstruum, less sugar will be taken up by the

liquid than in the case of pure water, as shown by the following table, but at the same time less sugar is required to insure stability owing to the preservative properties of the alcohol.

SOLUBILITY OF CANE-SUGAR IN MIXTURES OF ALCOHOL AND WATER. (According to Schufeldt.)

Percentage of Alcohol in the Mixture. By Volume.	By Weight.	Percentage of Sugar in Solution.	Number of Grammes of Sugar soluble in 100 Cc. of the Mixture.
0.	0	66.20	195.8
6.	5	64.25	179.7
12.	10	62.20	164.5
18.	15	60.40	152.5
24.	20	58.55	141.2
30.	25	56.20	128.3
36.	30	54.05	117.8
42.	35	51.25	105.3
47.	40	47.75	91.3
58.5	50	38.55	62.7
67.5	60	26.70	36.4
77.	70	12.25	13.9
85.5	80	4.05	4.2
93.5	90	0.95	0.09
96.75	95	0.15	0.01

Preparation.—In the preparation of syrups, solution of the sugar may be effected by one of the following methods: Agitation of sugar and solvent without heat, cold percolation of the sugar with the solvent, gentle heating of the sugar and solvent, or heating the mixture of sugar and solvent to the boiling-point. The application of heat in the manufacture of syrups should be avoided as far as possible, especially a boiling temperature, partly to prevent the loss of volatile constituents and partly to guard against any change in the character of the sugar, which, under the influence of heat and particularly with acid liquids, is converted into inverted sugar, resembling glucose, and thereby predisposed to fermentation; moreover, the use of heat in open vessels causes evaporation of a part of the solvent, which, if not restored, produces a supersaturated solution with the attending evil of crystallization referred to above.

The preparation of syrups without heat is a feature of American pharmacy, both the British and German pharmacopœias directing the use of heat in every instance. By some authorities it is claimed that syrups made with heat are more permanent than those made cold; this claim is not supported by experience in this country. For all syrups containing volatile principles or such as may be changed by heat, the cold process is decidedly preferable, and if pure sugar be used, such syrups keep admirably.

The process of cold percolation of sugar with the solvent was first suggested by L. Orinsky in 1871, and is now officially recommended in the preparation of several syrups; the process is of decided advantage whenever the syrup is to be prepared without heat, although it requires a little care in its management so as to insure perfect solution and a clear percolate. A cylindrical, slightly tapering percolator is best adapted for the purpose, and the mode of procedure as given under SYRUPUS has been found satisfactory. If the absorbent cotton has been properly adjusted, the solution will be perfectly clear and transparent, and pass out in drops only, all the sugar being taken up before the end of the process; but if the liquid passes too rapidly, or if it be turbid, it must be poured back into the percolator until the defect is remedied. It will be found advantageous to close the lower orifice of the percolator with a sound cork (or if a rubber tube be used, to tie the same up on the side of the percolator) as soon as the menstruum reaches the cotton, and allow it to remain closed for a short while, possibly an hour or two, so that the menstruum may have an opportunity of becoming saturated, and thus a more gradual and more satisfactory flow of the percolate be established. Some objections have been made to this process, such as the time necessary for perfect solution of the sugar, and the fact that albuminous principles liable to induce fermentation are best removed by heat; but it must be borne in mind that cold percolation requires very little attention after it has once been started, can be allowed to go on during the night, and does away with the necessity of subsequent filtration; the evil tendency of nitrogenized principles in the solvent may be overcome by the use of weak alcohol and glycerin, as is directed in many of the official formulas.

In the case of some syrups, where the viscid character of the solvent precludes rapid solution of the sugar, a moderate heat may be employed to facilitate solution, by putting the sugar and solvent into a strong bottle 1½ times as large as the required volume of syrup, and, after securely corking, keeping it in a water-bath at a temperature of about 50° C. (122° F.), and frequently agitating until perfect solution is effected; all loss of volatile principles is avoided by keeping the bottle well corked. Whenever the solvent contains latent ferments or a large proportion of albuminous matter, heating to the boiling-point is necessary, in order to render such principles harmless, as in the case of syrups prepared from fruit juices; but the heat should not be continued beyond the boiling-point, to avoid a change in the sugar.

When large quantities of syrup are to be made with heat, the mixture of sugar and solvent is placed in a porcelain-lined or well-tinned kettle and heated over a direct fire or on a steam-bath until the sugar is dissolved; it is then strained and water added to make up the desired volume.

Preservation.—Syrups are best preserved in completely filled bottles, in a cool place, and will keep unaltered for a long time if properly prepared; the addition of preservatives, such as salicylic or boric acid, calcium sulphite, ether, etc., is unnecessary, and, in fact, objectionable, and such syrups as cannot be kept with ordinary care should be made in small quantity only. It is well known that syrups containing acids gradually show a change in the sugar from cane-sugar to inverted sugar, and it has been shown by Woltersdorf and Richtmann, 1900, that the inversion is in direct proportion to the temperature to which the syrup is exposed; also that mineral acids cause greater inversion than organic acids, and that the presence of neutral salts in the syrup has the tendency to retard the inverting action of the acid. Air and heat are far more detrimental to the stability of sugar solutions than diffused light; but direct sunlight should always be avoided on account of the heat transmitted by the sun's rays. When syrups have undergone fermentation they are no longer fit for use, and even if the attempt be made to restore them by boiling, they are likely soon to spoil again, owing to the decreased proportion of sugar left in solution; the best and safest plan is to throw them away. Finished syrups should always be put into perfectly *clean and dry* bottles (if made by heat, not until they have become cold), so as to avoid dilution and possible contamination with fermentation germs, which are likely to lurk in imperfectly cleaned bottles. Bottles from which syrups have been dispensed should be thoroughly washed with weak lye and afterward with water, and then dried before they are refilled.

All syrups, whether made by cold or hot process (except cold percolation), require straining through flannel, previously moistened and expressed, to remove particles of dust and dirt; and in the case of colorless or light-colored syrups, their appearance will be greatly improved by filtering them, under cover, through paper or a pledget of cotton.

SYRUPUS, *U. S., Br.*—Syrup.

Sirupus simplex, P. G.; *Sirop de sucre*, Fr. Cod.; *Syrupus sacchari, Syrupus albus.*—*Simple syrup*, E.; *Sirop de sucre, Sirop simple*, Fr.; *Weisser Sirup*, G.

Preparation.—Sugar, in dry crystalline granules, 850 Gm.; distilled water, a sufficient quantity to make 1000 Cc. Dissolve the sugar, with the aid of heat, in 450 Cc. of distilled water, raise the temperature to the boiling-point, strain the liquid, and pass enough distilled water through the strainer to make the product, when cold, measure 1000 Cc. Mix thoroughly.—U. S.

Syrup may also be prepared in the following manner: Press down into the neck of a percolator of suitable size a pledget of purified cotton, not too tightly, and in such a manner that the cotton shall nearly fill the neck of the percolator, and moisten it with a few drops of distilled water. Place the sugar in the apparatus, make its surface level without shaking or jarring, then carefully pour on 450 Cc. of distilled water, and regulate the flow of the liquid, if necessary, so that it will pass out in rapid drops. Return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by distilled water, added in portions, so that all the sugar may be dissolved, and the product measure 1000 Cc. Mix thoroughly.—U. S.

To make 1 gallon of simple syrup dissolve 7 pounds 1½ avoirdupois ounces of sugar in 61 fluidounces of distilled water, and when cold add sufficient distilled water to bring the volume to 1 gallon.

The official syrup thus prepared has the specific gravity 1.313 at 25° C. (77° F.), and contains 64.54 per cent. of sugar. The British Pharmacopœia orders 5 pounds of sugar and sufficient distilled water to make 7½ pounds of syrup, which contains 66.667 per cent. of sugar, and is stated to have the density of 1.330 at 15.6° C. (60° F.). The French Codex orders 64.286 per cent. of sugar, and gives the density 1.32. The German Pharmacopœia orders 60 per cent. of sugar.

Pharmaceutical Uses.—Simple syrup is used in the preparation of certain confections, mixtures, and syrups, and as an excipient in several pill masses.

Uses.—Syrup is used to preserve medicines added to it, and to render them more palatable.

SYRUPUS ACACIÆ, *U. S.*—Syrup of Gum-Arabic.

Syrupus gummosus.—Sirop de gomme. Fr.; *Gummisirup,* G.

Preparation.—Acacia, in selected pieces, 100 Gm.; sugar, 800 Gm.; distilled water, 430 Cc. Introduce the acacia into an enamelled or porcelain dish, add the distilled water, and stir occasionally until the acacia is dissolved; then, having added the sugar, place the dish on a water-bath and apply heat, gradually increasing the temperature, and stirring from time to time until the sugar is dissolved. Strain the syrup, if necessary, and add sufficient distilled water to make the product measure 1000 Cc.—U. S.

To make a pint of syrup of acacia, dissolve 800 grains of acacia in 6¾ fluidounces of distilled water, add 14¾ avoirdupois ounces of sugar, dissolve by aid of gentle heat, strain and add sufficient distilled water to make 16 fluidounces. When small quantities of the syrup are wanted extemporaneously, 50 grains of granulated acacia may be dissolved in sufficient simple syrup to make 1 fluidounce.

Syrup of acacia should be preserved in small well-filled bottles in a cool place. In summer time it sours readily.

Uses.—Syrup of acacia is useful as a demulcent in mild inflammations of the larnyx and throat, but is chiefly employed as an agent to suspend active substances in mixtures from which they would otherwise be precipitated.

SYRUPUS ACIDI CITRICI, *U. S.*—Syrup of Citric Acid.

Sirup d'acide citrique, Sirop de limon, Fr.; *Citronsäuresirup,* G.

Preparation.—Citric acid, 10 Gm.; distilled water, 10 Cc.; tincture of fresh lemon peel, 10 Cc.; syrup, a sufficient quantity to make 1000 Cc. Dissolve the citric acid in the distilled water, and mix the solution with 500 Cc. of syrup. Then add the tincture of fresh lemon peel, and lastly enough syrup to make the product measure 1000 Cc. Mix thoroughly.—U. S.

To make a pint of syrup of citric acid will require 72 grains of citric acid, 80 minims each of water and tincture of fresh lemon peel, and sufficient syrup to bring the volume of the finished product up to 16 fluidounces.

Uses.—This syrup is used as a flavoring agent as a substitute for syrup of lemon.

SYRUPUS ACIDI HYDRIODICI, *U. S.*—Syrup of Hydriodic Acid.

Sirop d'acide iodhydrique, Fr.; *Jodwasserstoffsirup,* G.

A syrupy liquid, containing about 1 per cent., by weight, of absolute hydriodic acid, or about 1.19 Gm. in 100 Cc.—U. S.

Preparation.—Diluted hydriodic acid, 100 Gm.; water, 300 Gm.; syrup, 600 Gm. Mix them.—U. S.

To make a pint of syrup of hydriodic acid, mix 868 grains of diluted hydriodic acid with 5½ fluidounces of water and add sufficient syrup to make the product measure 16 fluidounces.

This formula differs materially from that of the last two editions of the Pharmacopœia, and is intended to eliminate the annoying feature of caramelization caused by the prolonged action of the acid liquid on the sugar. It should only be made in small quantities to suit the demand, or prepared extemporaneously as called for.

Properties and Tests.—Syrup of hydriodic acid is a transparent, colorless, or not more than pale straw-colored liquid, odorless, and having a sweet and acidulous taste. Its specific gravity is about 1.190 at 25° C. (77° F.). If a small portion of the syrup be mixed with a little starch test-solution, and a few drops of chlorine-water then added

the liquid will acquire a deep-blue color. Not more than a faint bluish tint should be produced in the syrup by starch test-solution alone (limit of free iodine). The addition of silver nitrate test-solution to a small portion of the syrup diluted with 4 volumes of water produces a pale-yellow precipitate, nearly insoluble in ammonia-water. If 31.73 (31.725) Gm. of syrup of hydriodic acid be diluted with distilled water to measure 50 Cc., and if to 10 Cc. of this solution about an equal volume of distilled water, 8 Cc. of tenth-normal silver nitrate solution, and 5 Cc. of diluted nitric acid be added, followed by 3 Cc. of ferric ammonium sulphate test-solution, then, after thoroughly shaking the mixture, not more than 3 Cc. of tenth-normal potassium sulphocyanate solution should be required to produce a permanent reddish-brown tint (each Cc. of tenth-normal silver nitrate solution consumed corresponding to 0.2 per cent. of absolute hydriodic acid).—U. S. When freshly made, syrup of hydriodic acid is colorless, but slowly assumes a yellowish tint, which is not due to the liberation of iodine, but is caused by the gradual action of the acid on the sugar.

Uses.—Syrup of hydriodic acid is given for its iodine influence. It is preferred by some practitioners to the alkaline iodides in the treatment of scrofulosis in children, and in chronic interstitial nephritis. It is a rather weak preparation, given in the dose of from ½ to 2 drachms (2–8 Cc.).

SYRUPUS ALTHÆÆ.—Syrup of Althæa.

Sirupus althææ, P. G.—*Syrup of marshmallow*, E.; *Sirop de guimauve*, Fr.; *Eibisch-sirup*, G.

Preparation.—Althæa, cut in small pieces, 2 parts; alcohol, 1 part; water, 50 parts; sugar, 63 parts. Wash the althæa with cold water, then add it to the alcohol and water previously mixed, and allow the mixture to stand for 3 hours at a temperature of 15° to 20° C. (59°–68° F.) without stirring. Strain without expression, and to 37 parts of the strained liquid add the sugar, and dissolve by aid of a gentle heat. When cool, add enough water to make the product equal 100 parts.—P. G.

Syrup of althæa has a yellowish color and a slight rather agreeable odor. It spoils quite readily, especially in warm weather, and should always be kept in small well-filled bottles in a cool place. The presence of 10 per cent. by volume of glycerin, as recommended in the 1890 U. S. Pharmacopœia, has been found to aid materially in preserving the syrup.

Uses.—This syrup has demulcent properties which render it of some value in sore throat. Its dose is from 1 to 4 drachms (4–16 Cc.).

SYRUPUS AMYGDALÆ, *U. S.*—Syrup of Almond.

Sirupus amygdalarum, P. G.; *Sirupus emulsivus.—Sirop d'amande, Sirop d'orgeat*, Fr.; *Mandelsirup*, G.

Preparation.—Spirit of bitter almond, 10 Cc.; orange flower water, 100 Cc.; syrup, a sufficient quantity to make 1000 Cc. Mix them.—U. S.

Take of sweet almonds, 15 parts; bitter almonds, 3 parts; water, 40 parts; sugar, 60 parts. Having blanched the almonds, prepare an emulsion with the aid of the water, and dissolve the sugar in 40 parts of the strained liquid with the aid of a gentle heat.—P. G.

The present official syrup of almond is an entirely different preparation from that of the 1890 Pharmacopœia, which closely resembled the syrup of German pharmacy. The syrup is rarely used in this country, and when ordered by French or German physicians, the preparation made by the second formula given above should be dispensed. The official syrup of almond has only a very faint color and the characteristic odor of bitter almond and orange flowers, whereas the German syrup is whitish and yields a milk-like liquid when diluted with water. Although the syrup of the U. S. P., 1890, did not keep well in warm weather, we think it would have been better to drop it entirely than to introduce the present syrup, so entirely different from the former, and hardly acceptable to the few physicians who use syrup of almond and are familiar with its appearance and taste.

Uses.—Syrup of almond is demulcent and slightly sedative. It is an agreeable addition to expectorant and diuretic mixtures. It is given in the dose of 1 to 2 drachms (4–8 Cc.).

SYRUPUS AROMATICUS, *Br.*—Aromatic Syrup.

Sirop aromatique, Fr.; *Aromatischer Sirup*, G.

Preparation.—Take of tincture of orange, 5 fluidounces; cinnamon water, 5 fluidounces; syrup, 10 fluidounces. Mix the tincture of orange and cinnamon water; shake the mixture with a little powdered talc; filter and add the syrup.—Br.

When tincture of orange and cinnamon water are mixed, turbidity results on account of the oil present in the tincture, and hence filtration through talc becomes necessary.

Uses.—The syrup is used solely as a flavoring agent, and somewhat resembles the aromatic elixir of the U. S. Pharmacopœia.

SYRUPUS AURANTII, *U. S., Br.*—Syrup of Orange.

Sirupus aurantii corticis, P. G.—*Syrup of orange peel*, E.; *Sirop d'écorce d'orange amère*, Fr.; *Pomeranzenschalensirup*, G.

Preparation.—Tincture of sweet orange peel, 50 Cc.; citric acid, 5 Gm.; magnesium carbonate, 10 Gm.; sugar, 820 Gm.; water, a sufficient quantity to make 1000 Cc. Triturate the magnesium carbonate in a mortar with the tincture, add gradually 400 Cc. of water, filter, and add sufficient water through the filter to obtain 450 Cc. of filtrate; in this dissolve the citric acid and sugar by agitation without heat, and add sufficient water to make the product measure 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of syrup of orange triturate 7 fluidrachms of tincture of sweet orange peel with 75 grains of magnesium carbonate, add 6¾ fluidounces of water, mix well, filter, and pass sufficient water through the filter to obtain 7½ fluidounces of filtrate; in this dissolve 40 grains of citric acid and 14 avoirdupois ounces of sugar, finally adding sufficient water to bring the volume up to 16 fluidounces.

Tincture of orange, 1 fluidounce: syrup, 7 fluidounces. Mix.—Br.

The corresponding syrups of the French and German Pharmacopœias are made with bitter orange peel, which, according to the former authority, is exhausted with alcohol of 6 per cent., and, according to the latter, with white wine; in the tincture thus obtained the sugar is dissolved.

The present official syrup of orange differs but slightly from that of 1890, except that it represents only about ½ as much fresh sweet orange peel and contains a slight proportion of citric acid, about 0.005 Gm. per Cc. or 2½ grains per fluidounce. It has a yellowish color and a pleasant acidulous taste.

The syrup of the British Pharmacopœia is made with tincture of orange prepared from fresh bitter orange peel. It is a slightly opalescent preparation, owing to partial precipitation of the oil held in solution in the tincture. If the syrup be mixed with water, the turbidity becomes more marked.

A fluidextract of sweet orange peel is sometimes offered for the preparation of syrup of orange, but should never be used, as it is made from dried peel with a hydro-alcoholic menstruum and forms dark-colored mixtures when added to solutions containing tincture of iron.

Uses.—This syrup is merely a pleasant flavoring agent.

SYRUPUS AURANTII FLORUM, *U. S.*—Syrup of Orange Flowers.

Syrupus aurantii floris, Br.—*Sirop de fleur d'oranger*, Fr.; *Pomeranzenblüthensirup*, G.

Preparation.—Sugar, 850 Gm.; orange flower water, a sufficient quantity to make 1000 Cc. Dissolve the sugar in 450 Cc. of orange flower water by agitation, without heat, add enough orange flower water to make the product measure 1000 Cc., and mix thoroughly.—U. S.

Syrup of orange flowers may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under SYRUP. Pour 450 Cc. of orange flower water upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by orange flower water until the product measures 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of syrup of orange flowers dissolve 14 avoirdupois ounces of sugar in 7¼ fluidounces of orange flower water, and add sufficient of the latter to bring the volume of the solution up to 16 fluidounces.

Dissolve 3 pounds of refined sugar in 16 fluidounces of boiling distilled water; strain, and when nearly cold add 8 fluidounces of undiluted orange-flower water of commerce, and sufficient recently boiled distilled water to make the product weigh 4½ pounds.—Br.

Uses.—This syrup is used for its agreeable taste. Its dose is ½ to 2 drachms (2–8 Cc.).

SYRUPUS CALCII LACTOPHOSPHATIS, *U. S., Br.*—Syrup of Calcium Lactophosphate.

Sirop de lactophosphate (phospholactate) de chaux, Fr.; *Calciumphospholactatsirup*, G.

Preparation.—Precipitated calcium carbonate, 25 Gm.; lactic acid, 60 Cc.; phosphoric acid, 36 Cc.; orange flower water, 50 Cc.; sugar, 725 Gm.; water, a sufficient quantity to make 1000 Cc. To the lactic acid, mixed with 100 Cc. of water and contained in a capacious mortar, gradually add the calcium carbonate, in portions, until it is dissolved. Then add the phosphoric acid, diluted with 50 Cc. of water, and triturate until the precipitate at first formed has disappeared. Add 100 Cc. of water, and filter, rinsing the mortar with 50 Cc. of water, and passing the rinsings through the filter. To the mixed filtrates add the orange flower water, and, having added the sugar, dissolve it by agitation without heat, and strain. Lastly, pass enough water through the strainer to make the product measure 1000 Cc., and mix thoroughly.—U. S.

To make 1 pint of syrup of calcium lactophosphate dissolve 183 grains of precipitated calcium carbonate in 7¾ fluidrachms of lactic acid diluted with 13 fluidrachms of water; add 276 minims of phosphoric acid, diluted with 1 fluidounce of distilled water, and triturate until perfect solution is effected. Now add 7 fluidrachms of water, filter, and wash filter with 6 fluidrachms of water; to the filtrate add 6 fluidrachms of orange flower water and 12½ avoirdupois ounces of sugar. Shake until dissolved, strain, and add sufficient water through the strainer to bring the volume up to 16 fluidounces.

The syrup of the British Pharmacopœia is identical with the above, except that it contains less orange flower water.

Calcium carbonate is readily dissolved by the diluted lactic acid, and upon the addition of phosphoric acid calcium phosphate is formed, which is held in solution by the lactic acid and excess of phosphoric acid present. Each Cc. of the finished syrup contains the equivalent of 0.02584 Gm., or each fluidrachm the equivalent of 1.48 grains of tricalcium phosphate ($Ca_3(PO_4)_2$).

The formula of the French Codex is as follows: Dissolve 12.5 Gm. of calcium phosphate in sufficient (14 Gm.) concentrated lactic acid and 340 Gm. of water; 630 Gm. of sugar are dissolved in the liquid, and 10 Gm. of essence of lemon added. Replacing the lactic acid by a sufficient quantity of hydrochloric acid, *sirop de chlorhydrophosphate de chaux* is obtained. *Sirop de phosphate acide de chaux* is made in the same manner, using sufficient phosphoric acid for dissolving the calcium salt.

Uses.—In scrofulosis and strumous states and allied conditions, as rickets, when it is desired to obtain the effect of phosphates upon the system, this preparation may be given with benefit in the dose of 1 to 4 drachms (4–16 Cc.).

SYRUPUS CALCIS, *U. S.*—Syrup of Lime.

Syrupus calcariæ.—Syrup of calcium hydroxide, E.; *Sirop de chaux*, Fr.; *Kalksirup*, G.

Preparation.—Lime, 65 Gm.; sugar, 350 Gm.; water, a sufficient quantity to make 1000 Cc. Slake the lime by the addition of 35 Cc. of water with the aid of heat, then mix it and the sugar thoroughly in a mortar, so as to form a homogeneous powder; add the mixture to 500 Cc. of boiling water, contained in a bright copper or tinned iron vessel, and boil for 5 minutes, constantly stirring. Dilute the liquid with sufficient water to make it measure 950 Cc., and filter through white paper, closely covering the funnel during filtration. Then add through the filter enough water to make the product measure 1000 Cc., and mix thoroughly. Keep the syrup in well-stoppered bottles.—U. S.

To make 1 pint of syrup of lime slake 1 avoirdupois ounce of lime with ½ ounce of

water, mix thoroughly with 7 avoirdupois ounces of sugar and add to 9 fluidounces of boiling water, and boil for 5 minutes. Dilute the mixture to 15½ fluidounces, filter, and add sufficient water to bring the volume up to 16 fluidounces. Distilled water is to be preferred in making this syrup.

Advantage is taken, in the preparation of syrup of lime, of the well-known fact that sugar largely increases the solubility of lime in water, and this solubility varies with the proportion of sugar to the water used; according to Peligot, 100 parts of sugar contained in 250 parts of aqueous solution will take up 26.5 parts of lime, while the same quantity of sugar in 2000 parts of solution takes up only 18 parts of lime. Choice lime should be used—as free from carbonate and other impurities as possible. The official syrup of lime is of uncertain strength, the Pharmacopœia not having fixed a definite proportion, but when freshly made it contains probably 0.032 Gm. of calcium oxide in every Cc. The direction to boil the lime, sugar, and water together for 5 minutes is not essential, except to gain time, for cold maceration with frequent agitation will cause an equally large amount of lime to be dissolved; but longer time is necessary —possibly 2 or 3 days.

Properties.—Syrup of lime is a transparent, pale-yellow liquid, of alkaline taste and reaction. Its specific gravity is about 1.145 at 25° C. (77° F.). The addition of a solution of an alkali carbonate produces a white precipitate, soluble in acids with effervescence. The addition of ammonium oxalate test-solution produces a white precipitate, insoluble in acetic acid, but soluble in hydrochloric acid.—U. S. On exposure to air syrup of lime absorbs carbon dioxide rapidly, and it must therefore be kept in well-stoppered vials. The official syrup contains very much more lime in solution than the saccharated solution of lime of the British Pharmacopœia (see LIQUOR CALCIS SACCHARATUS, which latter represents about 7½ grains in 1 fluidounce).

Uses.—This preparation presents no advantages over lime-water; in fact, because of the sugar present it is less desirable for many conditions, as gastric acidity and acid diarrhœa, in which lime is beneficial. It contains a much larger percentage of lime than does the official liquor, and its dose is from 20 to 60 minims (1.30–4 Cc.).

SYRUPUS CASCARÆ AROMATICUS, *Br.*—Aromatic Syrup of Cascara.

Sirop aromatique de cascara sagrada, Fr.; *Aromatischer Amerikanisch-Faulbaumrindensirup*, G.

Preparation.—Take of liquid extract of cascara sagrada 8 fluidounces; tincture of orange, 2 fluidounces; alcohol (90 per cent.), 1 fluidounce; cinnamon water, 3 fluidounces; syrup, 6 fluidounces. Mix.—Br.

This syrup is intended to present cascara in a more pleasant form, and contains in each teaspoonful the active virtues of 24 grains of cascara sagrada bark. It somewhat resembles the aromatic fluidextract of rhamnus purshiana of the U. S. Pharmacopœia, but contains less than ½ as much cascara sagrada, and is less palatable.

Uses.—Aromatic syrup of cascara may be given whenever the effect of the drug is desired. The dose is from ½ to 2 drachms (2–8 Cc.).

SYRUPUS CERASORUM.—Syrup of Cherries.

Sirupus cerasorum, P. G.—*Sirop des cerises*, Fr.; *Kirschensirup*, G.

Preparation.—Syrup of cherries is directed to be made as follows: Sour black cherries, including the seeds, are crushed, and set aside in a covered vessel at a temperature of about 20° C. (68° F.), with occasional stirring, until a small portion of the liquid after filtration forms a clear mixture with ½ its volume of alcohol. The mixture is then expressed and filtered, and 13 parts of sugar dissolved in every 7 parts of the filtrate, with the aid of heat.—P. G.

Syrup of cherries may be considered as a type of the class of fruit syrups, the above process of manufacture being equally applicable to strawberries, raspberries, currants, blackberries, etc. The object of setting the crushed fruit aside at a moderate temperature, for several days, is to insure the destruction of certain undesirable constituents, known as pectin, which, if allowed to remain in the fruit juice, would cause the syrup to gelatinize. The complete removal of pectin is shown by the test with alcohol, as the filtered juice will not mix clear with ½ its volume of alcohol as long as any pectin is

present; a concentrated solution of magnesium sulphate should also leave the filtered juice unaffected.

After removal of the pectin, the filtered juice should be allowed to subside in well-closed vessels, in a cool place, for 2 or 3 days until clear; the supernatant liquid must be carefully decanted or withdrawn and passed through a previously wetted paper filter. The sugar should be added to the filtrate without delay and dissolved by stirring before the mixture is heated to boiling; any albuminous matter remaining in the juice is coagulated by heating and removed by subsequent straining. The mixture of filtered juice and sugar must not be boiled for any length of time, but the heat should be withdrawn when the syrup begins to boil quietly after the first frothing and rising of the liquid.

Uses.—This syrup is used merely as an agreeable vehicle.

SYRUPUS CHLORAL, *Br.*—Syrup of Chloral.

Sirop de chloral, Fr.; *Chloralhydratsirup*, G.

Preparation.—Take of chloral hydrate 1600 grains; distilled water, 30 fluidrachms; syrup, a sufficient quantity. Dissolve the chloral hydrate in the water, and add the syrup until the mixed product measures 1 imperial pint.—Br.

The syrup of the F. Cod. contains only 5 per cent. of chloral hydrate, and is flavored with spirit of peppermint.

Uses.—This is a superfluous preparation. Each drachm contains 10 grains (0.60 Gm.) of chloral. The usual dose is from 1 to 2 drachms (4–8 Cc.).

SYRUPUS CINNAMOMI.—Syrup of Cinnamon.

Sirupus cinnamomi, P. G.—*Sirop de canelle*, Fr.; *Zimmtsirup*, G.

Preparation.—Take of cassia bark, in coarse powder, 1 part; cinnamon water, 5 parts; sugar, 6 parts. Macerate the cassia bark for 2 days with the cinnamon water warmed to 15° or 20° C. (59° or 68° F.), with frequent agitation. The mixture is then filtered, and in 4 parts of the filtrate the sugar is dissolved with the aid of moderate heat.—P. G.

Syrup of cinnamon has a reddish-brown color and a pleasant characteristic odor and taste.

Uses.—Syrup of cinnamon is merely a pleasant flavoring ingredient for medicinal mixtures.

SYRUPUS CODEINÆ, *Br.*—Syrup of Codeine.

Sirop de codéine, Fr.; *Kodeinsirup*, G.

Preparation.—Take of codeine phosphate 40 grains; distilled water, $\frac{1}{4}$ fluidounce; syrup, $19\frac{3}{4}$ fluidounces. Dissolve the codeine phosphate in the distilled water; add the syrup. Mix.—Br.

Each teaspoonful of the syrup contains $\frac{1}{4}$ grain of codeine phosphate.

Syrup of codeine of the French Codex contains $\frac{1}{5}$ per cent. of the pure alkaloid, and is made by dissolving 0.20 Gm. of codeine in 5 Gm. of alcohol (60 per cent.) and adding the solution to 95 Gm. of syrup.

Uses.—This syrup may be taken for coughs and other conditions in which codeine is indicated. The dose is from 1 to 4 drachms (4–16 Cc.).

SYRUPUS FERRI IODIDI, *U. S.*, *Br.*—Syrup of Ferrous Iodide.

Sirop d'iodure de fer, Fr. Cod.; *Sirupus ferri jodati*, P. G.—*Syrup of iodide of iron*, E.; *Eisenjodürsirup*, G.

A syrupy liquid containing about 5 per cent. by weight of ferrous iodide (FeI = 307.30) or about 6.74 Gm. in 100 Cc.—U. S.

Preparation.—Iron, in the form of fine bright wire, and cut into small pieces, 12.5 Gm.; iodide, 41.5 Gm.; diluted hypophosphorous acid, 20 Cc.; sugar, 600 Gm.; distilled water, a sufficient quantity to make 1000 Gm. Introduce the iron into a flask of thin glass having a capacity of about 500 Cc.; add to it 150 Cc. of distilled water,

and afterward the iodine. Shake the mixture occasionally, checking the reaction, if necessary, by the affusion of cold water, and, when the solution has acquired a greenish color and has lost the odor of iodine, heat it to boiling, and add at once 50 Gm. of the sugar; when this has dissolved, filter the solution into the remainder of the sugar contained in a porcelain dish. Rinse the flask and iron wire with 125 Cc. of distilled water and pass the washings through the filter into the sugar. Stir the mixture with a porcelain or wooden spatula, heating the liquid on a water-bath until complete solution is effected, and, having passed the syrup through a clean muslin strainer into a tared bottle, add the diluted hypophosphorous acid, and sufficient distilled water to make the product weigh 1000 Gm.—U. S.

To make 1 pint of syrup of ferrous iodide, add 125 grains of iron wire to 3 ounces of distilled water contained in a flask, and afterwards 410 grains of iodine. When a pale-green solution has been obtained, free from the odor of iodine, heat it to boiling and add 1 avoirdupois ounce of sugar; shake until dissolved, filter the solution into 12½ avoirdupois ounces of sugar, rinse the flask and wire with 2½ fluidounces of distilled water, and add to the filtrate. Dissolve the sugar with the aid of heat on a water-bath, strain the solution, add 208 minims of diluted hypophosphorous acid and sufficient distilled water to bring the volume up to 16 fluidounces.

The details of the process given above are very similar to those of the British and German Pharmacopœias, except that the latter authority directs the solution of ferrous iodide to be filtered into a prescribed quantity of syrup. The strength of this syrup varies in the different pharmacopœias, thus: While the U. S. P. and German syrups both contain 5 per cent. of ferrous iodide, the British syrup contains 10 per cent., and the French only ½ per cent. The present U. S. P. syrup is of exactly ½ strength of that of 1890. As a preservative of syrup of ferrous iodide, hypophosphorous acid has been found superior to all other substances; it was first suggested by Judge about 1855. Being a strong reducing agent, hypophosphorous acid prevents the oxidation of the ferrous into ferric salt, which would carry with it the liberation of iodine. The decoloration by glucose of syrup of ferrous iodide containing free iodine has been found to be due wholly to the sulphites present in commercial glucose, since pure glucose has no decolorizing effect on solution of iodine.

Properties and Tests.—Syrup of ferrous iodide is a transparent, pale-green liquid, having a sweet, strongly ferruginous taste and a neutral reaction. Its specific gravity is about 1.349 at 25° C. (77° F.) (1.380 to 1.387 Br. at 15.5° C.). On adding a few drops of potassium ferricyanide test-solution to a small portion of the diluted syrup a blue precipitate will be produced. If mixed with a little starch test-solution, and afterwards with a few drops of chlorine water, the syrup will acquire a deep-blue color. This color should not be produced in the syrup by starch test-solution alone (absence of free iodine). If 10 Gm. of syrup of ferrous iodide be diluted with distilled water to measure 100 Cc., and 15.4 (15.36) Cc. of the solution be mixed with 15 Cc. of water, 6 Cc. of tenth-normal silver nitrate solution, and 2 Cc. each of diluted nitric acid and ferric ammonium sulphate test-solution, then, after thoroughly shaking the mixture, not more than 1 Cc. of tenth-normal potassium sulphocyanate solution should be required to produce a permanent reddish-brown tint (each Cc. of tenth-normal silver nitrate solution consumed corresponding to 1 per cent. of ferrous iodide).—U. S. In the foregoing test, after all iodine present as ferrous iodide has been precipitated as silver iodide, the excess of silver added is precipitated as white silver sulphocyanate by the potassium sulphocyanate solution, and then the reddish-brown color due to formation of ferric sulphocyanate becomes permanent. From the equation $FeI_2 + 2AgNO_3 = 2AgI + Fe(NO_3)_2$ it may be seen that 1 Cc. of tenth-normal silver nitrate solution is capable of precipitating 0.015365 Gm. of ferrous iodide.

Uses.—While syrup of ferrous iodide may be employed in anæmia from any cause, it is particularly applicable to those cases of impoverished blood due to scrofulosis and struma, and accompanied by glandular enlargement. It is useful in chronic skin diseases, especially eczema of young children whose vitality is greatly impaired. By some it is considered useful in gonorrhœal rheumatism. Since the present official syrup is only ½ the strength of that of the Pharmacopœia of 1890, its dose is twice as large, from 20 minims to 2 drachms (1.30–8 Cc.). It should be well diluted and taken through a glass tube to prevent its discoloring the teeth.

SYRUPUS FERRI PHOSPHATIS, *Br.*—Syrup of Ferrous Phosphate.

Sirop de phosphate de fer, Fr.; *Eisenphosphatsirup*, G.

Preparation.—Take of iron, in wire, 75 grains; concentrated phosphoric acid (66.3 per cent.), 1¼ fluidounces; syrup, 14 fluidounces; distilled water, a sufficient quantity. Place the iron wire and the concentrated phosphoric acid, previously diluted with an equal volume of distilled water, in a small flask; plug the neck with cotton wool, and heat gently until the iron is dissolved. When cool, filter into the syrup, and pass sufficient distilled water through the filter to make the product measure 1 imperial pint.—Br.

Syrup of ferrous phosphate, which contains an excess of phosphoric acid, represents 1 grain of anhydrous ferrous phosphate in each fluidrachm.

Uses.—This syrup affords a palatable means for administering ferrous phosphate. Its dose is from ½ to 2 drachms (2–8 Cc.).

SYRUPUS FERRI, QUININÆ, ET STRYCHNINÆ PHOSPHATUM, *U. S.*—Syrup of the Phosphates of Iron, Quinine, and Strychnine.

Syrupus ferri phosphatis cum quinina et strychnina, Br.—*Syrup of phosphate of iron with quinine and strychnine, Easton's syrup*, E.; *Sirop tonique d'Easton*, Fr.; *Eisenphosphatsirup mit Chinin und Strychnin. Eastonscher Sirup*, G.

Preparation.—Glycerite of the phosphates of iron, quinine and strychnine, 250 Cc.; syrup, a sufficient quantity to make 1000 Cc.—U. S.

The formula is intended for the extemporaneous preparation of the syrup, by mixing 1 volume of the glycerite of the phosphates of iron, quinine, and strychnine with 3 volumes of syrup.

Take of iron, in wire, 75 grains; concentrated phosphoric acid (66.3 per cent.), 1¼ fluidounces; strychnine, 5 grains; quinine sulphate, 130 grains; syrup, 14 fluidounces; distilled water, a sufficient quantity. Place the iron wire and the concentrated phosphoric acid, previously diluted with an equal volume of distilled water, in a small flask; plug the neck with cotton wool, and heat gently until the iron is dissolved; in the resulting solution dissolve the strychnine and quinine sulphate; filter into the syrup; pass sufficient distilled water through the filter to make the product measure 1 imperial pint.—Br.

The two preparations differ somewhat in composition and strength. The U. S. P. syrup contains the iron in ferric condition, and represents in each fluidrachm about 1¼ grains of soluble ferric phosphate, 1½ grains of quinine, and $\frac{1}{87}$ grain of strychnine, whereas the British syrup contains ferrous salt, and in each fluidrachm represents 1 grain of ferrous phosphate, ⅘ grain of quinine, and $\frac{1}{32}$ grain of strychnine. If the syrup be kept on hand for some time, it will slowly darken, owing to the caramelizing effect of the acid on the sugar.

Uses.—While this is a convenient and elegant preparation, the combination of the ingredients in fixed quantity is not desirable. The average dose is 1 drachm (4 Cc.).

SYRUPUS GLYCYRRHIZÆ.—Syrup of Licorice.

Sirupus liquiritiæ, P. G.; *Sirop de réglisse*, Fr.; *Süszholzsirup*, G.

Preparation.—Licorice root, in very coarse powder, 4 parts; ammonia-water, 1 part; water, 20 parts; alcohol, 2 parts; simple syrup, a sufficient quantity. Macerate the licorice root in the water to which the ammonia-water has been added, for 12 hours, at a temperature of 15° to 20° C. (59°–68° F.), frequently stirring the mixture. Express, heat the liquid to the boiling-point, and evaporate on a water-bath to 2 parts. When cold, add the alcohol, set the mixture aside for 12 hours, filter, and add sufficient simple syrup to the filtrate to bring the weight of the product up to 20 parts.—P. G.

Uses.—This syrup is extensively employed to mask the taste of medicinal substances, particularly ammonium chloride and quinine salts. Its dose is 1 to 4 drachms (4–16 Cc.).

SYRUPUS GLUCOSI, *Br.*—Syrup of Glucose.

Sirop de glycose, Fr.; *Glykosesirup*, G.

Preparation.—Take of liquid glucose of commerce, 1 ounce; syrup, 2 ounces. Mix by the aid of gentle heat.—Br.

Uses.—Syrup of glucose is not intended to be used medicinally, but is serviceable as an excipient for pill-masses and similar preparations.

SYRUPUS HEMIDESMI, *Br.*—Syrup of Hemidesmus.

Sirop de hemidesmus, Fr.; *Hemidesmussirup*, G.

Preparation.—Take of hemidesmus-root, bruised, 4 ounces: refined sugar, 28 ounces; boiling distilled water, 1 pint (Imperial). Infuse the hemidesmus in the water, in a covered vessel, for 4 hours, and strain. Set the infusion aside until clear; then decant the clear liquor, add the sugar, and dissolve by means of a gentle heat. The product should weigh 2 pounds 10 ounces.—Br.

Uses.—The syrup of hemidesmus possesses no definite medicinal properties. It is used as a flavoring agent in the dose of 1 to 4 drachms (4–16 Cc.).

SYRUPUS HYPOPHOSPHITUM, *U. S.*—Syrup of Hypophosphites.

Syrupus calcii hypophosphitis compositus.—Sirop d'hypophosphite de chaux composé, Fr.; *Hypophosphitsirup*, G.

Preparation.—Calcium hypophosphite, 45 Gm.; potassium hypophosphite, 15 Gm.; sodium hypophosphite, 15 Gm.; diluted hypophosphorous acid, 2 Gm.; sugar, 650 Gm.; tincture of fresh lemon peel, 5 Cc.; water, a sufficient quantity to make 1000 Cc. Triturate the hypophosphites with 450 Cc. of water, until they are dissolved; add the tincture of fresh lemon peel and the hypophosphorous acid and filter the liquid. In the filtrate dissolve the sugar by agitation, without heat, and add enough water, through the filter, to make the product measure 1000 Cc. Strain if necessary.—U. S.

Syrup of hypophosphites may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under SYRUPUS. Pour the filtrate obtained as directed in the preceding formula upon the sugar, return the first portions of the percolate until it runs through clear, and when all the liquid has passed follow it by water until the product measures 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of the official syrup of hypophosphites use 330 grains of calcium hypophosphite, 110 grains each of potassium and sodium hypophosphite, 10 avoirdupois ounces and 390 grains of sugar, 1 fluidrachm of tincture of fresh lemon peel, 15 minims of diluted hypophosphorous acid, and 8 fluidounces of water. Each Cc. contains 0.075 Gm. or each teaspoonful nearly 4.3 grains of the combined hypophosphites, $\frac{3}{5}$ of the weight being calcium salt.

Uses.—This syrup may be given whenever the hypophosphites are indicated. The dose is 1 to 4 drachms (4–16 Cc.).

SYRUPUS HYPOPHOSPHITUM COMPOSITUS, *U. S.*—Compound Syrup of Hypophosphites.

Sirop des hypophosphites composé, Fr.; *Zusammengesetzter Hypophosphitsirup*, G.

Preparation.—Calcium hypophosphite, 35 Gm.; potassium hypophosphite, 17.5 Gm.; sodium hypophosphite, 17.5 Gm.; ferric hypophosphite, 2.25 Gm.; manganese hypophosphite, 2.25 Gm.; quinine, 1.1 Gm.; strychnine, 0.115 Gm.; sodium citrate, 3.75 Gm.; diluted hypophosphorous acid, 15 Cc.; sugar, 775 Gm.; water, a sufficient quantity to make 1000 Cc. Rub the ferric and manganese hypophosphites with the sodium citrate, add 30 Cc. of water, and warm the mixture for a few minutes until a clear greenish solution is obtained. Dissolve the calcium, potassium, and sodium hypophosphites in 450 Cc. of water, to which 5 Cc. of diluted hypophosphorous acid has previously been added; then dissolve the quinine and strychnine in 30 Cc. of water with the aid of 10 Cc. of diluted hypophosphorous acid, and finally dissolve the sugar, with agitation, in these solutions previously mixed. Strain the syrup if necessary, and add sufficient water, through the strainer, to make the product measure 1000 Cc.—U. S.

1 pint of compound syrup of hypophosphites may be prepared as follows: Rub 16½ grains each of ferric and manganese hypophosphites with 28 grains of sodium citrate, add ½ fluidounce of water, and warm the mixture until a clear greenish solution results. Dissolve 260 grains of calcium hypophosphite and 130 grains each of potassium and sodium hypophosphites in 7 fluidounces of water, to which 36 minims of diluted hypophosphorous acid have previously been added; then dissolve 8 grains of quinine and ⅞ grain of strychnine in ½ fluidounce of water with the aid of 80 minims of diluted hypophosphorous acid. Mix the three solutions and dissolve therein 13½ avoirdupois ounces of sugar, with agitation, strain, and add sufficient water to bring the volume of the syrup up to 16 fluidounces.

Compound syrup of hypophosphites is one of the new official preparations, although a very similar syrup has been in use for a number of years, the formula for which was available in the National Formulary. Each Cc. of the syrup contains 0.035 Gm. of calcium hypophosphite, 0.0175 Gm. each of potassium and sodium hypophosphites, 0.00225 Gm. each of ferric and manganese hypophosphites, 0.0011 Gm. of quinine, and 0.000115 Gm. of strychnine, or each fluidrachm contains about 2 grains of calcium hypophosphite, 1 grain each of potassium and sodium hypophosphites, ⅛ grain each of ferric and manganese hypophosphites, $\frac{1}{176}$ grain of quinine, and $\frac{1}{1416}$ grain of strychnine.

Uses.—This preparation is an efficient tonic and reconstructive in struma, scrofula, rickets, secondary anæmia, and other debilitated states. It has no specific action in tuberculosis, and is of value in this disease simply to improve the appetite and digestion and correct the anæmia. It is given in the dose of 1 to 4 drachms (4–16 Cc.).

SYRUPUS IPECACUANHÆ, *U. S.*—Syrup of Ipecac.

Sirupus ipecacuanhæ, P. G.—*Sirop d'ipécacuanha*, Fr.; *Brechwurzelsirup*, G.

Preparation.—Fluidextract of ipecac, 70 Cc.; acetic acid, 10 Cc.; glycerin, 100 Cc.; sugar, 700 Gm.; water, a sufficient quantity to make 1000 Cc. Dilute the fluidextract of ipecac with 300 Cc. of water to which the acetic acid has previously been added, and mix them thoroughly by shaking; set the liquid aside for 24 hours. Then filter, and pass enough water through the filter to obtain 450 Cc. of filtrate. To this add the glycerin; dissolve the sugar in the liquid, and add enough water to make the product measure 1000 Cc. Mix thoroughly, and strain if necessary.—U. S.

Syrup of ipecac may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under SYRUPUS. Mix the filtrate obtained as directed in the preceding formula with the glycerin, pour the mixture upon the sugar, return the first portions of the percolate until it runs through clear, and when all the liquid has passed follow it by water until the product measures 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of syrup of ipecac add 9 fluidrachms of fluidextract of ipecac to a mixture of 4½ fluidounces of water and 75 minims of acetic acid; shake well, filter, and wash filter with sufficient water to obtain 7 fluidounces of filtrate. To this add 1½ fluidounces of glycerin, 12 avoirdupois ounces of sugar, and sufficient water to bring the volume up to 16 fluidounces.

The present official formula, which is identical with that of 1890, aims at obtaining a perfect aqueous solution of the active virtues of ipecac by treating the fluidextract with very dilute acetic acid; the addition of 10 per cent., by volume, of glycerin will prevent subsequent changes in the syrup. Each Cc. represents the activity of 0.070 Gm. of ipecac, or each fluidrachm equals about 4 grains.

The syrup of the German Pharmacopœia represents 1 per cent. of its weight of ipecacuanha root, and that of the French Codex 1 per cent. of extract of ipecacuanha.

Uses.—Syrup of ipecac is the most frequently employed preparation of the drug. Its emetic dose to a child 2 to 4 years of age is from ½ to 1 drachm (2–4 Cc.); to an adult, ½ to 1 ounce (16–30 Cc.), repeated every 10 to 15 minutes until it acts. As an expectorant, its dose is 20 to 60 minims (1.30–4 Cc.) to an adult, and 2 to 10 minims (0.10–0.60 Cc.) to a child.

Allied Preparation.—SYRUPUS IPECACUANHÆ COMPOSITUS.—*Sirop d'ipécacuanha composé*, Fr. Cod.; *Compound syrup of ipecac*, E.; *Sirop de Desessartz*, Fr.—Take of ipecac root, moderately fine powder, 30 Gm.; senna leaves, 100 Gm.; wild thyme, 30 Gm.; poppy flowers, 125 Gm.; magnesium sulphate, 100 Gm.; white wine, 750 Gm.; orange flower water, 750

Gm.; boiling distilled water, 3000 Gm.; sugar, a sufficient quantity. Macerate the ipecac and senna in the white wine for 12 hours; express and filter. To the residue add the wild thyme and poppy flowers, pour the boiling water over the mixture and infuse during 6 hours, and then express. To the strained liquid add the magnesium sulphate and the orange flower water. Filter, and add the vinous liquid previously prepared, and for every 100 Gm. of liquid add 180 Gm. of sugar. Dissolve by heating on a water-bath.—Fr. Cod.

SYRUPUS KRAMERIÆ, *U. S.*—Syrup of Krameria.

Syrupus ratanhiæ.—Syrup of rhatany, E.; *Sirop de ratanhia*, Fr.; *Ratanhiasirup*, G.

Preparation.—Fluidextract of krameria, 450 Cc.; syrup, 550 Cc. to make 1000 Cc. Mix them.—U. S.

Each fluidounce of the official syrup contains 216 minims of fluidextract of rhatany, or 27 minims in each teaspoonful (fluidrachm).

Uses.—Syrup of krameria is chiefly used as a remedy in diarrhœa, and is usually combined with antacids and other astringents. Its dose is from 30 to 60 minims (2–4 Cc.) to a child, and ½ ounce (16 Cc.) to an adult.

SYRUPUS LACTUCARII, *U. S.*—Syrup of Lactucarium.

Sirop de lactucarium, Fr.; *Lactucariumsirup*, G.

Preparation.—Tincture of lactucarium, 100 Cc.; glycerin, 200 Cc.; citric acid, 1 Gm.; orange flower water, 50 Cc.; syrup, a sufficient quantity to make 1000 Cc. Mix the tincture of lactucarium with the glycerin, add the orange flower water, in which the citric acid has been dissolved, and filter, if necessary. Finally, add a sufficient quantity of syrup to make the product measure 1000 Cc.—U. S.

To make 1 pint of syrup of lactucarium mix 1 fluidounce and 288 minims of tincture of lactucarium with 3 fluidounces and 96 minims of glycerin, and add 384 minims of orange flower water in which 8 grains of citric acid have been previously dissolved. Filter if necessary, and add sufficient syrup to bring the volume up to 16 fluidounces

The present official formula is an improvement on that of the 1890 Pharmacopœia, and if the tincture of lactucarium has been carefully made so as to be free from the caoutchouc-like constituent of the drug, the resulting syrup should be clear and of a light brownish color. The addition of citric acid and orange flower water materially improves the taste of the syrup. It represents the virtues of 0.05 Gm. of lactucarium in each Cc., or about 3 grains in each fluidrachm.

Sirop de lactucarium opiacé, Fr. Cod., contains in each tablespoonful 0.005 Gm. ($\frac{1}{14}$ grain) of extract of opium and 0.01 Gm. ($\frac{1}{7}$ grain) of alcoholic extract of lactucarium.

Uses.—In the dose of 2 to 4 drachms (8–16 Cc.), syrup of lactucarium is a sedative of uncertain value.

SYRUPUS LIMONIS, *Br.*—Syrup of Lemon.

Syrupus succi citri.—Sirop de suc de limon (de citron), Fr.; *Citronensirup*, G.

Preparation.—Fresh lemon peel, in thin slices or grated, 1 ounce; alcohol (90 per cent.), a sufficient quantity; lemon juice, 25 fluidounces; refined sugar, 38 ounces. Macerate the lemon peel in 1½ fluidounces of the alcohol for 7 days; press; filter; add sufficient of the alcohol to produce 2 fluidounces. In the lemon juice, clarified by subsidence, dissolve the refined sugar by the aid of a gentle heat. When the resulting syrup is cold, mix with it the 2 fluidounces of alcoholic liquid. The product should weigh 4 pounds and 1 ounce.—Br.

Uses.—This syrup is used as a vehicle, and, diluted with carbonated water, forms a grateful drink in febrile affections.

SYRUPUS MANNÆ.—Syrup of Manna.

Sirupus mannæ, P. G.—*Sirop de manne*, Fr.; *Mannasirup, G.*

Preparation.—Manna, 10 parts; alcohol, 2 parts; water, 33 parts; sugar, 55 parts. Dissolve the manna in the water, to which the alcohol has previously been added, filter

the solution, and to the filtrate add the sugar and dissolve with the aid of a moderate heat.—P. G.

Syrup of manna has a yellowish color and a characteristic sweet taste.

Uses.—Syrup of manna is mildly laxative. Its dose is 2 to 8 drachms (8–30 Cc.).

SYRUPUS MENTHÆ PIPERITÆ.—Syrup of Peppermint.

Sirupus menthæ, P. G.—*Sirop de menthe poivrée*, Fr.; *Pfefferminzsirup*, G.

Preparation.—Peppermint leaves, in moderately fine powder, 2 parts; alcohol, 1 part; water, 10 parts; sugar, 13 parts. Moisten the peppermint leaves with the alcohol, add the water and macerate at ordinary room-temperature for 24 hours, stirring the mixture repeatedly. Express, filter the liquid, and in 7 parts of the filtrate dissolve the sugar with the aid of a gentle heat.—P. G.

Syrup of peppermint is of a greenish-brown color, and possesses the characteristic odor and taste of the drug.

Uses.—This syrup is used as an agreeable flavoring agent.

SYRUPUS PAPAVERIS.—Syrup of Poppies.

Sirupus papaveris, P. G.—*Syrupus capitum papaveris, Syrupus diacodii.—Sirop de pavot blanc*, Fr.; *Mohnsirup*, G.

Preparation.—Poppy capsules, in moderately fine powder, 10 parts; alcohol, 7 parts; water, 70 parts; sugar, 65 parts. Moisten the powder with the alcohol, add the water and macerate for 24 hours, at ordinary room-temperature, with frequent stirring. Express the mixture, heat the liquid to the boiling-point, evaporate to 35 parts and filter. In the filtrate, dissolve the sugar with the aid of moderate heat, and add sufficient water to the syrup, when cold, to bring the total weight up to 100 parts. Mix thoroughly.—P. G.

The French Codex directs that 1 part of an extract of poppy capsules, made with 60 per cent. alcohol, be dissolved in 3 parts of alcohol (60 per cent.), and this solution added to 96 parts of simple syrup.

Uses.—Because of the uncertain morphine strength of this preparation, it is inadvisable to employ it. Its dose is stated to be ½ drachm (2 Cc.).

SYRUPUS PICIS LIQUIDÆ, *U. S.*—Syrup of Tar.

Sirop de goudron, Fr. Cod.; *Syrupus cum aquâ piceâ; Syrupus piceus.—Theersirup*, G.

Preparation.—Tar, 5 Gm.; alcohol, 50 Cc.; magnesium carbonate, 10 Gm.; sugar, 850 Gm.; water, a sufficient quantity. Mix the tar intimately, in a mortar, with 10 Gm. of clean white sand, add 100 Cc. of water, and, after kneading the mass thoroughly with the pestle, pour off the water and throw it away. Treat the residue with the alcohol, and, when the tar is dissolved, add the magnesium carbonate and 50 Gm. of sugar, and after thorough trituration add 400 Cc. of water; stir the mixture occasionally during 2 hours, and filter. Dissolve the remainder of the sugar in the clear filtrate by means of gentle heat, strain, and add sufficient water to make the product measure 1000 Cc.—U. S.

To make 1 pint of syrup of tar, mix 30 grains of tar with 75 grains of clean sand, add 1½ fluidounces of water, knead well and throw the liquid away. Treat the residue with 5½ fluidrachms of alcohol, and, when the tar is dissolved, add 75 grains of magnesium carbonate and 400 grains of sugar, triturate well, and add 6 fluidounces of water; stir the mixture occasionally during 2 hours, filter, and in the clear filtrate dissolve 13 avoirdupois ounces of sugar with the aid of heat; finally add sufficient water to bring the volume up to 16 fluidounces.

This formula differs somewhat from that of the 1890 Pharmacopœia. The tar is first treated with water for the purpose of removing most of the acetic acid present, and this infusion is rejected. The various soluble constituents of tar are then extracted by a weak hydroalcoholic menstruum; in the solution thus obtained the sugar is dissolved. Thus prepared, the syrup is of a yellowish color, has the odor of tar, a slightly bitter taste and an acid reaction, and when rendered alkaline becomes brown.

SYRUPUS PICIS IODATUS, *Sirop de goudron iodé*, is much employed in France, and

contains $\frac{1}{10}$ per cent. of iodine. 1 grain of iodine dissolved in a little alcohol is added, with agitation, to 1000 grains of syrup of tar; the color of iodine will disappear in a few days, when the iodized syrup has about the same color as tar syrup.

Uses.—The present formula perhaps affords a slightly more efficient product than that in the Pharmacopœia of 1890, and may be used when tar is indicated. The dose is from 1 to 4 drachms (4–16 Cc.).

SYRUPUS PRUNI VIRGINIANÆ, *U. S., Br.*—Syrup of Wild Cherry.

Syrup of Virginian prune, Br.; *Sirop d'écorce de cerisier*, Fr.; *Wildkirschenrindensirup*, G.

Preparation.—Wild cherry, in No. 20 powder, 150 Gm.; sugar, 700 Gm.; glycerin, 150 Cc.; water, a sufficient quantity to make 1000 Cc. Moisten the wild cherry with a sufficient quantity of water, and macerate for 24 hours in a covered vessel; introduce the glycerin into a graduated receiving bottle; pack the wild cherry firmly in a cylindrical percolator, and gradually pour water upon it; continue the percolation (shaking the percolate occasionally with the glycerin), until the liquid measures 450 Cc. Dissolve the sugar in the liquid by agitation, without heat, strain, and pass enough water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—U. S.

Syrup of Wild Cherry may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under SYRUPUS. Pour the percolate obtained as directed in the preceding formula upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by water until the product measures 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of syrup of wild cherry bark use $2\frac{1}{2}$ avoirdupois ounces of the ground bark, and after maceration collect enough percolate to measure, with addition of $2\frac{1}{2}$ fluidounces of glycerin, $7\frac{1}{2}$ fluidounces. In this liquid dissolve 12 avoirdupois ounces of sugar and add sufficient water to bring the volume up to 16 fluidounces.

The formula of the British Pharmacopœia is practically identical with the above, except that the finished syrup contains a little more sugar and somewhat less than half as much glycerin as that of the U. S. P.

The treatment of wild cherry bark with cold water results in the production of hydrocyanic acid and oil of bitter almonds, which, together with the bitter and astringent principles, are contained in the syrup, which has a rich brownish-red color and a pleasant taste.

Enough menstruum should be added to the powder to thoroughly moisten it, and the vessel be kept tightly closed to prevent loss of hydrocyanic acid: a No. 20 powder being rather coarse, the mixture must be very firmly packed and the percolation be allowed to go on in slow drops, so as to ensure exhaustion of the bark. The present syrup is of much lighter color and less astringent taste than the syrup of 1890, due to the fact that the glycerin is not added to the water before percolation, but subsequently to the aqueous percolate. The syrup keeps well ordinarily, but in summer time should be stored in a cool place.

Uses.—Syrup of wild cherry is used for its pleasant taste and mildly sedative properties as a vehicle in expectorant mixtures. Its dose is from 1 to 4 drachms (4–16 Cc.).

SYRUPUS RHAMNI CATHARTICÆ.—Syrup of Buckthorn.

Sirupus rhamni catharticæ, P. G.; *Syrupus spinæ cervinæ.—Sirop de nerprun*, Fr.; *Kreuzdornbeerensirup*, G.

Preparation.—Fresh buckthorn-berries are mashed and allowed to ferment at 20° C. (68° F.) in a covered vessel, until 2 volumes of the filtered liquid mix clear with 1 volume of alcohol; the juice is then expressed, and in it sugar is dissolved in the proportion of 13 parts for every 7 parts by weight of juice.—P. G.

Uses.—In Europe this syrup is used as a purgative for children in the dose of 1 drachm (4 Cc.).

SYRUPUS RHEI, *U. S., Br.*—Syrup of Rhubarb.

Sirupus rhei, P. G.—*Sirop de rhubarbe*, Fr.; *Rhabarbersaft*, G.

Preparation.—Fluidextract of rhubarb, 100 Cc.; spirit of cinnamon, 4 Cc.; potassium carbonate, 10 Gm.; water, 50 Cc.; syrup, a sufficient quantity to make

1000 Cc. Mix the spirit of cinnamon with the fluidextract of rhubarb, and add to it the potassium carbonate dissolved in the water. Then add enough syrup to make the product measure 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of syrup of rhubarb use 1½ fluidounces and 48 minims of fluidextract of rhubarb, 30 minims of spirit of cinnamon, 73 grains of potassium carbonate, 388 minims of water, and sufficient syrup.

Take of rhubarb-root, in No. 20 powder, coriander-fruit, in No. 20 powder, each 2 ounces; refined sugar, 24 ounces; alcohol (90 per cent.), 8 fluidounces; distilled water, 24 fluidounces. Mix the rhubarb and coriander; moisten with a portion of the mixed alcohol and water, and set aside; pack them in a percolator; pass the remainder of the diluted alcohol slowly through them; evaporate the liquid that has thus passed until it is reduced to 14 fluidounces, and in this, after it has been filtered, dissolve the sugar with the aid of heat. The product should weigh nearly 2½ pounds.—Br.

The U. S. P. syrup of rhubarb is nearly twice as strong as that of the British and German Pharmacopœias, both of the latter representing only 5 per cent. by weight of rhubarb.

The present syrup is of a deep brown-red color, and is transparent in thin layers; the presence of alkali renders it unfit for combination with various salts, which are precipitated thereby. The syrup of the Br. P. is of a deep-brown color and somewhat opaque.

Uses.—Syrup of rhubarb, though rarely used, may be given as a cathartic to infants in the dose of 1 drachm (4 Cc.).

SYRUPUS RHEI AROMATICUS, *U. S.*—Aromatic Syrup of Rhubarb.

Spiced syrup of rhubarb, E.; *Sirop de rhubarbe aromatique*, Fr.; *Gewürzter Rhabarbersaft*, G.

Preparation.—Aromatic tincture of rhubarb, 150 Cc.; potassium carbonate, 1 Gm.; syrup, 850 Cc. to make 1000 Cc. Dissolve the potassium carbonate in the aromatic tincture of rhubarb. Filter if necessary, and add sufficient syrup to make the product measure 1000 Cc. Mix.—U. S.

To make 1 pint of aromatic syrup of rhubarb, dissolve 8 grains of potassium carbonate in 2½ fluidounces of aromatic tincture of rhubarb, and mix the solution with 13½ fluidounces of simple syrup.

The present official syrup differs from that of the 1890 Pharmacopœia in containing a small quantity of potassium carbonate, whereby a clearer mixture is produced. It has a rich reddish-brown color, an agreeable odor, and a spicy and bitterish but pleasant taste.

Uses.—The aromatic syrup is the most extensively employed preparation of rhubarb. It is used with marked benefit for its primary laxative action and its after-constipating effect in the diarrhœas of infants and children due to indigestion and intestinal fermentation in the dose of 1 to 2 drachms (4–8 Cc.).

SYRUPUS RHŒADOS, *Br.*—Syrup of Red Poppy.

Sirop de coquelicot, Sirop de pavot rouge, Fr.; *Klatschrosensaft*, G.

Preparation.—Take of red-poppy petals, 13 ounces; refined sugar, 2½ pounds; distilled water, 1 pint (Imperial), or a sufficiency; alcohol (90 per cent.) 2½ fluidounces. Add the petals gradually to the water heated in a water-bath, frequently stirring, and afterward, the vessel being removed, infuse for 12 hours. Then press out the liquor, strain, add the sugar, and dissolve by means of heat. When nearly cold add the alcohol and as much distilled water as may be necessary to make up for loss in the process, so that the product shall weigh 3 pounds 10 ounces.—Br.

The addition of alcohol to the finished syrup is designed to counteract its tendency to fermentation. The syrup is of a deep-red color.

Uses.—This preparation is of uncertain strength and rarely employed. The dose is stated to be 1 drachm (4 Cc.).

SYRUPUS ROSÆ, *U. S.*, *Br.*—Syrup of Rose.

Syrupus rosarum rubrarum.—Syrup of red rose, E.; *Sirop des roses rouges*, Fr.; *Rosensirup*, G.

Preparation.—Fluidextract of rose, 125 Cc.; diluted sulphuric acid, 10 Cc.; sugar, 750 Gm.; water, a sufficient quantity. Mix the fluidextract of rose and diluted sulphuric acid with 300 Cc. of water; after allowing the mixture to stand 2 hours, filter, and dissolve the sugar in the clear filtrate by agitation. Finally, add a sufficient quantity of water to make the product measure 1000 Cc. Strain if necessary.—U. S.

To make 1 pint of syrup of rose, add 2 fluidounces of fluidextract of rose and 73 minims of diluted sulphuric acid to 5 ounces of water, allow the mixture to stand 2 hours, filter, and in the filtrate dissolve 12½ avoirdupois ounces of sugar, adding sufficient water finally to bring the volume up to 16 fluidounces.

Take of dried red-rose petals, 2 ounces; refined sugar, 30 ounces; boiling distilled water, 1 pint. Infuse the petals in the water for 2 hours; strain with expression, heat the liquor to the boiling-point, and filter. Dissolve the sugar in the liquor by means of heat. The product should weigh 2 pounds 14 ounces.—Br.

The syrup is of a fine red color and has an agreeable acidulous somewhat astringent taste. Each fluidounce contains 1 fluidrachm of the fluidextract of red-rose petals.

Uses.—It is used to impart an agreeable flavor and color to other syrups and mixtures.

SYRUPUS RUBI, *U. S.*—Syrup of Rubus.

Syrup of blackberry-bark, E.; *Sirop d'écorce de ronce*, Fr.; *Brombeerrindensirup*, G.

Preparation.—Fluidextract of rubus, 250 Cc.; syrup, 750 Cc. to make 1000 Cc. Mix them.—U. S.

This syrup has a deep reddish-brown color and a strongly astringent taste. Each fluidounce contains 2 fluidrachms of the fluidextract.

Uses.—As a mild astringent this syrup is useful in serous diarrhœa in the dose of 1 to 2 drachms (4–8 Cc.).

SYRUPUS RUBI IDÆI.—Syrup of Raspberry.

Sirupus rubi idæi, P. G.—*Sirop de framboise*, Fr.; *Himbeersaft*, G.

Preparation.—Reduce the raspberries to a pulp, and let this stand, at a temperature of about 20° C. (68° F.), until a small portion of the filtered juice mixes clear with half its volume of alcohol. Then separate the juice by pressing, set it aside in a cool place until the liquid portion has become clear, and filter. To every 7 parts by weight of the filtrate add 13 parts of sugar, heat the mixture to boiling, and strain.—P. G.

Some care is necessary that the temperature during the fermentation of the fruit-pulp does not exceed that prescribed.

The French Codex directs the fresh fruit to be expressed and the juice to be fermented at a temperature of 12° to 15° C. (54–59° F.), fermentation to be arrested as soon as the liquid will readily pass through a filter; otherwise the flavor will be much impaired. Other fruit-juices are prepared in precisely the same manner. The juice of ripe raspberries ferments readily, and the fermentation is completed in a few hours or a day, according to the temperature. The formation of mould and acetic fermentation impair the flavor; the progress of fermentation should therefore be closely watched, and the expressed juice should be rapidly filtered and at once converted into syrup.

Properties.—Raspberry syrup has a bright-red color, a very agreeable fruit odor, a pleasant acidulous taste, and a distinct acid reaction. When agitated with amylic alcohol, ether, or chloroform, these liquids should not become colored. On being rendered alkaline the syrup becomes dark-blue or dingy-violet colored, and when treated with basic lead acetate a dingy-blue or blue-green precipitate is produced, the filtrate being colorless or nearly so. When strongly acidulated with cold nitric acid the red color is not changed to yellow. These reactions serve to distinguish raspberry syrup from imitations colored with aniline red or with other coloring matters of vegetable origin.

Uses.—This, like all other fruit syrups, is used as a palatable vehicle for other drugs, and diluted with water it is a refreshing drink in febrile conditions.

SYRUPUS SARSAPARILLÆ COMPOSITUS, *U. S.*—Compound Syrup of Sarsaparilla.

Syrupus sudorificus.—Sirop de salsepareille composé, Sirop sudorifique, Fr.; *Zusammengesetzter Sarsaparillsirup,* G.

Preparation.—Fluidextract of sarsaparilla, 200 Cc.; fluidextract of glycyrrhiza, 15 Cc.; fluidextract of senna, 15 Cc.; sugar, 650 Gm.; oil of sassafras, 0.2 Cc.; oil of anise, 0.2 Cc.; oil of gaultheria, 0.2 Cc.; water, a sufficient quantity to make 1000 Cc. Add the oils (equivalent to 4 drops each) to the mixed fluidextracts and shake the liquid thoroughly. Then add enough water to make up the volume to 600 Cc. and mix well. Set the mixture aside for 1 hour, then filter it. In the filtrate dissolve the sugar with the aid of a gentle heat, allow the liquid to cool, strain, and add enough water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of compound syrup of sarsaparilla mix 2 drops each of oils of gaultheria, anise, and sassafras with ¼ fluidounce each of fluidextracts of senna and glycyrrhiza, and 3¼ fluidounces of fluidextract of sarsaparilla; add sufficient water to make 9½ fluidounces, and after filtration dissolve 11 avoirdupois ounces of sugar in the filtrate, and add enough water to bring the volume up to 16 fluidounces.

The present official formula is identical with that of 1890, except that the quantity of volatile oils has been doubled.

The syrup of the French Codex is made by hot infusion of sarsaparilla, borage-flowers, pale rose, senna, and anise; it is known as *sirop de Cuisinier.* Under the name of *sirop de Laffecteur* and *rob Boyveau-Laffecteur* a similar but more complex preparation has been in use in France; more than 30 drugs entered into its composition.

Uses.—Compound syrup of sarsaparilla is wanting in active medicinal properties. It is a convenient vehicle for the administration of potassium iodide. Corrosive sublimate, which is sometimes dispensed in the syrup, is said to be converted into calomel. The dose of the syrup is from 1 to 4 drachms (4–16 Cc.).

SYRUPUS SCILLÆ, *U. S., Br.*—Syrup of Squill.

Syrupus aceti scillæ.—Sirop de scille, Fr.; *Meerzwiebelsirup,* G.

Preparation.—Vinegar of squill, 450 Cc.; sugar, 800 Gm.; water, a sufficient quantity to make 1000 Cc. Dissolve the sugar in the vinegar of squill with the aid of a gentle heat, then strain, and, when the strained liquid is cold, add enough water, through the strainer, to make the product measure 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of syrup of squill use 7½ fluidounces of vinegar of squill and 13½ avoirdupois ounces of sugar, finally adding sufficient water to bring the volume up to 16 fluidounces.

Syrup of squill should always be made in porcelain or glass vessels, and the use of metal avoided, on account of the acetic acid present. The syrup of the British Pharmacopœia is made by dissolving 38 ounces of sugar in 1 pint (20 fluidounces, Imperial) of vinegar of squill with the aid of heat, and the product should weigh 3 pounds and 10 ounces; hence it is slightly denser than the above preparation.

Uses.—This is the preparation of squill that is ordinarily used as an expectorant, and for such purpose is frequently combined with senega or ipecac. Its expectorant dose is from ½ to 1 drachm (2–4 Cc.), which, if repeated at short intervals, will act as an emetic.

SYRUPUS SCILLÆ COMPOSITUS, *U. S.*—Compound Syrup of Squill.

Sirup de scille composé, Fr.; *Zusammengesetzter Meerzwiebelsirup,* G.

Preparation.—Fluidextract of squill, 80 Cc.; fluidextract of senega, 80 Cc.; antimony and potassium tartrate, 2 Gm.; purified talc, 20 Gm.; sugar, 750 Gm.; water, a sufficient quantity to make 1000 Cc. Mix the fluidextracts, evaporate them, on a water-bath, in a tared capsule, to 100 Gm., and mix the residue with 350 Cc. of water. When the mixture is cold, incorporate with it, intimately, the purified talc, filter, pass enough water through the filter to obtain 400 Cc. of clear filtrate, and add to the filtrate the antimony and potassium tartrate, dissolved in 25 Cc. of hot water. In this liquid dissolve the sugar by agitation, without heat, strain, and add

enough water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—U. S.

Compound Syrup of Squill may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under SYRUPUS. Pour the filtrate, obtained as directed in the preceding formula, and mixed with the solution of antimony and potassium tartrate, upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by water, until the product measures 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of compound syrup of squill mix 10¼ fluidrachms each of fluidextracts of squill and senega, evaporate to 1½ avoirdupois ounces, and add 5 fluidounces of water. When cold incorporate 150 grains of purified talc and filter, passing enough water through the filter to obtain 7 fluidounces of clear filtrate; to the filtrate add 15 grains of tartar emetic, dissolved in ½ ounce of hot water. In the mixed liquid dissolve 12½ avoirdupois ounces of sugar, and add enough water to bring the volume of the syrup up to 16 fluidounces.

After the evaporation of the alcohol in the official process considerable insoluble matter (pectin compounds) is apt to separate, which it is intended to remove by aid of purified talc; if necessary the liquid should be returned to the filter until it runs clear, and the solution of tartar emetic should not be added until a clear filtrate has been obtained. The finished syrup contains a little less than ⅛ grain of tartar emetic in each fluid drachm, and if carefully prepared it will keep well.

This syrup is known as *hive syrup* and *croup syrup*, and is an official substitute for *Coxe's hive syrup*, which was made by boiling the drugs in water and preserving the liquid by honey.

Uses.—The combination of squill, senega, and tartaric emetic imparts to this preparation expectorant, diaphoretic, emetic, and, in large doses, purgative properties. It was introduced into medicine as a remedy in spasmodic croup or "hives," which it relieves through the relaxation dependent upon the nausea caused by it in proper dose. As an expectorant it is of especial service when the bronchial secretion is scant. In croup 10 to 30 minims (0.60–2 Cc.) should be given every 10 to 15 minutes until its nauseant effect is developed. Its expectorant dose in adults is from 20 to 30 minims (1.30–2 Cc.).

SYRUPUS SENEGÆ, *U. S.*—Syrup of Senega.

Sirupus senegæ, P. G.; *Sirop de polygala*, Fr.; *Senegasirup*, G.

Preparation.—Fluidextract of senega, 200 Cc.; syrup, 800 Cc. Mix them.—U. S.

The present official formula differs from that of 1890 in directing the admixture of the fluidextract with syrup, and the syrup can be made extemporaneously or for stock by simply mixing 1 volume of the fluidextract with 4 volumes of syrup. Experience has shown that syrup of senega thus made keeps fully as well as when made by the former more tedious method. It is a clear reddish syrup, having the characteristic odor of senega and a decidedly acrid taste.

The syrup of senega of the German Pharmacopœia is made by dissolving 12 parts of sugar in 8 parts of a weakly alcoholic tincture of senega, representing about 1 part of the drug, and hence is of about ¼ the strength of the above syrup.

Uses.—Syrup of senega is useful as an expectorant in subacute and chronic bronchitis in the dose of 1 to 2 drachms (4–8 Cc.).

SYRUPUS SENNÆ, *U. S., Br.*—Syrup of Senna.

Sirupus sennæ, P. G.—*Sirop de séné*, Fr.; *Sennasirup*, G.

Preparation.—Fluidextract of senna, 250 Cc.; oil of coriander, 5 Cc.; syrup, a sufficient quantity to make 1000 Cc. Mix the oil of coriander with the fluidextract of senna and add a sufficient quantity of syrup to make the product measure 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of syrup of senna add 38 minims of oil of coriander to 4 fluidounces of fluidextract of senna and mix this with sufficient syrup to bring the volume up to 16 fluidounces.

The British Pharmacopœia directs that 40 ounces of senna be exhausted with 20 per cent. alcohol and the extract concentrated to 40 fluidounces; in this liquid 50 avoirdupois ounces of sugar are dissolved with the aid of heat, and when cool 10 minims of oil of coriander dissolved in 40 minims of 90 per cent. alcohol are added, and the whole well shaken. The finished product should weigh 5 pounds 12 ounces.

Syrup of senna of the German Pharmacopœia is made by macerating 10 parts of senna and 1 part of fennel with a mixture of 5 parts of alcohol and 60 parts of water for 12 hours, and then expressing. The liquid is heated to the boiling point and allowed to cool. To every 35 parts of the liquid 65 parts of sugar are added and dissolved with the aid of a gentle heat.

The present official syrup of senna is not identical with the syrup of 1890, being made with a fluid extract prepared from senna previously deprived of resinous and other matter soluble in 95 per cent. alcohol; hence the syrup is far less apt to cause griping.

Uses.—Syrup of senna is a gentle cathartic for children in the dose of ½ to 2 drachms (2–8 Cc.). To adults about twice this quantity should be given.

SYRUPUS TOLUTANUS, *U. S., Br.*—Syrup of Tolu.

Sirop de baume de tolu, Sirop balsamique, Fr.; *Tolubalsamsirup,* G.

Preparation.—Tincture of tolu, 50 Cc.; magnesium carbonate. 10 Gm.; sugar, 820 Gm.; water, a sufficient quantity to make 1000 Cc. Rub the tincture of tolu in a mortar with the magnesium carbonate and 60 Gm. of sugar. Then gradually add 450 Cc. of water, with constant trituration, and filter. Dissolve the remainder of the sugar in the clear filtrate with the aid of a gentle heat, strain the syrup while hot, and add a sufficient quantity of water to make the product measure 1000 Cc.—U. S.

Syrup of tolu may also be made in the following manner: Prepare a percolator or funnel in the manner described under SYRUPUS. Pour the filtrate, obtained as directed in the preceding formula, upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by water until the product measures 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of syrup of tolu mix 385 minims of tincture of tolu with 75 grains of magnesium carbonate and 1 ounce of sugar, add gradually 7 fluidounces of water and filter. In the filtrate dissolve 13 avoirdupois ounces of sugar, strain, and add sufficient water to bring the volume up to 16 fluidounces.

Take of balsam of tolu 1¼ ounces; refined sugar, 2 pounds; distilled water, 1 pint or a sufficiency. Boil the balsam in the water for half an hour in a tightly-covered vessel, stirring occasionally. Then remove from the fire, and add distilled water, if necessary, so that the liquid shall measure 16 ounces. Filter the solution when cold, add the sugar, and dissolve with the aid of a steam- or water-bath. The product should weigh 3 pounds.—Br.

Uses.—This syrup is used as an agreeable addition to expectorant mixtures. Its dose is 1 to 4 drachms (4–16 Cc.).

SYRUPUS ZINGIBERIS, *U. S., Br.*—Syrup of Ginger.

Sirup de gingembre, Fr.; *Ingwersirup,* G.

Preparation.—Fluidextract of ginger, 30 Cc.; alcohol, 20 Cc.; magnesium carbonate, 10 Gm.; sugar, 820 Gm.; water, a sufficient quantity to make 1000 Cc. Mix the fluidextract of ginger and the alcohol, then triturate the liquid in a mortar with the magnesium carbonate and 60 Gm. of sugar. Then gradually add 450 Cc. of water, with constant trituration, and filter. Dissolve the remainder of the sugar in the clear filtrate with the aid of a gentle heat, strain the syrup while hot, and add a sufficient quantity of water to make the product measure 1000 Cc.—U. S.

Syrup of ginger may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under SYRUPUS. Pour the filtrate, obtained as directed in the preceding formula, upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by water until the product measures 1000 Cc. Mix thoroughly.—U. S.

To make 1 pint of syrup of ginger mix ½ fluidounce of fluidextract of ginger with 160 minims of alcohol and triturate the mixture with 75 grains of magnesium carbonate and 1 ounce of sugar; add gradually 7 fluidounces of water and filter. In the filtrate dissolve 13 avoirdupois ounces of sugar, strain, and add sufficient water to bring the volume up to 16 fluidounces.

The syrup of the British Pharmacopœia is milky; it is made by mixing strong tincture of ginger, 1 fluidounce, representing ½ avoirdupois ounce of ginger, with syrup 19 fluidounces.

Uses.—Syrup of ginger is largely employed as a flavoring agent of mixtures, especially those given for their purgative effect and for the relief of abdominal colic. Its dose is 1 to 4 drachms (4–16 Cc.).

T.

TABACUM.—Tobacco; Leaf Tobacco.

Folia nicotianæ, P. G.; *Tabaci folia.—Tabac, Feuille de nicotiane*, Fr.; *Tabak*, G.; *Folha de Nicociana, Herva do Tabaco, Herva Santa*, Port.; *Hoja de Nicociana*, Sp.

The commercial dried leaves of *Nicotiana Tabacum* L. (*N. Havanensis* Lag.—Fam. *Solanaceæ*).

Tobacco has been official in most pharmacopœias, but is now discarded from all the leading ones. One or two specify the green leaves, while most stipulate that the dried leaves are not to be otherwise treated than by drying.

Origin.—The plant named in the definition is a native of tropical America, and is now cultivated in all parts of the world having a suitable climate, cold-temperate and very dry climates not being suitable therefor. Although official definitions named *N. Tabacum*, several other species are considerably cultivated for commercial tobacco, especially the following, here given in the order of their importance: *N. rustica* L., native of Mexico, and yielding most of the East Indian tobacco; *N. alata* Link et Otto (*N Persica* Lindl.), of Brazil, considerably cultivated in Cuba; *N. repanda* Willd., of Mexico. It would be a very difficult problem to determine the proportional yield of the different species, but it is probable that *N. Tabacum* yields at least half of the three or four million tons annually produced. Horticulture has done comparatively little in the development of hybrids and new forms of the tobacco plants. *N. Tabacum* is a tall, stout, glandular-hairy herb, with enormous leaves, annual or perennial according to the country in which it grows. It requires a very rich and highly fertilized soil. The production of flowers and seeds is prevented as far as practicable by cutting off the tops. Usually, the entire leafy stem is gathered and hung up to dry with the tops downward, the drying requiring several weeks, and the leaves losing about 80 per cent. in weight. This operation is recognized as one of "curing" rather than of simple drying, and there are many variations in the details. Artificial heat may or may not be employed, and in some instances the smoke resulting is supposed to play an important part in developing special flavors. These are also supposed to depend to a considerable extent upon the particular bacteria which are active during the process in different countries. After curing, the leaves are removed from the stems, carefully assorted as to size and quality, gathered into little bundles called "hands," and packed, chiefly in hogsheads, for marketing.

Description.—From 15 to 50 Cm. (6 to 20 In.) long and a third to a half as broad, oval to ovate or slightly obovate, contracted at the base into a long, broad, margined petiole, acute, entire, thin, with stout and prominent midrib and principal veins, more or less hairy, of variable, and usually mottled, shades of brown; odor very heavy, narcotic, and peculiar; taste bitter, acrid, and nauseous,

For commercial purposes the petiole and sindrib are removed and marketed as *Tobacco-stems;* but the definition, formerly official, requires the use of all of the leaf for medicinal purposes. The powdered stems are very largely employed as an insecticide, especially in horticulture, and commercial powdered tobacco frequently consists wholly or chiefly of this product. Numerous adulterants are employed.

Constituents.—An important consideration in the composition of tobacco is the localization of the different constituents in different parts of the leaf. Another is the changes produced by curing and in the manner of use, especially in smoking. Tobacco contains a large amount of salts, consisting of sulphates, nitrates, chlorides, phosphates, and malates of potassium, calcium, and ammonium, and it yields from 14 to 18.5 per cent. of ash. Larger amounts have been obtained, sometimes as much as 25 to 27 per cent.—a result which is doubtless due in some cases to dust adhering to the viscid glands. Flückiger found 10 per cent. of potassium nitrate, existing chiefly in the petiole and midrib. The malate of potassium is supposed to favor the "burning" of smoking tobacco, and when this is imperfect, it may be improved by the addition of a soluble salt of potassium, especially the acetate or nitrate. The other constituents of tobacco are

albumen, resin, gum, sugar, tannin, extractive, citric acid, nicotianin, and nicotine. *Nicotianin* or *Tobacco-camphor* is supposed to be chiefly responsible for the aroma or flavor of tobacco. It separates from the aqueous distillate in the form of white foliaceous crystals, which have an odor resembling that of tobacco-smoke and a warm, aromatic, and bitterish taste. Landerer (1835) obtained nicotianin from the dried, but not from the fresh, leaves.

Nicotine or *nicotia* is the poisonous principle of tobacco, and was discovered by Posselt and Reimann (1828). De Toni found it confined almost wholly to the epidermal tissue, and especially at the base of the hairs. It occurs in the cortical tissue of the root of the mature plant, especially just under the epidermis, and in the stamens and pistil, but not in the seed nor in the young plant. He regards it as non-protective, and the result of the reduction of oxygenous substances. He found the best tests for it to be with double iodide of potassium and mercury, iodized iodide of potassium, tannic acid, tetrachloride of platinum and of gold, iodized iodic acid, and Dragendorff's reagent.

The percentage of nicotine is extremely variable, from less than 1 to more than 10 per cent., and the conditions of its variation are but imperfectly known. As a general thing a hot, moist climate and rich soil favor an increase in the production of nicotine. The percentage of this and of nicotianin appear to vary inversely to one another, hence the importance of blending tobaccos in order to secure both "strength" (nicotine content) and flavor or aroma. Owing to the superficial location of the nicotine, it is very easily lost in careless drying, and the percentage is supposed to be ordinarily greatly reduced in this process. Some of the methods of curing, by burying in the earth, etc., doubtless result in a high nicotine content because of the prevention of loss in this way. Cox reports the average percentages in different products as follows: Syrian, 1 to 2; Manilla and Havana, 1 to 3; Virginian and Kentucky, up to 7; French (and Algerian), up to 9. Nicotine may be prepared by exhausting bruised tobacco with acidulated water, concentrating the infusion, adding an excess of potassa, and agitating with ether, which dissolves the alkaloid, and on the addition of powdered oxalic acid nicotine oxalate, which is insoluble in ether, is separated (Schloesing); or, the ether is evaporated, the liquid neutralized with oxalic acid, evaporated to dryness, and the residue exhausted with boiling alcohol, which dissolves nicotine oxalate (Ortigosa). On evaporating the solution to a syrupy consistence and agitating it with potassa and ether, an ethereal liquid is obtained, which on fractional distillation yields the alkaloid. This is a colorless oily liquid, having at 15° C. (59° F.) the specific gravity 1.0111, and remaining liquid at —10° C. (14° F.). It has an unpleasant, and when heated a pungent, acrid, tobacco-like odor, a burning taste, and a strongly alkaline reaction. Exposed to air and light, it rapidly acquires a brown color and is partly converted into a resinous compound. It boils near 250° C. (482° F.), but distils at a lower temperature, always leaving a residue. Its composition is $C_{10}H_{14}N_2$ (molecular weight, 160.96). It absorbs water from the air, dissolves readily in water, and is separated from this solution by caustic potassa. Alcohol and ether dissolve it in all proportions, and it yields with acids neutral and acid salts, of which the former crystallize with difficulty and are mostly soluble in weak alcohol, but insoluble in ether. The alkaloid acquires a wine-red color with strong sulphuric acid, and on heating the mixture is charred. Chlorine gas colors it deep-red or red-brown. When heated with a little hydrochloric acid a violet color is produced, which on the further addition of nitric acid changes to yellowish-red. The double salts with mercuric and platinic chloride are sparingly soluble in cold water.

The narcotic constituents of tobacco-smoke are as yet very imperfectly known. The volatile character of nicotine presupposes that certain amounts of it will appear in the smoke, even though it may be mostly destroyed, a supposition borne out by the experiment of collecting it in water through which the smoke is passed. A larger amount is volatilized and drawn into the mouth of the smoker, or condensed on its way there. Kissling believed the toxic action of tobacco-smoke to be chiefly due to nicotine, but Vahl and Eulenburg found chiefly *collidine*, *pyridine*, *picoline*, and other bases of the same series, besides ammonia and traces of *ethylamine;* and, in passing the vapors through potassium hydroxide solution, hydrocyanic, hydrosulphuric, acetic, formic, butyric, valerianic, carbolic, and probably other acids, were retained. Thoms obtained from the smoke a very poisonous oily substance, which produced violent headache, trembling, and giddiness. Its chief part boils between 220° and 230° C. (428° to 446° F.). By treatment with 2 per cent. potassium hydroxide solution, a phenol-like

body may be separated, which has an odor resembling creosote and boils at 190° to 200° C. (374° to 392° F.). It thus appears that not too much reliance should be placed upon the properties and presence of nicotine in determining the injurious effects of tobacco-smoking. Fruit fumigated with tobacco-smoke has been found to collect an oily coating which is very poisonous.

Pharmaceutical Preparations.—Although no longer official, both an ointment and a wine of tobacco were at one time recognized in the U. S. P. The former was made by incorporating an aqueous extract made from ½ ounce of tobacco with 8 ounces of lard. Wine of tobacco was made by exhausting 120 grains of tobacco with 4 fluidounces of white wine. When subjected to dry distillation, tobacco yields a brown-black, tar-like liquid of a strong and very peculiar empyreumatic odor. This was at one time (1870) officially recognized as *Oleum Tabaci*—Oil of Tobacco. Its composition is naturally very complex, and it is likely that some nicotine is present.

Action and Uses.—Tobacco is rarely employed to-day as a remedy except in domestic practice. It is a local irritant to mucous membranes, stimulating the secretions, increasing the flow of saliva when chewed, acting as a laxative when swallowed in small quantity, and as a purge in larger dose. Used in moderate amount, by being smoked, chewed, or snuffed by those who have acquired toleration to its influence, it produces a sense of mental and physical restfulness and well-being which has not been accounted for by studies of the physiological action of the crude drug or its alkaloid, nicotine. The effects of overdoses of tobacco, as usually manifested, consist in nausea and vomiting, quick, deep, and afterward labored respiration, great muscular relaxation, giddiness, mental confusion, restlessness, an enfeebled circulation, general depression, and occasionally clonic convulsions, followed by complete loss of reflexes and a fatal issue. The convulsions are considered to be of spinal origin, and death is due chiefly to paralysis of respiration, the heart continuing to pulsate after the cessation of breathing. The continuous over-indulgence in the use of tobacco results in chronic inflammation of the upper respiratory passages, indigestion, and loss of appetite. A condition known as "tobacco heart," characterized by cardiac irregularity and palpitation, frequently follows abuse of the drug. Headache, giddiness, tremors, and other nervous symptoms are of common occurrence. Certain eye symptoms, notably dimness of vision for colors, and even complete blindness, may occur. Examination of the eye-grounds in these cases reveals paleness of the retina in the milder type, and in the severe ones the optic nerve is found degenerated. Tobacco has been given internally to correct habitual constipation, and used in enemata to overcome impaction of feces and intestinal obstruction. As an antispasmodic, tobacco and nicotine were recommended in the treatment of laryngismus stridulus, asthma, hiccough, tetanus, and strychnine poisoning. Locally, an infusion and ointment have been applied with benefit in scabies, tinea, and other skin affections. Many cases of poisoning, some with fatal issue, have resulted from its external application, so that this use has been abandoned. Tobacco may be given as an emetic in the dose of 5 grains (0.30 Gm.), but is unsafe. The dose of nicotine is stated to be from $\frac{1}{60}$ to $\frac{1}{6}$ grain (0.001–0.01 Gm.).

Other Species.—The genus *Nicotiana* L. is credited with about 44 species, nearly all American. Several, besides those named above, yield commercial tobacco, and a number have been called species which are doubtless mere forms of others, especially of *N. Tabacum*. Others are known to be poisonous. A Mexican species grows rapidly as a small tree, resembling an alder or willow, and is planted for binding the shifting soil of the banks of rivers and canals. Its leaves are used in the South American Andes as a hypnotic.

TALCUM, *U. S., P. G.*—Talc.

Talcum venetum.—Soapstone, E.; *Talc, Talc de Vénise, Craie de Briançon*, Fr.; *Talk, Talkstein, Speckstein*, G.

A native hydrous magnesium silicate.—U. S.

Commercial native talc, although largely used for technical purposes, is not suitable for pharmaceutical work on account of the impurities present, and the Pharmacopœia, therefore, has very wisely recognized a purified article and given a method for preparing the same. The following properties are officially mentioned as belonging to native talc suitable for purification and subsequent use in pharmacy:

Properties and Test.—Talc is a white or grayish-white powder or grayish-green irregular masses of waxy lustre; when rubbed upon the skin it imparts a feeling like

greasiness; permanent in the air. Inodorous and tasteless. Insoluble in water, and in dilute solutions of the acids and alkali hydroxides. Specific gravity: 2.2 to 2.8. Mix 0.5 Gm. of talc with about 2 Gm. each of anhydrous sodium and potassium carbonates, heat the mixture in a platinum crucible until fusion is complete, and treat the resulting fused mass with hot water; then neutralize the liquid with diluted sulphuric acid, and, after adding an additional 10 Cc. of the latter, evaporate the mixture until the white fumes of sulphuric anhydride are evolved, then add 20 Cc. of water, and, after boiling the mixture and filtering, an insoluble residue of silica should be left. If to the filtrate ammonia-water and ammonium chloride test-solution be added, a white, gelatinous precipitate of aluminum hydroxide may be formed, while the filtrate from this, upon the addition of sodium phosphate test-solution, should yield a white, crystalline precipitate (magnesium). If 1 Gm. of talc be boiled with 25 Cc. of diluted hydrochloric acid for ½ hour, adding water from time to time to maintain approximately the original volume, and the liquid filtered, then the filtrate should yield, upon evaporating to dryness, igniting, and quickly weighing, not more than 0.05 Gm. of residue.—U. S.

TALCUM PURIFICATUM, *U. S.*—Purified Talc.

Talc purifié, Fr.; *Gereinigter Talk*, G.

Preparation.—Talc, in fine powder, 500 Gm.; hydrochloric acid, 75 Cc.; water, a sufficient quantity. Mix the powdered talc with about 2500 Cc. of boiling water, gradually add 50 Cc. of the hydrochloric acid, and boil the mixture during 15 minutes, then allow it to stand for 15 minutes. Decant, and reject the supernatant liquid containing the finer particles of talc in suspension, and again boil the residue with 2500 Cc. of water, mixed with the remainder of the hydrochloric acid, and allow it to stand for 15 minutes. Again decant and reject the finer suspended particles, and wash the coarser residue with water by repeated decantation, until a portion of the wash-water, after filtering and acidifying with nitric acid, fails to become opalescent upon the addition of silver nitrate test-solution. Then transfer the magma to a close linen or muslin strainer, allow it to drain, and dry it at 110° C. (230° F.).—U. S.

Properties and Test.—Purified talc, when subjected to ignition at red heat, should lose not more than 5 per cent. of its weight. If 10 Gm. of purified talc be boiled with 50 Cc. of distilled water for ½ hour, adding water from time to time to maintain approximately the original volume, it should yield a filtrate which is neutral to litmus-paper, and ½ of this filtrate, when evaporated and dried at 110° C. (230° F.), should yield not more than 0.005 Gm. of residue (limit of soluble substances). The remaining ½ of the filtrate, after slightly acidulating with hydrochloric acid, should not yield a blue color upon the addition of potassium ferrocyanide test-solution (absence of iron).—U. S.

The chief use to which purified talc is put in pharmacy is as a filtering medium, and for such purpose the powder should not be too fine, otherwise it will pass through the filter-paper and necessitate frequent pouring back of the filtrate. A No. 60 or perhaps 80 powder is far superior to the finer bolted varieties used for dusting purposes. It is absolutely essential that the washing with water be continued until all traces of hydrochloric acid have been removed.

Action and Uses.—Purified talcum is an excellent dusting-powder to allay the itching of prickly heat and other pruritic skin diseases. It forms the base of many cosmetic powders.

TAMARINDUS, *U. S., Br.*—Tamarind.

Pulpa tamarindorum cruda, P. G.; *Fructus tamarindorum (tamarindi).—Tamarind*, E.; *Tamarindenmus*, G.; *Tamarinier (pulpe)*, (Cod.), *Tamarin, Pulpe bruto de Tamarins*, Fr.; *Tamarindi in pasta, Pulpa di tamarindo*, It.; *Polpa de tamarindos em Rame*, Port.; *Tamarindo*, Sp.

The preserved pulp of the fruit of *Tamarindus Indica* L. (*T. officinalis* Hook.; *T. occidentalis* Gaertn.; *T. umbrosa* Salisb.—Fam. *Leguminosæ*).

Tamarind is official in nearly all pharmacopœias. The definition of the Br. P. is more definite than the above, specifying that the brittle outer part of the pericarp shall be removed and the remainder preserved in sugar. This is also more accurate, since the seeds as well as the pulp are included. The definition of the P. G. is much longer, but also provides for the inclusion of the seeds.

Origin and Properties.—The tamarind is a large, broadly spreading tree, much resembling the sugar-maple at a distance, native of India, and cultivated in nearly all tropical countries where there is sufficient rainfall, especially in the West Indies. The habit of the leaf, flower, and fruit is here illustrated. In the West Indies the fruit grows relatively much stouter than in the Orient, the length only about 3 times the breadth, this form being Gaertner's *T. occidentalis*. The indehiscent legume is of a rich brown color and smoothish. The exocarp is thin and brittle, the mesocarp fleshy, and bearing on its surface, on each side, three stout branching veins. The endocarp is thin, flexible, and tough, and divided transversely into from 3 to 10 cavities, each containing a flattened, somewhat quadrangular and glossy, dark-brown seed. The fresh leaves and flowers have an acidulous taste, and are used in tropical countries for the preparation of cooling drinks. Before tamarinds enter commerce the shell is removed, and the inner portion is in India pressed together into a mass to which sometimes sugar is added. In Upper Egypt it is formed into cakes which are dried in the sun, and in the West Indies hot syrup is poured over the pulpy mass. West Indian tamarinds are preferred in the United States, rather because of the method of their preparation than because of any natural difference in the fruit.

Fig. 439.

West Indian tamarind: flowering branch, pod, and pod with shell removed (fruit, ⅓ Nat.).

Description.—As seen in our commerce, tamarinds form a dark-brown soft mass, in which the interior portion of the fruit is more or less broken. They have a fruit-like odor and a subacid to strongly acid and sweet taste. *East Indian tamarinds* are tougher and darker in color and have a less sweet taste. *Egyptian tamarinds* appear in hard, flattish, circular cakes, about 15 Cm. (6 In.) in diameter, of a brown-black color externally, and frequently mouldy. The last two varieties are rarely met with in American commerce. On leaving the clean blade of an iron spatula for 30 minutes in contact with tamarinds, it should not become covered with a coating of copper.

The Austrian Pharmacopœia specifically excludes tamarinds of a reddish-brown color; the Russian allows about 17 per cent. of seeds; the Italian requires 12 to 13 per cent. of acid, chiefly tartaric.

Constituents.—C. Müller's analysis (1882) of East Indian tamarinds, which is generally accepted, gave a very little malic acid; citric acid varied between 6 and 4 per cent., tartaric acid between 5.3 and 8.8 per cent., potassium bitartrate between 4.7 and 6 per cent., the insoluble matter of the pulp between 12 and 20 per cent., and the seeds between 1.5 and 38 (average 13.9) per cent. A little acetic acid, which has been reported, is supposed to result from sugar-decomposition. There is a little tannin in the seed-coats.

Pharmaceutical Preparations.—Tamarinds are directed to be used in the preparation of confection of senna both by the U. S. and Brit. Pharmacopœias. A purified pulp of tamarinds is recognized in the Germ. Pharm. as *Pulpa Tamarindorum Depurata—Gereinigtes Tamarindenmus*. It is prepared by treating commercial tamarinds with hot water, straining the mixture through a coarse hair sieve, evaporating to the consistence of a thick extract, and incorporating 1 part of powdered sugar with every 5 parts of the extract. This purified pulp is of brownish-black color, and has a pleasant acidulous taste. If evaporated to dryness at 100° C. (212° F.) it yields 60 parts of residue. 2 Gm. of purified tamarind pulp, shaken with 50 Cc. of hot water and allowed to cool, should yield a filtrate, 25 Cc. of which should require not less than 1.2 Cc. of normal potassium hydroxide solution to become perfectly neutral.

Action and Uses.—The combination of acids and acid salts in tamarinds impart to them mild laxative and refrigerant properties. They are used in association with other laxatives, notably senna, in the treatment of habitual constipation, but are claimed

by some to detract from the efficacy of the other drugs. An infusion, strained and allowed to cool, is sometimes given as a grateful draught in fevers. The dose of tamarinds is from 1 drachm to 1 ounce (4–30 Gm.).

TANACETUM.—Tansy.

Summitates tanaceti.—Bitter-buttons, Hind-heel, Parsley or *Scented fern*, E.; *Rainfarn, Wurmkraut*, G.; *Tanaisie, Herbe aux vers*, Fr.; *Tanasia*, Port.; *Tanaceto*, Sp.

The dried leaves and tops of *Tanacetum vulgare* L. (*Chrysanthemum Tanacetum* Karsch; *Pyrethrum T.* DC.—Fam. *Compositæ*).

Tansy is official in a number of pharmacopœias, but has been dropped from the more important ones. A number recognize only the flower-heads (*Flores tanaceti*); several admit the entire plant.

Origin.—Tansy is a highly aromatic perennial herb, native of Europe and temperate Asia, widely naturalized in countries having a similar climate, and very abundant along roadsides, in waste fields, and similar localities in the eastern United States. The stout and fibrous many-headed root sends up a cluster of nearly simple stems, 3 or 4 feet high, roundish-angular, frequently purplish at the base, and bearing opposite leaves and a corymbose inflorescence.

FIG. 440.

Tansy plant (½ Nat.); leaf segment (× 2).

Description.—Leaves shortly and stoutly petioled, rarely exceeding 20 Cm. (8 In.) long and 10 Cm. (4 In.) broad, obovate when flattened, pinnate, the pinnæ about 10 or 12 pairs, linear-oblong, obtusish, pinnatifid, their segments oblong, acute, incisely serrate or lobed; thin, with a strong mid-rib, smooth, dark green, finely depressed-glandular; flower-heads in a small, loose, terminal corymb, long-peduncled, yellow, nearly 1 Cm. (about ⅓ In.) broad, having an imbricated, saucer-shaped involucre, a convex, naked receptacle, and numerous yellow tubular florets, which are perfect, or the outer circle pistillate; highly and peculiarly aromatic, the taste pungent and very bitter.

Constituents.—Together with resin, tannin, fat, sugar, gum, citric, tartaric, and malic acids, tansy contains about ½ per cent. of volatile oil (see OLEUM TANACETI) and the amaroid *tanacetin*, which was isolated by Leroy (1845) by a process similar to that for digitalin. This *tanacetin* is described as being yellowish-white, granular, inodorous, fusible, soluble in ether, less freely soluble in alcohol, and sparingly soluble in water. Leppig (1882) gives for it the formula $C_{11}H_{16}O_4$, and found it to be present chiefly in the flowers; sulphuric acid colors it yellow, then brown, red-brown, and blood-red, the margin becoming blue.

Action and Uses.—Tansy possesses carminative, emmenagogue, and anthelmintic properties, and in poisonous doses is a violent irritant to the stomach and intestines. Many deaths are recorded from its use. The symptoms preceding the fatal issue are variable, but consist usually in vomiting and purging, severe abdominal pain, a rapid, feeble pulse, dilated pupils, convulsions of an epileptiform type, coma, and asphyxia. The lethal doses of the drug or its volatile oil are undetermined. Very grave symptoms have followed the ingestion of from 15 to 30 minims (1–2 Cc.) of the oil of tansy. Tansy is another drug esteemed as a domestic remedy, and rarely employed in regular practice. It is used to promote or restore the menstrual function, and not infrequently as an abortifacient. Its employment for the latter purpose, however, not only fails to produce abortion, but is attended by grave dangers. In infusion it is given to remove lumbricoid worms from the intestine, as a febrifuge in mild fevers, and to correct hysterical disorders. The powdered drug is given in the dose of 20 to 60 grains (1.30–4 Gm.). The dose of the oil is from 1 to 3 minims (0.05–0.20 Cc.). In household medicine, tansy tea, made by adding 1 ounce (30 Gm.) of the leaves or tops to 1 pint (480 Cc.) of boiling water, is taken in the dose of 1 to 2 ounces (30–60 Cc.).

Other Species.—There are about 50 species in the genus *Tanacetum* L., distributed mostly throughout the North Temperate Zone, and several of them are used like the above. *T. umbelliferum* Boiss., of Persia and the adjacent region, is the *Busidan* or *Micha-akkar-kara*, used as an anthelmintic, purgative, and aphrodisiac. Its root is known as *White Pellitory*, and bears considerable resemblance to *Roman Pyrethrum*, though lighter colored, and of a sweetish and only slightly acrid taste.

TARAXACUM, *U. S.*—Taraxacum (Dandelion).

Taraxaci radix, Br.; *Radix taraxaci cum herba*, P. G.; *Radix taraxaci*, P. A.—*Dandelion root, Blow-ball, Milk, Witch*, or *Yellow gowan, Lion's-tooth*, etc., E.; *Löwenzahn, Pfaffenröhrchen*, G.; *Dent de lion, Pissenlit, Couronne de moine*, Fr.; *Radice do Tarassaco*, It.; *Diente de Leon*, Sp.

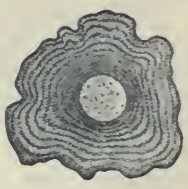
The dried root of *Taraxacum Taraxacum* (L.) Karsten (*Leontodon T.*—L.; *T. officinale* Weber; *T. Dens-leonis* Desf.; *T. vulgare* Schrank.—Fam. *Cichoriaceæ*), gathered in the autumn.

Taraxacum is official in nearly all pharmacopœias, most of which use the synonym *T. officinale* Weber, as is done by the U. S. P., the technical inaccuracy involved being less objectionable than the literary form of the correct name. The Swiss requires that it be collected in the spring. The German does the same, and includes the entire herb.

Origin.—The dandelion plant, native almost throughout the North Temperate Zone, and very widely dispersed, is so well known that a general description is superfluous. The young leaves are extensively consumed both as a pot-herb and as a salad. Although the species number more than a score, there is no reason to believe that the medicinal properties, which are rather insignificant, differ appreciably. The roots are chiefly collected in central Europe. Those collected in the United States are mostly small, branched, and inferior. The spring-collected root loses 80 to 85 per cent. on drying, that of the autumn only 70 to 75 per cent.

After frost and early in the spring, particularly when grown in a rich soil, the root contains much sugar and levulin; during the spring and summer the milk-juice becomes thicker and the bitter taste increases; the root is therefore directed to be collected in the autumn. The early spring root yields a sweetish-bitter extract. Bentley regards the root collected about July as most efficient. The Austrian Pharmacopœia directs also the leaves, *Folia taraxaci*, collected in the spring, for use in the preparation of the extract.

Fig. 441.



Transverse section of taraxacum root.

Description.—Mostly in pieces about 7 to 15 Cm. (3–6 In.) long and 1 to 2 Cm. ($\frac{2}{5}$–$\frac{4}{5}$ In.) thick, consisting of the upper portions of longer, tapering roots, usually simple or with one or two similar, parallel, and approximate, branches, crowned with several short, thickish crowns; dark brown, strongly longitudinally wrinkled when dry; fracture short, showing a thick, whitish bark marked with closely approximate circles of usually glistening latex-tubes and a thin, bright-yellow, porous wood; inodorous and bitter; free from starch.

Small roots of chicory might easily be mistaken for dandelion, but their transverse section reveals the lacticiferous ducts in radial rows.

Constituents.—A great amount of attention has been bestowed by Sayre upon the study of the constituents of taraxacum. He reports (1) a resin soluble in chloroform and ether, insoluble in alcohol; (2) a resin soluble in alcohol; (3) *taraxacerin* ($C_9H_{15}O$), a white waxy substance separating in cauliflower-like forms; (4) a bitter principle, which in somewhat concentrated solution is precipitated by a number of alkaloidal reagents. Solutions containing the seemingly pure principle when evaporated produced a film which under the microscope revealed oftentimes crystals of acicular form mixed with globules of oleoresinous appearance. When this mixture was treated with oxidizing agents—even by hydrogen peroxide—it was gradually converted into a crystalline mass which proved to be oxalic acid. The ash, of complex composition, amounted to nearly 12 per cent. In the autumn there is a large amount of inulin, which mostly disappears in early spring, when large amounts of sugar and levulin appear. The bitter principle has been called *taraxacin*. It was obtained by Sayre in a nearly pure condition to the extent of about 0.05 per cent.

Pharmaceutical Preparations.—Extract of Taraxacum, Fluidextract of Taraxacum, U. S. P.

Action and Uses.—Taraxacum was formerly largely employed for its mildly tonic, laxative, and diuretic properties. It was thought to greatly enhance the activity of the liver and promote the secretion of bile, but recent investigations disprove its hepatic influence. It is used, especially by German physicians, in the treatment of atonic dyspepsia and constipation associated with torpidity of the liver, and also in catarrhal jaundice and hepatic congestion. Its diuretic effect is too feeble to be of service. The best preparation of taraxacum is the fluidextract, given in the dose of 1 drachm to 1 ounce (4–30 Cc.). The dose of the extract is from 5 to 20 grains (0.30–1.30 Gm.).

Allied Drugs.—A large number of the milky-juiced *Compositæ*, or *Cichoriaceæ*, are very similar to dandelion in constituents and properties. Many have been used by aborigines and country people on fanciful grounds because the juice is milky; for example, *Lygodesmia juncea* is largely used by the North American Indians under names which mean *milk-medicine*.

Cichorium, *Chicory*, *Succory* or *Blue dandelion* (*Cichorie*, G.; *Chichorée*, Fr.), the dried root of *Cichorium Intybus* L., native of Europe and Asia, and growing commonly along roads and in waste places in the United States, is somewhat employed as a substitute for dandelion, besides being very extensively mixed with coffee. Its constituents are practically identical with those of dandelion. Its leaves are considerably used in salads, like those of the *Endive* or *Garden succory* (*C. Endivia* L.).

TEREBENUM, *U. S., Br.*—Terebene.

Terebène, Fr.; *Tereben*, G.

A liquid consisting of dipentene and other hydrocarbons, obtained by the action of concentrated sulphuric acid on oil of turpentine and subsequent rectification with steam.—U. S. The British Pharmacopœia states that terebene is obtained by the action of successive portions of sulphuric acid on oil of turpentine until it no longer rotates the ray of polarized light.

Preparation.—By repeatedly treating oil of turpentine with concentrated sulphuric acid or phosphoric anhydride it is rendered optically inactive. After purification this constitutes the so-called terebene. As a working formula Hirsch proposes the following method: Mix 1000 parts of oil of turpentine with 25 parts of sulphuric acid in one portion, and agitate thoroughly. When the heat generated has moderated to 70° C., add the same quantity of acid as before, and repeat this a number of times, taking care that the temperature does not rise too high. Shake the mixture at intervals for a short time, and put it aside for 24 hours. Remove the oil and wash it with solution of soda to remove all trace of acidity, and distil the oil in a brisk current of steam. The distillate thus obtained should be optically inactive, and if such is not the case the product should again be treated with sulphuric acid in the proportion of 5 to 100, the further procedure being as mentioned above. The inactive liquid finally obtained is a mixture of terebene with various hydrocarbons, from which terebene is obtained pure by fractional distillation, the portion boiling above 160° C. (320° F.) being rejected. According to Riban, it can be further purified by distilling over metallic sodium.

Properties and Tests.—Terebene is a colorless, thin liquid, having a rather agreeable thyme-like odor, and an aromatic, somewhat terebinthinate taste. Its specific gravity is about 0.850 at 25° C. (77° F.) (0.862 to 0.866 at 15.5° C. (60° F.), Br.). It is only slightly soluble in water, but soluble in 3 times its volume of alcohol. It boils at 155° to 165° C. (311° to 329° F.). On exposure to light and air, terebene gradually becomes resinified, and acquires an acid reaction, hence it should be kept in well-stoppered bottles, in a cool place, protected from light. Terebene should possess its characteristic agreeable odor, should not redden moistened blue litmus-paper (absence of acids), and should be completely inactive toward polarized light (absence of unaltered oil of turpentine). If about 10 Cc. of terebene is evaporated in a porcelain dish, on a water-bath, not more than a very slight residue should be left (absence of more than traces of resinous substances).—U. S. The British Pharmacopœia demands that not more than 15 per cent. should distil below 165° C. (329° F.). Tyrer and Westheimer (*Trans. Brit. Ph. Conf.*, 1900) state that commercial terebene will vary to some degree with the kind of oil of turpentine used and the conditions of its preparation, the products from Russian, French, and American oil of turpentine not being alike.

Action and Uses.—Terebene is stimulant to all mucous membranes, and in large doses is apt to severely irritate the stomach and kidneys. It is used chiefly in the later stages of acute bronchitis and in the chronic forms of the disease to liquefy and aid in

the expulsion of thick, tenacious mucus. For this purpose it is given by the mouth or inhaled in an oily spray. Terebene is also a mild antiseptic, and as such is employed in the treatment of fermentative dyspepsia. Its effect upon the genito-urinary tract is similar to that of other balsamic drugs, and it may be employed in chronic cystitis and urethritis, but is less efficacious than copaiba or sandal oil. Terebene is best given in capsule in the dose of 5 to 10 minims (0.30–0.60 Cc.). Another useful method is to drop the desired quantity upon sugar.

TEREBINTHINA, *U. S.*, *P. G.*—Turpentine.

Thus Americanum, Br.; *Terebinthina communis.*—*Crude turpentine*, E.; *Térébinthine commune*, Fr. Cod.; *Gemeiner Terpentin*, G.; *Balsamum pini*, Russ.; *B. Pinorum*, Nor.; *Terementine commune*, It.; *Trementina commune*, Sp.; *Leite* (or *Terebinthina*) *de Pinheiro*, Port.

A concrete oleoresin obtained from *Pinus palustris* (Miller) and from other species of *Pinus* (Fam. *Pinaceæ*).

Origin.—This definition would include the oleoresin of any true pine not excluded by the official description which, consisting as it does of but three lines of the most general description, seems designed to be thus comprehensive. The term, however, unless qualified, is generally construed as referring to the products of the long-leaved or pitch-pines of the southern United States, *P. palustris* Miller (*P. australis* Mx.) and *P. tæda* L. The former is often called the *Broom-pine*, the latter the *Old-field* or *Loblolly pine*. The forests of these trees originally covered most of the Atlantic coast plain from North Carolina to northern Florida, inclusive, and most of the Gulf plain from Florida westward. The methods of collection are very destructive and, in the absence of some energetic efforts at preservation, the industry seems doomed to an early practical extinction. The method of collection consists in chopping a pocket-shaped cavity called a "box," having a capacity of from a quart to a gallon, into the trunk a few inches above the ground, or several such boxes if the tree is very large. This work is done in the winter, and it is said that an expert can cut more than 10,000 boxes during the season. With the approach of warm weather the oleoresin begins to "run," and the boxes fill in about two weeks. To preserve the flow the bark and about ¼ inch of the wood are chipped off weekly above the edge of the box. The warmer and dryer the weather the more rapid the flow, but, on an average, the boxes fill once in 3 weeks. The product of the tree the first year it is cut is greater in amount and of better quality than that of any subsequent year, and is known as "virgin." The virgin yield of 10,000 trees is ordinarily regarded as about 200 barrels of 320 lbs. each, besides about 50 barrels of "scrape" or "scrapings," this being the product which dries and is scraped from the bark above and about the boxes. The trees continue to yield a profitable amount for about 3 or 4 years, after which they are abandoned to the lumbermen. By this time the bark will have been hacked to a height of from 5 to 8 feet above the boxes. More rational methods, by the use of vessels to catch the exudation, are being slowly introduced. In the early history of the industry nearly all of the turpentine was exported or shipped north for distillation, but the necessities of economy gradually caused the distillation to be performed at the point of collection. This was formerly done with iron, now with copper, stills. The yield of oil varies with the grade of turpentine. Virgin dip yields about 6 gallons to the barrel, common yellow dip of the second or third year about 4 gallons, and scrapings about 2 gallons.

Description.—Turpentine is a yellowish or brownish yellow, viscid liquid, which, when it exudes, is transparent, but soon becomes opaque from a crystalline deposit, is rendered thinner and clear by a moderate heat, and has an agreeable terebinthinate odor and a pungent, bitterish and acrid taste. In this condition turpentine is recognized by the pharmacopœias of Continental Europe, but in the United States and in Great Britain the oleoresin which has concreted on the trees is official, and is generally kept under the name of white turpentine, and in England is known as common frankincense. It is identical with the granular sediment deposited from liquid turpentine, and is found in irregular yellowish-white, more or less tough masses, which contain fragments of bark and wood, are brittle in the cold, breaking with a crummy fracture, and are more tenacious, or even semi-liquid, in warm weather. It contains from 12 to 16 per cent. of volatile oil, on the loss of which by exposure it becomes firm and friable.

The adulterations of turpentine are referable to the oil, and will be considered under that title.

Constituents.—The constituents of turpentine are described in connection with RESINA and OLEUM TEREBINTHINÆ, its two constituent parts.

Action and Uses.—The medicinal virtues of all the turpentines depend upon the volatile oil (see OLEUM TEREBINTHINÆ). Turpentine was anciently esteemed as a remedy in chronic inflammations of mucous membranes, as atonic amenorrhœa, catarrhal affections of the lungs and urinary organs, ulceration of the bowel, hemorrhoids, etc. In chronic rheumatic conditions it was administered internally, and its vapor at a high temperature applied in a bath. Its external application in ointment was resorted to for the cure of scabies and sluggish skin diseases. The dose of turpentine is from 20 to 60 grains (1.30–4 Gm.), given usually in pill or emulsion. Chian turpentine was recommended by Mr. Clay, of Birmingham, Eng., as a cure for uterine cancer. He gave it in the dose of 25 grains (1.60 Gm.) or more. Its present disuse reflects the opinion of the medical profession as to its value.

Other Turpentines.—The number of turpentines, many of them from species not in the genus *Pinus*, is too great to allow of their being named in this article. European turpentine closely resembles the American, and is obtained in Russia from *P. sylvestris* L. (the European Red, Scotch, Baltic, Norway, or Riga pine or "Scotch Fir"); in Germany from the same and from *P. rotundata* Link; in Austria, from *P. Laricio* Poir (the Corsican pine); in southwestern Europe, from *P. Pinaster Soland* (*P. maritima* Poir., the Cluster Pine or Pinaster). The last, or Bordeaux turpentine, is often called *Gallipot*. Aleppo turpentine is from *P. Halapensis* Miller (*P. maritima* Lambert). Mexican or Brea turpentine is from *P. Teocotl* Ch. and Sch., the Ocote pine. Hungarian turpentine (or balsam), Krummholzöl or Latschenöl, is from *P. Pumilio* Haenke, but, instead of being taken from the trunk, it is caused to exude by cutting off the tops of the branches in the spring.

Pinus Cembra L., the Siberian or Swiss stone-pine or Siberian cedar, yields a turpentine called Riga or Carpathian Balsam.

ABIETENE (C_7H_{16}) is the volatile oil obtained from the terebinthinate exudation of *Pinus Sabiniana*, Douglas, the Nut or Digger pine of California. According to Wenzell (1872), the crude oil is colorless, and commences to boil at 101° C. (213.8° F.), the thermometer gradually rising to 115° C. (239° F.). Pure abietene boils at 101° C. (213.8° F.), has a strong, penetrating orange-like odor, is highly inflammable, very volatile, of the specific gravity .694 at 16.5° C. (61.6° F.), soluble in 5 parts by measure of 95 per cent. alcohol, dissolves freely iodine and bromine, and yields with chlorine a substitution-compound boiling at 260° C. Thorpe (1879) found it to have the composition of *heptane* C_7H_{16}, to boil at 98.42° C., and to be slightly dextrogyre.

The volatile oil of *Pinus ponderosa* Douglas of California, which was examined by Sadtler (1879), seems to have the same composition.

A number of turpentines are obtained in India from various species of pines. (See *Agricult. Ledger*, 1896, No. 14.)

The European Larch, *Larix Larix* (L.), Karsten (*Pinus L.* L.; *Abies L.* Lam.; *Larix Europæa* DC.; *L. decidua* Mill.), yields the Venice or Larch turpentine, *Terebinthina laricine* (*T. laricis* or *T. veneta*; *Terebinthine de Venise*, Fr. Cod.; *Trementina de Venecia*, Sp.), which is obtained from the heart-wood by boring a hole into the trunk. It is a nearly transparent or slightly opaque and somewhat fluorescent thick liquid, of a terebinthinate odor, a bitter and aromatic taste, and a yellowish or greenish-yellow color. It is freely soluble in alcohol, amyl alcohol, acetone, and glacial acetic acid, and does not become hard when mixed with magnesia. The article usually sold here under this name is an artificial product. The average importation of Venice turpentine is about 48,000 pounds. Larch turpentine contains from 20 to 22 per cent. of volatile oil, having the odor of turpentine, a specific gravity of about 0.872, boiling at between 155° and 170° C. (338° F.) and soluble in alcohol. The remainder consists of about 14 to 15 per cent. of indifferent resin, and 60 to 64 per cent. of acid resins; *α-* and *β-larinolic acids* ($C_{18}H_{26}O_2$) are amorphous, *laricinolic acid* ($C_{20}H_{30}O_2$) is crystalline.

Chian turpentine (*Scio* or *Cyprian turpentine*, *Terebinthina chia* or *cypria*, *Alk gum*) is a totally different product, derived from *Pistacia terebinthus* L. (*P. Terebinthina* Lag.—Fam. *Anacardiaceæ*), a small tree of the Mediterranean region, and thence eastward. It exudes precisely like mastiche, to which it is closely related, and like it becomes hard and brittle with time. The genuine article is very scarce, and that of commerce is usually spurious, of Pinaceous origin. It is of a yellowish-green color, slightly like fennel in odor when fresh, soluble in alcohol, benzol and ether. It consists of about 10 or 12 per cent. of volatile oil, the remainder being resin.

TEREBINTHINA CANADENSIS, *U. S.*, *Br.*—Canada Turpentine.

Balsamum Canadense.—Canada balsam, balsam of fir, E.; *Térébenthine du Canada, Baume de Canada*, Fr. Cod.; *Canadischer Terpentin*, G.; *Trementina de Canada*, Sp.

A liquid oleoresin obtained from *Abies balsamea* (L.) Miller (Fam. *Pinaceæ.*, U. S. P.).

The Balsam, Balsam fir, Balm of Gilead fir, American silver fir, Fir pine, or Blister pine (Fig. 443), is a slender evergreen of 50 to 60 feet, abundant in the northern U. S. and Canada. Its dried leaves possess a deliciously sweet fragrance, and are esteemed for the making of "pine" or "balsam" pillows. The Indians of Hudson's Bay deprive the bark of its periderm, leaving the vesicles exposed, and dry it. This product, under the name *wayakosh*, is applied to wounds. It is bitter, astringent, and has the odor of this turpentine.

FIG. 442.

Abies balsamea (½ Nat.).

FIG. 443.

Instrument for collecting balsam of fir.

The oleoresin collects in bark-lacunæ, externally visible as transversely elongated blisters, which are pierced by the sharp nozzle of the collecting vessel here figured. The principal collecting districts are in Quebec. The average yield of a tree is about 8 ounces, less at each succeeding collection, these occurring at intervals of two or three years. A gallon is said to represent a good day's collecting for a man, with the assistance of two children.

The substance is yellowish or faintly greenish, transparent, viscid, of an agreeable terebinthinate odor, and a bitterish, slightly acrid taste. When exposed to the air, it gradually dries, forming a transparent mass. It is completely soluble in ether, chloroform, or benzol. Its principal value is derived from its perfect transparency and peculiar optical properties, which fit it for use in the mounting of miscroscopical specimens.

Its composition, so far as chemical analyses go, is practically the same as that of ordinary turpentine.

Tschirch and Bruening give the following composition: Volatile oil, mostly boiling between 160 and 167° C. (332.6° F.), 23 to 26 per cent.; indifferent resin ($C_{21}H_{40}O$), 11 to 12 per cent.; acid resins, about 63 per cent., these being *Canadinic* resin ($C_{19}H_{34}O_2$), *Canadolic acid* ($C_{19}H_{28}O_2$), and (the main part) α- and *β-Canadinolic acid* ($C_{19}H_{30}O_2$). The volatile oil is regarded as of very complex composition.

The so-called "Oregon Balsam Fir" is fictitious, being a preparation of ordinary turpentine.

Action and Uses.—The properties and uses of Canada turpentine differ in no essential from those of ordinary TURPENTINE (which see).

Other Fir Products.—The genus *Abies* Juss. contains about 20 species, of cool-temperate regions of the northern hemisphere, and some tropical mountains. There appears no reason why any one of them should not be utilized in medicine like that above considered.

Strassburg turpentine (*Terebinthina Argentoratensis; Térébentine d'Alsace* or *des Vosges, T. ou Citron*, Fr.) is actually so collected, on an extensive scale, from the vesicles of *A. Picea* (L.) Lyons (*Pinus Picea* L., *P. pectinata* Lam., *P. Abies* Du Roi., *Abies alba* Mill., *A. pectinata* DC., *A. excelsa* Link.), the European Silver Fir, Silver Pine, or Strassburg Pine. It closely resembles the Canada article, but has a lemon-like fragrance. Tschirch and Weigel give the composition of Strassburg turpentine as follows: Greenish, fluorescent volatile oil, of the specific gravity 0.860, boiling between 148 and 165° C. (329° F.), 28 to 30 per cent.; the amorphous resin *abiennic acid* ($C_{13}H_{20}O_3$), 8 to 10 per cent.; the crystalline resin *abietolic acid* ($C_{20}H_{28}O_2$), 1.5 to 2 per cent.; *α-* and *β-abietinolic acid* ($C_{16}H_{24}O_2$), 46 to 50 per cent.; a little succinic acid, bitter principle, and coloring-matter. From the young shoots of this species is distilled an "extra-fine pine-needle oil," highly prized in perfumery manufacture.

A somewhat similar oil is distilled from the young shoots of *A. Pichta* (Fisch.) Forb. (*A. Sibirica* Ledeb.), and one from the young cones of another species.

A. Menziesii Lindl., the Pacific Coast Balsam Fir, yields a product similar to Canada turpentine, rarely collected.

The term "Balm of Gilead Buds" is applied to the buds of *A. balsamea*, as well as (more properly) to those of *Populus candicans*.

The leaves of the Balsam Fir contain 5.13 per cent. of tannin, the stem-bark 12.49 per cent., and the root-bark 11.93 per cent. (*Bastin and Trimble*). Similar amounts of tannin have been found in other species.

(*Pix Burgundica*, also from this genus, is considered elsewhere).

Spruce Gum is to be regarded as a turpentine. It is derived from *Picea Mariana* (Mill.); B. S. P. (*P. nigra* Link; *Abies Mariana* Mill.; *Abies nigra* Desf.; *Pinus nigra* Ait.), a small tree of the northern part of North America. It collects in blister-like cavities of the bark, like Canada turpentine, and is either semi-soft when removed, or already hard. Sometimes it is found occupying longitudinal fissures in the wood. The latter is poorer, and is purified after collection. This article is used almost wholly as a masticatory, probably 500,000 pounds being consumed annually in this way.

TERPINI HYDRAS, *U. S.*—Terpin Hydrate.

Terpinum hydratum, P. G.; *Terpine*, Fr. Cod.—*Dihydrate de térébenthène, Hydrate de terpilène*, Fr.; *Terpinhydrat*, G.

Formula, $C_{10}H_{20}O_2 + H_2O$ or $C_{10}H_{18}(OH)_2 + H_2O$. Molecular weight, 188.74.

The hydrate of the diatomic alcohol terpin. Terpin hydrate should be kept in well-stoppered bottles.—U. S.

Preparation.—The French Codex alone gives a process for the manufacture of terpin hydrate, as follows: 39 Gm. of nitric acid of 1.39 specific gravity are mixed with 11 Gm. of water and the mixture allowed to cool. The liquid is then poured into a shallow dish, and 50 Gm. of 85 per cent. alcohol and 200 Gm. of French oil of turpentine added. After covering the dish loosely with paper it is set aside for several days at a temperature of 15° to 20° C. (59°–68° F.), the contents being stirred occasionally. As soon as crystals cease to be formed, they are removed and pressed between paper, the mother-liquor being neutralized with sodium hydroxide solution and made to yield a further crop of crystals. Finally the crystals are purified by solution in 95 per cent. alcohol and recrystallization.

The formation of terpin hydrate depends largely upon the temperature at which the reaction is allowed to go on. If the temperature be too high, resinification takes place, and if too low, terpin hydrate is formed very slowly. According to Krentmann (*Pharm. Zeitg.*, 1900), a larger yield of crystals is obtained if a solution of hydrogen dioxide is substituted for the alcohol. Terpin hydrate is also slowly formed if oil of turpentine be kept in contact with water for a long time.

Properties and Tests.—Terpin hydrate occurs in colorless, lustrous, rhombic prisms, nearly odorless, and having a slightly aromatic and somewhat bitter taste. It is permanent in the air. Soluble in about 200 parts of water, and in 10 parts of alcohol at 25° C. (77° F.); in 32 parts of boiling water, and in 2 parts of boiling alcohol; also soluble in about 100 parts of ether, 200 parts of chloroform, or 1 part of boiling glacial acetic acid. Terpin hydrate melts when quickly heated at 116° to 117° C. (240.8°–242.6° F.), with loss of water, and, at the temperature of boiling water, sublimes in fine needles. When heated in a flask adapted for distillation, it first loses water. At 258° C. (496.4° F.) anhydrous terpin distils over without decomposition, soon solidifying to a crystalline, hygroscopic mass, which melts at 102° to 105° C. (215.6°–221° F.). When strongly heated on platinum foil, it burns with a bright, smoky flame, leaving no residue. If to its hot, aqueous solution a few drops of sulphuric acid be added, the liquid will become turbid and develop a strongly aromatic odor. Terpin hydrate should not have the odor of turpentine, and its hot, aqueous solution should not redden blue litmus paper.—U. S. Terpin hydrate is insoluble in oil of turpentine, and is optically inactive.

Action and Uses.—Like the terebinthinates in general, terpin hydrate has a stimulant action upon mucous membranes. It was introduced into medicine as a remedy for chronic nephritis, but its employment in this disease is rare. It is quite extensively administered in subacute and chronic bronchitis and laryngitis to facilitate the expulsion of mucus from the inflamed part. Some cases of hay fever yield promptly to full doses of the drug. The average dose is 2 to 5 grains (0.12–0.30 Gm.), but it may be given in the dose of 15 to 20 grains (1–1.3 Gm.), 3 times a day in hay fever. It may be dispensed in capsule, suspended in mucilage, or dissolved in elixir, which should be strongly alcoholic to hold in solution enough of the drug so that the dose of the liquid be not too bulky.

Derivative Product.—Terpinol, Fr. Cod.—*Terpinol.*—If terpin hydrate be distilled in the presence of moderately dilute mineral acids, an oily liquid of pleasant odor is obtained, to which the name terpinol has been given (not to be confounded with terpineol). According to Wallach it consists of a mixture of terpineol, terpinene, terpinolene, and dipentene, in

varying proportions, depending chiefly upon the dilution of the acid employed. The French Codex directs that 100 Gm. of terpin hydrate be distilled with a mixture of 10 Gm. of sulphuric acid of 1.843 specific gravity and 500 Gm. of water, the resulting product being a colorless liquid, of 0.850 specific gravity, boiling between 170° to 220° C. (338°–428° F.), and having a pleasant hyacinth-like odor.

THEA.—Tea.

Thee, G.; *Thé*, Fr.; *Te, Te de China*, Sp.; *The dried leaves of Thea Chinensis* (or *Sinensis*) L. (*Camellia Thea* Link; *C. theifera* Griffith—Fam. *Theaceæ*).

Origin and Preparation.—Tea is obtained from a shrub which is indigenous to China and probably to other parts of southern and southeastern Asia, and has been cultivated in India, China, and Japan from a very early period. The varieties produced by long cultivation were formerly regarded as distinct species, and described as Thea Bohea, T. viridis, T. stricta, etc. The plant has been successfully introduced in several parts of the United States. It bears white axillary flowers and roundish-triangular, three-celled, and three-seeded capsules. The seeds are subglobular, somewhat flattened, of the size of a cherry stone, glossy brown, yellow at the hilum, and have a brittle testa, a short radicle, and unequal thick plano-convex cotyledons. There is probably no other agricultural product in the cultivation of which such refined methods enter as in that of tea. The finest Chinese tea is grown under shelter, neither sunshine nor rainwater being ever permitted to reach the growing leaves. Partly upon the methods of growing, but more largely upon those of preparing, depend the peculiarities of the very numerous varieties of commercial tea. After the leaves have been gathered, they are either rapidly dried, when they change to a dull-green color (green teas), or they are allowed to wilt, and are subsequently kept for some time in heaps, when they acquire a dark color (black tea). Both varieties are subjected to various manipulations, such as rolling upon a table, heating over a fire, etc., and are sometimes flavored by being left in contact with the flowers of the orange, fragrant olive, jessamin, and others. Hyson, Young Hyson, Gunpowder, and Imperial are some of the best-known brands of green tea, and Souchong, Oolong, and Pekoe are black teas.

Fig. 444.

Tea leaves (Nat.).

Very great improvements have recently been introduced into the manufacture of tea in India and Ceylon, chiefly through the efforts of Dr. (now Sir) George Watt. The careless, and even filthy, operations inseparable from the domestic and uncontrolled processes of manufacture which largely prevail in China have been replaced, in India, by methods of scientific accuracy and cleanliness.

Description.—Tea is met with in commerce in the form of little cylinders or rolls, into which the leaves have been twisted during the manipulation of rolling and in some varieties these leaves have again been formed into balls of different sizes. Tea leaves after having been softened in water and unfolded are found to be from 25 to 75 Mm. (1 to 3 In.) long, varying between oblong-ovate and oblanceolate in shape, short-stalked, pointed at both ends or blunt, sometimes emarginate at the apex and irregularly toothed at the margin. They have a prominent midrib, the lateral branches of which are curved upward near the margin. Tea has an agreeable odor, which varies, however, in the different varieties; its taste is pleasantly astringent and bitterish. The green color is not unfrequently heightened or imparted to tea by a mixture of Prussian blue and gypsum.

Constituents.—The important constituent of tea is from 1 to 4 per cent. of caffeine or "théine" (see Caffeina). About 15 per cent. (10 to 21 per cent. *Hooper*) of gallotannic

acid gives powerfully astringent properties to tea. Rochleder described *boheic acid* ($C_{14}H_{20}O_{12}$) as being amorphous, deliquescent, freely soluble in water and alcohol, and colored brown, but not precipitated, by ferric chloride, and precipitated by lead acetate. There are also small amounts of gallic acid, albumin, wax, resin, from ½ to 1 per cent. of volatile oil of a yellowish color, strongly aromatic odor and taste, and readily congealing. Two alkaloids isolated in very small amount are *theophylline*, an isomer of theobromine, highly diuretic, and *ademine* ($C_5H_5N_5$). The finest varieties of green tea contain the most tannin. The mode of drying (green or black) is said not to affect the percentage of caffeine, but the green will be the more astringent.

Synthetic Theophylline.—The very small yield of the natural alkaloid has until recently precluded its use in medicine, but in 1903 its synthetic production in large quantity, based on the researches of E. Fischer, Traube and others, made its use as a valuable diuretic possible. The name *theocine* has been given to the synthetic product for the purpose of distinguishing it from the natural alkaloid, and its manufacture on a commercial scale is now carried on in Europe under a German patent, involving the use of ammonia, carbon dioxide, potassium cyanide, acetic and formic acids in a series of 12 simple reactions. Theocine is the first instance of the successful production of an alkaloid on a commercial scale by strictly synthetic methods. It occurs in colorless needles, melting at 268° C. (514.4° F.), which are said to be insoluble in ether and difficultly soluble in alcohol. It requires 179 parts of cold water for solution, and considerably less than that of warm water. Like theobromine, theocine forms double compounds with the salts of ammonium, potassium, and sodium, of which the two first-named are said to be readily soluble and the latter only slightly soluble.

Action and Uses.—Taken in moderate quantity, tea quickens the activity of the brain and general nervous system, induces a grateful sense of exhilaration, a lively flow of ideas, and relieves hunger. Because of these pleasant effects, tea has become the favorite beverage of a great number of individuals, particularly those who lead sedentary, monotonous lives, and feel the need of something to arouse them from their lethargy. Another class who indulge freely in it are those who, though fatigued by mental or physical exertion, desire to continue their labor, even if it be at the expense of their reserve energy. It is affirmed by some and denied by others that tea diminishes tissue waste and the excretion of urea. The excessive use of tea results in derangement of the nervous system, manifested by vertigo, headache, ringing in the ears, tremors and mental confusion, and disorder of the digestion is common, as is evidenced by pyrosis, eructations, flatulence, and constipation. Dyspeptic symptoms are more apt to follow over-indulgence in green tea, which contains more tannin than the black variety. Owing to its tannin, tea may be used as a mild astringent in diarrhœa. A strong infusion of green tea may be used as an injection in subacute gonorrhœa and leucorrhœa, and as a gargle in sore throat. The wakefulness and stimulation induced by tea adapts it as a remedy in opium poisoning. It is one of the best remedies to relieve the headache due to nervous exhaustion. Theine, being identical with caffeine, may be employed interchangeably with it (see Caffeine).

Related Plants and Products.—Tea seeds contain about 20 per cent. of fixed oil, with saponin, the latter dissolving to some extent in the oil, thus rendering the latter undesirable for internal use. The seeds of the related plants *Camelia drupifera* Lour. and *C. Kissi* Wall. yield a fatty oil which is eaten and has many mechanical uses.

Other Caffeine-bearing Products.—The important sources of caffeine, Coffea, Guarana, Kola, and Theobroma, have been considered in order. The following American species of the genus *Ilex* are or have been consumed extensively for the same constituent: *Mate, Paraguay* or *Brazilian Tea* (*Jesuit's* or *St. Bartholomew's Tea,* E.; *St. Bartholomykraut, Jesuitenthée,* G.; *Maté,* Fr.; *Yerba Maté,* Sp.) is the dried leaves of *Ilex Paraguensis* St. Hil. (*I. Paraguariensis* Don.; *I. Paraguayensis* Hook.; *I. thœzans* Bonpl.—Fam. *Ilicineæ*), and of several other species of Ilex growing in Paraguay, southern Brazil, etc. The plants are large shrubs or small trees. The small, leafy twigs are gathered and dried, usually in ovens, and shipped to the towns, where they are garbled, prepared and packed for the market. They are marketed entire, or coarsely or finely powdered, according to the taste of the user. They constitute a very cheap substitute for tea, and most of those who have learned their use are said to prefer them to genuine tea. They are very generally consumed in southern Brazil and the adjacent regions. The leaves are oblong-lanceolate or oblong-ovate, about 5 Cm. (2 In.) long, obtusish, sparingly toothed, thick, and coriaceous, of slight odor and astringent and bitter taste. They contain usually from 0.5 to 1.5 per cent. of caffeine, about 15 per cent. of tannin, a little volatile oil, and a glucoside, besides ordinary plant-constituents.

Cassine (*Youpon, Dahoon, Black drink, Black draught, North American tea*) is the dried

leaves of *I. Cassine* L. This is in some respects one of the most interesting of North American medicinal plants. It is a small tree of the southeastern United States, growing chiefly near the coast. Its infusion was a favorite beverage of the North American Indians. Not only was it consumed by those who lived in its vicinity, but distant tribes made annual pilgrimages thither and engaged in trade, and celebrated religious rites, while remaining to drink of it. It thus becomes involved in important ways in the aboriginal history of our country. (See *Bulletin No. 14*, U. S. Dept. Agric., by Dr. E. M. Hale, of Chicago). It contains caffeine, to the extent of about ¼ per cent., with about 7 per cent. of tannin.

A great many vegetable substances which do not contain caffeine have been used as tea substitutes, and quite a number of them have been elsewhere referred to in this work. especially *Ledum* and *Ceanothus*.

THEOBROMA.—Cacao.

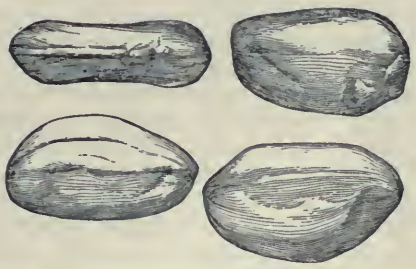
Semen, or *Fabæ cacao.—Cacao* (incorrectly "*Cocoa*") *beans* or *seeds*, *Chocolate beans* or *seeds*, E.; *Kakaobohnen*, G.; *Cacao, Fèves du Mexique*, Fr.; *Cacao*, Sp.

The prepared and dried ripe seeds of *Theobroma Cacao* L. (*Cacao sativa* Aubl.; *C. minor* Gaertn.; *C. Theobroma* Fuss.—Fam. *Sterculiaceæ*).

Cacao seeds are official in very few pharmacopœias, though their products, especially Oleum Theobromatis, are represented in all.

Origin.—The chocolate-tree is a native of tropical America, and is everywhere cultivated in tropical regions where the rainfall is abundant. It is of the size of a small apple tree, which it resembles in habit. The flowers are produced from the bark of the branches, or even of the trunk. The fruit is about 15 Cm. (6 In.) long, ovoid, longitudinally 10-grooved, terminates in a thick, nipple-shaped point, and resembles a small squash. It is of a yellow to orange-red color. The shell is somewhat like that of a squash, and it is filled with a soft, juicy, whitish, sweet pulp, in which numerous seeds, attached to a soft central placenta, are imbedded. After collection, the fruits are divided longitudinally and the contents scooped out. The seeds are then freed from pulp, the latter being often made into a delicious jelly. If the seeds are then dried, they will have a bitter and astringent taste. The practice is, therefore, to subject them to a sweating process to destroy, by fermentation, the tannin and bitter substance. Apparently, this sweating process results also in developing the derivative constituents on which the properties of chocolate depend, in part. This process is variously performed; sometimes by merely enclosing them in a tight box, and perhaps steaming, or placing in an oven. The original rude method of burying in pits in a clayey soil appears, however, to produce the best results, and the highest-priced cacao of the market is the yellow or orange-colored "clayed" Venezuelan article. "Claying" occupies about three days, after which the seeds are thrown into heaps and covered with leaves for about a week and dried.

Fig. 445.



Theobroma (Nat.).

Description.—The seeds are 15 to 25 Mm. (⅗–1 In.) long, ovate or oblong, somewhat flattened, and vary in color, according to the manner in which they have been prepared, from brown red to brown or grayish brown. A prominent raphe runs along one edge of the seed from one end to the other, uniting the hilum and chalaza, and is divided at the latter into many branching nerves. The testa is thin, papery, and fragile. The embryo has the shape of the seed, and consists of a small conical radicle and two large oily cotyledons, which are strongly ribbed upon their faces, and by the projecting folds of the inner seed-coat are divided from the back into numerous small irregular lobes, so that they readily break into many angular pieces. The odor of cacao-seeds is slight, but on warming is agreeably aromatic; their taste is oily, aromatic, and bitterish.

Among growers it is considered an indication of good quality when the cotyledons are shrunken away from one another, leaving a good-sized cavity between them.

Constituents.—From a pharmaceutical standpoint, the important constituent of cacao is its fat (see Oleum Theobromatis), which exists up to the extent of about 50 per cent. in the best seeds, and is contained in the kernel, which latter represents about 88 per cent. of the weight of the seed. Of more importance from a physiological stand-

point are the alkaloids, caffeine, 0.35 per cent. or less, and theobromine, of which the percentage is exceedingly variable. Of the latter, the entire seeds yield from less than 1 to about 2.5 per cent.; the seed-coats or "shells," an amount said to vary from less than 0.5 to 4.5 per cent. of their weight. The relations of those substances are of great interest and importance. Theobromine is said to be not present in the unfermented seeds, but to be developed in the curing process, through the conversion of a glucoside, the other products being dextrose and the coloring-matter *cacao-red*, of which there is about 5 or 6 per cent. Caffeine (*methyl-theobromine*) then results, and this can be artificially produced from theobromine by heating the silver compound with methyl iodide to 100° C. (212° F.). Other constituents of theobroma are about 15 per cent. of starch and an equal amount of proteids and 0.6 per cent. of sugar. The ash-yield of the seeds is about 3.5 per cent., of the kernel scarcely 3 per cent. There is also a very small amount of an unknown volatile and odorous principle. Caffeine is elsewhere discussed (see CAFFEINA). *Cacao-red*, soluble in water and alcohol and precipitated by lead acetate, appears to be combined with a proteid. When pure, it has a carmine-red color, and it is neutral to litmus. *Theobromine* or *dimethylxanthine* ($C_7H_8N_4O_2$), molecular weight, 179.75, occurs in minute white or colorless rhombic crystals, subliming without decomposition at 290° C. (554° F.), soluble in 736.5 parts of water at 18° C. (64.4° F.) in 818 parts of boiling absolute alcohol, in 21,000 parts of ether at 17° C. (62.6° F.), and in 15,808 parts of chloroform at 18° C. (64.4° F.), and is decomposed by warming with alkalies or earthy or hydrated lead oxide for some time (*Emminger*). It is neutral, but yields crystallizable salts which are decomposed by water. Emminger estimates theobromine by the following method, thus avoiding the necessity for dissolving it in ammonia and precipitating with silver nitrate, as previously recommended by Kuntze: Digest 10 grams finely powdered cacao in 150 parts petroleum spirit, dry the residue, and boil a weighed portion with 100 Cc. with a 3.4 per cent. solution of sulphuric acid in a flask with reflex condenser for about half an hour, until the formation of cacao-red ceases; neutralize the contents exactly, while hot, with a previously calculated quantity of baryta, evaporate to dryness with some sand, extract in a Soxhlet apparatus with 150 parts of chloroform for 5 hours, distil off the chloroform, and dry the residue at 100° C. (212° F.); wash the residue with not more than 100 Cc. of carbon tetrachloride, which dissolves the fat and caffeine; collect the insoluble theobromine on a filter, dissolve in boiling water, filter, evaporate, and weigh. It is said to be prepared most cheaply from the shells by boiling in water, filtering and pressing, precipitating tannin and coloring-matter with lead acetate, removing the lead with sulphuric acid, concentrating, adding burned magnesia, evaporating to dryness, extracting with 80 per cent. alcohol, and purifying by recrystallization from water.

Chocolate is made from Theobroma by roasting, removing the shells, breaking coarsely and removing the plumule, of stony hardness, grinding, the heat of friction being sufficient to melt the fat and produce a thick liquid, which is then run into molds and cooled. The fat may then be more or less completely removed by pressure between hot plates. The finest chocolate consists of the original, with the addition of some fat removed from the poorer grades. "Breakfast cocoa" consists of chocolate from which all the fat possible has been expressed. Chocolate is adulterated to a remarkable extent, a great variety of substances being employed, Thousands of tons of coco-nut-shells, raw or roasted, are thus used. Their presence is indicated by the presence of stone-cells, as is that of other nut-shells similarly employed. In Europe, ground chestnuts and other starchy substances are employed. Added starch to so slight an extent as 1 per cent. is said to be detected as follows: Boil 2 grains of the chocolate for 2 minutes in a test-tube with 20 Cc. of water, Cool, add 20 Cc. of water, and then, without shaking, 0.5 Cc. of a mixture of iodine 5, potassium iodide 10, and water 100. If pure, there may be a transient blue color, not lasting more than 12 minutes. If there is added starch, there will be an intense, persistent blue coloration (*Posetto*). For microscopical examination, a gram of finely powdered chocolate can be prepared by several extractions and decantations of ether to remove the fat, then one decantation with water, to remove the sugar. The starch grains of Theobroma are small (1 to 10 mikrons), single or compound, the former nearly circular in outline, with central films, and without lines, unless one or two close to the hilum.

Action and Uses.—The theobromine in cacao imparts to the nut stimulant properties closely resembling but less marked than those of tea or coffee. The fixed oil present

renders it highly nutritious. It contains only a trace of tannic acid, and is less likely to cause disorders of digestion than the other beverages. "Breakfast cocoa" particularly is easily borne by dyspeptics, because it is nearly free of fixed oil.

The genus *Theobroma* contains about a dozen species, and the seeds of several of them are used as Theobroma. *Caracas-cacao, Cacao blanco* or *Paporte* is the product of *T. bicolæ* H. et B. *Soconusco* or *Esmeraldas-cacao*, of Mexico, is derived from *T. ovalifolia* Sesse. The seeds of one or more species of *Herrania*, of South America, are similarly employed upon a very limited scale.

THUJA.—Thuja (Arbor Vitæ).

White, or Northern or False white cedar, Feather-leaf cedar, E.; *Thuya, Arbre de vie*, Fr.; *Lebensbaum*, G.

The fresh tops of *Thuja occidentalis* L. Fam. *Pinaceæ* (U. S. P., 1880).

Origin.—A handsome evergreen of northeastern North America, extending southward in the Alleghenies, reaching a height of about 50 feet, often planted, both at home and abroad, as an ornamental tree and for hedge-making. The branchlets spread out in a flattened or fan-like form, and the twigs are flattened, bearing 4 rows of closely imbricated and appressed scale-like leaves, which are 3 to 4 Mm. ($\frac{1}{8}$–$\frac{1}{6}$ In.) long, rhombic-ovate, obtusish or acutish. Those upon the sides are flat, those upon the edges folded into a boat-form. At the tips of the twigs the leaves are very broad, farther back they are elongated. A conspicuous elevated gland is borne upon the back, toward the apex, though many of these fall off in age. Thuja is strongly aromatic, pungent, camphoraceous, and bitter.

Fig. 446.

Thuja occid. branch (¾ Nat.); twig (×3).

Although sometimes dried, the drug is more active in the fresh state, and its common occurrence in cultivation renders it easily obtained. Care should be taken to distinguish it from the Asiatic *T. orientalis* L., which has the leaves grooved upon the back and wanting in the gland. Its branches are also erect, while those of the American are spreading.

Constituents.—Kawalier (1854–58) obtained from Thuja about 1 per cent. of volatile oil, a gelatinous compound, sugar, two resins, wax, a tannin identical with pinitannic acid, pinipicrin, and thujin. Pinipicrin and pinitannic acid are also found in the leaves and bark of *Pinus sylvestric* L., and doubtless occur elsewhere in the family. The volatile oil is colorless or greenish yellow, with bitter, sharp, camphoraceous taste, and a camphor-like odor resembling that of tansy. It has the specific gravity 0.925, boils between 190° and 206° C. (374° and 401° F.), and by fractional distillation can be separated into three portions (Wallach, 1892). It is readily soluble in alcohol, and with sulphuric acid or potassa turns black. *Pinipicrin* ($C_{22}H_{36}O_{11}$) is a yellow, bitter, powdery glucoside, which softens at 55° C. (130° F.), fuses to a transparent liquid at 100° C. (212° F.), and is not precipitated by lead salts. It dissolves in water, alcohol, and spirit of ether, but it is insoluble in pure ether. Boiled with dilute acids, it yields sugar and ericinol. *Thujin* ($C_{20}H_{22}O_{12}$) is a glucoside which forms astringent lemon-yellow crystals, and closely resembles quercitrin. It is soluble in hot water and alcohol, and with alkalies acquires a deep-yellow or red-brown color, and with ferric chloride turns green. It is precipitated by the acetate and subacetate of lead. Heated with dilute acids, it yields sugar and *thujigenin* ($C_{14}H_{12}O_7$), some of the latter being hydrolized to *thujetin* ($C_{14}H_{14}O_8$). These principles are almost insoluble in cold water, and, in alcoholic solution, acquire a handsome blue-green color with ammonia. Boiled with barium hydroxide, thujin is split into sugar and *thujetic acid* ($C_{28}H_{22}O_{13}$), which is insoluble in water.

Action and Uses.—Arbor vitæ somewhat resembles savin in its properties. Internally it may be used as an emmenagogue, and has been recommended in fevers, bronchial catarrh, rheumatism, and to remove intestinal worms. For these purposes it is administered in decoction or fluidextract. It has been applied locally in ointment to repress fungus granulations of ulcers, to remove warts and even cancerous growths. The ointment may be prepared either from the powdered leaves or from an oil distilled from them. The dose of the fluidextract is about 1 drachm (4 Cc.) given several times a day.

THYMOL, *U. S., Br., Fr. Cod.*—Thymol.

Thymolum, P. G.; *Acidum thymicum.—Thymic acid*, E.; *Acide thymique*, Fr.; *Thymiansaure, Thymolkampher*, G.

Formula, $C_{10}H_{14}O$ or $C_6H_3(CH_3)(OH)(C_3H_7)$. Molecular weight, 148.98.

A phenol occurring in the volatile oil of *Thymus vulgaris* L., and in some other volatile oils.—U. S.

A crystalline substance obtained from the volatile oils of *Thymus vulgaris* L., *Monarda punctata* L., and *Carum copticum* Benth. and Hook f., purified by recrystallization from alcohol.—Br.

Source.—Although thymol is found in several volatile oils, it is obtained for commerce chiefly from the oil of ajowan seed, the fruit of *Ptychotis Ajowan*. This oil is subjected to distillation, that portion passing over below 200° C. (392° F.) being collected. The residue, which has become rich in thymol by concentration, is then treated with sodium hydroxide solution, whereby the phenol is taken up as sodium-thymol, the resulting aqueous solution separated, diluted with water, and set aside until clear. Upon addition of hydrochloric acid the thymol is precipitated in the form of an oily layer, which is separated, and set aside in a cool place to solidify. If colored, the thymol may be treated with animal charcoal, and then crystallized from diluted alcohol.

The amount of thymol present in different oils varies considerably. Thus it is stated that while oil of thyme usually contains from 20 to 30 per cent. of thymol and its isomer carvacrol, ajowan oil contains from 45 to 55 per cent. of thymol, and oil of Monarda punctata as much as 60 per cent.

Properties and Tests.—Thymol occurs in large, colorless, translucent, rhombic prisms, having an aromatic, thyme-like odor, and a pungent aromatic taste, with a very slight caustic effect upon the lips. Its specific gravity as a solid is 1.030 at 25° C. (77° F.), but when liquefied by fusion it is lighter than water. It melts at 50° to 51° C. (122°–123.8° F.), remaining liquid at considerably lower temperatures. When triturated with about equal quantities of camphor, menthol, or hydrated chloral, it liquefies. Thymol is soluble in about 1100 parts of water at 25° C. (77° F.), and in less than its own weight of alcohol, ether, or chloroform; soluble in glacial acetic acid and fixed and volatile oils. Its alcoholic solution is optically inactive. If a very small crystal of thymol be dissolved in 1 Cc. of glacial acetic acid, and then 6 drops of sulphuric acid and 1 drop of nitric acid be added, the liquid will assume by reflected light a deep bluish-green color. If 1 Gm. of thymol be heated in a test-tube, in a water-bath, with 5 Cc. of a 10 per cent. solution of sodium hydroxide, a clear, colorless, or very slightly reddish solution should be formed, which becomes darker on standing, but without the separation of oily drops. If to this solution a few drops of chloroform be added and the mixture agitated, a violet color will be produced. An alcoholic solution of thymol should not be colored by ferric chloride test-solution. When a crystal of thymol is heated in an open dish, or in a watch-glass, on a water-bath, it should gradually volatilize, leaving no residue (absence of inorganic impurities).—U. S. Thymol should be kept in well-stoppered bottles in a cool place, on account of its volatile nature. If kept at ordinary room temperature, 25° C. (77° F.), it is apt to sublime on the sides of the container. Thymol acts as an antizymotic, but is inferior to carbolic and salicylic acids as an antiseptic.

Action and Uses.—Thymol was introduced into medicine as a substitute for phenol, the antiseptic and germicidal properties of which it possesses in almost equal degree. It has the advantage over phenol of a pleasant odor, of being much less irritating when applied locally, and of not causing toxic symptoms unless taken in very large amounts, at least 100 grains (6.6 Gm.) in 24 hours. In full medicinal doses its effects are similar to those produced by large quantities of salicylic acid—viz., a sensation of burning in the epigastrium, ringing in the ears, deafness, headache, and a marked decline in febrile temperature, accompanied by profuse sweating. The urine is sometimes decreased in quantity, and assumes a dark, greenish hue, due to the presence of oxidation products of thymol. In animals poisonous doses produce death by paralysis of respiration. The chief use of thymol is as an antiseptic. It is employed in mouth-washes for stomatitis, in gargles for tonsillitis, diphtheria, and other inflammations of the throat, in irrigations for otorrhœa, gonorrhœa, leucorrhœa, and ozena, and to correct the fetor of mucous discharges and sloughing wounds and ulcers. For these purposes solutions are employed

varying in strength from 1 to 10 parts dissolved in 1000 of water to which a small quantity of alcohol is added. In parasitic and sluggish skin diseases the application of an ointment containing 5 to 30 grains of thymol to the ounce (0.30–2.30 Gm.) is efficacious. It has the power of attracting flies, and in consequence its employment during the summer months is apt to cause annoyance to the patient. Internally thymol is recommended as an intestinal antiseptic in typhoid fever, diarrhœa, and dysentery, and as an antipyretic in many febrile affections. It is considered almost a specific in uncinariasis or hookwork disease. The dose of thymol is from ½ to 3 grains, given usually in capsule. It is best to follow it with a drink of milk to prevent it from irritating the stomach.

Derivatives of Thymol.—Thymacetin. $CH_3.C_3H_7.C_6H_2.OC_2H_5.NH.C_2H_5O$. — This compound bears the same relation to thymol as phenacetin does to phenol (carbolic acid), and is prepared in an analogous manner. It occurs as a white crystalline powder, sparingly soluble in water and ether, but readily soluble in alcohol.

Thymoform. $2(C_6H_3(CH_3)(C_3H_7)O).CH_2$.—A condensation product obtained by interaction upon heating 100 Gm. of thymol and 100 Cc. of a 40 per cent. solution of formaldehyde and gradually stirring in 100 Gm. of concentrated hydrochloric acid. The viscid oil, which separates after a violent reaction, is removed and thoroughly washed with water. It forms a yellowish, tasteless powder, having a faint odor of thymol. Thymoform is readily soluble in ether, alcohol, chloroform, and fixed oils, but is insoluble in water, glycerin, and petroleum benzin.

THYMOLIS IODIDUM, *U. S.*—Thymol Iodide.

Diiodothymol, Fr. Cod.; *Aristolum.—Dithymol diiodide, Aristol*, E.; *Dithymol biiodé*, Fr.; *Dithymoldijodid, Aristol, Annidalin, Thymotol*, G.

Formula, $C_{20}H_{24}O_2I_2$ or $(C_6H_2.CH_3.C_3H_7.OI)_2$. Molecular weight, 545.76.

Dithymol diiodide is obtained by the condensation of 2 molecules of thymol and the introduction of 2 atoms of iodine into the phenolic groups of the thymol; it contains 45 per cent. of iodine.—U. S.

Preparation.—The French Codex gives the following directions for the preparation of thymol iodide: Dissolve 60 Gm. of finely powdered iodine and 80 Gm. of potassium iodide in water, and dilute the solution to 300 Cc. Make a separate solution of 16 Gm. of sodium hydroxide and 15 Gm. of thymol, with sufficient water to make 300 Cc. of solution. Add the iodine solution to the alkaline solution of thymol, with constant stirring, and wash the resulting brown precipitate with 1 or 1½ liters of water, and dry the product at 40° to 50° C. (104°–122° F.).

Properties and Tests.—Thymol iodide is a bright, chocolate-colored, or reddish-yellow, bulky powder, with a very slight aromatic odor. It is insoluble in water and glycerin; slightly soluble in alcohol at 25° C. (77° F.); readily soluble in ether, chloroform, collodion, and in fixed and volatile oils, leaving a slight residue. It is decomposed when heated to a melting-point. It is not soluble in solution of sodium hydroxide, either cold or warm. When heated with concentrated sulphuric acid, it is decomposed with the separation of iodine. If 0.5 Gm. be shaken with 10 Cc. of water, the mixture, on filtering, will yield a filtrate which should not become more than opalescent on the addition of nitric acid and silver nitrate test-solution (absence of iodides). If 0.5 Gm. be shaken with 10 Cc. of water, and the mixture filtered, no blue color should be imparted by the filtrate to red litmus-paper (absence of alkalies). If 0.5 Gm. be shaken with 10 Cc. of water, and the mixture filtered, the filtrate should not be colored blue upon the addition of starch test-solution (absence of free iodine). If 0.1 Gm. of thymol iodide be thoroughly ignited in a porcelain crucible, it should leave not more than 0.003 Gm. of residue (limit of ash).—U. S. Thymol iodide is decomposed by light, and should be preserved in amber-colored vials, protected from the light.

Action and Uses.—Thymol iodide possesses in some degree the antiseptic properties of its component ingredients. It is used as a substitute for iodoform, chiefly because of its disagreeable odor. Its effect upon bacteria is not so powerful as that of iodoform, and it is not generally considered as efficient an antiseptic. It may, however, be employed with benefit in many cases. Internally it is claimed to be innocuous, but this can be true only when moderate doses are taken. Thymol iodide is an useful application in nasal, aural, and cutaneous affections, and in the treatment of wounds and sores when a mild antiseptic is indicated. It favorably influences the course of purulent otitis media, chronic rhinitis, balanitis, chancroids, ulcers, etc. It is applied either in powder or in

ointment (10 per cent.). Upon lupus it produces little effect, unless the surface is first curetted, and in psoriasis it is not so efficacious as chrysarobin. In fine powder it has been found of marked value in interstitial keratitis.

Allied Products.—Isobutylorthocresol Iodide. $C_{22}H_{29}O_2I$.—This compound, better known by its commercial name, *Europhen*, is prepared in a manner similar to that given above for thymol iodide, and is formed by reaction between a solution of iodine and an alkaline solution of isobutylorthocresol. It is a yellow powder, insoluble in water, but soluble in alcohol, ether, chloroform, and fixed oils. It contains about 28 per cent. of iodine. Europhen is permanent when dry, but when moistened with water, iodine is split off and a soluble iodine compound is formed. Europhen is used like thymol iodide.

Carvacrol Iodide. $C_{13}H_{13}OI$.—A yellowish-brown powder obtained if carvacrol be substituted for thymol in the process given above for the preparation of thymol iodide. It is insoluble in water, difficultly soluble in alcohol, but readily soluble in ether, chloroform, and olive oil. At 50° C. (122° F.) it begins to soften, and melts at 90° C. (194° F.) to a brownish-colored liquid.

THYMUS.—Thyme.

Herba Thymi, P. G.—*Common or Garden thyme*, E.; *Thymian, Gartenthymian, Römischer Quendel*, G.; *Thym*, Fr.; *Tomillo*, Sp.

The dried flowering herb of *Thymus vulgaris* L. (Fam. *Labiatæ*).

Origin and Description.—Thyme is a native of southern Europe, and is very largely cultivated, for medicinal purposes, for the extraction of the oil and thymol, and as a condiment. It is a low, slender, much-branched, hairy, highly aromatic perennial, the base more or less prostrate and rooting. The leaves are ovate-oblong or linear, revolute on the margin, grayish green, glandular-punctate on both sides and pubescent beneath, the upper ones bearing in their axils small clusters of whitish or reddish flowers with exserted stamens. The nutlets are about 1 Mm. ($\frac{1}{25}$ In.) in diameter, spheroidal, and finely tuberculate. The odor is agreeable, the taste warm, aromatic and pungent.

Fig. 447.

Thyme: flowering branch (slightly reduced); flower (× 3).

Constituents.—Besides a little tannin, resin, and unimportant substances, thyme contains about 2.5 per cent. of volatile oil (see Oleum Thymi), which constitutes its active constituent.

Action and Uses.—Thyme depends for its medicinal virtues upon its volatile oil (see Oleum Thymi). In infusion which is mildly diaphoretic and stimulant it is sometimes employed in domestic medicine.

Other Species.—The genus *Thymus* L. contains about 35 species, mostly of the Mediterranean region, and many of them have an odor similar to that of the above.

Fig. 448.

Serphyllum (¾ Nat.).

Serphyllum (*Herba Serphylli*, P. G.—*Wild thyme*, E.; *Feldthymian, Quendel*, G.; *Serpolet*, Fr.; *Serpol*, Sp.) is the dried flowering herb of *T. Serpyllum* L., a native of Europe and northern Asia, and sparingly naturalized in the United States. The stems are prostrate, more slender than those of the garden thyme, and usually purplish. The leaves are petiolate, flat, ovate, or roundish-lanceolate, occasionally linear, entire, ciliate near the base, glandular on both sides, otherwise smooth. The purple or rose-colored flowers are in aggregated heads or dense spikes terminating the branches, and have the four stamens included or sometimes exserted. It is a variable plant, including several nominal species, among them *Thymus citriodorus* Schreber, the *Lemon-thyme*, which has an agreeable odor resembling that of melissa and of lemon. In odor, taste, constituents, properties and uses, it agrees closely with garden thyme.

TILIA.—Linden-flowers.

Flores tiliæ, P. G.—*Lime-flowers, Basswood (Bast-wood) Flowers, Locust-bloom, Tiltree Flowers*, E.; *Lindenblüten*, G.; *Fleurs de tilleul*, Fr.; *Tilo*, Sp.

The dried inflorescence of *Tilia Europæa* L. and of other species of *Tilia* (Fam. *Tiliaceæ*).

Origin.—The *Linden, Lime, Basswood*, or *White-wood* trees are about 16 in number, natives of the North Temperate Zone, of about the dimensions of the elm, and largely planted for ornament and shade. The wood is soft but very tough, and is used in a great variety of important ways. The bark is very fibrous and tough, the leaves alternate, stipulate, petioled, broadly and usually obliquely heart-shaped, and serrate. The flower-clusters are abundant, axillary, and drooping, and very fragrant, being much sought by honey-bees.

FIG. 449.

a *b*

Tilia Europæa: *a*, flower (× 2); *b*, stamen-cluster (× 3½).

Description.—Cymes 3- to many-flowered, the peduncle united by its lower portion to the midrib of a large oblong or lance-oblong greenish-yellow bract; flowers yellowish or greenish white, pedicelled, 5-merous, the parts free and distinct, except that the original (mostly 5) stamens have each developed a cluster of stamens and, in the European species, an extra, narrow petal; ovary 5-celled, style stout, stigma 5-lobed; fruit a globular, nut-like, 1-celled capsule, containing 1 or 2 seeds.

Constituents.—Tilia flowers contain nearly 0.05 per cent. of a colorless, very thin volatile oil, of delightful fragrance, soluble in alcohol and ether in all proportions. There are also gum, sugar, pectin, fat, little tannin, etc. The glucoside *tiliacin*, occurring in the leaves, may be expected also in the inflorescence-bract, which is herbaceous, and which forms a part of the drug. This glucoside yields *tiliaretin* and this yields anisic acid.

Action and Uses.—An infusion of linden flowers is used in household medicine, especially on the Continent, to relieve nervous headache, hysteria, and painful indigestion, and to abort colds. The infusion is made by adding 30 to 60 grains (2–4 Gm.) of the flowers to 1 pint (480 Cc.) of water.

TILIACEÆ (The Linden Family).

This is a small family of 35 genera and about 300 species of trees and shrubs. Chief interest in the family relates to its tough bast-fibers, some of which are used for cordage. *Jute* is the product of several species of *Corchorus*. *Maqui* is the fruit of *Aristotelia Macqui* L'Herit. (*Cornu Chilensis* Mol.) of Chili, much used for imparting a fine red color to wine. The fruits of some species of *Grewia* are used as fish-poisons. *Tang-li* is a Chinese remedy for diarrhœa, consisting of the leaves and fruits of *G. Asiatica* L. The East Indian species, *G. tiliæfolia* Vahl. (*Dhamani* or *Tharra*) is reputed as an antidote to opium-poisoning. The root of *G. scabrophylla* Roxb. (*Katkhati*) is a substitute for Althæa. *Muntingia Calabura* L. and *Prockia dulcis* L. yield edible fruits. The bark of *Lühea grandiflora* Mart. is used in Brazil as an astringent, under the name *Azoite Cavallo*. Various species of *Triumfetta* are used in the West Indies as astringents, especially in gonorrhœa, under the names *Cousin Mahaut* and *Cardillo de Perro*. The seeds of the South American tree *Apeiba Tibourba* Aubl. (*Cabeza de Negro* or *Nigger-head*) yield a peculiar fixed oil of disagreeable odor.

TINCTURÆ.—Tinctures.

Teintures, Alcoolés, Fr.; *Tinkturen*, G.; *Tinturas, Alcoholados*, Sp.

Tinctures are solutions of non-volatile or only partially volatile substances, in liquids other than simple water or glycerin, and which invariably contain alcohol; solutions of volatile substances in alcohol are always termed spirits or essences. While tinctures are usually assumed to be solutions of vegetable principles, this is not the case in all the official tinctures; two of these, the tinctures of iodine and ferric chloride, are solutions of inorganic substances, and must also be classed as exceptions to the rule that tinctures are solutions of non-volatile substances. The menstruum or solvent used in the preparation of tinctures may be simply alcohol, various mixtures of alcohol and water, or of

alcohol, glycerin, and water, ammoniated alcohol in the form of aromatic spirit of ammonia, and mixtures of alcohol and ether; according as these different menstrua are employed, tinctures are divided into groups designated as alcoholic, hydro-alcoholic, ammoniated, and ethereal tinctures, respectively.

The U. S. Pharmacopœia recognizes 64 tinctures, of which 18 are made with alcohol, 44 with a hydro-alcoholic menstruum, and 2 with ammoniated alcohol; from this it is seen that the tendency is in the direction of weaker alcohol, and many tinctures formerly made with alcohol exclusively are now found equally efficient and permanent when made with a mixture of alcohol and water. The valuable solvent and preservative properties of alcohol are retained in the various hydro-alcoholic mixtures, in which the proportions of alcohol and water are so adjusted that complete extraction of the valuable constituents of the drug is insured as well as permanence of the solution; the solution of much inert and unstable matter is likewise thus avoided. Tinctures made with weak alcohol are also more readily miscible with aqueous liquids—a point often of great value in dispensing medicines. The addition of glycerin to the menstruum is frequently desirable to facilitate the perfect extraction of astringent and other principles, and to prevent subsequent changes in the finished tincture, due to atmospheric influences, which cause gelatinization of the solution or deposit of unsightly precipitates.

Preparation.—Tinctures of resins, oleoresins, balsams, and most gum-resins and extractive drugs are best prepared by maceration. Specific directions are given under each official process, and maceration should be conducted preferably at a temperature of about 15° to 20° C. (59°–68° F.), and in a shady place. Nearly all other drugs are conveniently extracted by percolation, which process is fully described in the Pharmacopœia, as given below, and if the process is properly conducted the drug will be practically exhausted long before the requisite amount of tincture has been obtained.

Official Process of Percolation.—"The percolator is prepared for percolation by pressing a small tuft of cotton into the neck above the cork, and this may then be moistened by pouring a few drops of the menstruum upon the cotton, to facilitate the passage of the first portion of the percolate, which is often very dense.

"The powdered substance to be percolated (which must be uniformly of the fineness directed in the formula, and should be perfectly air-dry before it is weighed) is put into a basin, the specified quantity of menstruum is poured on, and the powder thoroughly stirred with a spatula, or other suitable instrument, until it appears uniformly moistened. The moist powder is then passed through a coarse sieve—No. 40 powders, and those which are finer, requiring a No. 20 sieve, while No. 30 powders require a No. 15 sieve for this purpose. Powders of a less degree of fineness usually do not require this additional treatment after the moistening. The moist powder is now transferred to a sheet of thick paper, and the whole quantity poured from this into the percolator. It is then shaken down lightly and allowed to remain in that condition for a period varying from fifteen minutes to several hours, unless otherwise directed; after which the powder is pressed, by the aid of a plunger of suitable dimensions, more or less firmly, in proportion to the character of the powdered substance and the alcoholic strength of the menstruum, strongly alcoholic menstrua, as a rule, permitting firmer packing of the powder than the weaker. The percolator is now placed in position for percolation, and, the rubber tube having been fastened at a suitable height, the surface of the powder is covered by an accurately fitting disk of filtering paper or other suitable material, and a sufficient quantity of the menstruum poured on through a funnel reaching nearly to the surface of the paper. If these conditions be accurately observed, the menstruum will penetrate the powder equally until it has passed into the rubber tube and has reached, in this, a height corresponding to its level in the percolator, which is now closely covered to prevent evaporation. The apparatus is then allowed to stand at rest for the time specified in the formula.

"To begin percolation, the rubber tube is lowered and its glass end introduced into the neck of a bottle previously marked for the quantity of liquid to be percolated, if the percolate is to be measured, or of a tared bottle, if the percolate is to be weighed; and by raising or lowering this receiver the rapidity of percolation may be increased or decreased as may be desirable. A layer of menstruum must constantly be maintained above the powder so as to prevent the access of air to its interstices, until all has been added, or the requisite quantity of percolate has been obtained. This is conveniently accomplished, if the space above the powder will admit of it, by inverting a bottle containing the entire

quantity of menstruum over the percolator in such a manner that its mouth may dip beneath the surface of the liquid, the bottle being of such shape that its shoulder will serve as a cover for the percolator.

"When the dregs of a tincture, or of a similar preparation, are to be subjected to percolation, after maceration with all or with the greater portion of the menstruum, the liquid portion should be drained off as completely as possible, the solid portion packed in a percolator, as before described, and the liquid poured on, until all has passed from the surface, when immediately a sufficient quantity of the original menstruum should be poured on to displace the absorbed liquid, until the prescribed quantity has been obtained.

"It is obvious that the success of the process of percolation largely depends upon the regulation of the flow of the percolate; if this should be too rapid, incomplete exhaustion will result, but if too slow, valuable time may be wasted. The rate of flow for extracts and fluidextracts for 1000 Gm. of powder should range from 2 to 5 drops a minute; for official quantities of tinctures and preparations of about the same strength from 8 to 15 drops a minute, and the word "slowly" throughout the text is understood to mean a rate of flow corresponding to this; it is evident that the proper rate of flow should vary with the quantity and character of the drug employed and the density of the menstruum."

In connection with the official formulas for tinctures, specific directions are given as to the length of time the moistened drug is to stand before being packed, and also how long the packed drug is to be macerated after saturation with menstruum, before percolation is allowed to go on. This previous treatment of the drug is for the purpose of insuring perfect exhaustion, and has been found very effectual, but there are a few exceptions, where maceration before percolation has been found unnecessary or undesirable.

The British Pharmacopœia employs both percolation and maceration in the preparation of tinctures. In the former case the solid materials are moistened with the prescribed quantity of menstruum, and set aside in a closed vessel for 24 hours. The mixture is then packed in a percolator, firmly or lightly according to the nature of the drug, and further portions of the menstruum poured over the contents at intervals, until a sufficient quantity of menstruum has been used to produce about ¾ of the volume of the finished tincture. When liquid ceases to pass, the marc is removed from the percolator and expressed. The expressed liquid is filtered, either at once or after 24 hours, and mixed with the percolate, sufficient menstruum being finally added to produce the prescribed volume of tincture. If the tincture is to be made by maceration, the solid materials, together with the whole quantity of the menstruum, are placed in a closed vessel and allowed to stand for 7 days, with frequent agitation. The mixture is then strained and the marc expressed. After mixing the two liquids the whole is filtered.

The German Pharmacopœia prepares all tinctures by maceration. The drugs, either coarsely powdered or cut into thin slices, and the menstruum are introduced into a bottle, which should be only partly filled, so as to permit the frequent agitation of the contents; after macerating in a shady place at about 15° C. (59° F.) for a week, the liquid is decanted and the residue subjected to pressure; the liquids thus obtained are mixed, set aside for a day or two, and then filtered, care being taken to prevent the evaporation of alcohol. The liquid which remains absorbed in the drug is not replaced.

The French Codex directs its tinctures to be made by maceration or by displacement. For the latter process the directions are similar to those of the United States Pharmacopœia, except that the powder is ordered to be of medium fineness and is not moistened previous to its introduction into the percolator.

Strength of Tinctures.—The strength of the tinctures of the U. S. Pharmacopœia varies from 1.6 Gm. to 50 Gm. of drug, being in the majority of cases 10 or 20 Gm., for every 100 Cc. of finished product. 11 of the official tinctures are directed to be standardized to a definite alkaloidal strength, thus: Aconite, belladonna leaves, cinchona, colchicum seed, hydrastis, hyoscyamus, nux vomica, opium, deodorized opium, physostigma, stramonium. In accordance with suggestions made by the International Conference for Unification of Formulas for Potent Remedies, held at Brussels, in Belgium, in September, 1902, and in a few cases also for other reasons, a number of tinctures have been reduced in strength and others have been increased, as compared with the 1890 Pharmacopœia, as shown below:

Increased in Strength.—Tinctures of calumba, cantharides, capsicum, cinnamon, orange (sweet), quassia, rhubarb, serpentaria, strophanthus, and tolu.

Reduced in Strength.—Tinctures of aconite, belladonna leaves, benzoin (compound), catechu, cannabis (Indian), colchicum seed, deodorized opium, digitalis, gelsemium, hyoscyamus, kino, lobelia, opium, physostigma, sanguinaria, squill, stramonium, and veratrum.

The British Pharmacopœia of 1898 offers duplicate formulas for the preparation of its tinctures: in one, imperial weights and measures are employed, in the other, metric weights and measures. The strength of the official British tinctures varies from ¼ ounce to 5 ounces of drug in 1 imperial pint (20 fluidounces) of finished product, or from 12.5 Gm. to 250 Gm. in 1000 Cc.; of the 68 tinctures recognized, 29 are directed to be made by percolation and 26 by maceration. The French and German Pharmacopœias direct their tinctures to be prepared by maceration, and, almost without exception, of such strength that 1 part of drug is represented by about 5 or 10 parts of tincture by weight.

Preservation.—Upon exposure to air and light, tinctures, like all vegetable solutions, are prone to undergo change, and should, therefore, be kept in well-closed containers, in places not exposed to direct sunlight; extremes of temperature are equally hurtful on account of possible change in the menstruum. Fortunately, the deposits formed in tinctures consist, as a rule, only of inert extractive matter, which may be removed by filtration.

TINCTURA ACONITI, *U. S., Br., P. G.*—Tincture of Aconite.

Tinctura aconiti radicis.—Tincture of aconite-root, E.; *Teinture de racine d'aconit*, Fr.; *Akonittinktur, Eisenhuttinktur*, G.

Note.—The strength of this tincture has been reduced from 35 Gm. (1890) to 10 Gm. of aconite in 100 Cc.—U. S.

Preparation.—Aconite, in No. 60 powder, containing not less than 0.5 per cent. of aconitine, 100 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix alcohol and water in the proportion of 700 Cc. of alcohol to 300 Cc. of water. Moisten the aconite with 40 Cc. of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it very firmly, and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, gradually adding menstruum until 1000 Cc. are obtained.

Tincture of aconite, when assayed by the process given below, should contain in 100 Cc. 0.045 Gm. of aconitine.—U. S.

To make 1 pint of tincture of aconite, use 730 grains of the powdered aconite root, and moisten with 5 fluidrachms of the menstruum (alcohol 7 volumes, water 3 volumes). After maceration, percolate until 16 fluidounces of tincture have been obtained.

Aconite-root, in No. 40 powder, 1 ounce; alcohol (70 per cent.), sufficient to make 1 imperial pint (20 fluidounces) of tincture, by percolation.—Br.

Aconite-root, in coarse powder, 1 part; alcohol (68.5 per cent.), 10 parts. Make the tincture by maceration.—P. G.

Aconite-root, in coarse powder, 20 Gm.; alcohol (60 per cent.), 1000 Gm. Macerate for 10 days, express, and filter.—Fr. Cod.

Assay of Tincture of Aconite.—Transfer 100 Cc. of tincture of aconite to an evaporating dish and evaporate it carefully to dryness at a temperature not exceeding 60° C. (140° F.), and assay the resulting extract by the method given under Fluidextractum Aconiti (page 649), using the same details as there directed for 10 Cc. of fluidextract of aconite, with the exception that the multiplication of the product by 10 must be omitted; the result will represent the weight in grammes of aconitine contained in 100 Cc. of tincture of aconite.—U. S.

It will be found advantageous to add about 5 Gm. of powdered pumice stone to the tincture while evaporating, since the resulting residue will then be more readily acted upon by the acid liquid and the mixture be more easily filtered. Should the tincture be found to contain more aconitine than officially prescribed, it should be diluted with the proper amount of menstruum, and, on the other hand, if found deficient in aconitine, it should be concentrated, by evaporation at a gentle heat, until the official standard is obtained.

The present official tincture of aconite is considerably weaker than that of 1890, which latter represented about 160 grains of aconite in each fluidounce, but was not standardized to a definite alkaloidal content. It contains in each Cc. 0.00045 Gm., or in each fluidrachm about $\frac{1}{3\,6}$ grain, of aconitine. This fact must not be overlooked in determining the dose to be administered.

Tincture of aconite leaves is still recognized in the French Codex, and is made according to that authority, of the same strength as its tincture of aconite root.

The selection of efficient root and its careful percolation are of the utmost importance. The tincture is of a yellowish-brown color, and on the addition of water becomes milky from the precipitation of resin.

FLEMING'S TINCTURE OF ACONITE is still prescribed by some physicians; it is prepared by carefully percolating 10 troyounces of powdered aconite root with sufficient alcohol to obtain 15 fluidounces of tincture. Since the introduction of the very efficient official fluidextract of aconite there seems no longer to be any necessity for this tincture.

Uses.—The tincture is the preparation of aconite most frequently employed. Because of the decrease of the strength of this tincture in the U. S. P., 1900, the dose must be larger, and is from 3 to 10 minims (0.20–1 Cc.).

TINCTURA ALOES, *U. S., Br., P. G.*—Tincture of Aloes.

Teinture d'aloès, Fr.; *Aloetinktur*, G.; *Tintura de Acibar*, Sp.

Preparation.—Purified aloes, in No. 40 powder, 100 Gm.; glycyrrhiza, in No. 40 powder, 200 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Macerate the purified aloes and glycyrrhiza in a stoppered container, in a moderately warm place with 750 Cc. of diluted alcohol, for 7 days, with occasional agitation; then filter through purified cotton, or a plain paper filter, and, when the liquid has drained off completely, pass enough diluted alcohol through the residue to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of aloes macerate 730 grains of purified aloes and 3 avoirdupois ounces and 148 grains of licorice root, both in No. 40 powder, with 12 fluidounces of diluted alcohol for 7 days, and after filtration pass sufficient diluted alcohol through the residue to bring the volume up to 16 fluidounces.

Take of extract of Barbadoes aloes ½ ounce; liquid extract of licorice, 3 fluidounces; alcohol (45 per cent.), a sufficient quantity. Place the extract of Barbadoes aloes in a closed vessel with 16 fluidounces of the alcohol; set aside for 48 hours, occasionally shaking until dissolved; add the liquid extract of licorice; filter; pass sufficient of the alcohol through the filter to produce 1 imperial pint (20 fluidounces) of the tincture.—Br.

The formulas of other pharmacopœias require: Aloes, 1 part; alcohol (90 per cent.), 5 parts.—P. G. Aloes, 1 part; alcohol (60 per cent.), 5 parts.—Fr. Cod.

Tincture of aloes has a dark, blackish-brown color and a bitter taste, which latter, however, is considerably modified by the licorice.

Uses.—On account of the large dose required (½ ounce [16 Cc.]), this preparation is rarely used as a purgative, but may be given as a laxative in the dose of 2 drachms (8 Cc.). It has been applied locally to indolent ulcers, excoriations, bed-sores, and fissures.

TINCTURA ALOES ET MYRRHÆ, *U. S.*—Tincture of Aloes and Myrrh.

Elixir proprietatis Paracelsi.—Elixir de propriété, Fr.; *Aloëelixir*, G.

Preparation.—Purified aloes, in No. 40 powder, 100 Gm.; myrrh, in No. 40 powder, 100 Gm.; glycyrrhiza, in No. 40 powder, 100 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water. Macerate the purified aloes, myrrh, and glycyrrhiza in a stoppered container, in a moderately warm place, with 750 Cc. of the menstruum, for 7 days, with occasional agitation; then filter through purified cotton, or a plain paper filter, and, when the liquid has drained off completely, pass enough menstruum through the residue to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of aloes and myrrh macerate 730 grains each of purified aloes, myrrh, and licorice root, all in No. 40 powder, with 12 fluidounces of menstruum

(alcohol, 3 volumes; water, 1 volume), for 7 days, and after filtration pass sufficient menstruum through the residue to bring the volume up to 16 fluidounces.

The color of this tincture is deep reddish brown; if prepared with saffron, it is of a rich orange brown. It is precipitated by water.

In this connection should be mentioned the following preparation, which has long enjoyed considerable reputation on the continent of Europe:

Tinctura Aloes Composita, P. G.; *Elixir ad longam vitam, Elixir suedicum.—Compound tincture of aloes, Swedish bitters,* E.; *Elixir de longue vie, Elixir suédois,* Fr.; *Lebenselixir,* G.—Aloes, 6 parts, and gentian, rhubarb, zedoary, and saffron, each 1 part, are macerated for a week with 200 parts of alcohol, specific gravity 0.894; the tincture is expressed and filtered.—P. G. The formula of the French Codex reduces the aloes to 4 parts, the other ingredients to ½ part, and adds ½ part each of agaric and of confection of opium.

Uses.—The combination of myrrh and aloes renders this preparation of service as an emmenagogue to be given in amenorrhœa associated with constipation. The dose is 1 to 2 drachms (4–8 Cc.).

TINCTURA AMARA, *P. G.*—Bitter Tincture.

Teinture amère, Fr.; *Bittere Tinktur,* G.

Preparation.—Gentian, 3 parts; European centaury, 3 parts; bitter orange-peel, 2 parts; orange berries, 1 part; zedoary root, 1 part; alcohol (68½ per cent.), 50 parts. Reduce the drugs to a moderately fine powder, add the menstruum, and macerate for 7 days with occasional agitation. Then filter.—P. G.

Bitter tincture is of greenish-brown color, and has an aromatic odor and spicy bitter taste.

Uses.—Bitter tincture is a grateful stomachic and a stimulant to the appetite and digestion. It is given in the dose of 1 to 2 drachms (4–8 Cc.).

TINCTURA ARNICÆ, *U. S., Br., P. G.*—Tincture of Arnica.

Teinture de fleur d'arnica, Fr.; *Arnikatinktur,* G.

Preparation.—Arnica, in No. 20 powder, 200 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Macerate the arnica with 500 Cc. of diluted alcohol in a closed vessel, in a moderately warm place, for 3 days, with occasional stirring, and express strongly. Repeat this operation twice successively with 250 Cc. of diluted alcohol, macerating for 24 hours each time; then, having ascertained the volume of the united expressed liquids, macerate the residual marc for 6 hours with sufficient menstruum to make approximately 1000 Cc. and express as before. Mix the expressed liquids, filter through paper, and pass sufficient diluted alcohol through the filter to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of arnica macerate 3 avoirdupois ounces and 148 grains of ground arnica flowers with 8 fluidounces of diluted alcohol for 3 days and express strongly. Macerate twice more, each time with 4 ounces of diluted alcohol for 24 hours and again express. Measure the volume of expressed liquids and macerate the residue for 6 hours with sufficient menstruum to make 16 fluidounces. Finally filter.

The British Pharmacopœia directs 1 ounce of arnica rhizome, in No. 40 powder, to be percolated with 70 per cent. alcohol to obtain 1 imperial pint (20 fluidounces) of tincture. This tincture being made from arnica root differs materially in color, odor, and taste from the U. S. P. tincture, and is almost identical with the tincture of arnica root of the 1890 Pharmacopœia, which was dropped at the last revision.

The French and German Pharmacopœias both recognize tincture of arnica made from the flowers by maceration, the former directing 20 parts of drug and 100 parts of 60 per cent. alcohol, and the latter 10 parts of drug and 100 parts of 68½ per cent. alcohol.

Tincture of arnica has a yellowish-brown color and the characteristic odor of arnica flowers. If made with a stronger menstruum than diluted alcohol, it will be lighter in color and form a more opalescent mixture with water, containing, no doubt, more resinous matter. In our experience equally perfect exhaustion of the drug may be effected by moistening the powder with about ½ its weight of diluted alcohol, packing very

firmly in a percolator, saturating with menstruum, macerating for 48 hours, and then percolating slowly until the required volume of tincture has been obtained.

Uses.—Tincture of arnica is a popular household remedy, applied externally, either alone or diluted, for bruises, sprains, or local pains. The benefit it produces is probably due to the alcohol. Though rarely employed internally, it may be given in the dose of 10 to 30 minims (0.60–2 Cc.).

TINCTURA AROMATICA, *P. G.*—Aromatic Tincture.

Teinture aromatique, Fr.; *Aromatische Tinktur*, G.

Preparation.—Cassia bark, in coarse powder, 5 parts; ginger, in moderately fine powder, 2 parts; galanga root, in moderately fine powder, clove in moderately fine powder, and Malabar cardamom, crushed, each, 1 part; alcohol (68½ per cent.), 50 parts. Macerate for 7 days, shaking occasionally, and filter.—U. S.

Aromatic tincture has a brownish-red color and a decidedly aromatic odor, and a pungent, strongly spicy taste. It forms a turbid mixture with water.

Uses.—This tincture may be employed as a grateful addition to preparations designed to increase the appetite and promote digestion. The dose is from 1 to 2 drachms (4–8 Cc.).

TINCTURA ASAFŒTIDÆ, *U. S., Br.*—Tincture of Asafetida.

Teinture d'asafœtida, Fr.; *Asanttinktur*, G.

Preparation.—Asafetida, bruised, 200 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Macerate the asafetida in a stoppered container, in a moderately warm place, with 750 Cc. of alcohol, during 3 days, with frequent agitation; then filter through purified cotton, or a plain paper filter, and, when the liquid has drained off completely, pass enough alcohol through the residue to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of asafetida, macerate 3 avoirdupois ounces and 148 grains of well-bruised asafetida with 12 fluidounces of alcohol for 3 days, shaking frequently; then filter and pass sufficient alcohol through the residue to bring the volume up to 16 fluidounces.

The proportions of other pharmacopœias are: Asafetida, bruised, 4 ounces; alcohol (70 per cent.), sufficient to make 1 imperial pint (20 fluidounces).—Br. Asafetida, 1 part; alcohol (80 per cent.), 5 parts.—Fr. Cod.

Tincture of asafetida has a yellowish brown-red color, and the strong, disagreeable odor of the drug. It is rendered milky on the addition of water. Owing to the inferior quality of much of the commercial asafetida, care should be taken to use only such as is quite free from sand and other impurities, and more than ½ of which is soluble in alcohol.

Tinctura Asafœtidæ Ætherea.—The French Codex recognizes an ethereal tincture of asafetida under the name of *Teinture éthérée d'asafœtida* or *Ethérolé d'asafœtida*, which is made by macerating 1 part of asafetida in 5 parts of a mixture of ether 7 Gm. and alcohol 3 Gm. for 10 days, with occasional agitation, and then filtering.

Uses.—On account of its unpleasant taste, the administration of tincture of asafetida by the mouth is rarely resorted to except in hysterical conditions. The emulsion is a better preparation to be used in enemata to dislodge flatus. The dose is from 10 to 30 minims (0.60–2 Cc.).

TINCTURA AURANTII AMARI, *U. S.*—Tincture of Bitter Orange Peel.

Tinctura aurantii, Br.; P. G.—*Tincture of orange*, E.; *Teinture d'orange amère*, Fr.; *Pomeranzentinktur*, G.

Preparation.—Bitter orange peel, in No. 40 powder, 200 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix alcohol and water in the proportion of 600 Cc. of alcohol to 400 Cc. of water. Moisten the bitter orange peel with 80 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, gradually pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of bitter orange peel, moisten 3 avoirdupois ounces and 148 grains of the powdered peel with 1½ fluidounces of menstruum (alcohol 6 volumes, water 4 volumes), allow the mixture to stand for 6 hours, pack firmly in a percolator, saturate with menstruum until 16 fluidounces of percolate have been obtained.

Fresh bitter orange peel, cut small, 5 ounces; alcohol (90 per cent.), 20 fluidounces. Macerate in a closed vessel for 7 days, frequently agitating. Strain. Press the marc. Mix the expressed and strained liquids, and filter if necessary.—Br.

The German Pharmacopœia directs tincture of orange to be prepared by macerating 1 part of finely-cut bitter orange peel with 5 parts of 68½ per cent. alcohol for 7 days, and then filtering. The French Codex uses the same proportions, but orders 80 per cent. alcohol to be used.

The U. S. bitter tincture of bitter orange peel is not identical with the tincture of orange of the British Pharmacopœia, having a different color and taste. It is greenish brown, and has a somewhat bitter taste, and closely resembles the German tincture. The British tincture has a reddish-yellow color and a pleasant aroma, being made from fresh peel and containing chiefly the volatile oil of bitter orange. It resembles strongly the next following tincture.

Uses.—Tincture of bitter orange peel is employed chiefly as a flavoring ingredient of tonic mixtures. The dose is ½ to 2 drachms (2–8 Cc.).

TINCTURA AURANTII DULCIS, *U. S.*—Tincture of Sweet Orange Peel.

Teinture d'orange douce, Fr.; *Apfelsinenschaalentinktur*, G.

Preparation.—Sweet orange peel, from the fresh fruit, in thin shavings and cut into narrow shreds, 500 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Macerate the sweet orange peel in a stoppered wide-mouthed container, and in a moderately warm place, with 750 Cc. of alcohol, during 48 hours, with frequent agitation; then filter through purified cotton, and when the liquid has been drained off completely, gradually pass enough menstruum through the residue to make 1000 Cc. of tincture; finally filter through paper.—U. S.

To make 1 pint of tincture of sweet orange peel, macerate 8 avoirdupois ounces and 152 grains of fresh peel for 48 hours with 12 fluidounces of alcohol, pass through purified cotton, and then wash the residue with sufficient alcohol to bring the volume up to 16 fluidounces. Instead of cutting the orange peel into narrow shreds, it will be found more convenient to grate the outer rind, and then wash the grater with a little of the alcohol to be used as menstruum.

The present official tincture of sweet orange peel is 2½ times as strong as that of 1890. It has a deep reddish-yellow color, and a strong, fragrant odor of fresh orange peel, and is superior to a solution of the oil of orange in alcohol as a flavoring agent.

Uses.—This tincture is used solely as a flavoring agent in the dose of ½ to 2 drachms (2–8 Cc.).

TINCTURA BELLADONNÆ FOLIORUM, *U. S.*—Tincture of Belladonna Leaves.

Tinctura belladonnæ, Br.—*Tincture of belladonna*, E.; *Teinture de belladone*, Fr.; *Belladonnatinktur*, G.

Preparation.—Belladonna leaves, in No. 60 powder (containing not less than 0.35 per cent. of alkaloids), 100 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 40 Cc. of diluted alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 3 hours; then pack it firmly and pour on enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, gradually pouring on diluted alcohol until 1000 Cc. of percolate are obtained.

Tincture of belladonna leaves, when assayed by the process given below, should contain in 100 Cc. 0.035 Gm. of the alkaloids from belladonna leaves.—U. S.

To make 1 pint of tincture of belladonna leaves, moisten 730 grains of the powdered leaves with 5 fluidrachms of diluted alcohol and proceed as above, finally collecting 16 fluidounces of percolate.

Assay of Tincture of Belladonna Leaves.—Transfer 100 Cc. of tincture of belladonna leaves to an evaporating dish and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under FLUIDEXTRACTUM BELLADONNÆ RADICIS (page 652), using the same details as there directed for 10 Cc. of fluidextract of belladonna root, with the exception that the multiplication of the product by 10 must be omitted; the result will represent the weight in grammes of alkaloids contained in 100 Cc. of tincture of belladonna leaves.—U. S.

Take of liquid extract of belladonna root 2 fluidounces; alcohol (60 per cent.), a sufficient quantity. To the liquid extract of belladonna add enough of the alcohol to form 30 fluidounces of tincture; filter after 24 hours' rest. On evaporation to a small bulk and assay by the process given for liquid extract of belladonna root, 100 Cc. of the tincture should yield not less than 0.048 nor more than 0.052 Gm. of alkaloid.—Br.

Tincture of belladonna of the French Codex is made from the leaves with 60 per cent. alcohol, in the proportion of 5 Gm. of leaves for 100 Gm. of finished tincture.

The present official tincture of belladonna leaves is about one-third weaker than that of 1890, besides being standardized to contain 0.00035 Gm. of alkaloid in each cubic centimeter, or about $\frac{1}{50}$ grain in each fluidrachm. It has a deep greenish-brown color, and characteristic narcotic odor. The British tincture, being made from the root, is brownish yellow in color, and is about 50 per cent. stronger than that of the U. S. P.

TINCTURA BELLADONNÆ ÆTHEREA.—The French Codex recognizes an ethereal tincture of belladonna under the name *Teinture éthérée de belladone* or *Éthérolé de belladone*, which is made by exhausting 1 part of belladonna leaves with a menstruum composed of 7 parts of ether and 3 parts of alcohol until 5 parts of tincture have been obtained.

Uses.—This preparation fully represents the properties of the drug. It is given in the dose of 5 to 20 minims (0.30–1.30 Cc.).

TINCTURA BENZOINI, *U. S.*—Tincture of Benzoin.

Tinctura benzoës, P. G.—*Teinture de benjoin*, Fr.; *Benzoëtinktur*, G.; *Tinctura de benjui*, Sp.

Preparation.—Benzoin, No. 40 powder, 200 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Triturate the benzoin with 250 Cc. of alcohol until a uniform magma is obtained. Transfer this to a stoppered container with the aid of 500 Cc. of alcohol, and set it aside in a moderately warm place, shaking frequently during 3 days. Then transfer the mixture to a paper filter, and when the liquid has drained off completely, pour on enough alcohol to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of benzoin, triturate 3 avoirdupois ounces and 148 grains of benzoin with 4 fluidounces of alcohol until a uniform magma is obtained. Transfer to a bottle with the aid of 8 fluidounces of alcohol, and macerate in a moderately warm place for 3 days. After filtering, pour enough alcohol on the residue to bring the volume up to 16 fluidounces.

Macerate benzoin, 1 part, in alcohol, 5 parts.—Fr. Cod., P. G.

The tincture is brownish red, and yields with water a milky mixture having an acid reaction.

LAC VIRGINIS.—*Virgin's milk*, E.; *Lait vaginal*, Fr.; *Jungfernmilch*, G.—is a cosmetic preparation consisting of tincture of benzoin 1 part and rose-water from 20 to 100 parts.

Uses.—Tincture of benzoin was formerly applied to many conditions for which the compound tincture is employed. It is still popularly used in combination with rose-water as a lotion for chapping, sunburn, freckles, and slight eruptions of the skin. Its dose is from 10 to 20 minims (0.60–1.30 Cc.).

TINCTURA BENZOINI COMPOSITA, *U. S., Br.*—Compound Tincture of Benzoin.

Tinctura balsamica, Fr. Cod.; *Balsamum commendatoris, Elixir traumaticum.—Teinture balsamique, Baume du commandeur de Permes*, Fr.; *Persischer Wundbalsam*, G.

Preparation.—Benzoin, in No. 40 powder, 100 Gm.; purified aloes, in No. 50 powder, 20 Gm.; storax, 80 Gm.; balsam of Tolu, 40 Gm.; alcohol, a sufficient quan-

tity to make 1000 Cc. Triturate the benzoin and purified aloes with 250 Cc. of alcohol until a uniform magma is obtained. Transfer this to a stoppered container with the aid of 500 Cc. of alcohol, add the storax and balsam of Tolu, and set the mixture aside in a moderately warm place, shaking it frequently during three days; then transfer it to a a paper filter, and when the liquid has drained off completely, pour on enough alcohol to make 1000 Cc. of tincture.—U. S.

To make 1 pint of compound tincture of benzoin, triturate 730 grains of benzoin in No. 40 powder, 150 grains of purified aloes with 4 fluidounces of alcohol, until a uniform magma is obtained. Transfer this to a stoppered container with the aid of 8 fluidounces of alcohol, add 600 grains of storax and 300 grains of balsam of Tolu, and set the mixture aside in a moderately warm place for 3 days. After filtering, pour enough alcohol on the residue to bring the volume up to 16 fluidounces.

Take of benzoin, in coarse powder, 2 ounces; prepared storax, 1½ ounces; balsam of Tolu, ½ ounce; socotrine aloes, 160 grains; alcohol (90 per cent.), sufficient for 1 pint (imperial). Macerate for 2 days and filter.—Br.

St. Johnswort, 2 parts; angelica root, myrrh, olibanum, and aloes, of each, 1 part; balsam of Tolu and benzoin, of each, 6 parts; alcohol (80 per cent.), 72 parts.—Fr. Cod.

The older pharmacopœias had still more complicated formulas.

The tincture is intended to take the place of numerous preparations formerly employed, as *Wade's*, *Vervain's*, *Saint Victor's*, *Jesuits'*, *Friars'*, *Turlington's*, *Persian*, and *Swedish balsam*. It is of a deep red-brown color, and yields with water a reddish-white opaque mixture having an acid reaction.

Uses.—This preparation is sometimes given as an expectorant in subacute and chronic bronchitis to aid in the expulsion of mucous. Other drugs have supplanted it in the treatment of chronic diarrhœa and catarrh of the urinary organs. Locally, it is useful as a stimulant and protective for ulcers, bed-sores, cracked nipples, and fissures of the lips and anus. The dose is from 20 to 60 minims (1.30–4 Cc.).

TINCTURA BUCHU, *Br.*—Tincture of Buchu.

Teinture de buchu, Fr.; *Buchutinktur*, G.

Preparation.—Take of buchu leaves, in No. 20 powder, 4 ounces; alcohol (60 per cent.) a sufficient quantity. Moisten the powder with 4 fluidounces of the alcohol, and complete the percolation process. The resulting tincture should measure 1 pint (imperial).—Br. Buchu, 1 part; alcohol (80 per cent.), 5 parts.—Fr. Cod.

The first tincture has a greenish-brown, the second a brownish-green, color; both have the odor and taste of the drug.

Uses.—This preparation is not so frequently employed as an infusion in the conditions for which buchu is indicated. The dose is from 1 to 2 drachms (4–8 Cc.).

TINCTURA CALAMI, *P. G.*—Tincture of Calamus.

Teinture d'acore vrai, Fr.; *Kalmustinktur*, G.

Preparation.—Calamus, finely cut, 1 part; alcohol (68½ per cent.), 5 parts. Macerate for 7 days with occasional agitation, then filter.—P. G.

Tincture of calamus has a brownish-yellow color and a pungent, bitter, spicy taste.

Uses.—Tincture of calamus is used as a stomachic and flavoring agent. The dose is 1 to 2 drachms (4–8 Cc.).

TINCTURA CALENDULÆ, *U. S.*—Tincture of Calendula.

Tincture of marigold, E.; *Teinture de souci*, Fr.; *Calendulatinktur*, G.

Preparation.—Calendula, in No. 20 powder, 200 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the calendula with 80 Cc. of alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it very firmly, and pour on enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of calendula, moisten 3 avoirdupois ounces and 148 grains of calendula, in No. 20 powder, with 10 fluidrachms of alcohol, and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

This tincture is not recognized by other pharmacopœias.

Uses.—This tincture is employed as a cooling, soothing application in bruises, sprains, etc.

TINCTURA CALUMBÆ, *U. S., Br.*—Tincture of Calumba.

Tinctura colombo.—Teinture de colombo, Fr.; *Kolombotinktur*, G.

Preparation.—Calumba, in No. 20 powder, 100 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 400 Cc. of water. Moisten the calumba with 100 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 24 hours; then pack it with moderate pressure, pour on enough menstruum to saturate the powder and leave a stratum above it, and allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of calumba moisten 3 avoirdupois ounces and 148 grains of calumba, in No. 20 powder, with 1½ fluidounces of menstruum (alcohol, 6 volumes; water, 4 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

The British Parmacopœia directs tincture of calumba to be made by maceration, the strength being 2 avoirdupois ounces to 20 fluidounces imperial measure, and the menstruum alcohol of 60 per cent.

Colombo, 1 part; alcohol (60 per cent.), 5 parts.—Fr. Cod.

The tincture has a brown-yellow color, and is much less prone to unsightly precipitation than that made with diluted alcohol.

Uses.—Tincture of calumba is an excellent bitter tonic, given to stimulate the appetite and aid digestion. It is one of the bitters that can be added to fluid preparations of iron without causing precipitation and dark discoloration. The dose is ½ to 2 drachms (2–8 Cc.).

TINCTURA CANNABIS INDICÆ, *U. S., Br.*—Tincture of Indian Cannabis.

Tincture of hemp (Indian hemp), E.; *Teinture de chanvre de l'Inde*, Fr.; *Indischhanftinktur*, G.

Preparation.—Indian cannabis, in No. 40 powder, 100 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the Indian cannabis with 50 Cc. of alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it very firmly and pour on enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of Indian cannabis moisten 730 grains of the drug, in No. 40 powder, with 6 fluidrachms of alcohol, and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

Extract of Indian hemp, 1 ounce; alcohol (90 per cent.), a sufficient quantity. Dissolve the extract in 18 fluidounces of alcohol, filter, and add sufficient alcohol to bring the volume up to 20 fluidounces, imperial measure.—Br.

The present official tincture is ⅓ weaker than that of 1890, and about ¼ as strong as the British tincture, since Indian cannabis of good quality yields about 12½ per cent. of extract. The tincture of the French Codex is made from the drug with 60 per cent. alcohol, 100 Gm. of the finished tincture representing 20 Gm. of Indian cannabis, but it is doubtful whether the drug is completely exhausted by such weak alcohol.

Uses.—This tincture possesses all the medicinal properties of the crude drug. Being a resinous tincture, when added to aqueous mixtures its resin must be held in suspension by the aid of gum. Because of the uncertain quality of the crude drug, the dose of the tincture is estimated at from 5 to 60 minims (0.30–4 Cc.).

TINCTURA CANTHARIDIS, *U. S., Br.*—Tincture of Cantharides.

Tinctura cantharidum, P. G.—*Teinture de cantharide*, Fr.; *Spanischfliegentinktur*, G.

Preparation.—Cantharides, in No. 60 powder, 100 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the cantharides with 35 Cc. of alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it very firmly and pour on enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of cantharides moisten 730 grains of the powdered cantharides with 5 fluidrachms of alcohol and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

Cantharides, in No. 40 powder, ¼ ounce; alcohol (90 per cent.), 1 imperial pint. Prepare the tincture by maceration.—Br.

The tincture has the burning taste and the peculiar odor of cantharides. Made with alcohol, it is of a greenish-yellow color; but diluted alcohol dissolves the dark extractive matter and yields a brown-yellow tincture. The present official tincture of cantharides is twice as strong as that of 1890, representing 0.10 Gm. in each Cc. or about 5¾ grains in each fluidrachm. It is 8 times as strong as the British tincture and of about equal strength with the tinctures of the French and German Pharmacopœias.

Uses.—This is the preparation of cantharides best suited for internal administration. In overdose it will produce all of the irritating toxic symptoms of the crude drug. Its external application in liniments is rarely resorted to, both because its action is slow and because it is apt to induce vesication. The dose of the tincture is from 1 to 10 minims (0.05–0.60.).

TINCTURA CAPSICI, *U. S., Br., P. G.*—Tincture of Capsicum.

Teinture de piment des jardins, Fr.; *Spanischpfeffertinktur*, G.

Preparation.—Capsicum, in No. 50 powder, 200 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 950 Cc. of alcohol with 50 Cc. of water. Moisten the capsicum with 35 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of capsicum moisten 730 grains of capsicum, in No. 50 powder, with 5 fluidrachms of menstruum (alcohol, 95 volumes; water, 5 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

The British Pharmacopœia directs 1 ounce of capsicum to be macerated with 20 fluidounces of 70 per cent. alcohol, the resulting tincture being about ½ as strong as the U. S. P. preparation. The German tincture of capsicum is of about the same strength as our own.

Tincture of capsicum has a light reddish-orange color and the fiery taste of capsicum. The present official tincture is twice as strong as that of 1890.

Uses.—Tincture of capsicum is an efficient preparation of the drug, and is indicated in atonic conditions of the stomach, especially of chronic alcoholism, when a powerful impression upon the gastric mucosa is desired. Topically, it is a rubefacient added to liniments. Diluted, it is employed in gargles for relaxed sore throat. The dose is from 5 to 30 minims (0.30–2 Cc.).

TINCTURA CARDAMOMI, *U. S.*—Tincture of Cardamom.

Teinture de cardamome, Fr.; *Kardamomentinktur*, G.

Preparation.—Cardamom, in No. 30 powder, 200 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the cardamom with 80 Cc. of diluted alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient diluted alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of cardamom, moisten 3 avoirdupois ounces and 148 grains of the powdered cardamom with 1¼ fluidounces of diluted alcohol, and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

Simple tincture of cardamom is not official in the British, French, or German pharmacopœias. It is of a brownish-yellow color, and has the aromatic odor and spicy taste of cardamom in a marked degree. The present tincture is twice as strong as that of 1890.

Uses.—The compound tincture of cardamom has almost entirely replaced this preparation as a carminative and aromatic. Its dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA CARDAMOMI COMPOSITA, *U. S.*, *Br.*—Compound Tincture of Cardamom.

Teinture de cardamome composée, Fr.; *Zusammengesetzte Kardamomentinktur*, G.

Preparation.—Cardamom, 25 Gm.; Saigon cinnamon, 25 Gm.; caraway, 12 Gm.; cochineal, 5 Gm.; glycerin, 50 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Mix the glycerin with 950 Cc. of diluted alcohol. Reduce the cardamom, Saigon cinnamon, caraway, and cochineal to a No. 40 powder, and macerate in a stoppered container in a moderately warm place with 750 Cc. of the menstruum during 7 days, with occasional agitation; then filter through purified cotton or a plain filter, and when the liquid has drained off completely, pour on the residue, first the remainder of the menstruum, and then sufficient diluted alcohol to make 1000 Cc. of tincture.—U. S.

To make 1 pint of compound tincture of cardamom, mix 185 grains each of cardamom and Saigon cinnamon with 90 grains of caraway and 38 grains of cochineal, all in No. 40 powder, and macerate the mixture with 12 fluidounces of menstruum (diluted alcohol, 95 volumes; glycerin, 5 volumes) in a stoppered container in a moderately warm place during 7 days with occasional agitation. Filter through purified cotton, and pass enough menstruum through the residue to bring the volume up to 16 fluidounces.

The British Pharmacopœia directs ½ ounce each of bruised cardamom and caraway, 2 ounces of commercial raisins freed from seeds, ½ ounce of bruised Ceylon cinnamon, and 55 grains of powdered cochineal to be macerated with 20 fluidounces of 60 per cent. alcohol for 7 days.

Both tinctures have a red color, due to cochineal, and are of an agreeable aromatic odor and taste.

Uses.—This is a deservedly popular tonic, largely used as a pleasant vehicle for other drugs, and possessing valuable carminative and stomachic qualities. The dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA CASCARILLÆ, *Br.*—Tincture of Cascarilla.

Teinture de cascarille, Fr.; *Caskarilltinktur*, G.

Preparation.—Take of cascarilla, in No. 40 powder, 4 ounces; alcohol (70 per cent.), a sufficient quantity. Moisten the powder with 3 fluidounces of the alcohol and complete the percolation process. The resulting tincture should measure 1 pint imperial (20 fluidounces).—Br.

Uses.—Though an efficient tonic and stimulant to the gastro-intestinal tract, this preparation is rarely employed in this country. Its dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA CASTOREI, *Fr. Cod.*—Tincture of Castor.

Teinture de castoreum, Fr.; *Bibergeiltinktur*, G.

Preparation.—Castor, in coarse powder, 10 Gm.; alcohol (80 per cent.), 100 Gm. Macerate in a closed vessel for 10 days with frequent agitation. Express and filter.—Fr. Cod.

The tincture has a deep reddish-brown color, is rendered opalescent by water, and with a larger quantity of water becomes milky, of a dingy brownish-white color, deposits red-brown resinous matter, and on standing becomes nearly colorless and almost transparent; on the addition of excess of ammonia the resin remains undissolved.

TINCTURA CASTOREI ÆTHEREA.—*Ethereal Tincture of Castor.*—The French Codex directs this tincture to be made exactly like the above, except that instead of alcohol a menstruum composed of 7 parts of ether and 3 parts of alcohol is used.

Uses.—Tincture of castor is occasionally given in hysterical disorders, more for a psychic effect than for any sedative qualities that the drug may possess. Its dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA CATECHU COMPOSITA.—Compound Tincture of Catechu.

Tinctura Catechu, Br., P. G.; *Teinture de Cachou*, Fr. Cod.—*Tincture of catechu*, E.; *Katechutinktur*, G.

See TINCTURA GAMBIR COMPOSITA.

The change of title of this well-known preparation in the U. S. Pharmacopœia of 1900 seems unfortunate and hardly justified in view of the fact that recent editions of foreign pharmacopœias recognize Gambir or Pale Catechu under the official title of Catechu. It would perhaps have been better to have retained the old title for the tincture and transferred the title Catechu to the product now usually sold under that name, which is derived from Uncaria or Ourouparia Gambir and not, as heretofore, from Acacia Catechu. Very little if any catechu from Acacia Catechu is now to be found in the market.

Uses.—(See TINCTURA GAMBIR COMPOSITA.)

TINCTURA CHIRATÆ, *Br.*—Tincture of Chiretta.

Tincture of chirata, E.; *Teinture de chirette*, Fr.; *Chirettatinktur*, G.

Preparation.—Chiretta, in No. 40 powder, 2 ounces; alcohol (60 per cent.), a sufficient quantity. Moisten the powder with 2 fluidounces of the alcohol, and complete the percolation process. The resulting tincture should measure 1 imperial pint.—Br.

Uses.—This is used as a bitter tonic in the dose of ½ to 2 drachms (2–8 Cc.).

TINCTURA CHLOROFORMI ET MORPHINÆ COMPOSITA, *Br.*—Compound Tincture of Chloroform and Morphine.

Preparation.—Chloroform, 1½ fluidounces; morphine hydrochloride, 87½ grains; diluted hydrocyanic acid, 1 fluidounce; tincture of capsicum, ½ fluidounce; tincture of Indian hemp, 2 fluidounces; oil of peppermint, 14 minims; glycerin, 5 fluidounces; alcohol (90 per cent.), a sufficient quantity. Mix the chloroform, tincture of capsicum, tincture of Indian hemp, oil of peppermint, and glycerin with 9 fluidounces of the alcohol, and dissolve the morphine hydrochloride in the mixture; add the diluted hydrocyanic acid; then mix with enough of the alcohol to form 1 imperial pint of the compound tincture.—Br.

The above preparation contains in each fluidrachm 4½ minims of chloroform, 3 minims of diluted hydrocyanic acid, 6 minims of tincture of Indian hemp, 1½ minims of tincture of capsicum, and $\frac{6}{11}$ grain of morphine hydrochloride.

Uses.—This tincture resembles in its formula the preparation known as chlorodyne. It is used chiefly to allay abdominal colic and check diarrhœa. The dose is from 10 to 30 minims (0.60–2 Cc.).

TINCTURA CIMICIFUGÆ, *U. S., Br.*—Tincture of Cimicifuga.

Tinctura actææ racemosæ.—Tincture of black cohosh, Tincture of black snakeroot, E.; *Teinture d'actée à grappes*, Fr.; *Cimicifugatinktur*, G.

Preparation.—Cimicifuga, in No. 40 powder, 200 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the cimicifuga with 60 Cc. of alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolator to proceed slowly, pouring on sufficient alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of cimicifuga, moisten 3 avoirdupois ounces and 148 grains of the powdered drug with 1 fluidounce of alcohol, and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

The tincture of the British Pharmacopœia is a much weaker preparation, being made by percolating 2 ounces of cimicifuga with sufficient 60 per cent. alcohol to produce 1 imperial pint of finished tincture.

Owing to the large resin content of cimicifuga, strong alcohol is necessary to insure perfect exhaustion, which, on the other hand, renders the tincture less desirable. Since both a fluid and a powdered extract of cimicifuga are officially recognized, there seems to be little or no need for this preparation.

Uses.—The quantity of alcohol in each dose of this tincture is somewhat disadvantageous. The fluidextract is a better preparation. The dose of the tincture is from ½ to 2 drachms (2–8 Cc.).

TINCTURA CINCHONÆ, *U. S., Br.*—Tincture of Cinchona.

Teinture de quinquina jaune, Fr. Cod.; *Tinctura chinæ*, P. G.; *Tincture cinchonæ flavæ.—Tincture of yellow cinchona*, E.; *Chinatinktur*, G.; *Tintura de quina*, Sp.

Preparation.—Cinchona, in No. 60 powder (yielding not less than 4 per cent. of anhydrous ether-soluble alkaloids), 200 Gm.; glycerin, 75 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 675 Cc. of alcohol and 250 Cc. of water. Moisten the cinchona with 80 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of alcohol and water, made in the same proportions as before, until 1000 Cc. of percolate are obtained.

Tincture of cinchona, when assayed by the process given below, should contain in 100 Cc. 0.75 Gm. of anhydrous ether-soluble alkaloids of cinchona.—U. S.

To make 1 pint of tincture of cinchona moisten 3 avoirdupois ounces and 148 grains of the prescribed cinchona bark with 1¼ fluidounces of menstruum (glycerin, 7½ volumes; alcohol, 67½ volumes; water, 25 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture are obtained.

Assay of Tincture of Cinchona.—Transfer 50 Cc. of tincture of cinchona to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc., transfer the liquid to a bottle having the capacity of about 180 Cc., rinsing the dish with 10 Cc. of diluted alcohol, then assay the resulting liquid by the method given under FLUIDEXTRACTUM CINCHONÆ (p. 657), with the exception that the multiplication of the product should be by 4 instead of 20; the result will represent the weight in grammes of anhydrous ether-soluble alkaloids contained in 100 Cc. of the tincture.—U. S.

Tincture of cinchona of the British Pharmacopœia is made by moistening 4 ounces of red cinchona bark, in No. 40 powder, with 4 fluidounces of alcohol (70 per cent.), setting aside for 24 hours in a closed vessel, and then percolating until 14 fluidounces of percolate have been obtained; the marc is expressed and the liquid added to the percolate; after 24 hours' rest the mixture is filtered and assayed. To the bulk of the

strong tincture sufficient 70 per cent. alcohol is added so that the resulting tincture shall contain 1 Gm. of alkaloids in every 100 Cc.

Uses.—Tincture of cinchona is used as a stomachic and tonic in the dose of ½ to 2 drachms (2–8 Cc.).

TINCTURA CINCHONÆ COMPOSITA, *U. S., Br.*—Compound Tincture of Cinchona.

Tinctura chinæ composita, P. G.; *Huxham's tincture of bark*, E.; *Teinture de quinquina composée, Elixir fébrifuge d'Huxam*, Fr.; *Zusammengesetzte Chinatinktur*, G.

Preparation.—Red cinchona (yielding not less than 5 per cent. of cinchona alkaloids), 100 Gm.; bitter orange peel, 80 Gm.; serpentaria, 20 Gm.; glycerin, 75 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 675 Cc. of alcohol and 250 Cc. of water. Reduce the red cinchona, bitter orange peel, and serpentaria to a No. 60 powder, moisten this powder with 80 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of alcohol and water, made in the same proportions as before, to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of compound tincture of cinchona mix 730 grains of the prescribed red cinchona, 584 grains of bitter orange peel, and 146 grains of serpentaria, all in No. 60 powder, moisten with 1¼ fluidounces of menstruum (glycerin, 7½ volumes; alcohol, 67½ volumes; water, 25 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture are obtained.

The British Pharmacopœia directs 1 ounce of bitter orange peel, well bruised, ½ ounce of serpentaria, in No. 40 powder, 28 grains of cochineal, in powder, and 55 grains of saffron to be macerated with 10 fluidounces of alcohol (70 per cent.) for 7 days, agitating frequently; the mixture is then strained and the marc expressed. After mixing the liquids 10 fluidounces of tincture of cinchona are added and sufficient of the alcohol to produce 1 imperial pint of compound tincture. After standing for 24 hours the tincture is filtered.

While the alkaloidal strength of the two tinctures is about the same, both containing in each Cc. about 0.005 Gm. of anhydrous cinchona alkaloids, there is a marked difference in appearance due to the presence of cochineal and saffron in the British tincture.

Compound tincture of cinchona of the German Pharmacopœia differs markedly from the above, being prepared by maceration with alcohol of about 68 per cent. and representing in 100 parts by weight the soluble constituents of 12 parts of cinchona bark, 4 parts each of bitter orange peel and gentian, and 2 parts of cassia bark.

Uses.—The percentage of cinchona alkaloids in this preparation is too small to permit of its being used as an antiperiodic unless very large doses are given. It is, however, an excellent stimulant to the stomach, to be employed to enhance the appetite, especially during convalescence from fevers. Its dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA CINNAMOMI, *U. S., Br., P. G.*—Tincture of Cinnamon.

Teinture de cannelle, Fr.; *Zimmttinktur*, G.; *Tintura de canela*, Sp.

Preparation.—Saigon cinnamon, in No. 50 powder, 200 Gm.; glycerin, 75 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 675 Cc. of alcohol and 250 Cc. of water. Moisten the Saigon cinnamon with 80 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of alcohol and water, made in the same proportions as before, to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of cinnamon, moisten 3 avoirdupois ounces and 148 grains of Saigon cinnamon, in No. 50 powder, with 1¼ fluidounces of menstruum (glycerin, 7½ volumes; alcohol, 67½ volumes; water, 25 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

Ceylon cinnamon, in No. 40 powder, 4 avoirdupois ounces; alcohol (70 per cent.), a sufficient quantity. Moisten the powder with 4 fluidounces of the alcohol, and prepare the tincture by percolation. The resulting tincture should measure 1 imperial pint.—Br.

The German Pharmacopœia directs tincture of cinnamon to be made by maceration with alcohol (68½ per cent.), using 5 parts of cassia bark for every 100 parts of menstruum. Tincture of cinnamon of the French Codex represents 1 part of Ceylon cinnamon in every 5 parts of finished product, and is made with 80 per cent. alcohol.

The tincture has a red-brown color and a sweetish, warmly aromatic, and somewhat astringent taste. It sometimes gelatinizes when the menstruum becomes too weak in alcohol. This is intended to be overcome by the presence of glycerin and greater alcoholic strength in the official formula.

Uses.—Because of its carminative and slight astringent properties, tincture of cinnamon is frequently added to diarrhœa mixtures. Its pleasant taste is also employed to mask less agreeable drugs. The dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA COCCI, *Br.*—Tincture of Cochineal.

Teinture de cochenille, Fr.; *Cochenilletinktur*, G.

Preparation.—Take of cochineal, in powder, 2 ounces; alcohol (45 per cent.), 1 imperial pint. Prepare by maceration.—Br.

The French Codex prescribes 80 per cent. alcohol as a menstruum, using 10 Gm. of cochineal for every 100 Gm. of tincture.

Uses.—This tincture is used solely as a coloring agent.

TINCTURA COLCHICI SEMINIS, *U. S., Br.*—Tincture of Colchicum Seed.

Tinctura colchici, P. G.—*Tincture of colchicum*, E.; *Teinture de colchique*, Fr.; *Zeitlosentinktur*, G.; *Tintura de semilla de colchico*, Sp.

Preparation.—Colchicum seed, in No. 50 powder (containing not less than 0.55 per cent. of colchicine), 100 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 400 Cc. of water. Moisten the colchicum seed with 40 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquor begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of percolate.

Tincture of colchicum seed, when assayed by the process given below, should contain in 100 Cc. 0.05 Gm. of colchicine.—U. S.

To make 1 pint of tincture of colchicum seed, moisten 730 grains of the prescribed seed, in No. 50 powder, with 5 fluidrachms of menstruum (alcohol, 6 volumes; water, 4 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

Assay of Tincture of Colchicum Seed.—Transfer 100 Cc. of tincture of colchicum seed to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under FLUIDEXTRACTUM COLCHICI SEMINIS (page 659), with the exception that the multiplication of the product by 10 be omitted; the result will represent the weight in grammes of colchicine contained in 100 Cc. of the tincture.—U. S.

Other pharmacopœias direct: Colchicum seed, 4 ounces; alcohol (45 per cent.), sufficient for 1 imperial pint.—Br. Colchicum seed, 1 part; alcohol (68½ per cent.), 10 parts.—P. G. Colchicum seed, 5 parts; alcohol (60 per cent.), 100 parts.—Fr. Cod.

Uses.—This tincture is an efficient preparation of colchicum, although it is not used as often as the wine. The dose is from 15 to 60 minims (1–4 Cc.). (See COLCHICUM.)

TINCTURA COLOCYNTHIDIS, *P. G.*—Tincture of Colocynth.

Teinture de coloquinte, Fr.; *Koloquinthentinktur*, G.

Preparation.—Colocynth, in coarse powder, 1 part; alcohol, 10 parts. Macerate in a closed vessel for 7 days, frequently agitating; strain with expression, and filter the liquid.—P. G.

Uses.—Colocynth is rarely, if ever, used in this country in the form of the tincture. The dose is from 5 to 30 minims (0.30–2 Cc.). (See COLOCYNTH.)

TINCTURA CONII, *Br.*—Tincture of Conium.

Teinture de ciguë, Fr.; *Schierlingstinktur*, G.

Preparation.—Conium fruit, recently reduced to No. 40 powder, 4 ounces; alcohol (70 per cent.), a sufficient quantity. Moisten the powder with 4 fluidounces of the alcohol, and prepare the tincture by percolation, collecting 1 imperial pint of percolate.

Uses.—The dose of this tincture is from 20 to 60 minims (1.30–4 Cc.).

TINCTURA CROCI, *Br.*—Tincture of Saffron.

Teinture de safran, Fr.; *Safrantinktur*, G.

Preparation.—Saffron, 1 ounce; alcohol (60 per cent.), 1 imperial pint. Prepare by maceration.—Br.

Tincture of saffron of the French Codex is made by macerating 10 Gm. of saffron in 100 Gm. of alcohol (80 per cent.), and hence is about twice as strong as the British tincture.

The tincture has a rich orange-yellow color, and the odor and taste of saffron. It was dropped from the 1900 edition of the U. S. P. The former official tincture was made with diluted alcohol, in the proportion of 10 Gm. to 100 Cc. of menstruum.

Uses.—Tincture of saffron is used chiefly to impart its color to mixtures. The dose is from 1 to 2 drachms (4–8 Cc.).

TINCTURA CUBEBÆ, *Br.*—Tincture of Cubeb.

Teinture de cubèbe, Fr.; *Kubebentinktur*, G.

Preparation.—Cubebs, in powder, 4 ounces; alcohol (90 per cent.), a sufficient quantity. Moisten the powder with 2 fluidounces of the alcohol, and prepare the tincture by percolation, as directed elsewhere. The resulting tincture should measure 1 imperial pint.—Br.

The French Codex directs the tincture to be made by macerating 1000 Gm. of cubebs in 500 Gm. of 80 per cent. alcohol.

Tincture of cubeb has a greenish-brown color, and the characteristic odor and taste of the drug, and, when mixed with water, becomes milky. It is no longer official in the U. S. P.

Uses.—Tincture of cubeb may be employed whenever cubeb is indicated. The dose is from ½ to 2 drachms (2–8 Cc.). (See CUBEBA.)

TINCTURA DIGITALIS, *U. S., Br., P. G.*—Tincture of Digitalis.

Teinture de digitale, Fr.; *Fingerhuttinktur*, G.

Preparation.—Digitalis, in No. 60 powder, 100 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the digitalis with 40 Cc. of diluted alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolator to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of digitalis, moisten 730 grains of the powdered drug with 5 fluidrachms of diluted alcohol and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

Other pharmacopœias direct: Digitalis leaves, 2½ ounces; alcohol (60 per cent.), sufficient to make 1 imperial pint of tincture by percolation.—Br. Digitalis leaves, 1 part; alcohol (68½ per cent), 20 parts.—P. G. Digitalis leaves, 2 parts; alcohol (60 per cent.), 10 parts.—Fr. Cod.

Tincture of digitalis has a brown-green color, the peculiar odor of the leaves, and a bitter taste. The present official tincture is about ⅓ weaker than that of 1890, representing in each fluidrachm about 5¾ grains of digitalis leaves.

TINCTURA DIGITALIS ÆTHEREA. *Ethereal Tincture of Digitalis.*—This preparation is recognized in the French Codex under the title *Teinture ethérée de digitale* or *ethérolé de digitale*, and is made by exhausting 20 Gm. of the powdered leaves with 100 Gm. of a mixture of ether 7 parts and alcohol 3 parts. It has a dark-green color.

Uses.—Tincture of digitalis contains a smaller quantity of digitonin than the infusion, and for this reason is claimed by some to be less diuretic in its action. Many physicians, however, employ the tincture exclusively, both for its diuretic and its cardiant effect. The dose is from 10 to 30 minims (0.60–2 Cc.), and may be cautiously increased to produce the desired result.

TINCTURA ERGOTÆ AMMONIATA, *Br.*—Ammoniated Tincture of Ergot.

Tinctura secalis cornuti ammoniata.—Teinture ammoniacale de seigle ergoté, Fr.; *Ammoniakalische Mutterkorntinktur*, G.

Preparation.—Ergot, in No. 20 powder, 5 ounces; solution of ammonia, 2 fluidounces; alcohol (60 per cent.), a sufficient quantity. Mix the solution of ammonia with 18 fluidounces of the alcohol; moisten the powder with 2 fluidounces of this mixture and percolate with the remainder; press the marc; mix the expressed liquid with the percolate; add enough of the alcohol to form 1 imperial pint of the tincture. After 24 hours, filter.—Br.

Uses.—The dose of this tincture is from ½ to 2 drachms (2–8 Cc.).

TINCTURA FERRI CHLORIDI, *U. S.*—Tincture of Ferric Chloride.

Tinctura ferri perchloridi, Br.; *Tinctura ferri sesquichloridi.—Tincture of perchloride of iron, Tincture of chloride of iron*, E.; *Teinture de perchlorure de fer*, Fr.; *Eisenchloridtinktur*, G.

A hydro-alcoholic solution of ferric chloride containing not less than 13.28 per cent. of the anhydrous salt, corresponding to 4.6 (4.58) per cent. of metallic iron.—U. S.

Preparation.—Solution of ferric chloride, 350 Cc.; alcohol, a sufficient quantity to make 1000 Cc. Mix the solution with enough alcohol to make 1000 Cc. Let the tincture stand in a closely covered vessel at least three months; then transfer it to glass-stoppered bottles, and keep it protected from light.—U. S.

To make 1 pint of the tincture, mix 5 fluidounces and 288 minims of solution of ferric chloride with sufficient alcohol to produce 16 fluidounces of finished tincture.

Mix strong solution of ferric chloride, 5 fluidounces, with alcohol (90 per cent.), 5 fluidounces, and distilled water, 10 fluidounces.—Br.

The two tinctures are practically alike, except that the first contains free hydrochloric acid, and when it is kept on hand for some time, as directed by the Pharmacopœia, previous to dispensing it, acquires an ethereal odor from the formation of various compounds, resulting from the action upon the alcohol of the free acid, and probably also of the ferric chloride, the latter being reduced to ferrous chloride, more particularly on exposing the tincture to the light.

Inasmuch as the present official solution of ferric chloride is considerably weaker than that of 1890, it became necessary to increase the proportion of solution to be used in making a definite volume of the tincture, in order to maintain the actual strength of the finished product. The 350 Cc. of solution of ferric chloride directed in the above formula correspond about in iron-content to 250 Cc. of the solution of the 1890 Pharmacopœia. When the solution is mixed with alcohol, contraction of volume takes place and the liquid becomes warm, hence after cooling it will be necessary to add more alcohol so as to bring the finished product up to the prescribed volume.

Properties and Tests.—Tincture of ferric chloride is a bright brownish liquid, having a slightly ethereal odor, a very astringent, styptic taste, and an acid reaction.

Its specific gravity is about 1.005 at 25° C. (77° F.). The tincture yields a brownish-red precipitate with ammonia water, a blue one with potassium ferrocyanide test-solution, and a white one, insoluble in nitric acid, with silver nitrate test-solution. After the tincture has been exposed for some time to daylight, it yields a greenish or greenish-blue color with potassium ferricyanide test-solution, showing the presence of some ferrous salt, due to reduction. On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the tincture (1 in 10), the crystal should not become colored brown, nor should there be a brownish-black zone developed around it (absence of nitric acid). Evaporate 2.22 Gm. of the tincture to dryness on a water-bath, add 2 Cc. of hydrochloric acid and 5 Cc. of solution of hydrogen dioxide, and again evaporate the mixture to dryness; dissolve the residue in 10 Cc. of water, pour the solution into a glass-stoppered bottle having a capacity of about 100 Cc., rinsing the vessel with 10 Cc. more of water, add 1 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and keep the mixture for half an hour at a temperature of 40° C. (104° F.), then cool, and add a little starch test-solution; it should require not less than 18.3 Cc. of tenth-normal sodium thiosulphate solution to discharge the blue color of the liquid (each Cc. of the volumetric solution used indicating 0.25 per cent. of metallic iron).—U. S. If the solution of ferric chloride contained oxychloride, as is sometimes the case, a yellowish precipitate is apt to form in the tincture, either immediately or upon standing. The presence of oxychloride in the tincture may be tested for by diluting the tincture with 8 times its volume of distilled water and then boiling the mixture, when upon cooling it will remain clear if the impurity be absent, or become turbid if it be present.

Allied Tinctures.—Tinctura Ferri Chlorati Ætherea, P. G. *Tinctura tonico-nervina Bestuscheffii, Liquor anodynus martiatus, Spiritus ferri chlorati œthereus.—Ethereal tincture of ferric chloride,* E.; *Ätherische Chloreisentinktur,* G.—1 part of solution of ferric chloride specific gravity 1.282 (containing 19.9 per cent. $FeCl_3$) is mixed with alcohol 7 parts and ether 2 parts, the mixture exposed to the sunlight until colorless, and afterward kept in partially filled bottles in a shady place until it has acquired a yellow color. During the bleaching process the ferric is reduced to ferrous chloride, ethyl chloride and a little aldehyde being generated through the influence of the nascent chlorine. On exposure to the air the salt is partly oxidized to ferric oxychloride. This is known as *Bestuscheff's tincture.* It has a warm and ferruginous taste, is precipitated black by ammonia, white by silver nitrate, and blue by both ferrocyanide and ferricyanide of potassium, and contains 1 per cent. of iron. 10 Cc. of this tincture, after being agitated with an equal volume of the solution of potassium acetate, should separate on standing 3 Cc. of ethereal liquid.

This tincture represents about 1 per cent. of metallic iron.

Tinctura Ferri Citro-chloridi.—*Tincture of Citro-chloride of Iron.*—This preparation, better known as Tasteless Tincture of Iron, was introduced by Creuse in 1873. It represents very nearly the same amount of metallic iron as the official tincture, but the same is in different combination, and the tincture has a deep green color. While not tasteless, the characteristic taste of the official tincture of iron has been materially modified by the presence of alkali citrate. A process for preparing this tincture may be found in the National Formulary of the American Pharmaceutical Association.

Uses.—Tincture of ferric chloride is one of the most astringent preparations of iron, and applied locally acts as a caustic upon delicate tissues. It is one of the best and most useful preparations to be given as a chalybeate in anæmia and debilitated states, and its acid reaction increases its efficiency as a tonic. The diuretic action of the tincture is not due to the presence of ethers, as is generally held, but probably to the inherent property of the ferric chloride. Like the solution of ferric chloride, the tincture may be used locally as a styptic, but is more often given internally to arrest passive hemorrhages from the kidneys, bladder, and uterus. As a topical application it is serviceable in diphtheria and tonsillitis. Its administration has been found of value in chronic inflammations of mucous membranes, as leucorrhœa, bronchorrhœa, diarrhœa, and gleet. In the treatment of erysipelas no other drug has produced such gratifying results, and by many physicians it is considered a valuable internal remedy in follicular tonsillitis and septic infection, especially that following childbirth. In these conditions it should be given in full doses, well diluted, frequently repeated, 10 to 15 minims (0.60–1 Cc.) every 2 or 3 hours, if the stomach does not rebel. In chronic parenchymatous nephritis it augments the

flow of urine and diminishes the quantity of albumin. Tincture of ferric chloride is usually given in the dose of from 5 to 20 minims (0.30–1.30 Cc.), well diluted with water and taken through a glass tube to prevent injury to the teeth.

TINCTURA FERRI POMATI, *P. G.*—Tincture of Ferrous Malate.

Teinture de malate de fer, Fr.; *Apfelsaure Eisentinktur*, G.

Preparation.—Extract of ferrous malate, 1 part; cinnamon water, 9 parts. Dissolve the extract in the cinnamon water and filter the liquid.—P. G.

Tincture of ferrous malate has a brown-black color and the odor of cinnamon. It is miscible in all proportions with water and has a decided ferruginous taste. It should be borne in mind that the cinnamon water of the German Pharmacopœia is made by distilling 1 part of cassia bark with 1 part of alcohol and sufficient water to obtain 10 parts of distillate, hence it has a slight spirituous odor.

Uses.—This tincture is practically identical with the tinctura ferri pomata of our National Formulary, and is given in the dose of from 5 to 30 minims (0.30–2 Cc.).

TINCTURA GALLÆ, *U. S.*—Tincture of Nutgall.

Tinctura gallarum, P. G.—*Tincture of galls*, E.; *Teinture de noix de galle*, Fr.; *Galläpfeltinktur*, G.

Preparation.—Nutgall, in No. 40 powder, 200 Gm.; glycerin, 100 Cc.; alcohol, a sufficient quantity to make 1000 Cc. Mix the glycerin with 900 Cc. of alcohol; introduce the nutgall, without moistening it, into a glass percolator, shaking down the powder evenly and compactly, and pour on sufficient of the menstruum to saturate it and leave a stratum above it. Allow the percolation to proceed slowly, pouring on the remainder of the menstruum, and then sufficient alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of nutgall introduce 3 avoirdupois ounces and 148 grains of nutgall in No. 40 powder, without previous moistening, into a percolator, shake down evenly and compactly, and percolate with enough menstruum (glycerin, 1 volume; alcohol, 9 volumes) to produce 16 fluidounces of finished product.

The German Pharmacopœia directs that 1 part of coarsely powdered nutgall be macerated with 5 parts of 68½ per cent. alcohol. The French Codex orders the same proportions, but 60 per cent. alcohol.

Nutgall of good quality yields over 60 per cent. of extract. The addition of glycerin is intended to retard the formation of gallic acid. The tincture has a yellowish-brown color, a strongly astringent taste, and an acid reaction, and yields blue-black precipitates with ferric salt.

Uses.—Tincture of galls is rarely given internally, but diluted is used as an astringent application in sore throat and relaxed conditions of the rectum. Its dose by the mouth is from ½ to 1 drachm (2–4 Cc.).

TINCTURA GAMBIR COMPOSITA, *U. S.*—Compound Tincture of Gambir.

Tinctura catechu, Br., P. G.; *Tinctura catechu composita*, U. S. 1890.—*Tincture of catechu*, E.; *Teinture de cachou*, Fr.; *Katechutinktur*, G.

Preparation.—Gambir, in No. 50 powder, 50 Gm.; Saigon cinnamon, in No. 50 powder, 25 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Macerate the gambir and Saigon cinnamon in a stoppered container, in a moderately warm place, with 750 Cc. of diluted alcohol during 48 hours, with frequent agitation; then filter through purified cotton, or a plain filter, and when the liquid has drained off completely, pass enough menstruum through the residue to make 1000 Cc. of tincture.—U. S.

To make 1 pint of compound tincture of gambir macerate 365 grains of gambir and 183 grains of Saigon cinnamon, both in No. 50 powder, with 12 fluidounces of diluted alcohol during 48 hours, frequently shaking the mixture. Filter through cotton and pass enough menstruum through the residue to make 16 fluidounces.

The British Pharmacopœia directs that catechu, in coarse powder, 4 ounces, and Ceylon cinnamon, bruised, 1 ounce, be macerated with 1 imperial pint of 60 per cent. alcohol. The German and French Pharmacopœias both omit the cinnamon, simply macerating 1 part of catechu with 5 parts of 68½ per cent. and 60 per cent. (respectively) alcohol.

The tincture has a dark red-brown color, a strongly astringent taste, and an acid reaction; it does not become milky on the addition of water, produces with ferric salts greenish-black precipitates, and when heated with potassium dichromate becomes brownish-red.

Uses.—This tincture is used almost exclusively as an astringent in diarrhœa of the acute serous form. When the stools contain much mucus the administration of this or any other astringent mixture should be preceded by a purgative, preferably castor oil. The dose is from ½ to 2 drachms (2–8 Cc.) or more.

TINCTURA GELSEMII, *U. S., Br.*—Tincture of Gelsemium.

Teinture de gelsemium, Fr.; *Gelsemiumtinktur*, G.

Preparation.—Gelsemium, in No. 60 powder, 100 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 650 Cc. of alcohol with 350 Cc. of water. Moisten the gelsemium with 35 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of gelsemium moisten 730 grains of the powdered drug with ½ fluidounce of menstruum (alcohol, 6½ volumes; water, 3½ volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

The British Pharmacopœia directs the same proportion of gelsemium and alcohol of 60 per cent. as a menstruum.

Tincture of gelsemium is of a brownish-yellow color, becomes milky when mixed with water, and has the aromatic odor and bitter taste of the drug. The present official tincture is ⅛ weaker than that of 1890, representing about 5¾ grains of gelsemium in each fluidrachm.

Uses.—This is an efficient preparation of the drug, given in the dose of 5 to 15 minims (0.30–1 Cc.). (See GELSEMIUM.)

TINCTURA GENTIANÆ COMPOSITA, *U. S., Br.*—Compound Tincture of Gentian.

Teinture de gentiane composée, Fr.; *Zusammengesetzte Enziantinktur*, G.

Preparation.—Gentian, 100 Gm.; bitter orange peel, 40 Gm.; cardamom, 10 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 400 Cc. of water. Reduce the gentian, bitter orange peel, and cardamom to a No. 40 powder, moisten this powder with 60 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 12 hours; then pack it moderately and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 12 hours; then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of the tincture.—U. S.

To make 1 pint of compound tincture of gentian mix 730 grains of gentian, 292 grains of bitter orange peel, and 73 grains of cardamom, all in No. 40 powder, moisten with 1 fluidounce of menstruum (alcohol, 6 volumes; water, 4 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

The British Pharmacopœia directs gentian, 2 ounces; bitter orange peel, ¾ ounce, and cardamom, ¼ ounce, all well bruised, to be macerated with 1 imperial pint of 45 per cent. alcohol.

Compound tincture of gentian has a brown yellow-color, an agreeable aromatic odor, and a very bitter taste. It acquires with ferric salts a dark blackish-brown color. The stronger alcoholic menstruum directed in the U. S. P. formula is preferable, because the deposit occurring in the tincture is thereby reduced to a minimum.

Uses.—Compound tincture of gentian is an efficient bitter tonic in atony of the stomach, especially following that of an alcoholic debauch. The dose is from ½ to 2 drachms (2–8 Cc.).

Allied Tinctures.—TINCTURA GENTIANÆ.—*Tincture of gentian*, E.; *Teinture de gentiane*, Fr.; *Enziantinktur*, G. This preparation is official in both the French and German Pharmacopœias. It is made by macerating 1 part of the ground root in 5 parts of 60 per cent. alcohol (68½ per cent. alcohol.—P. G.).

TINCTURA GENTIANÆ ALKALINA.—*Alkaline Tincture of Gentian.*—*Teinture de gentiane alcaline, Elixir amèr de Peyrylhe*, Fr. Cod.; *Alkalische Enziantinktur*, G. It is made by macerating gentian, in coarse powder, 10 parts, crystallized sodium carbonate 3 parts, with 300 parts of alcohol of 60 per cent.

TINCTURA GUAIACI, *U. S.*—Tincture of Guaiac.

Teinture de résine de gayac, Fr.; *Guajaktinktur*, G.

Preparation.—Guaiac, in No, 40 powder, 200 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Macerate the guaiac in a stoppered container in a moderately warm place with 750 Cc. of alcohol during 3 days, with frequent agitation; then filter, and, when the liquid has drained off, pour on enough alcohol to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of guaiac, macerate 3 avoirdupois ounces and 148 grains of coarsely powdered guaiac with 12 fluidounces of alcohol for 3 days, with frequent agitation; then filter, and pass enough alcohol through the filter to bring the volume up to 16 fluidounces.

Since guaiac resin dissolves completely in alcohol with the exception of the impurities, the tincture is conveniently made by maceration. The tincture has a dark brownish-red color, is precipitated by water, and is colored green or blue by ferric chloride and other agents.

Uses.—Tincture of guaiac has been largely used in chronic rheumatism, gout, and amenorrhœa, but its employment is rare at present. Diluted with water, it is occasionally used as a gargle in subacute tonsillitis and pharyngitis. Since it is precipitated on the addition of water, it should be administered in mucilage or syrup. The dose is from ½ to 2 drachms (2–8 Cc.).

Allied Tincture.—TINCTURA GUAIACI LIGNI.—*Tincture of Guaiacum-wood*, E.; *Teinture de gayac*, Fr. Macerate for 10 days guaiacum-wood 10 parts in alcohol (60 per cent.) 50 parts; express and filter.—Fr. Cod.

TINCTURA GUAIACI AMMONIATA, *U. S., Br.*—Ammoniated Tincture of Guaiac.

Teinture de gayac ammoniacale, Fr.; *Ammoniakalische Guajaktinktur*, G.

Preparation.—Guaiac, in No. 40 powder, 200 Gm.; aromatic spirit of ammonia, a sufficient quantity to make 1000 Cc. Macerate the guaiac in a stoppered container in a moderately warm place with 750 Cc. of aromatic spirit of ammonia during 3 days, with frequent agitation; then filter, and when the liquid has drained off, pour on enough aromatic spirit of ammonia to make 1000 Cc. of tincture.—U. S.

To make 1 pint of ammoniated tincture of guaiac, macerate 3 avoirdupois ounces and 148 grains of coarsely powdered guaiac with 12 fluidounces of aromatic spirit of ammonia for 3 days, with frequent agitation; then filter, and pass enough aromatic spirit of ammonia through the filter to bring the volume up to 16 fluidounces.

The British Pharmacopœia directs that guaiacum resin, in powder, 4 ounces, be added to a mixture of strong solution of ammonia, 1½ fluidounces, and alcohol, 16 fluidounces, set aside in a closed vessel for 48 hours, with frequent agitation, and then filtered; oil of lemon, 20 minims, and oil of nutmeg, 30 minims, are then dissolved in the filtrate, and sufficient alcohol passed through the filter to bring the volume of tincture up to 1 imperial pint.

The two formulas yield practically identical tinctures, which resemble tincture of guaiac in appearance, but have an ammoniacal odor and taste.

Uses.—This tincture is the one generally employed when it is desired to administer guaiac. It is supposed to be more efficient than the simple tincture in amenorrhœa and scanty menstruation. Its dose is from ½ to 2 drachms (2–8 Cc.).

Allied Tincture.—DEWEES'S TINCTURE OF GUAIAC.—Digest for a few days powdered guaiacum resin 4 ounces, sodium or potassium carbonate 90 grains, powdered pimento 1 ounce, in diluted alcohol 1 pint. Add spirit of ammonia, if required, in the proportion of 1 or 2 drachms to each 4 fluidounces of the tincture.

TINCTURA HAMAMELIDIS, *Br.*—Tincture of Hamamelis.

Teinture de hamamélis, Fr.; *Hamamelistinktur*, G.

Preparation.—Hamamelis bark, in No. 20 powder, 2 ounces; alcohol (45 per cent.), a sufficient quantity. Moisten the powder with 1 fluidounce of the alcohol, and prepare a tincture by percolation. The resulting tincture should measure 1 imperial pint.—Br.

Uses.—This tincture is rather weak for internal administration. The dose is from 2 to 4 drachms (8–16 Cc.).

TINCTURA HYDRASTIS, *U. S.*, *Br.*—Tincture of Hydrastis.

Teinture de hydrastis, Fr.; *Hydrastistinktur*, G.

Preparation.—Hydrastis, in No. 60 powder (containing not less than 2.5 per cent. of hydrastine), 200 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix alcohol and water in the proportion of 650 Cc. of alcohol and 350 Cc. of water. Moisten the hydrastis with 60 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly, and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, gradually adding menstruum until 1000 Cc. of percolate are obtained.

Tincture of hydrastis, when assayed by the process given below, should contain in 100 Cc. not less than 0.4 Gm. hydrastine.—U. S.

To make 1 pint of tincture of hydrastis, moisten 3 avoirdupois ounces and 148 grains of the prescribed hydrastis with 1 fluidounce of menstruum (alcohol, 65 volumes; water, 35 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

Assay of Tincture of Hydrastis.—Transfer 100 Cc. of tincture of hydrastis to an evaporating dish, and evaporate it on a water-bath until the liquid measures about 10 Cc. If any insoluble matter has separated, add sufficient alcohol to dissolve it, and then assay the resulting liquid by the method given under FLUIDEXTRACTUM HYDRASTIS (page 669), using the same details as there directed for 10 Cc. of fluidextract of hydrastis, with the exception that the weight of the residual alkaloids must be multiplied by 2 instead of by 20, as there directed, to give the weight in grammes of hydrastine contained in 100 Cc. of tincture of hydrastis.—U. S.

The tincture of the British Pharmacopœia is of about ½ the strength of the above, and made with 60 per cent. alcohol. It is not standardized to any definite alkaloidal content.

Uses.—This tincture fully represents the remedial properties of the drug. The dose is from ½ to 2 drachms (2–8 Cc.). (See HYDRASTIS.)

TINCTURA HYOSCYAMI, *U. S.*, *Br.*—Tincture of Hyoscyamus.

Teinture de jusquiame, Fr.; *Bilsenkrauttinktur*, G.

Preparation.—Hyoscyamus, recently dried and in No. 60 powder (containing not less than 0.08 per cent. of mydriatic alkaloids), 100 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the hyoscyamus with 40 Cc. of diluted alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, gradually adding diluted alcohol until 1000 Cc. are obtained.

Tincture of hyoscyamus, when assayed by the process given below, should contain in 100 Cc. 0.007 Gm. of mydriatic alkaloids.—U. S.

To make 1 pint of tincture of hyoscyamus, moisten 730 grains of the prescribed hyoscyamus with 5 fluidrachms of diluted alcohol, and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

Assay of Tincture of Hyoscyamus.—Transfer 100 Cc. of tincture of hyoscyamus to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc. If any insoluble matter has separated, add sufficient alcohol to dissolve it, and then assay the resulting liquid by the method given under FLUIDEXTRACTUM BELLADONNÆ RADICIS (page 652), using the same details as there directed for 10 Cc. of fluidextract of belladonna root, with the exception that the multiplication by 10 must be omitted; the result will represent the weight in grammes of alkaloids contained in 100 Cc. of tincture of hyoscyamus.—U. S.

The tincture of the British Pharmacopœia is of about the same strength as the above, and made with 45 per cent. alcohol. It is not standardized, however, to any definite alkaloidal content.

The tincture is greenish-brown, and has the narcotic odor of the leaves and a bitter taste.

Uses.—Tincture of hyoscyamus contains all the virtues of the drug, and is given in the dose of from 10 to 30 minims (0.60–2 Cc.). (See HYOSCYAMUS.)

TINCTURA IODI, *U. S., Br., P. G.*—Tincture of Iodine.

Tinctura iodinii.—Teinture d'iode, Fr.; *Jodtinktur,* G.; *Tintura de yodo,* Sp.

Preparation.—Iodine, 70 Gm.; potassium iodide, 50 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Triturate the iodine and potassium iodide rapidly in a mortar to a coarse powder, and transfer it at once to a graduated bottle. Rinse the mortar with several successive portions of alcohol, and pour the rinsings into the bottle. Then add enough alcohol, shaking the bottle occasionally until the iodine and potassium iodide are dissolved and the finished tincture measures 1000 Cc.

If 5 Cc. of the tincture be mixed with about 25 Cc. of water and titrated with tenth-normal sodium thiosulphate solution, about 27.25 Cc. of tenth-normal sodium thiosulphate solution should be required for complete decolorization (corresponding to about 6.86 Gm. of iodine in 100 Cc.).—U. S.

To make 1 pint of tincture of iodine dissolve 1 avoirdupois ounce and 74 grains of iodine and 365 grains of potassium iodide in sufficient alcohol to produce 16 fluidounces of solution.

Tincture of iodine of the British Pharmacopœia contains considerably less than ½ as much iodine as the U. S. P. preparation. It is made by dissolving ½ ounce each of iodine and potassium iodide in ½ fluidounce of distilled water, and adding to this solution sufficient alcohol to produce 1 imperial pint of tincture.

The French and German Pharmacopœias direct simply the solution of iodine in 90 per cent. alcohol, the former ordering 1 part of iodine for every 12 parts of alcohol, the latter 1 part for every 10 parts.

Tincture of iodine has a deep brown-red color and the odor of iodine. Upon evaporation the U. S. and Br. tinctures will leave a residue of potassium iodide, but the French and German preparations leave no residue. It should be prepared only in small quantities, as the iodine is slowly changed into hydriodic acid. The object of adding potassium iodide is to permit the addition of the tincture to aqueous liquids without precipitation.

Uses.—The properties and uses of this preparation are discussed under IODUM. This tincture is precipitated on the addition of water, and is therefore not well suited for internal administration. The compound solution is preferable. The dose of the tincture is from 1 to 3 minims (0.05–0.20 Cc.). It is sometimes used for obstinate vomiting,

Allied Tinctures.—TINCTURA IODI DECOLORATA.—*Decolorized Tincture of Iodine.*—Digest 610 grains each of iodine and sodium thiosulphate with 1½ fluidounces of distilled water at a gentle heat until a perfect solution is obtained. Then add 2 fluidounces of alcohol, and afterward 1 fluidounce of stronger ammonia-water. Shake until the liquid has become colorless; cool and add enough alcohol to make 16 fluidounces. Set aside in a cold place for a few hours and filter. The solution contains ammonium iodide, ethyl iodide, C_2H_5I, triethylamine hydro-iodide, $N(C_2H_5)_3HI$, together with sodium iodide, sulphate, and tetrathionate: a crystalline precipitate of the latter salt is apt to form upon standing for a short time.

Decolorized tincture of iodine, being simply a solution of iodides, is of no value as a counterirritant, and is an unnecessary preparation

TINCTURA IODI (Churchill).—*Churchill's Tincture of Iodine.*—Dissolve 240 grains of potassium iodide in 4 ounces of distilled water, add 1200 grains of iodine, and, lastly, enough alcohol to make the tincture measure 16 fluidounces. (Churchill's tincture of iodine must not be confounded with *Churchill's iodine caustic*, which is much stronger and is made by dissolving 480 grains of iodine and 960 grains of potassium iodide in 4 fluidounces of distilled water.)

Lugol's iodine caustic is a solution of 1 part each of iodine and potassium iodide in 2 parts of water. *Hebra's iodine caustic* is of the same strength, but glycerin is used in place of water.

TINCTURA IPECACUANHÆ ET OPII, *U. S.*—Tincture of Ipecac and Opium.

Preparation.—Tincture of deodorized opium, 1000 Cc.; fluidextract of ipecac, 100 Cc.; diluted alcohol, a sufficient quantity to make 1000 Cc. Evaporate the tincture of deodorized opium on a water-bath until it weighs 800 Gm. When it has become cold add to it the fluidextract of ipecac; filter the mixture and pass enough diluted alcohol through the filter to make the tincture measure 1000 Cc.

To make 1 pint of tincture of ipecac and opium evaporate 16 fluidounces of tincture of deodorized opium on a water-bath to 13 fluidounces, and when cold add to it 1 fluid ounce and 288 minims of fluidextract of ipecac; filter the mixture, and pass enough diluted alcohol through the filter to bring the volume up to 16 fluidounces.

Uses.—This tincture is supposed to present the virtues of Dover's powder in a liquid form. It is not generally considered as active a diaphoretic as the powder. The dose is from 5 to 20 minims (0.30–1.30 Cc.).

TINCTURA JABORANDI, *Br.*—Tincture of Jaborandi.

Tinctura pilocarpi.—Tincture of pilocarpus, E.; *Teinture de jaborandi*, Fr.; *Jaboranditinktur*, G.

Preparation.—Jaborandi leaves, in No. 40 powder, 4 ounces; alcohol (45 per cent.), a sufficient quantity. Moisten the powder with 2½ fluidounces of the alcohol, and percolate as directed elsewhere. The resulting tincture should measure 1 imperial pint.—Br.

The tincture of the French Codex represents 1 part of jaborandi in every 5 parts of tincture, and is made with 60 per cent. alcohol.

Uses.—The dose of this preparation is from 1 to 3 drachms (4–12 Cc.).

TINCTURA JALAPÆ, *Br.*—Tincture of Jalap.

Teinture de jalap, Fr.; *Jalapentinktur*, G.

Preparation.—Jalap, in No. 40 powder, 4 ounces; alcohol (70 per cent.), a sufficient quantity. Moisten the powder with 2 fluidounces of the alcohol, and, after packing in a percolator, gradually add more menstruum until 12 fluidounces have been collected. Then express the marc and add the expressed liquid to the percolate. After 24 hours' rest, filter. The amount of the resin present in 10 Cc. of the tincture having been determined, enough menstruum is added to the balance of the strong tincture so that the finished product shall contain 1.5 Gm. of the resin in 100 Cc.—Br.

Uses.—Jalap is rarely administered in this country except in powder or resin. This tincture is a useful addition to other purgative liquids. Its dose is from ½ to 1 drachm (2–4 Cc.).

TINCTURA KINO, *U. S., Br.*—Tincture of Kino.

Teinture de kino, Fr.; *Kinotinktur*, G.

Preparation.—Kino, 50 Gm.; purified talc, 10 Gm.; glycerin, 150 Cc.; alcohol, 650 Cc.; water, a sufficient quantity to make 1000 Cc. Mix the glycerin with 200 Cc. of water, and triturate the kino and purified talc with sufficient of the mixture to produce a thin, smooth magma. Transfer this magma by the aid of the remainder of the mixture to a flask, and, having ascertained the weight of the flask and contents, heat it on a water-bath for about 1 hour; allow the flask and contents to cool, and restore the original weight by the addition of sufficient water. Then add the alcohol, mix, and pass the tincture through a filter of purified cotton, keeping the filter well covered.—U. S.

To make 1 pint of tincture of kino, 365 grains of kino and 75 grains of purified talc are rubbed into a smooth magma with a mixture of 2½ fluidounces of glycerin and 3¼ fluidounces of water. Transfer to a flask, and, having ascertained the weight of the flask and contents, heat it on a water-bath for about 1 hour. When cool, restore the original weight by addition of water. Then add 10¼ fluidounces of alcohol and mix. Finally filter through purified cotton.

The tincture of the British Pharmacopœia is twice as strong as the above, and is made by rubbing 2 ounces of kino with a mixture of 3 fluidounces of glycerin and 5 fluidounces of water to smooth paste; after addition of 10 fluidounces of alcohol, the whole is set aside for 12 hours, with frequent agitation, and then filtered through cotton. Sufficient alcohol is passed through the filter to produce 1 imperial pint.

Tincture of kino is conveniently prepared by maceration, and has a dark brown-red color. Made with alcohol and properly preserved, it will remain limpid, but if made with diluted alcohol it will gradually lose its astringency and become gelatinous. The origin of kino, and probably also its age, may influence the tendency to gelatinize.

In our experience tincture of kino keeps remarkably well if preserved in small vials, so as to avoid frequent exposure to the air; we have kept the tincture in well-corked 2-ounce vials for over a year without observing the slightest change.

Uses.—Tincture of kino is employed chiefly as an addition to astringent mixtures given for serous diarrhœa. The dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA KRAMERIÆ, *U. S., Br.*—Tincture of Krameria.

Tinctura ratanhiæ, P. G.—*Tincture of rhatany*, E.; *Teinture de ratanhia*, Fr.; *Ratanhiatinktur*, G.

Preparation.—Krameria, in No. 40 powder, 200 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the krameria with 80 Cc. of diluted alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly, and pour on enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient diluted alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of rhatany, moisten 3 avoirdupois ounces and 148 grains of krameria in No. 40 powder, with 5 fluidrachms of diluted alcohol, and proceed as directed above, continuing percolation until 16 fluidounces of percolate have been obtained.

The British and French Pharmacopœias both prepare tincture of krameria with 60 per cent. alcohol, the former using 4 ounces of the drug for 1 imperial pint of tincture to be made by percolation, the latter 1 part of drug for 5 parts of menstruum by weight.

This tincture has a brown-red color and a strongly astringent taste. After having been kept in partly-filled bottles it deposits rhatany-red, and occasionally gelatinizes. It is therefore best prepared in small quantities. In our experience tincture of rhatany keeps very much better if the menstruum contains about ⅛ of its volume of glycerin.

Uses.—Tincture of krameria may be substituted for the tinctures of kino or gambir in the treatment of diarrhœa. Diluted with water, it may be used as a gargle in sore throat and as an astringent injection in gonorrhœa. The dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA LACTUCARII, *U. S.*—Tincture of Lactucarium.

Teinture de lactucarium, Fr.; *Lactucariumtinktur*, G.

Preparation.—Lactucarium, 500 Gm.; glycerin, 250 Cc.; alcohol, purified petroleum benzin, diluted alcohol, each a sufficient quantity to make 1000 Cc. Beat the lactucarium in an iron mortar, with clean sand, to a coarse powder, and introduce it into a bottle; add 2000 Cc. of purified petroleum benzin, cork the bottle tightly, and set it aside for 48 hours, frequently agitating the mixture. Pour the mixture on a double filter, and allow it to drain. Wash the residue by gradually adding 1500 Cc. of purified petroleum benzin, and allow the lactucarium to dry by exposing it to a current of air. When it is dry and free from the odor of benzin, reduce it to powder, using more sand,

if necessary, and pack it moderately in a conical percolator. Mix the glycerin with 200 Cc. of water and 500 Cc. of alcohol, and moisten the powder with 500 Cc. of the mixture. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed very slowly, gradually adding, first the remainder of the menstruum, and then diluted alcohol, until the lactucarium is exhausted. Reserve the first 750 Cc. of the percolate, evaporate the remainder on a water-bath, at a temperature not exceeding 70° C. (158° F.), to 250 Cc., and mix this with the reserved portion. Filter, and add enough diluted alcohol through the filter to obtain 1000 Cc. of the tincture.—U. S.

To make 1 pint of tincture of lactucarium, reduce 8 avoirdupois ounces and 150 grains of lactucarium to a coarse powder with the aid of sand, macerate with 2 pints of purified benzin for 48 hours, shaking frequently, filter and allow to drain, and wash the residue gradually with 1½ pints of purified benzin. Allow the lactucarium to dry in a current of air, and when all odor of benzin has disappeared, reduce it to powder, using more sand, if necessary, and proceed as directed above, using first a mixture of 4 fluidounces of glycerin, 3¼ fluidounces of water, and 8 fluidounces of alcohol, and finally diluted alcohol; reserve the first 12 fluidounces of percolate, and evaporate the remainder to 4 fluidounces, and mix with the reserve portion. Filter if necessary.

Since tincture of lactucarium is intended chiefly for the preparation of the syrup, it is desirable that a liquid be obtained which shall give a clear mixture with syrup, and as lactucarium contains objectionable inert matter in the form of caoutchouc, the treatment with benzin (suggested by Lemberger in 1875) is directed for its removal. The subsequent percolation of the powder mixed with sand presents no difficulty, as the active bitter principles are soluble in the menstruum ordered, but the percolate should be collected in very slow drops. Each Cc. of the tincture represents 0.5 Gm. of the drug.

Uses.—The medicinal virtues of lactucarium are too feeble to justify the trouble necessary to prepare this tincture. The dose is from 20 to 60 minims (1.30–4 Cc.).

TINCTURA LAVANDULÆ COMPOSITA, *U. S.*, *Br.*—Compound Tincture of Lavender.

Spiritus lavandulæ compositus.—Compound spirit of lavender, Lavender drops, E.; *Teinture de lavande composée,* Fr.; *Zusammengesetzte Lavendeltinktur,* G.

Preparation.—Oil of lavender flowers, 8 Cc.; oil of rosemary, 2 Cc.; Saigon cinnamon, 20 Gm.; cloves, 5 Gm.; nutmeg, 10 Gm.; red saunders, 10 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Reduce the Saigon cinnamon, cloves, nutmeg, and red saunders to a No. 50 powder, and macerate this powder for 3 days in a mixture of 750 Cc. of alcohol and 250 Cc. of water, in which liquid the oils have been dissolved. Then filter through purified cotton or a plain filter, and, when the liquid has drained off completely, pass enough of a mixture of alcohol and water, made in the same proportions as before, through the residue on the filter to make 1000 Cc. of tincture.—U. S.

To make 1 pint of compound tincture of lavender, mix 146 grains of Saigon cinnamon, 37 grains of cloves, 74 grains each of nutmeg and red saunders, all reduced to a No. 50 powder, and macerate the mixture with 16 fluidounces of menstruum (alcohol, 3 volumes; water, 1 volume), in which have been dissolved 1 fluidrachm of oil of lavender flowers and 15 minims of oil of rosemary, for 3 days, then filter through cotton and drain, passing enough menstruum through the residue to bring the volume up to 16 fluidounces.

Take of oil of lavender 1½ fluidrachms; oil of rosemary, 10 minims; cinnamon-bark, bruised, nutmeg, bruised, each 150 grains; red sandal-wood, 300 grains; alcohol (90 per cent.), 2 pints (imperial). Macerate the cinnamon, nutmeg, and red sandal-wood in the spirit for 7 days in a closed vessel, with occasional agitation; then strain and press, dissolve the oils in the strained tincture, filter, and add sufficient rectified spirit to make 2 pints.—Br.

The tincture of the first formula is stronger in volatile oils and aromatics than that made by the British formula. Both have a red color, form opalescent mixtures with water, and, if prepared from good materials, have an agreeable odor and a strong but pleasant aromatic taste.

Uses.—This pleasant aromatic preparation is largely employed both in regular and domestic medicine to allay nausea, gastric distress, and flatulence. The dose is from 30 to 60 minims (2–4 Cc.), administered usually on some sugar or in sweetened water.

TINCTURA LIMONIS CORTICIS, *U. S.*—Tincture of Lemon Peel.

Tinctura Limonis, Br.—*Tincture of lemon*, E.; *Teinture de zeste de citron*, Fr.; *Citronenschalentinktur*, G.

Preparation.—Lemon peel, from the fresh fruit, in thin shavings and cut into narrow shreds, 500 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Macerate the lemon peel in a stoppered, wide-mouthed container, and in a moderately warm place, with 750 Cc. of alcohol during 48 hours, with frequent agitation; then filter through purified cotton, and when the liquid has drained off completely, gradually pour on enough menstruum to make 1000 Cc. of tincture, and filter through paper.—U. S.

To make one pint of the tincture, macerate 8 avoirdupois ounces and 150 grains of shredded or grated fresh lemon peel with 12 fluidounces of alcohol for 48 hours, as directed above, finally passing enough alcohol through the residue to bring the volume up to 16 fluidounces.

Tincture of lemon of the British Pharmacopœia is about ½ as strong as the above, and is made by macerating 5 ounces of finely-cut fresh lemon peel with 1 imperial pint of 90 per cent. alcohol.

This preparation is intended to replace the spirit of lemon of the 1890 Pharmacopœia. It is a much stronger tincture, and has a very much finer flavor.

Uses.—Tincture of lemon peel is used chiefly as a flavoring agent. The dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA LOBELIÆ, *U. S., P. G.*—Tincture of Lobelia.

Teinture de lobélie enflée, Fr.; *Lobeliatinktur*, G.

Preparation.—Lobelia, in No. 50 powder, 100 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the lobelia with 40 Cc. of diluted alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient diluted alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of lobelia, moisten 730 grains of the powdered drug with 5 fluidrachms of diluted alcohol, and proceed as directed above, allowing percolation to continue until 16 fluidounces of tincture have been obtained.

Other pharmacopœias direct: Lobelia, 1 part; alcohol (68 per cent.), 10 parts.—P. G. Lobelia, 1 part; alcohol (60 per cent.), 5 parts.—Fr. Cod.

The present official tincture of lobelia is of exactly ½ the strength of the tincture of 1890, representing about 5¾ grains of the drug in each fluidrachm. It has a greenish-brown color, a somewhat heavy odor, and a bitter and acrid taste.

Uses.—This is the preparation of lobelia nearly always employed. Its dose as an expectorant is from 10 to 20 minims (0.60–1.30 Cc.). To relieve asthmatic attacks it should be given in the dose of from 1 to 2 drachms (4–8 Cc.) every hour or two until it causes nausea or relieves the spasmodic condition. (See LOBELIA.)

TINCTURA LOBELIÆ ÆTHEREA, *Br.*—Ethereal Tincture of Lobelia.

Teinture éthérée de lobélie enflée, Fr.; *Ätherische Lobelientinktur*, G.

Preparation.—Lobelia, in No. 40 powder, 4 ounces; spirit of ether, a sufficient quantity. Moisten the powder with 2 fluidounces of spirit of ether, and prepare the tincture by percolation, as explained elsewhere. The resulting tincture should measure 1 imperial pint.—Br.

This preparation has a decided ethereal odor, and is of a brownish-green color.

Uses.—This preparation is considered more efficacious than the simple tincture in the treatment of asthma. The dose is from 5 to 20 minims (0.30–1.30 Cc.).

TINCTURA LUPULI, *Br.*—Tincture of Hops.

Tinctura humuli.—Teinture de houblon, Fr.; *Hopfentinktur*, G.

Preparation.—Hops, 4 ounces; alcohol (60 per cent.), 1 imperial pint. Prepare the tincture by maceration.—Br.

Tincture of hops is of a yellowish-brown color, and has the peculiar odor and strong taste of the drug.

Uses.—The dose of this tincture is from 1 to 2 drachms (4–8 Cc.). (See HUMULUS.)

TINCTURA MOSCHI, *U. S.*—Tincture of Musk.

Teinture de musc, Fr.; *Moschustinktur*, G.

Preparation.—Musk, 5 Gm.; alcohol, 45 Cc.; water, 45 Cc.; diluted alcohol, a sufficient quantity to make 100 Cc. Triturate the musk with the water, a little at a time, until a smooth mixture is obtained; transfer this mixture to a bottle and allow it to stand 24 hours; add the alcohol and macerate the mixture for 6 days, occasionally shaking it. Then filter through a plain paper filter, and when the liquid has drained off completely, pass enough diluted alcohol through the filter to make 100 Cc. of tincture.—U. S.

To make 2 fluidounces of tincture of musk, use 46 grains of musk, 7 fluidrachms each of water and alcohol, and diluted alcohol, a sufficient quantity, proceeding as directed above.

Neither the British nor the German Pharmacopœia recognizes this preparation, but the tincture of musk of the French Codex is nearly twice as strong as that of the U. S. P., and is made with 80 per cent. alcohol, containing 10 Gm. of musk in 100 Gm. of finished product.

Strong alcohol yields a light-brown tincture, which becomes slightly opalescent with water; but weak alcohol produces a dark-brown tincture, which has a strong odor of musk and remains clear on the addition of water.

Uses.—This preparation will be found convenient for the rare occasions in which musk is used medicinally. The dose is from ½ to 2 drachms (2–8 Cc.). (See MOSCHUS.)

TINCTURA MYRRHÆ, *U. S., Br., P. G.*—Tincture of Myrrh.

Teinture de myrrhe, Fr.; *Myrrhentinktur*, G.

Preparation.—Myrrh, in moderately coarse powder, 200 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Macerate the myrrh in a stoppered container, and in a moderately warm place, with 750 Cc. of alcohol during 3 days, with frequent agitation; then filter through purified cotton or a plain paper filter, and, when the liquid has drained off completely, pour on enough menstruum to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of myrrh, macerate 3 avoirdupois ounces and 148 grains of coarsely powdered myrrh with 12 fluidounces of alcohol for 3 days, with frequent agitation; then filter through a plain paper filter, and pass enough alcohol through the residue to bring the volume up to 16 fluidounces.

Other pharmacopœias direct: Myrrh, 4 ounces; alcohol (90 per cent.), sufficient to make 1 imperial pint of tincture.—Br. Myrrh, 1 part; alcohol, 5 parts.—P. G. Myrrh, 1 part; alcohol (80 per cent.), 5 parts.—Fr. Cod.

Tincture of myrrh is a brownish-yellow or reddish-yellow liquid having the balsamic odor of myrrh and a bitter aromatic taste. On the addition of water it yields a precipitate of resin.

Uses.—Tincture of myrrh is used nearly always as a local application. In full strength it is applied as a stimulant and protective agent to chronic, sloughing ulcers. Diluted with water in the proportion of about 1 part to 20, it is used in the treatment of stomatitis, spongy gums, relaxed uvula, and sore throat. It is rarely given internally. The dose is from 10 to 30 minims (0.60–2 Cc.).

TINCTURA NUCIS VOMICÆ, *U. S., Br.*—Tincture of Nux Vomica.

Tinctura strychni, P. G.—*Teinture de noix vomique*, Fr.; *Brechnusstinktur, Krähenaugentinktur*, G.

Preparation.—Extract of nux vomica (containing 5 per cent. of strychnine), 20 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Dissolve the extract of nux vomica in a sufficient quantity of a mixture of alcohol and water, made in the proportion of 750 Cc. of alcohol and 250 Cc. of water, to make the solution measure 1000 Cc., and filter through a well-covered paper filter.

Tincture of nux vomica, when assayed by the process given below, should contain in 100 Cc. 0.1 Gm. of strychnine.—U. S.

To make 1 pint of tincture of nux vomica, dissolve 146 grains of the prescribed extract of nux vomica in 14 fluidounces of menstruum (alcohol, 3 volumes; water, 1 volume), filter through paper, and wash the filter with sufficient menstruum to bring the volume up to 16 fluidounces.

Assay of Tincture of Nux Vomica.—Transfer 100 Cc. of tincture of nux vomica to a porcelain dish, evaporate it to dryness on a water-bath, and assay the resulting extract by the method given under EXTRACTUM NUCIS VOMICÆ (page 606), using the same details as there directed for 2 Gm. of extract of nux vomica, with the exception that the multiplication by 50 be omitted; the result will represent the weight in grammes of strychnine contained in 100 Cc. of tincture of nux vomica.—U. S.

Liquid extract of nux vomica, 2 fluidounces; distilled water, 3 fluidounces; alcohol (90 per cent.), a sufficient quantity. Mix the liquid extract of nux vomica with the distilled water, and add sufficient alcohol to produce 12 fluidounces. Finally filter. 100 Cc. of the tincture, when assayed, should yield not less than 0.24 Gm. nor more than 0.26 Gm. of strychnine.—Br.

The French and German Pharmacopœias direct the tincture to be made by maceration direct from the nux vomica seed, the former ordering 1 part of drug for 5 parts of 80 per cent. alcohol, and the latter 1 part of drug for 5 parts of 68½ per cent. alcohol. The German Pharmacopœia demands that if 50 Gm. of the tincture be assayed by the process given, an alkaloidal content of not less than 0.251 Gm. of total alkaloids shall be found to be present in 100 Gm.

Tincture of nux vomica has a yellowish color and a very bitter taste, and becomes opalescent when mixed with water. The different official tinctures do not agree in strength: thus the U. S. tincture, which is about ⅓ weaker than the tincture of 1890, is less than ½ as strong as the British tincture, and also somewhat weaker than the German tincture. It contains in each Cc. 0.001 Gm., or in each fluidrachm between $\frac{1}{18}$ and $\frac{1}{17}$ grain of strychnine.

Uses.—Tincture of nux vomica is an excellent preparation to be used when it is desired to add the drug to mixtures. The dose is from 5 to 20 minims (0.30–1.30 Cc.).

TINCTURA OPII, *U. S., Br.*—Tincture of Opium.

Tinctura opii simplex, P. G.—*Teinture d'extrait d'opium*, Fr. Cod.; *Tinctura extracti opii, Tinctura thebaica, Tinctura meconii.—Laudanum*, E.; *Teinture thébaïque*, Fr.; *Einfache Opiumtinktur*, G.; *Tintura de extracto de opio*, Sp.

Preparation.—Granulated opium (containing 12 to 12.5 per cent. of crystallizable morphine), 100 Gm.; alcohol, water, diluted alcohol, each a sufficient quantity to make 1000 Cc. Heat 400 Cc. of water to boiling, and pour it on the granulated opium contained in a tared vessel, weigh, and stir occasionally during 12 hours; then restore the original weight by the addition of cold water, add 400 Cc. of alcohol, pour the mixture into a bottle, and continue the maceration for 48 hours, occasionally shaking. Transfer the mixture to a percolator, return the first portion of the percolate until it runs through clear, and, when the liquid ceases to drop, continue the percolation slowly, pouring on sufficient diluted alcohol until 1000 Cc. are obtained.

Tincture of opium, when assayed by the process given below, should contain in 100 Cc. not less than 1.2 nor more than 1.25 Gm. of crystallized morphine.—U. S.

To make 1 pint of tincture of opium, mix 730 grains of the prescribed opium with 6½ fluidounces of boiling water in a tared dish and weigh; stir frequently during 12

hours, and restore the original weight by addition of cold water, transfer to a bottle, add 6½ fluidounces of alcohol, shake well, and macerate for 48 hours. Transfer the mixture to a percolator, allow percolation to go on slowly, and, when all liquid has disappeared from the surface, pour on sufficient diluted alcohol to bring the total volume of percolate up to 16 fluidounces.

Assay of Tincture of Opium.—Tincture of opium, 100 Cc.; ammonia-water, 3.5 Cc.; alcohol, ether, water, lime-water, each a sufficient quantity. Transfer 100 Cc. of tincture of opium to an evaporating dish and evaporate it on a water-bath to about 20 Cc., add 40 Cc. of water, mix thoroughly, and set the liquid aside for 1 hour, occasionally stirring to disintegrate the resinous flakes adhering to the dish. Then filter the liquid and wash the filter and residue with water until all soluble matter is extracted, collecting the washings separately. Evaporate in a tared dish, first, the washings to a small volume, then add the first filtrate and evaporate the whole to a weight of 14 Gm. Determine the morphine in this extract by the method given under OPIUM (page 1126, beginning with the word "Rotate" in the first paragraph), using the same details as there directed for 10 Gm. of opium, with the exception that the final multiplication by 10 be omitted. The result will represent the weight in grammes of crystallized morphine yielded by 100 Cc. of the tincture.—U. S.

The British Pharmacopœia directs a process similar to the above, using the same menstruum, and preparing from 3 ounces of opium a strong tincture, which is then assayed, and from the results of the assay the amount of diluted alcohol is calculated necessary to be added to the strong tincture in order to bring the strength of the finished product up to the official requirement, namely, that each Cc. shall contain 0.0075 Gm. of anhydrous morphine, or 0.75 Gm. in 100 Cc.

The French Codex orders 10 Gm. of extract of opium to be dissolved in 120 Gm. of 60 per cent. alcohol. No alkaloidal standard is prescribed.

Tincture of opium of the German Pharmacopœia is made by macerating 15 parts of opium with a mixture of 70 parts each of water and 68½ per cent. alcohol. It contains in 100 Gm. 1 to 1.2 Gm. of morphine, and as its specific gravity is given as 0.976 the strength corresponds nearly with that of the U. S. preparation.

Opium readily yields its active constituents to water, and the preliminary treatment of the drug with hot water is intended to facilitate complete exhaustion by the hydro-alcoholic menstruum used subsequently. The tincture has a deep reddish-brown color and the characteristic narcotic odor and bitter taste of opium. The official U. S. P. preparation contains in each fluidrachm very nearly ¾ grain of crystallized morphine.

Uses.—This is the preparation of opium which is used as an addition to anodyne liniments, poultices, etc. The tincture of deodorized opium is preferable for internal administration, because it is free from narcotine to which the nausea following the use of the drug is attributed. The dose is from 5 to 20 minims (0.30–1.30 Cc.).

TINCTURA OPII AMMONIATA, *Br.*—Ammoniated Tincture of Opium.

Teinture d'opium ammoniacale, Fr.; *Ammoniakalische Opiumtinktur*, G.

Preparation.—Tincture of opium, 3 fluidounces; benzoic acid, 180 grains; oil of anise, 1 fluidrachm; solution of ammonia, 4 fluidounces; alcohol (90 per cent.), a sufficient quantity. Dissolve the oil of anise and the benzoic acid in 12 fluidounces of the alcohol; then add the tincture of opium and solution of ammonia, and mix well. Filter and add enough alcohol to form 1 imperial pint of the tincture.—Br.

This preparation is very much weaker in morphine than the preceding tincture, representing in each fluidounce about 5 grains of opium containing 10 per cent. of anhydrous morphine. It contains the alkaloids of opium in solution in a free state, and is very similar to the preparation formerly known as *Scotch Paregoric Elixir*.

Uses.—This preparation corresponds to paregoric, and is used for the same purposes, in the dose of ½ to 1 drachm (2–4 Cc.).

TINCTURA OPII CAMPHORATA, *U. S.*—Camphorated Tincture of Opium.

Tinctura camphoræ composita, Br.; *Élixir parégorique*, Fr. Cod.; *Tinctura opii benzoica*, P. G.; *Elixir paregoricum, Tinctura extracti opii camphorata.—Paregoric, Paregoric elixir*, E.; *Teinture d'opium camphrée*, Fr.; *Benzoësäurehaltige Opiumtinktur*, G.

Preparation.—Powdered opium, 4 Gm.; benzoic acid, 4 Gm.; camphor, 4 Gm.;

oil of anise, 4 Cc.; glycerin, 40 Cc.; diluted alcohol, 900 Cc. Place all the ingredients in a stoppered container and macerate for 3 days with frequent agitation: then filter the mixture through a well-covered paper filter, adding sufficient diluted alcohol through the filter to make 1000 Cc. of tincture.—U. S.

To make 1 pint of paregoric macerate powdered opium, 30 grains; benzoic acid, 30 grains; camphor, 30 grains; oil of anise, 30 minims; and 5 fluidrachms of glycerin with 15 fluidounces of diluted alcohol for 3 days with frequent agitation; filter and pass enough diluted alcohol through the residue to bring the volume up to 16 fluidounces.

Tincture of opium, 585 minims; benzoic acid, 40 grains; camphor, 30 grains; oil of anise, 30 minims; alcohol (60 per cent.), a sufficient quantity. Having dissolved the benzoic acid, camphor, and oil of anise in 18 fluidounces of the alcohol add the tincture of opium and, finally, sufficient of the alcohol to make 1 imperial pint of the tincture.—Br.

Other pharmacopœias direct: Opium, powdered, 1 part; anethol, 1 part; camphor, 2 parts; benzoic acid, 4 parts; alcohol (68½ per cent.), 192 parts.—P. G. Extract of opium, 3 Gm.; benzoic acid, 3 Gm.; oil of anise, 3 Gm.; camphor, 2 Gm.; alcohol (60 per cent.), 650 Gm.—Fr. Cod.

Camphorated tincture of opium has a brownish-yellow color, an anise-like and camphoraceous odor, a sweetish, aromatic, somewhat pungent and slightly bitter taste, and an acid reaction. Upon the addition of water it turns milky, owing to the precipitation of the oil of anise, benzoic acid, and camphor. Each Cc. of the official tincture represents 0.004 Gm., or each fluidrachm very nearly ¼ grain, of opium and a like quantity of camphor and benzoic acid.

Uses.—Paregoric possesses anodyne and carminative properties, and is largely employed to relieve abdominal pain due to flatus, to check diarrhœa, to allay cough, and as a mild sedative for infants. The dose is from 1 to 4 drachms (4–16 Cc.).

TINCTURA OPII DEODORATI, *U. S.*—Tincture of Deodorized Opium.

Teinture d'opium sans odeur, Fr.; *Desodorirte Opiumtinktur*, G.

Preparation.—Granulated opium (containing 12 to 12.5 per cent. of crystallized morphine), 100 Gm.; purified petroleum benzin, 75 Cc.; alcohol, 200 Cc.; water, a sufficient quantity to make 1000 Cc. Heat 500 Cc. of water to boiling, and pour it on the granulated opium contained in a suitable vessel, stirring the mixture frequently during 24 hours. Then transfer the mixture to a percolator, return the first portion of the percolate until it runs through clear, and, when the liquid ceases to drop, continue the percolation with water until the opium is exhausted. Concentrate the percolate by evaporation on a water-bath until it measures 150 Cc., and, when cooled, shake it frequently and vigorously for 10 minutes with 65 Cc. of the purified petroleum benzin. Separate the benzin, repeat the shaking out for a few minutes with the remainder of the benzin, and, having carefully and completely separated this second portion of benzin, evaporate the remaining liquid in a warm place spontaneously until the odor of benzin has disappeared, removing the last traces by the heat of a water-bath. Mix the deodorized liquid so obtained with 600 Cc. of water, filter the mixture through a paper filter, and, having mixed the alcohol with the filtrate, wash the filter with sufficient water to make 1000 Cc. of tincture.—U. S.

To make 1 pint of the tincture, macerate 730 grains of the prescribed opium with 8 fluidounces of water, previously heated to boiling, for 24 hours, stirring the mixture frequently. Then proceed as directed above, and, when the opium is exhausted, concentrate the percolate to 2½ fluidounces, and when cold add 1 fluidounce of purified petroleum benzin and agitate vigorously for 10 minutes. Transfer to a separator and draw off the aqueous fluid, and again shake the same with 2 fluidrachms of the benzin. Again separate the benzin and drive off the last traces by the heat of a water-bath. To the deodorized liquid add 9 fluidounces of water, filter, add 3¼ fluidounces of alcohol to the filtrate, and pass enough water through the filter to bring the volume of finished tincture up to 16 fluidounces.

Assay of Tincture of Deodorized Opium.—If 100 Cc. of tincture of deodorized opium be assayed by the process given under TINCTURA OPII, it should yield from 1.2 to 1.25 Gm. of crystallized morphine.—U. S.

The present tincture of deodorized opium differs from previous preparations mainly in the use of purified petroleum benzin in place of ether, whereby deodorization is effected equally well and the narcotine is permitted to remain in solution. It is now claimed that narcotine is not the nauseating principle in opium, and that instead of being objectionable it is in reality a desirable constituent of the drug. Although the treatment of the concentrated infusion of opium with purified benzin is much less objectionable than with ether, as no annoying emulsion is formed, it is nevertheless undesirable on account of the persistent odor of the benzin. If deodorized opium, in fine or granulated powder, be used, the resulting infusion simply requires concentration, addition of the alcohol and filtration, and thus the process is greatly simplified.

Another unobjectionable method for preparing the tincture is to follow the suggestion of F. T. Gordon (1900), which consists in exhausting 730 grains of standard opium with water, concentrating the infusion to 8 fluidounces on a water-bath, and while still hot adding 2½ ounces of paraffin in small pieces. When the paraffin has melted, the mixture is thoroughly stirred for 10 to 15 minutes until the paraffin no longer seems to darken in color. After cooling, the hardened paraffin crust is broken and washed with a little cold water, the washings being added to the deodorized liquid. The mixture is filtered through paper, enough water passed through the filter to bring the volume, after addition of 3¼ fluidounces of alcohol, up to 16 fluidounces. We have found this method very satisfactory.

It must be borne in mind that the present tincture is somewhat weaker than that of 1890, due to the fact that the morphine standard for opium has been slightly lowered in the 1900 Pharmacopœia. At present tincture of deodorized opium should contain not less than 0.012 nor more than 0.0125 Gm. of crystallized morphine in each Cc., or nearly ¾ grain in each fluidrachm.

Uses.—This is the preferable fluid preparation of opium to be given internally, because it is less apt to cause nausea. The dose is from 5 to 20 minims (0.30–1.30 Cc.).

Allied Preparations.—Liquor Opii Compositus. Opium is exhausted with water, the infusion concentrated, precipitated by alcohol, the clear liquid evaporated to a small bulk equal in weight to that of the opium, and agitated with ether. The aqueous liquid, freed from the ether, is diluted with 1 part of its own weight of water, filtered, mixed with 1 part of stronger alcohol, and diluted with water to 5 parts. A portion of this is assayed, and the whole liquid is then mixed with the remaining ingredients in such proportions that 30 Cc., or 1 fluidounce, shall contain 6 grains of morphine, 1 Cc. of chloroform, 2 Cc. of acetic ether, and 13 Cc. of stronger alcohol, the remaining liquid being water. As originally suggested by Dr. Squibb, this preparation contained 4 grains of morphine in the fluidounce, but after the appearance of the Pharmacopœia of 1880 this amount was increased to 6 grains. (For details see *Amer. Jour. Phar.*, 1870, page 47.)

Battley's Sedative Drops.—Three ounces of extract of opium are dissolved in 30 ounces of hot water, and the solution filtered and mixed with 6 ounces of alcohol. This preparation is about 50 per cent. stronger than those above described.

TINCTURA PHYSOSTIGMATIS, *U. S.*—Tincture of Physostigma.

Teinture de fève du Calabar, Fr.; *Kalabarbohnentinktur*, G.

Preparation.—Physostigma, in No. 50 powder (containing 0.15 per cent. of ether-soluble alkaloids), 100 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the physostigma with 40 Cc. of alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient alcohol to obtain 1000 Cc. of tincture.

Tincture of physostigma, when assayed by the process given below, should contain in 100 Cc. 0.014 Gm. of the ether-soluble alkaloids from physostigma.—U. S.

To make 1 pint of tincture of physostigma, moisten 730 grains of the prescribed physostigma with 5 fluidrachms of alcohol, and proceed as directed above, allowing percolation to continue until 16 fluidounces of tincture have been obtained.

Assay of Tincture of Physostigma.—Transfer 100 Cc. of tincture of physostigma to a porcelain dish, evaporate it to dryness on a water-bath, and assay the resulting extract by the method given under Extractum Physostigmatis (page 609), using the same details as

there directed for 1 Gm. of extract of physostigma, with the exception that the product must be multiplied by 2 instead of 200; the result will represent the weight in grammes of ether-soluble alkaloids from physostigma contained in 100 Cc. of tincture of physostigma.—U. S.

The present tincture of physostigma is about ⅓ weaker than that of 1890. It has a pale brownish-yellow color, and should be preserved in small, well-stoppered vials, protected against light, on account of the sensitiveness of the alkaloidal salts, when in solution, to the influence of air and light. Each Cc. of the tincture represents 0.00014 Gm. of the ether-soluble alkaloids, or each fluidrachm about $\frac{1}{120}$ grain.

Uses.—This tincture possesses all the medicinal virtues of the drug, and is given in the dose of 10 to 30 minims (0.60–2 Cc.).

TINCTURA PIMPINELLÆ, *P. G.*—Tincture of Pimpinell.

Teinture de grand boucage, Fr.; *Bibernelltinktur*, G.

Preparation.—Pimpinell root, cut moderately fine, 1 part; alcohol (68½ per cent.), 5 parts. Macerate for 7 days, strain and express; finally filter the mixed liquids. —P. G.

Tincture of pimpinell has a brownish-yellow color and a disagreeable acrid taste.

Uses.—Tincture of pimpinell is not used in this country. It is employed in Germany as a carminative, diuretic, and emmenagogue in the dose of ½ to 1 drachm (2–4 Cc.).

TINCTURA PODOPHYLLI, *Br.*—Tincture of Podophyllum.

Teinture de résine de podophyllum, Fr.; *Podophyllintinktur*, G.

Preparation.—Resin of podophyllum, 320 grains; alcohol (90 per cent.), a sufficient quantity. Add the resin of podophyllum to 18 fluidounces of alcohol and let the mixture stand, with occasional agitation, for 24 hours; then filter and pass enough alcohol through the filter to bring the volume of filtrate up to 1 imperial pint.—Br.

This tincture is simply a solution of resin of podophyllum in strong alcohol, representing 2 grains of the resin in each fluidrachm.

Uses.—This tincture may be given whenever podophyllum is indicated. The dose is from 1 to 2 drachms (4–8 Cc.).

TINCTURA PRUNI VIRGINIANÆ, *Br.*—Tincture of Virginian Prune.

Teinture d'écore de cerisier, Fr.; *Wildkirschenrindentinktur*, G.

Preparation.—Virginian prune bark, in No. 20 powder, 4 ounces; alcohol (90 per cent.), 12½ fluidounces; distilled water, 7½ fluidounces. After mixing the powder with the water, it is set aside for 24 hours; the alcohol is then added and the tincture prepared by maceration.—Br.

Uses.—This preparation is useful when it is desired to give wild cherry for its stomachic, tonic properties. Its dose is from 1 to 2 drachms (4–8 Cc.).

TINCTURA PYRETHRI, *U. S., Br.*—Tincture of Pyrethrum.

Tincture of pellitory, E.; *Teinture de pyrèthre*, Fr.; *Bertramwurzeltinktur*, G.

Preparation.—Pyrethrum, in No. 50 powder, 200 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the pyrethrum with 80 Cc. of alcohol, transfer it to a percolator, and without pressing the powder allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of pyrethrum, moisten 3 avoirdupois ounces and 148 grains of the powdered drug with 10 fluidrachms of alcohol, and proceed as directed above, allowing percolation to continue until 16 fluidounces of percolate have been obtained.

Other pharmacopœias direct: Pyrethrum root, in No. 40 powder, 4 ounces; alcohol (70 per cent.)—Br. Pyrethrum root, 1 part; alcohol (80 per cent.), 5 parts.—Fr. Cod.

Tincture of pyrethrum has a brownish-yellow color and a very acrid taste, and on the addition of water becomes opalescent and milky.

Uses.—Tincture of pyrethrum is never given internally, but is used as a stimulant application in paralysis of the tongue, uvula, and pharynx.

TINCTURA QUASSIÆ, *U. S., Br.*—Tincture of Quassia.

Teinture de quassie amère, Fr.; *Quassiatinktur*, G.

Preparation.—Quassia, in No. 50 powder, 200 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 350 Cc. of alcohol with 650 Cc. of water. Moisten the quassia with 60 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of quassia moisten 3 avoirdupois ounces and 148 grains of the powdered drug with 1 fluidounce of menstruum (alcohol, 35 volumes; water, 65 volumes), and proceed as directed above, allowing percolation to continue until 16 fluidounces of tincture have been obtained.

The British Pharmacopœia directs that the tincture be prepared by macerating 2 ounces of rasped quassia with 1 imperial pint of alcohol (45 per cent.). The French tincture is of the same strength.

Tincture of quassia has a light brownish-yellow color and a persistently bitter taste. It differs from most bitter tinctures in not being colored black or green by ferric salts, since it contains no tannin. The present tincture is twice as strong as that of 1890.

Uses.—Tincture of quassia is used as a bitter tonic, usually in combination with similar preparations. Diluted with water, it is sometimes employed in enema to destroy threadworms, but the infusion is better for this purpose. The dose is from 15 to 60 minims (1–4 Cc.).

TINCTURA QUILLAJÆ, *U. S.*—Tincture of Quillaja.

Tincture of soap-bark, E.; *Teinture d'écorce de quillaya*, Fr.; *Seifenrindentinktur*, G.

Preparation.—Quillaja, coarsely ground, 200 Gm.; alcohol, 350 Cc.; water, a sufficient quantity to make 1000 Cc. Boil the quillaja in a covered vessel with 800 Cc. of water for 15 minutes, strain while hot, and wash the residue on the strainer with 200 Cc. of water, previously heated to boiling. Then evaporate the strained liquid to 600 Cc., allow it to cool, add the alcohol, and set it aside for 12 hours. Decant the clear liquid, filter it through paper, then pour the residue on the filter, and, when the liquid ceases to drop, wash the filter with sufficient water to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of quillaja, boil 3 avoirdupois ounces and 148 grains of coarsely-ground soap-bark with 13 fluidounces of water for 15 minutes, strain while hot, and wash the residue with 3 fluidounces of water. Evaporate the strained liquid to 9½ fluidounces, cool, and add 5½ fluidounces of alcohol and set aside for 12 hours. Filter and wash the residue in the filter with sufficient water to obtain 16 fluidounces of tincture.

The British Pharmacopœia directs tincture of soap-bark to be made by moistening 1 ounce of quillaja, in No. 20 powder, with ½ fluidounce of alcohol (60 per cent.), and macerating for 24 hours, to percolate with the same menstruum until 1 imperial pint of tincture has been obtained.

Uses.—This tincture may be used for the purposes mentioned under QUILLAJA.

TINCTURA QUININÆ, *Br.*—Tincture of Quinine.

Teinture de quinine, Fr.; *Chinintinktur*, G.

Preparation.—Take of quinine hydrochloride 175 grains; Tincture of orange, 1 pint (imperial). Dissolve the quinine hydrochloride in the tincture.—Br.

Uses—This preparation is unnecessary. The dose is from 1 to 2 drachms (4–8 Cc.) as a bitter tonic.

TINCTURA QUININÆ AMMONIATA, *Br.*—Ammoniated Tincture of Quinine.

Teinture ammoniacale de quinine, Fr.; *Ammoniakhaltige Chinintinktur*, G.

Preparation.—Quinine sulphate, 175 grains; solution of ammonia, 2 fluidounces; alcohol (60 per cent.), 18 fluidounces. Mix the solution of ammonia with the alcohol and add the quinine sulphate; shake until a clear solution is obtained, then set aside for 3 days and filter.—Br.

Uses.—This combination is supposed to be of particular service as a tonic in nervous exhaustion. The dose is from ½ to 1 drachm (2–4 Cc.).

TINCTURA RHEI, *U. S.*—Tincture of Rhubarb.

Tinctura rhei composita.—Compound tincture of rhubarb, Br.; *Teinture de rhubarbe*, Fr.; *Rhabarbertinktur*, G.

Preparation.—Rhubarb, 200 Gm.; cardamom, 40 Gm.; glycerin, 100 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 500 Cc. of alcohol and 400 Cc. of water. Reduce the rhubarb and cardamom to a No. 40 powder and moisten it with 90 Cc. of the menstruum; transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 12 hours; then pack it moderately and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of alcohol and water, made in the same proportions as before, to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of rhubarb, mix 3 avoirdupois ounces and 148 grains of rhubarb, and 300 grains of cardamom, both in No. 40 powder, moisten with 1½ fluidounces of menstruum (alcohol, 5 volumes; glycerin, 1 volume; water, 4 volumes), and proceed as directed above, allowing percolation to continue, pouring on diluted alcohol after 16 fluidounces of original menstruum have been used until 16 fluidounces of tincture have been obtained.

The British Pharmacopœia directs that 18 fluidounces of tincture be made by percolation with alcohol (60 per cent.) from rhubarb 2 ounces, and ¼ ounce each of cardamom and coriander; this is set aside for 48 hours, filtered, and then mixed with 2 fluidounces of glycerin.

Tincture of rhubarb has a deep reddish-brown color, and the odor and taste of rhubarb, modified slightly by the cardamom. It becomes turbid when mixed with water, and deposits on standing, which latter tendency is materially reduced by the presence of glycerin. The present tincture contains twice as much rhubarb and cardamom as that of 1890.

Uses.—Tincture of rhubarb fully represents the properties of the drug, but is rarely employed. The dose as a purgative is from ½ to 1 ounce (16–30 Cc.); as a stomachic, from ½ to 1 drachm (2–4 Cc.).

Allied Tinctures.—TINCTURA RHEI AQUOSA, P. G.—*Aqueous tincture of rhubarb*, E.; *Wässerige Rhabarbertinktur*, G. Take of rhubarb, cut into thin pieces, 100 parts; powdered borax, potassium carbonate, each 10 parts; add boiling distilled water, 900 parts, and after 15 minutes alcohol, 90 parts; macerate for 1 hour, express slightly, and to 850 parts of liquid add cinnamon-water, 150 parts.

TINCTURA RHEI VINOSA, P. G.—*Vinous tincture of rhubarb*, E.; *Weinige Rhabarbertinktur*, G. Take of rhubarb, cut into slices, 8 parts; cardamom, bruised, 1 part; bitter orange peel, finely cut, 2 parts; sherry wine, 100 parts. Macerate for 7 days and filter. In the filtrate dissolve ⅐ of its weight of sugar.

TINCTURA RHEI AROMATICA, *U. S.*—Aromatic Tincture of Rhubarb.

Teinture de rhubarbe aromatique, Fr.; *Aromatische Rhabarbertinktur*, G.

Preparation.—Rhubarb, 200 Gm.; Saigon cinnamon, 40 Gm.; cloves, 40 Gm.; nutmeg, 20 Gm.; glycerin, 100 Cc.; alcohol, water, diluted alcohol, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 500 Cc. of alcohol and 400 Cc. of

water. Reduce the rhubarb, Saigon cinnamon, cloves, and nutmeg to a No. 40 powder, and moisten it with 90 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand for 12 hours; then pack it moderately and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of alcohol and water, made in the same proportions as before, to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of aromatic tincture of rhubarb, mix 3 avoirdupois ounces and 148 grains of rhubarb, 300 grains each of Saigon cinnamon and cloves, and 150 grains of nutmeg, all in No. 40 powder, with 1½ fluidounces of menstruum (alcohol, 5 volumes; glycerin, 1 volume; water, 4 volumes), proceed as directed above, and allow percolation to continue, pouring on diluted alcohol after 16 fluidounces of original menstruum have been used, until 16 fluidounces of tincture have been obtained.

This tincture, intended for preparing aromatic syrup of rhubarb, has a dark red-brown color, a pleasant aromatic odor, and a spicy and bitter taste. When mixed with syrup or aqueous fluids, it becomes turbid, which may be overcome by the previous addition of a little borax or alkali carbonate.

Uses.—This preparation may be used for the same purposes as the aromatic syrup when saccharine solutions are not desirable. The dose is from 15 to 60 minims (1–4 Cc.).

TINCTURA SANGUINARIÆ, *U. S.*—Tincture of Sanguinaria.

Tincture of bloodroot, E.; *Teinture de sanguinaire*, Fr.; *Blutwurzeltinktur*, G.

Preparation.—Sanguinaria, in No. 60 powder, 100 Gm.; acetic acid, 20 Cc.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 400 Cc. of water. Moisten the sanguinaria with the acetic acid and 30 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of sanguinaria, moisten 730 grains of the powdered drug with 2½ fluidrachms of acetic acid and ½ fluidounce of menstruum (alcohol, 6 volumes; water, 4 volumes), and proceed as directed above, allowing percolation to continue until 16 fluidounces of tincture have been obtained.

Tincture of sanguinaria has a rich brownish-red color and the bitter, acrid taste of the drug. The addition of acetic acid not only facilitates the extraction of the alkaloidal constituents of the sanguinaria, but also materially aids in preventing or retarding precipitation. The present tincture is ⅛ weaker than that of 1890, representing in each Cc. 0.10 Gm., or in each fluidrachm about 5¾ grains, of sanguinaria.

Uses.—This tincture contains all the virtues of sanguinaria. The dose as an expectorant is from 10 to 30 minims (0.60–2 Cc.). In the dose of 1 drachm (4 Cc.) or more it is emetic.

TINCTURA SCILLÆ, *U. S., Br., P. G.*—Tincture of Squill.

Teinture de Scuille, Fr.; *Meerzwiebeltinktur*, G.

Preparation.—Squill, in No. 20 powder, 100 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water. Macerate the squill with 600 Cc. of the menstruum, in a closed vessel, in a moderately warm place for 3 days, occasionally stirring, and express strongly. Repeat this operation with 300 Cc. of menstruum, macerating 1 day before expression; and, finally, macerate the residue for 6 hours in sufficient menstruum to make the united expressed liquids measure about 1000 Cc. Express as before, mix the expressed liquids, filter through paper, and pass sufficient menstruum through the filter to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of squill, macerate 730 grains of squill, in No. 20 powder,

with 9½ fluidounces of menstruum (alcohol, 3 volumes; water, 1 volume) for 3 days and express strongly. Again macerate with 4½ fluidounces of menstruum for 1 day and express; finally macerate the residue for 6 hours with sufficient menstruum to make the united liquids measure 16 fluidounces. Express as before, mix the liquids, filter, and pass sufficient menstruum through the filter to make 16 fluidounces.

Other pharmacopœias direct: Squill, 4 ounces; alcohol (60 per cent.), 1 imperial pint.—Br. Squill, 100 Gm.; alcohol (60 per cent.), 500 Gm.—Fr. Cod. Squill, 1 part; alcohol (68½ per cent.), 5 parts.—P. G.

Tincture of squill has a light yellow color and the nauseous bitter taste of the drug. The strongly alcoholic menstruum is necessary to avoid extraction of much inert mucilaginous matter. The present tincture is ⅓ weaker than that of 1890.

Uses.—This tincture fully represents the diuretic and expectorant qualities of squill, and is given in the dose of 10 to 30 minims (0.60–2 Cc.).

TINCTURA SENEGÆ, *Br.*—Tincture of Senega.

Teinture de polygala de Virginie, Fr.; *Senegatinktur*, G.

Preparation.—Senega, in No. 40 powder, 4 ounces; alcohol (60 per cent.), a sufficient quantity. Moisten the powder with 4 fluidounces of the alcohol and prepare the tincture by percolation. The resulting tincture should measure 1 imperial pint.—Br.

Uses.—Tincture of senega possesses no advantages over the syrup or fluidextract. The dose is from ½ to 1 drachm (2–4 Cc.).

TINCTURA SENNÆ COMPOSITA, *Br.*—Compound Tincture of Senna.

Elixir salutis.—Teinture de séné composée, Fr.; *Zusammengesetzte Sennatinktur*, G.

Preparation.—Take of senna, broken small, 4 ounces; raisins, freed from seeds, 2 ounces; caraway-fruit, bruised, coriander-fruit, bruised, each ½ ounce; alcohol (45 per cent.), 1 pint. Prepare 1 pint (imperial) of tincture by maceration.—Br.

Uses.—This preparation is employed for the same purposes as the confection of senna. The dose is from 1 to 4 drachms (4–16 Cc.).

TINCTURA SERPENTARIÆ, *U. S., Br.*—Tincture of Serpentaria.

Tincture of serpentary, Br.; *Teinture de serpentaire*, Fr.; *Schlangenwurzeltinktur*, G.

Preparation.—Serpentaria, in No. 50 powder, 200 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 650 Cc. of alcohol with 350 Cc. of water. Moisten the serpentaria with 60 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of serpentaria, moisten 3 avoirdupois ounces and 148 grains of the ground drug with 1 fluidounce of menstruum (alcohol, 65 volumes; water, 35 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

The British Pharmacopœia directs that 4 ounces of ground serpentaria be moistened with 4 fluidounces of alcohol (70 per cent.), and the tincture prepared by percolation. The resulting tincture should measure 1 imperial pint.

Tincture of serpentaria has a brownish-yellow color and the characteristic camphoraceous odor and taste of the drug. The present tincture is twice as strong as that of 1890, representing in each Cc. 0.20 Gm., or in each fluidrachm about 12 grains, of serpentaria.

Uses.—Tincture of serpentaria is rarely prescribed alone, but in combination with other tonic drugs to promote their absorption and increase their effects. The dose is from ½ to 2 drachms (2–8 Cc.).

TINCTURA STRAMONII, *U. S., Br.*—Tincture of Stramonium.

Tincture of stramonium leaves, E.; *Teinture des feuilles de stramoine*, Fr.; *Stechapfelblättertinktur*, G.

Preparation.—Stramonium, in No. 60 powder (containing not less than 0.35 per cent. of mydriatic alkaloids), 100 Gm.; diluted alcohol, a sufficient quantity to make 1000 Cc. Moisten the stramonium with 40 Cc. of diluted alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 3 hours; then pack it firmly and pour on enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, gradually pouring on diluted alcohol until 1000 Cc. are obtained.—U. S.

Tincture of stramonium, when assayed by the process given below, should contain in 100 Cc. 0.03 Gm. of mydriatic alkaloids from stramonium.—U. S.

To make 1 pint of tincture of stramonium, moisten 730 grains of the prescribed stramonium leaves with 5 fluidrachms of diluted alcohol and proceed as directed above, allowing percolation to continue until 16 fluidounces of tincture have been obtained.

Assay of Tincture of Stramonium.—Transfer 100 Cc. of tincture of stramonium to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under *Fluidextractum Belladonnæ Radicis* (page 652), using the same details as there directed for 10 Cc. of fluidextract of belladonna root, with the exception that the multiplication by 10, as there directed, be omitted; the result will represent the weight in grammes of alkaloids contained in 100 Cc. of tincture of stramonium.—U. S.

The British Pharmacopœia directs that 4 ounces of coarsely ground stramonium leaves be moistened with 4 fluidounces of alcohol (45 per cent.), and the tincture prepared by percolation. The resulting tincture should measure 1 imperial pint. The French Codex orders 1 part of stramonium leaves and 5 parts of 60 per cent. alcohol.

Tincture of stramonium has a greenish-brown color and a heavy narcotic odor. The present tincture differs from that of 1890 in being made from the leaves instead of the seed. Each Cc. contains 0.0003 Gm., or each fluidrachm about $\frac{1}{50}$ grain, of the mydriatic alkaloids of the drug.

Uses.—Tincture of stramonium contains all the virtues of the drug, and may be used whenever stramonium is indicated, whether internally or externally. The dose is from 5 to 20 minims (0.30–1.30 Cc.).

TINCTURA STROPHANTHI, *U. S., Br., P. G.*—Tincture of Strophanthus.

Teinture des semences de strophantus, Fr.; *Strophanthussamentinktur*, G.

The present tincture of strophanthus is twice as strong as that of 1890.—U. S.

Preparation.—Strophanthus, in No. 60 powder, 100 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 650 Cc. of alcohol with 350 Cc. of water. Moisten the strophanthus with 50 Cc. of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of strophanthus, moisten 730 grains of the powdered seed with 6 fluidrachms of menstruum (alcohol, 65 volumes; water, 35 volumes), and proceed as directed above, continuing percolation until 16 fluidounces of tincture have been obtained.

Strophanthus seeds, in No. 30 powder, $\frac{1}{2}$ ounce; alcohol (70 per cent.), a sufficient quantity. Pack the powder in a percolator; moisten it with 1 fluidrachm of the alcohol; set aside for 48 hours; pour on successive quantities of the alcohol, allowing percolation to proceed slowly, until 10 fluidounces of percolate have been obtained; filter and add sufficient alcohol to produce 1 imperial pint of the tincture.—Br.

The German Pharmacopœia directs 1 part of strophanthus seeds, in moderately fine powder, to be macerated with 10 parts of alcohol (68½ per cent.).

The color of tincture of strophanthus will vary with the menstruum employed; if pure alcohol be used, the color will be greenish-yellow, whereas the official menstruum yields a brownish-yellow tincture. Its taste is very bitter. When freshly made it is apt to be cloudy, and gradually deposits fatty matter, slowly becoming brighter. Strophanthus seeds contain considerable fixed oil, which can be removed by ether, but a simpler plan is that suggested by Scoville and Loewe (1899). The tincture of strophanthus is placed in a flask and then buried in a mixture of crushed ice and salt, and allowed to remain there for 2 hours. The temperature rapidly sinks to —14 C. (6.8 F.), and at the end of the prescribed time an abundant semiflocculent grayish sediment will have formed, which is removed by filtration through paper in a funnel kept packed in ice and salt. The resulting product is bright in appearance, and leaves no fatty stain when evaporated on bibulous paper.

Each Cc. of tincture of strophanthus represents 0.100 Gm., or each fluidrachm about 5¾ grains, of the drug. The British tincture is ¼ as strong.

Uses.—This is the preparation of strophanthus nearly always employed. The dose is from 3 to 15 minims (0.20–1 Cc.).

TINCTURA SUMBUL, *Br.*—Tincture of Sumbul.

Teinture de sumbul, Fr.; *Sumbultinktur*, G.

Preparation.—Sumbul, bruised, 2 ounces; alcohol (70 per cent.), 1 imperial pint. Prepare the tincture by maceration.—Br.

Uses.—The dose of this tincture is from 1 to 4 drachms (4–16 Cc.).

TINCTURA TOLUTANA, *U. S., Br.*—Tincture of Tolu.

Teinture de baume de Tolu, Fr.; *Tolubalsamtinktur*, G.

Preparation.—Balsam of tolu, 200 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Macerate the balsam of tolu in 900 Cc. of alcohol, shaking frequently until dissolved; then filter through paper, and wash the filter with sufficient alcohol to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of tolu, macerate 3 avoirdupois ounces and 148 grains of balsam of tolu with 15 fluidounces of alcohol, shaking frequently until dissolved; then filter through paper, and wash the filter with sufficient alcohol to bring the volume of the filtrate up to 16 fluidounces.

Other pharmacopœias direct: Balsam of tolu, 2 ounces; alcohol (90 per cent.), a sufficient quantity to make 1 imperial pint of tincture.—Br. Balsam of tolu, 1 part; alcohol (80 per cent.), 5 parts.—Fr. Cod.

Tincture of tolu has a yellowish color and a pleasant balsamic odor. It becomes milky on the addition of water, due to precipitation of resin. The present tincture is twice as strong as that of 1890.

Uses.—This tincture is sometimes used as a flavoring ingredient in expectorant mixtures. The dose is from 15 to 60 minims (1–4 Cc.). It is decomposed by aqueous solutions, the resin being precipitated.

TINCTURA VALERIANÆ, *U. S., P. G.*—Tincture of Valerian.

Teinture de valériane, Fr.; *Baldriantinktur*, G.

Preparation.—Valerian, in No. 60 powder, 200 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water. Moisten the valerian with 60 Cc. of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of valerian, moisten 3 avoirdupois ounces and 148 grains of the ground valerian with 1 fluidounce of menstruum (alcohol, 3 volumes; water,

1 volume), and proceed as directed above, allowing percolation to continue until 16 fluidounces of tincture have been obtained.

Other pharmacopœias direct: Valerian, 100 Gm.; alcohol (60 per cent.), 500 Gm.—Fr. Cod. Valerian, 1 part; alcohol (68½ per cent.), 5 parts.—P. G.

Tincture of valerian is of a brown or reddish-brown color, varying with somewhat the variety of valerian employed, and has the characteristic odor and taste of the drug. On the addition of water it becomes opalescent and turbid.

Uses.—This tincture possesses all the properties of valerian, and is found useful as a sedative in hysterical disorders and as a rapidly acting stimulant in certain low states occurring during the course of acute febrile affections. The dose is from ½ to 2 drachms (2–8 Cc.).

Allied Tincture.—TINCTURA VALERIANÆ ÆTHEREA.—*Ethereal tincture of valerian*, E.; *Teinture éthérée de valériane*, Fr.; *Aetherische Baldriantinktur*, G.—Valerian, 1 part; spirit of ether, 5 parts.—P. G. Valerian, 2 parts; ether (sp. gr. 0.724), 7 parts; alcohol, 3 parts.—Fr. Cod. It is of a yellow or brownish-yellow color, and becomes opalescent and turbid on the addition of water.

TINCTURA VALERIANÆ AMMONIATA, *U. S., Br.*—Ammoniated Tincture of Valerian.

Teinture de valériane ammoniacale, Fr.; *Ammoniakalische Baldriantinktur*, G.

Preparation.—Valerian, in No. 60 powder, 200 Gm.; aromatic spirit of ammonia, a sufficient quantity to make 1000 Cc. Moisten the valerian with 60 Cc. of aromatic spirit of ammonia, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough aromatic spirit of ammonia to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient aromatic spirit of ammonia to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of ammoniated tincture of valerian, moisten 3 avoirdupois ounces of the ground drug with 1 fluidounce of aromatic spirit of ammonia and proceed as directed above, allowing percolation to continue until 16 fluidounces of tincture have been obtained.

The British Pharmacopœia directs the tincture to be prepared by macerating valerian in No. 40 powder, 4 ounces, with a mixture of oil of nutmeg 30 minims, oil of lemon 20 minims, solution of ammonia 2 fluidounces, and alcohol (60 per cent.) 18 fluidounces.

Ammoniated tincture of valerian has a brown color and the odor and taste of valerian and ammonia.

Uses.—This preparation is more largely used than the simple tincture, especially in the treatment of hysterical females. The dose is from 15 to 60 minims (1–4 Cc.).

TINCTURA VANILLÆ, *U. S.*—Tincture of Vanilla.

Teinture de vanille, Fr.; *Vanilletinktur*, G.

Preparation.—Vanilla, cut into small pieces and bruised, 100 Gm.; sugar, in coarse powder, 200 Gm.; alcohol, water, each a sufficient quantity to make 1000 Cc. Mix 650 Cc. of alcohol with 350 Cc. of water. Macerate the vanilla in 500 Cc. of the mixture for 12 hours; then drain off the liquid and set it aside. Transfer the vanilla to a mortar, beat it with the sugar into a uniform powder, then pack it in a percolator and pour upon it the reserved liquid. When this has disappeared from the surface, continue the percolation by pouring on gradually sufficient menstruum to make 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of vanilla, macerate 730 grains of vanilla beans, cut small and bruised, with 8 fluidounces of menstruum (alcohol, 65 volumes; water, 35 volumes) for 12 hours, and decant the liquid. Beat the residue with 3 avoirdupois ounces and 148 grains of sugar into a uniform powder, pack in a percolator and pour upon the reserved liquid. When this has passed through, pour on more of the menstruum and continue percolation until 16 fluidounces of tincture have been obtained.

The French Codex directs tincture of vanilla to be prepared by macerating 10 Gm. of cut vanilla bean with 100 Gm. of 80 per cent. alcohol for 10 days, and then expressing.

If prepared from prime vanilla bean, the above tincture will be an excellent preparation, but it should be borne in mind that all tinctures or so-called extracts of vanilla are greatly improved by age. If allowed to stand for 3 or 6 months before using, the odor is vastly improved.

Commercial extracts of vanilla are sometimes not made from vanilla bean, but are simply hydro-alcoholic solutions of vanillin suitably colored and sweetened. Such practice can be readily detected as follows: If some of the extract be freed from alcohol by evaporation on a water-bath, made up to its original volume by addition of water and acidified with acetic acid, a reddish-brown precipitate of resin will form in the case of the tincture made from vanilla bean; absence of such resin would indicate an artificial extract. The filtrate from this resin, in a tincture made from the bean, should give a copious precipitate with basic lead acetate solution. If the extract consist partly of vanillin solution and partly of tincture of vanilla bean, the detection becomes more difficult. Adulteration of extract of vanilla with coumarin may be detected by the method given under VANILLINUM (which see).

Uses.—Tincture of vanilla is used solely as a flavoring agent.

TINCTURA VERATRI, *U. S., P. G.*—Tincture of Veratrum.

Tincture of American hellebore, E.; *Teinture de vératre*, F.; *Nieswurzeltinktur*, G.

NOTE.—The strength of this tincture has been reduced from 40 Gm. to 10 Gm. of veratrum in 100 Cc.—U. S.

Preparation.—Veratrum, in No. 60 powder, 100 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the veratrum with 40 Cc. of alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of veratrum, moisten 730 grains of veratrum, in No. 60 powder, with 5 fluidrachms of alcohol, and proceed as directed above, allowing percolation to continue until 16 fluidounces of tincture have been obtained.

The French and German Pharmacopœias both direct the tincture to be made from white hellebore by maceration, the former using 100 Gm. of the drug for 500 Gm. of 80 per cent. alcohol, and the latter 1 part of drug for 10 parts of 68½ per cent. alcohol.

The present tincture of veratrum is only ¼ as strong as that of 1890, and, besides, may be made either from the green or white veratrum, since both varieties are now officially recognized under the title Veratrum. It is of a reddish-brown color, and has a bitter and acrid taste, and becomes opalescent and turbid when mixed with water. Each Cc. of the official tincture represents 0.10 Gm., or each fluidrachm about 5¾ grains, of the drug.

Norwood's Tincture of Veratrum Viride, a semi-proprietary preparation, which at one time was largely used by physicians, has been almost entirely replaced by the official fluidextract of the drug. It was supposed to be a saturated tincture, and was prepared from the fresh root of veratrum viride by maceration with alcohol, in the proportion of 240 grains of drug for every fluidounce of alcohol. It can be safely asserted that Norwood's tincture was decidedly inferior to the present fluidextract, and that its strength was perhaps rarely uniform.

Uses.—The present tincture being only one-fourth the strength of the U. S. P., 1890, it is given in 4 times the quantity of the former tincture. The dose is from 10 to 30 minims (0.60–2 Cc.).

TINCTURA ZINGIBERIS, *U. S., Br., P. G.*—Tincture of Ginger.

Teinture de gingembre, Fr.; *Ingwertinktur*, G.

Preparation.—Ginger, in No. 50 powder, 200 Gm.; alcohol, a sufficient quantity to make 1000 Cc. Moisten the ginger with 60 Cc. of alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for 6 hours; then pack it firmly and pour on enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and,

having closely covered the percolater, macerate for 24 hours. Then allow the percolation to proceed slowly, pouring on sufficient alcohol to obtain 1000 Cc. of tincture.—U. S.

To make 1 pint of tincture of ginger, moisten 3 avoirdupois ounces and 148 grains of the powdered drug with 1 fluidounce of alcohol, and proceed as directed above, allowing percolation to continue until 16 fluidounces of tincture have been obtained.

Other pharmacopœias direct: Ginger, 2 ounces; alcohol, sufficient to make 1 imperial pint of tincture by percolation.—Br. Ginger, 100 Gm.; alcohol (80 per cent.), 500 Gm. —Fr. Cod. Ginger, 1 part; alcohol (68½ per cent.), 5 parts.—P. G.

Tincture of ginger, also familiarly known as essence of ginger, if made with strong alcohol as officially directed, has a brownish yellow or reddish color, and the aromatic odor and hot taste of the root. When added to water a milky mixture results, owing to precipitation of the resin. If the tincture be made with diluted alcohol a darker but somewhat turbid tincture will be obtained.

Uses.—Tincture of ginger is employed as a carminative for the relief of abdominal pain due to flatus, and as an addition to tonic and purgative mixtures to enhance their efficiency. Locally, it is mildly irritant. The dose is from 20 to 60 minims (1.30–4 Cc.).

TINCTURÆ HERBARUM RECENTIUM, *U. S.*—Tinctures of Fresh Herbs.

Alcoolaturæ, Fr. Cod.; *Alcoolatures*, Fr.; *Tinkturen von frischen Pflanzen*, G.

Tinctures made from fresh herbs were to some extent prepared more than two hundred years ago, but were more prominently introduced by Hahnemann, and are extensively employed in homœopathic practice. They have attracted more or less attention in Europe since about 1817, when Schrader (*Buchner's Repertorium*, iii. 20) made a number of investigations, and recommended such tinctures prepared from the fresh juice and twice its weight of alcohol. A similar method was subsequently advocated by Béral and by Deschamps, while Soubeiran suggested the use of the fresh plants and their maceration with strong alcohol in definite proportions. This method was adopted in the French Codex of 1866, and has been retained in that of 1884. Tinctures made from fresh herbs have been retained in the new U. S. Pharmacopœia, which, however, gives only a general formula.

Preparation.—"These tinctures, when not otherwise directed, are to be prepared by the following formula: Take of the fresh herb, bruised or crushed, 500 Gm.; alcohol, 1000 Cc. Macerate the herb with the alcohol for 14 days; then express the liquid and filter."—U. S.

This is essentially the formula for preparing the third class of tinctures of the Homœopathic Pharmacopœia. The French Codex directs equal parts of the fresh drug and of 90 per cent. alcohol, the maceration to be continued for 10 days; in this manner alcoholatures are prepared from aconite leaves and root, arnica flowers, belladonna leaves and root, bryony, colchicum flowers and root, conium leaves, digitalis leaves, drosera (entire plant), eucalyptus leaves, hyoscyamus leaves, pulsatilla (flowering herb), spilanthes flowers, and stramonium leaves.

It is evident that these preparations must vary in strength at least to the same extent as juices (see p. 1471), and that they are of doubtful utility, except perhaps for such drugs which owe their virtues to very volatile uncombined principles.

TRAGACANTHA, *U. S., Br., P. G.*—Tragacanth.

Gummi tragacanthæ or *Astragalorum.*—*Traganth*, E.; *Gomme Adragante*, Fr.; *Goma Adraganta*, G.; *Draganta*, It.; *Alcatira, Alquitira*, Port.; *Goma Tragacanta, Alquitira*, Sp.

A gummy exudation from *Astragalus gummifer* Labill. and from other species of *Astragalus* (Fam. *Leguminosæ*).

Tragacanth is official in all pharmacopœias, a number of species being variously named by them.

Origin and Collection.—The species of Astragalus yielding this product are members of the subgenus *Tragacantha*, the petioles united with the permanent stipules, which become thorny, and which subgenus properly should be regarded as forming a distinct

genus. They are low shrubs, indigenous to a portion of the territory lying between eastern Persia and Greece. Boissier names 9 or 10 species.

The secretion of tragacanth is due to a transformation of the cell-walls, with their incrusting layers, of the pith and medullary rays contained in the stem and older branches, as was first observed by Hugo von Mohl (1857), whose observations were corroborated by Wigand (1861). The altered tissue is confined in the plant between the wood-wedges with considerable tension, and oozes out with some force on breaking a branch or making an incision. Tragacanth exudes spontaneously either from fissures or from punctures and longitudinal incisions made into the stem and older branches. From such incisions flake tragacanth is obtained, while the spontaneously exuding gum often forms irregularly globular or somewhat conical pieces. The rapidity with which the gum exudes chiefly determines the shape in which it ultimately hardens, and the time which elapses before it is sufficiently hard for collection influences the color of the product, which is white if congealed rapidly, and more or less yellowish and brown if hardened slowly. Tragacanth enters commerce from the ports of Asia Minor and from the Persian Gulf.

Fig. 450.

Tragacanth (Nat.).

Properties.—Tragacanth consists of different layers, either laid one upon another and spirally twisted, or confluent into tear-like masses, or extended into curved, narrow, or broad bands, varying in width between 6 and 25 Mm. ($\frac{1}{4}$ and 1 In.), and sometimes 10 to 13 Cm. (4–5 In.) long. These bands are rarely made up of a single layer, but usually are marked with several parallel ridges, indicating the various strata, which are united into broader and thicker laminæ. This form of tragacanth is known as flake tragacanth or leaf gum, and is the more valuable the whiter and more translucent it is. Smyrna tragacanth is mostly in rather broad and thick flakes, which are yellowish or of a brownish tint, and often prominently ridged. Thin, ribbon-like, and white flakes are produced in Kurdistan and Persia, but are sometimes distinguished in commerce as Syrian tragacanth. Another variety is vermiform tragacanth, also called vermicelli. It consists of very narrow, variously coiled, and contorted string-like pieces, the different coils of which are most frequently confluent. Common tragacanth, or sorts, in Europe known as traganton, is the product obtained by spontaneous exudation, forming subglobular, conical, or variously shaped tear-like pieces, with the surface rounded and more or less irregular, and usually of a brownish or brown color, and rather waxy in appearance; but it shows the stratification described above, and, like the white and thin bands, encloses starch.

Tragacanth is hard, tough, difficult to powder, inodorous, and tasteless, insoluble in alcohol and ether, and forms with 50 parts of water a thick, jelly-like mucilage. When diffused in a much larger quantity of water it forms a ropy liquid which may be passed through a filter, leaving behind an insoluble residue, which in contact with iodine acquires a blue color from the presence of starch. The mucilage acquires a yellow color on the addition of caustic soda, and the solution of tragacanth yields clear mixtures with borax, ferric chloride, and sodium silicate, is precipitated by alcohol, thickened by cold lead acetate and subacetate, and precipitated by these salts on heating (Flückiger).

Composition.—The soluble gum is not identical with arabin, though its solution is precipitated by alcohol and ammonium oxalate. The insoluble gum is known as bassorin, traganthin, adraganthin. It is soluble in hydrochloric acid and in ammonia, and is stated to have the composition $C_{12}H_{10}O_{10}$. By drying, tragacanth loses about 15 per cent. of moisture; the ash contains over half its weight of calcium carbonate.

Action and Uses.—Tragacanth is demulcent, and was formerly employed to allay the irritation and cough of bronchitis and sore throat. Its medicinal and pharmaceutical properties resemble those of acacia, but on account of its difficult solubility it is less eligible than gum arabic in most instances.

Allied Gums.—A large number of gums of more or less commercial importance have been described elsewhere, especially under Acacia. The following are of special interest in connection with Tragacanth.

Bassora or *Kutera Gum* is a Persian product of unknown derivation. It may be closely related to, or even identical with, the article known as *Persian Sarcocolla* (see below). It is met with in yellowish or brownish, semi-transparent, and tasteless masses, which swell considerably with water. It is used in Smyrna for adulterating the cheaper varieties of tragacanth, and is then usually broken into smaller pieces of about the same size as the tragacanth. Such broken pieces are angular, and are said to be sometimes artificially whitened with white lead. This fraud may be readily detected by treating the gum with cold dilute nitric acid.

Sarcocolla (*Fleischleimgummi, Fischleimgummi,* G.; *Sarcocolle,* Fr.) is the gummy exudation of *Penœa Sarcocolla* L. and *P. mucronata* L. (Fam. *Penœaceœ*), small shrubs of Central and South Africa. Dymock, however, believed the Persian variety to be derived from a species of *Astragalus*. Sarcocolla occurs in small, roundish, somewhat spongy, and friable grains which are sometimes agglutinated to larger masses, often mixed with fine hairs, and have a yellowish, reddish, or brownish color. It is inodorous, has an insipid, sweetish, afterward somewhat acrid and bitter taste, resembling that of licorice-root; is soluble in water, almost completely soluble in alcohol, except the impurities, and when heated burns and gives off the odor of burning sugar. On treating sarcocolla with ether, Pelletier (1834) separated a resin; the undissolved residue yielded to alcohol sarcocollin, and left gummy matter behind. Sarcocollin is uncrystallizable, soluble in alcohol and water, possesses a bitter-sweet taste, and when oxidized with nitric acid yields oxalic acid. Its composition is said to be $C_{13}H_{23}O_6$. The name of this substance, which means a "joiner" or "healer of the flesh," it has borne since an early period in the history of medicine. It was held in great repute for agglutinating wounds and curing defluxions of the eyes, and was applied to joints affected with chronic inflammation. It was reputed to be a depilatory, was used with honey to check otorrhœa, and was applied with nitre as a discutient of scrofulous glands.

TRIMETHYLAMINA.—Trimethylamine.

Triméthylamine, Fr.; *Trimethylamin,* G.

Formula, $N(CH_3)_3$. Molecular weight, 58.66.

Origin and Preparation.—This compound, frequently incorrectly called *propylamine*, with which it is isomeric, has been obtained from ergot (*secaline*), from the leaves of beta vulgaris and chenopodium vulvaria, from the flowers of arnica montana, pyrus communis, sorbus aucuparia, and cratægus oxyacantha, and from codliver oil, bone oil, and guano. It is also produced on heating codeine with potassium hydroxide, but may be economically obtained from herring-pickle, which contains this alkaloid in considerable quantity and owes to it its peculiar odor. A mixture of herring-pickle and lime is subjected to distillation, the alkaline distillate is neutralized with hydrochloric acid and evaporated, and the saline residue is treated with absolute alcohol, which leaves ammonium chloride undissolved. The alcoholic solution is evaporated, the residue redissolved in a little water, and again carefully distilled with lime. If the vapors are first passed through an empty bottle, before they are condensed by means of ice or conducted into water, several less volatile alkaloids are separated in the bottle. Large quantities of trimethylamine are now obtained from the residues left in the preparation of sugar from beets.

Properties.—In its pure state trimethylamine is a colorless, thin, strongly alkaline liquid which at 0° C. (32° F.) has a specific gravity of 0.673, and boils at 9.8° C. (49.6° F.). At ordinary temperatures it is a colorless inflammable gas. It has a strong ammoniacal odor modified by the peculiar odor of herring-pickle. It is readily soluble in water and alcohol. An impure aqueous solution of trimethylamine has been sold as *propylamine*. It combines with mineral acids to form salts which are soluble in alcohol. Its acid aqueous solutions yield precipitates with potassium ferrocyanide, iodine in potassium iodide, tannic acid, potassium mercuric iodide, and phosphomolybdic acid.

Trimethylamine chloroplatinate is soluble in alcohol and water, crystallizes in well-defined orange-colored octahedrons, and contains 37.21 per cent. of platinum. More characteristic, particularly in the presence of methylamine and allied bases, is the double salt with gold, which is very sparingly soluble in cold water, and has the composition $N(CH_3)_3HCl.AuCl_3$ (Hesse, 1857, 1883).

Trimethylamine Hydrochloride, $N(CH_3)_3HCl$, is obtained on neutralizing the alkaloid with hydrochloric acid and evaporating. It crystallizes in white or colorless prisms, is nearly inodorous, has a saline pungent taste, is very deliquescent on exposure, and dissolves freely in water and alcohol.

Action and Uses.—Trimethylamine and its chloride possess no properties which commend their employment in modern medicine. Upon the skin and mucous membranes trimethylamine itself has a decidedly irritant effect, resembling that of ammonia. In full medicinal doses it and its salt are likely to excite gastric pain and depress the heart and lower body temperature. They are claimed by some to decrease the excretion of urea in all cases, but that this effect is constant is denied by others. In the treatment of acute rheumatic fever and gout they were highly recommended 30 or 40 years ago, especially by Russian and French physicians. It was asserted that under the influence of these drugs the pain rapidly diminished, the swelling of the joints subsided, the temperature fell, and the duration of the disease was considerably shortened. Such beneficial results were not obtained from their employment by English and American physicians. The dose of trimethylamine is from 2 to 8 minims (0.10–0.50 Cc.) every 3 or 4 hours. Of the chloride, 2 to 5 grains (0.12–0.30 Gm.) may be given.

Allied Compounds.—AMYLAMINE, $NH_2C_5H_{11}$, is a colorless liquid, having a penetrating ammoniacal odor, and the density 0.7503 at 18° C. and boiling at 95° C. (203° F.). The hydrochloride crystallizes in octahedrons, is freely soluble in water and alcohol, and is insoluble in ether.

PROPYLAMINE, $NH_2C_3H_7$, is a colorless, strongly refracting, inflammable liquid of an ammoniacal odor, boiling at 50° C. (122° F.), and yielding with platinic chloride a double salt, which crystallizes in orange-yellow clinorhombic plates.

METHYLAMINE, NH_2CH_3, and DIMETHYLAMINE, $NH(CH_3)_2$, are colorless inflammable gases of an ammoniacal odor, very soluble in water, and condensing to colorless liquids, the former at —18° C. (0.4° F.), the latter below 8° C. (46.4° F.).

BILINEURINE, CHOLINE, $C_5H_{15}NO_2$, is obtained by boiling bile with caustic baryta, and in a similar manner from brain, yolk of egg (see VITELLUS), and mustard-seed (*sinkaline*). It is present also in cotton-seed, fenugreek, fly agaric, herring-pickle; is formed in the human corpse in the beginning of decomposition, and has also been prepared synthetically. It is a colorless, syrupy, non-volatile liquid of a strong alkaline reaction, very hygroscopic, combining readily with carbon dioxide, and soluble in alcohol or water in all proportions; on heating it gives off trimethylamine, and on boiling its aqueous solution the same alkaloid is given off and ethyleneglycol produced. On treating its hydroiodide with silver oxide, the anhydrous base, $C_5H_{13}NO$, is separated. By careful oxidation *betaine*, $C_5H_{11}NO_2$, is produced.

TRITICUM, *U. S.*—Triticum, Couch-grass.

Rhizoma (*Radix*) *graminis.*—*Quick-grass, Scotch-grass, Twitch-grass, Witch-grass, Quickens, Quitch,* E.; *Chiendent officinal, Petit chiendent,* Fr. Cod.; *Queckenwurzel, Grasswurzel,* G.; *Grama,* Sp.; *Grama Franceza,* Port.; *Gramigna,* It.

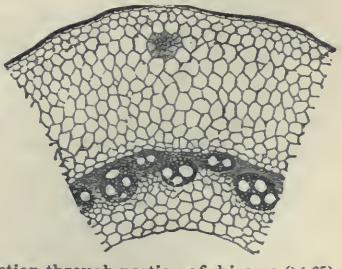
The dried rhizome of *Agropyron repens* (L.) Beauv. (*Triticum r.* L.—Fam. *Gramineæ*), collected in the spring and deprived of its roots.

Origin.—A tall, perennial, weedy grass, growing about buildings and troublesome in cultivated grounds, native of Europe and Asia, and widely naturalized in North

FIG. 451.

Triticum: rhizome; transverse section (× 3).

FIG. 452.

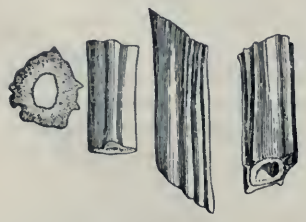


Section through portion of rhizome (× 65).

America. The compressed spikes somewhat resemble those of wheat, the spikelets being 4- to 8-flowered, the glumes mostly shortened or acute. The plant derived its names "Dog-grass" and "Couch-grass" from the fondness of dogs for lying in it; of quick-grass, from the rapidity with which its long, slender rhizomes extend its growth. The drug is almost wholly collected in central Europe.

Description.—About 2 Mm. ($\frac{1}{12}$ In.) thick, mostly cut into sections about 5 to 10 Mm. ($\frac{1}{5}$ to $\frac{2}{5}$ In.) long, pale straw colored, smooth and slightly shining, wrinkled, hollow, inodorous, gummy when chewed, and of a sweetish taste. The transverse section shows the central cavity surrounded by a narrow layer of delicate parenchyma, projecting somewhat into the equally narrow circle of fibro-vascular bundles, which is separated by the nucleus-sheath from the broad outer layer of parenchyma, containing about six or eight isolated, distant fibro-vascular bundles in a loose circle.

Fig. 453.



Commercial triticum (× 4).

Constituents.—The generally accepted analysis is that of Ludwig and Muller (1872): Dextrose and levulose 2.5–3.3 per cent., a dextrorotatory sugar (different from cane-sugar), triticin, acid malates, 11 per cent. of nitrogenous gummy matter (which forms an insoluble compound with acetate and subacetate of lead), and 4.5 per cent. of ash, containing much silica. Pope (1894) obtained inosit. Mannit, formerly thought to be present, has not been obtained by recent analysts, though it is said to sometimes form when fermentation occurs. Triticin is an amorphous, very hygroscopic and deliquescent white powder, without odor or taste, soluble in water and dilute alcohol, and insoluble in ether and absolute alcohol. It is oxidized to oxalic acid by nitric acid, and yields levulose on hydrolysis with water or strong alcohol.

Pharmaceutical Preparation.—Fluidextract of Triticum, U. S. P.

Action and Uses.—Triticum possesses only feeble medicinal qualities. In decoction or infusion it was formerly largely used as a domestic remedy in fevers, jaundice, bronchitis, gout, and a host of other diseases. Its sole employment to-day is as a gentle, soothing diuretic in acute inflammations of the urinary passages. It is best administered in decoction in any quantity. The fluidextract may be used in the dose of 1 to 2 drachms (4–8 Cc.), well diluted.

Allied Drugs.—The rhizome of a number of other grasses, notably of *Imperata Braziliensis* Trin., *T. exaltata* Brongn., *Capriola Dactylon* (L.) Kuntze (*Panicum D. L.*; *Cynodon D.* Pers.), the *Scotch* or *Bermuda Grass*, and one called "Grama Dulce," in the Andes, are similarly used. The grain of the sorghum, both the sugar and the broom-corn varieties, is commonly so used by our Southern negroes, and has been found by Dr. Garnett to have the properties in a mild degree. It is about 3 or 4 Mm. ($\frac{1}{8}$ to $\frac{1}{6}$ In.) long, broadly oval, obtuse, lightly flattened, enclosed in the glossy, somewhat granular palets, of varying shades, of yellow, red, or purple brown, internally white and mealy, inodorous, and of a farinaceous and sweetish taste. The seeds of *Coix Lachryma-Jobi* L. (*Lithagrostis L.* Gaertn.), the Job's tears, often used as beads for rosaries, are reputed diuretic and lithontriptic, though the idea appears to be rather imaginative, deduced apparently from their popular name. The Asiatic species, *C. gigantea* Roxb., called *Y-dzi* and *Bobo*, used as a food, are also reputed diuretic. Their meal is supposed to be useful in purifying water for drinking purposes when thrown upon its surface. They are rather rich in fat.

The seeds of *Phalaris Canariensis* L., the well-known canary seed, *Kanariensamen* (G.), *Aepiste* (Fr., Sp.), are rather nutritive, and have been used as food by man, as well as for birds.

TRITURATIONES, *U. S.*—Triturations.

Triturations, Fr.; *Triturationen*, G.

This term has been used in homœopathic pharmacy in the same sense in which it has been adopted by the U. S. Pharmacopœia—namely, for powders prepared by trituration of a medicinal substance with a definite quantity of milk-sugar. In homœopathy this is done with a view of developing the medicinal power, and two proportions are used, termed the centesimal and the decimal scales; 1 part of the substance being triturated with 99 parts or with 9 parts of the milk-sugar gradually added.

Preparation.—The directions for preparing these powders are very similar to those followed in homœopathic dispensing, excepting that the length of time for mixing and triturating has been omitted.

"Triturations are to be prepared by the following formula: Take of the substance 10 Gm.; sugar of milk, in moderately fine powder, 90 Gm.; to make 100 Gm. Weigh the substance and sugar of milk separately; then place the substance, previously reduced, if necessary, to a moderately fine powder, in a mortar; add about an equal bulk of sugar of milk, mix well by means of a spatula, and triturate them thoroughly together. Add

fresh portions of the sugar of milk from time to time until the whole is added, and continue the trituration, after each addition, until the substance is intimately mixed with the sugar of milk, and reduced to fine powder."—U. S.

Uses.—Triturations play quite an important part in the practice of pharmacy, and will often be found very convenient at the dispensing counter when small fractions of potent drugs are needed in prescriptions. Thus, if 0.100 Gm. of the drug be thoroughly mixed by trituration with 0.900 Gm. of milk-sugar, every 0.010 Gm. of the mixture will represent 1 milligramme of the drug, and therefore any given multiple of 0.010 Gm. may be used to obtain the corresponding number of milligrammes. Likewise, if $\frac{1}{2}$ grain of the drug be mixed with 4½ grains of milk-sugar, or 1 grain with 9 grains, each grain of the mixture will represent $\frac{1}{10}$ grain of the drug; or if 1 grain of the drug be mixed with 47 grains of milk-sugar, 1 grain of the mixture will be equal to $\frac{1}{48}$ grain of the drug, 1½ grains = $\frac{1}{32}$ grain, 2 grains = $\frac{1}{24}$ grain, 3 grains = $\frac{1}{16}$ grain, 4 grains = $\frac{1}{12}$ grain, 6 grains = $\frac{1}{8}$ grain, 8 grains = $\frac{1}{6}$ grain, 12 grains = $\frac{1}{4}$ grain, 16 grains = $\frac{1}{3}$ grain, and 24 grains = $\frac{1}{2}$ grain.

TRITURATIO ELATERINI, *U. S.*—Trituration of Elaterin.

Trituration d'élatérine, Fr.; *Elaterintrituration*, G.

Preparation.—Elaterin, 10 parts; sugar of milk, 90 parts; to make 100 parts. Mix them thoroughly by trituration.—U. S.

Uses.—The dose of this preparation is from ¼ to 1 grain (0.015–0.06 Gm.).

TROCHISCI, *U. S., Br.*—Troches.

Tablettes, Pastilles, Fr. Cod.; *Pastilli, Rotulæ*, P. G.—*Lozenges*, E.; *Tablettes*, Fr.; *Pastillen, Plätzchen*, G.

Troches or lozenges are solid, flattened masses of round, oval, or other desirable shape, not intended for mastication, but to be dissolved slowly in the mouth, therefore not adapted for medicines which are expected to undergo disintegration in the stomach prior to any therapeutic action. In one or two cases the cylindrical form is preferred, as for the well-known licorice lozenges. The remedial action of lozenges is generally designed to be purely local, either as an expectorant, demulcent, stimulant, sedative, astringent, or antiseptic.

The usual base or vehicle for lozenges is sugar (that known among confectioners as lozenge sugar being preferred), although powdered extract of licorice also is added at times, and, of late years, fruit paste, made from black or red currants, has come extensively into use for certain kinds of lozenges. Adhesiveness is obtained by the addition of tragacanth or acacia, and syrup or water (plain or aromatic) is used to supply the necessary moisture. All medicinal constituents, as well as the sugar or extract of licorice, should be in very fine powder to insure a smooth paste, and potent remedies, wherever possible, should be added either in the form of solution or triturated with a small quantity of sugar before being mixed with the other ingredients, so as to insure uniform distribution. Tragacanth is preferable to acacia for making a lozenge-mass, as the resulting paste is more tenacious; in both cases the mucilage is to be preferred to the powder with the subsequent addition of water, as in the latter case it is often difficult to avoid an excess of moisture, which retards subsequent drying.

The British Pharmacopœia (1898) admits acacia only as the adhesive agent for lozenges, and designates four distinct bases or vehicles of the following composition: *Simple basis*—Refined sugar, 17½ avoirdupois ounces; powdered acacia, 300 grains; mucilage of acacia, 1¼ fluidounces; distilled water, a sufficient quantity. *Fruit basis*—Refined sugar, 15½ avoirdupois ounces; powdered acacia, 300 grains; mucilage of acacia, 1¼ fluidounces; black-currant paste, 2 avoirdupois ounces; distilled water, a sufficient quantity. *Rose basis*—Refined sugar, 17½ avoirdupois ounces; powdered acacia, 300 grains; mucilage of acacia, 5 fluidrachms; rose water, a sufficient quantity. *Tolu basis*—Refined sugar, 17 avoirdupois ounces; powdered acacia, 300 grains; mucilage of acacia, 1¼ fluidounces; tincture of tolu, 3 fluidrachms; distilled water, a sufficient quantity; dissolve what salts of alkaloids may be ordered in 3 fluidrachms of distilled water, and mix this solution with the sugar. Instead of giving individual formulas for making the 17 varieties of lozenges recognized, a general formula, adjusted for 500 loz-

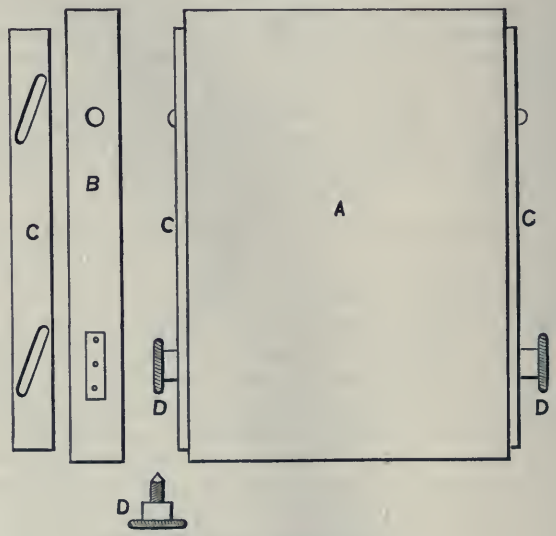
enges, is given under the head of each basis, as follows: 500 times the quantity of medicinal agent required for 1 lozenge is intimately mixed with the sugar and acacia, and a paste then made with the other ingredients, which is divided into 500 equal parts and dried at a moderate temperature.

Lozenge-masses are made after the manner of pill-masses, except that more adhesive material is used, and the paste is made somewhat softer. The proportion of powdered tragacanth necessary for a well-made plastic mass may vary from 1 to 3 per cent. of the total weight of the mixed powders (acacia about 3 or 4 times as much); and in making the mass the necessary water or syrup should be added cautiously, and the mixture well kneaded after each addition, so as to avoid too soft a condition, which readily occurs on account of the great solubility of the sugar. A good plan is to follow the suggestion of Hager, to reserve about $\frac{1}{5}$ of the powder, and when the remaining $\frac{4}{5}$ have been made into a plastic mass, quickly incorporate the reserve portion, which can be done without risk of the mass becoming dry and crumbly. For massing small quantities of material a Wedgewood mortar and pestle will be found quite convenient, while for large quantities hand- or steam-power machines, such as are used for pill-masses. are needed.

After a suitable mass has been made, it is transferred to a hardwood board or a stone slab, rolled out into either a flat sheet or a cylinder, and divided into the requisite number of parts. When cylindrical lozenges are to be made, the mass is rolled out without dusting and divided into pieces about $\frac{5}{8}$ of an inch in length, by means of a special cutter. In order to prevent the mass from adhering, the flat roller may be lightly rubbed with a very small quantity of oil of sweet almond. For flat lozenges the mass is conveniently rolled out into a sheet, the required thickness of which must be ascertained by experiment; this is done by dividing the weight of the whole mass by the number of lozenges to be made, then weighing off as many grains of the mass as correspond to the quotient obtained, and forming this into a lozenge by means of a punch or spatula. As every well-made lozenge-board is provided with guides and screws for regulating different thicknesses, no difficulty will be experienced in adjusting the side strips to the proper height, and then rolling out the mass by means of a cylindrical roller. To prevent adhesion of the mass, the board may be dusted with a little starch or a mixture of starch and sugar.

The lozenge-board designed by Wallace Procter is very useful and simple in construction, as shown in Fig. 454. A is a board of well-seasoned hard wood, 1½ inches

FIG. 454.



Procter's lozenge-board.

thick, 10 inches wide, and 14 inches long, planed perfectly flat, and both sides and ends made square and true. At each side, about 3 inches from one end, a plate is let in flush and tapped with a screw, as shown in B. On each side of the board a plate of brass, 1½ inches

wide, 14 inches long, and $\frac{3}{16}$ of an inch thick, is fitted. Each plate has two slots crossing it diagonally (see C) $\frac{3}{8}$ of an inch from each edge; these slots must have exactly the same slope, and the front slot should be ruled to divisions of $\frac{1}{32}$ of an inch. Through one slot of each plate a square-shouldered screw passes, and is screwed in until it presses the plate close to the side of the board, but still permits it to move easily; through the other slot in each plate passes a set-screw, which enters the screw-plate before mentioned. When the plates have been adjusted to a given height the set-screws are turned until they prevent motion of the plate.

The punches used for cutting lozenges are usually in the form of tapering cylinders, made of heavily tinned iron, and frequently provided with sharp cutters of hardened steel, the shape of which varies with the fancy of the operator; sometimes they are made with straight sides and fitted with a plunger, operated by a spring, for the ready expulsion of the lozenges. In large manufacturing establishments 10 or 12 cutters are frequently combined and operated as one, greatly expediting the work. Whenever it is desired to stamp lozenges with some special letter or design, this is done at the time of cutting them, the plunger being provided with the necessary die.

For a number of years lozenges have also been made by compression of the material in the form of a granular powder into lenticular-shaped disks by means of specially constructed apparatus operated by hand, steam, gas, or electric power. Such lozenges are more appropriately designated as compressed tablets, and vary from $\frac{3}{8}$ to $\frac{5}{8}$ of an inch in diameter.

Gelatin lozenges, variously medicated, have been in use for some time, more particularly in Europe. They are composed of a mixture of gelatin, glycerin, and water, holding the medicinal ingredients either in solution or simple admixture. The base is often termed glyco-gelatin, and is made by macerating gelatin with water on a water-bath, and then adding glycerin; two kinds, containing different proportions of gelatin and glycerin, are in use. A mixture of gelatin, 1 ounce; orange-flower water, 2½ ounces; and glycerin, 2½ ounces (by weight), yields the softer variety, which is very readily soluble in the mouth; whereas a mixture of gelatin, 5 ounces; orange-flower water, 6 ounces; and glycerin, 6 ounces (by weight), evaporated to 15 ounces, produces a much firmer mass, dissolving more slowly, but probably better adapted for stock lozenges in this latitude; in the latter case at least 12 hours' maceration should be given the gelatin and water before adding the glycerin and applying heat. Gelatin lozenges must always be made with the aid of heat, and the mass after thorough admixture with the medicinal ingredients, while still in a melted condition, is poured into suitable molds, where it rapidly congeals. A very convenient mold for a small number of the lozenges is found in the two side plates of the Konseal filling and closing apparatus mentioned on p. 1264. If either of these plates be laid upon a cold porcelain or glass plate, the mixture may be poured directly into the particular perforations selected, and when cold the lozenges are easily removed by being pushed through the perforations. The proper quantity of gelatin mass to use for any particular case is ascertained by filling the perforations with some of the melted plain mass, and when cold weighing the disk; by keeping a memorandum of the weight of such disks much annoyance and labor can be saved. Gelatin lozenges vary in weight from 5 to 15 grains (0.3–1.0 Gm.).

Gelatin lozenges, while admirably adapted for the exhibition of such substances as cocaine, boric acid, carbolic acid, etc., are unsuited for tannin, extract of rhatany, and other agents incompatible with gelatin.

Chocolate lozenges, also known as chocolate tablets and chocolate pastilles, or simply as chocolates, may be conveniently made at the dispensing-counter as follows: The medicinal ingredients are intimately mixed with powdered sugar previously flavored with vanilla, Ceylon cinnamon, peppermint, or other flavoring agent, and the mixture then added to three-fourths of its weight of chocolate, in mass or powder, contained in a mortar or porcelain dish. By means of water-bath heat a soft mass is obtained, which is thoroughly mixed, and when cool divided into the requisite number of parts on a lozenge-board or a pill-tile. Chocolate lozenges vary in weight from 5 to 15 grains (0.3–1 Gm.), and are not intended to be dissolved slowly in the mouth, but to be swallowed with or without previous mastication.

Lozenges intended for immediate use do not require much drying, but those intended for stock must be thoroughly dried before they are put away in glass containers, otherwise they are liable to soften and adhere, and may even become moldy. The drying

is best effected on perforated trays in a moderately warm room. To avoid cracking of the edges, which will sometimes occur when lozenges are dried, the addition of a small quantity of glycerin to the water used will be found advantageous, and does not interfere with proper desiccation.

The average weight of lozenges is between 10 and 20 grains, (0.650 and 1.30 Gm.), although in the fifteen working formulas of the Pharmacopœia the weight is found to vary between 6½ and 24 grains (0.42 and 1.59 Gm.).

TROCHISCI ACIDI BENZOICI.—Benzoic Acid Lozenges.

Trochiscus acidi benzoici.—Benzoic acid lozenge, Br.; *Tablettes de l'acide benzoique*, Fr.; *Benzoesäurepastillen*, G.

Preparation.—Benzoic acid, ½ grain or 0.0324 Gm. Mix with the fruit basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—This is a useful voice lozenge, 1 to be taken every 2 or 3 hours.

TROCHISCI ACIDI CARBOLICI.—Carbolic Acid Lozenges.

Trochiscus acidi carbolici.—Phenol lozenge, Br.; *Tablettes de l'acide phénique*, Fr.; *Phenolpastillen*, G.

Preparation.—Phenol, 1 grain or 0.0648 Gm. Mix with the tolu basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—These lozenges may be used as a mild sedative and antiseptic in inflammations of the mouth or throat. 1 every 2 or 3 hours.

TROCHISCI ACIDI TANNICI, *U. S.*—Troches of Tannic Acid.

Trochiscus acidi tannici.—Tannic acid lozenge, Br.; *Tablettes de tannin*, Fr.; *Tanninpastillen*, G.

Preparation.—Tannic acid, 6 Gm.; sugar, in fine powder, 65 Gm.; tragacanth, in fine powder, 2 Gm.; stronger orange-flower water, a sufficient quantity to make 100 troches. Rub the powders together until they are thoroughly mixed; then with orange-flower water form a mass, to be divided into 100 troches.—U. S.

To make 25 tannin lozenges use 25 grains of tannic acid, 250 grains of sugar, and 8 grains of powdered tragacanth.

Tannic acid, ½ grain or 0.0324 Gm. Mix with the fruit basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—Tannic acid troches are suitable to allay cough and irritation and huskiness of the voice due to relaxed states of the mouth, throat, and larynx.

TROCHISCI AMMONII CHLORIDI, *U. S.*—Troches of Ammonium Chloride.

Tablettes de sal ammoniac, Fr.; *Salmiakpastillen*, G.

Preparation.—Ammonium chloride, in fine powder, 10 Gm.; extract of glycyrrhiza, in fine powder, 20 Gm.; sugar, in fine powder, 40 Gm.; tragacanth, in fine powder, 2 Gm.; syrup of tolu, a sufficient quantity to make 100 troches. Rub the powders together until they are thoroughly mixed; then with syrup of tolu form a mass, to be divided into 100 troches.—U. S.

To make 25 ammonium chloride lozenges use 40 grains of ammonium chloride, 80 grains of extract of licorice, 160 grains of sugar, and 8 grains of powdered tragacanth.

Uses.—These troches are used to relieve subacute and chronic inflammations of the throat and lungs.

TROCHISCI BISMUTHI.—Bismuth Lozenges.

Trochiscus bismuthi compositus.—Compound bismuth lozenge, Br.; *Tablettes de sous-nitrate de bismuth*, Fr. Cod.; *Wismuthpastillen*, G.

Preparation.—Bismuth oxycarbonate, 2 grains or 0.1296 Gm.; heavy magnesium carbonate, 2 grains or 0.1296 Gm.; precipitated calcium carbonate, 4 grains or

0.2592 Gm. Mix with the rose basis to form a lozenge.—Br. (See general directions on page 1579.)

The corresponding lozenges of the French Codex contain 1.5 grains (0.10 Gm.) of bismuth subnitrate, but no magnesia or calcium carbonate.

Uses.—Bismuth troches may be used to correct acidity of the stomach and to relieve diarrhœa. 1 to 3 will usually be sufficient.

TROCHISCI CUBEBÆ, *U. S.*—Troches of Cubeb.

Pastilles de cubèbe, Fr.; *Kubebenpastillen*, G.

Preparation.—Oleoresin of cubeb, 2 Gm.; oil of sassafras, 1 Cc.; extract of glycyrrhiza, in fine powder, 25 Gm.; acacia, in fine powder, 12 Gm.; syrup of tolu, a sufficient quantity to make 100 troches. Rub the powders together until they are thoroughly mixed; then add the oleoresin and oil and incorporate them with the mixture. Lastly, with syrup of tolu form a mass, to be divided into 100 troches.—U. S.

To make 25 cubeb lozenges use 8 grains of oleoresin of cubebs, 6 drops of oil of sassafras, 100 grains of extract of licorice, and 48 grains of powdered acacia.

This is a modification of the formula for Spitta's lozenges, from which it differs essentially in the substitution of oleoresin for powdered cubebs. The lozenges are usually made of a cylindrical shape, and each contains about ½ grain of oleoresin of cubeb.

The present lozenges contain ½ as much oleoresin of cubeb as those of the 1890 Pharmacopœia.

Uses.—These troches are useful in subacute inflammations of the pharynx and larynx.

TROCHISCI EUCALYPTI.—Eucalyptus Lozenges.

Trochisci eucalypti gummi.—Eucalyptus gum lozenge, Br.; *Tablettes d'eucalypte*, Fr.; *Eucalyptuspastillen*, G.

Preparation.—Eucalyptus gum, 1 grain or 0.0648 Gm. Mix with the fruit basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—Troches of eucalyptus, popularly known as "red gum lozenges," are employed to allay the irritation and cough of pharyngitis and laryngitis.

TROCHISCI FERRI REDUCTI.—Reduced Iron Lozenges.

Trochiscus ferri reducti.—Reduced iron lozenge, Br.; *Tablettes de fer réduit par l'hydrogène, Pastilles chalybées*, Fr.; *Eisenpastillen*, G.

Preparation.—Reduced iron, 1 grain or 0.0648 Gm. Mix with the simple basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—This is an unnecessary preparation. The dose is 1 to 3 lozenges.

TROCHISCI GAMBIR, *U. S.*—Troches of Gambir.

Trochisci catechu, U. S., 1890.—*Trochiscus catechu, Catechu lozenge*, Br.; *Tablettes de cachou*, Fr. Cod.; *Katechupastillen*, G.

Preparation.—Gambir, in fine powder, 6 Gm.; sugar, in fine powder, 65 Gm.; tragacanth, in fine powder, 2 Gm.; strong orange-flower water, a sufficient quantity to make 100. Rub the powders together until they are thoroughly mixed; then, with stronger orange-flower water, form a mass, to be divided into 100 troches.—U. S.

Catechu, 1 grain or 0.0648 Gm. Mix with the simple basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—These troches are employed for the same purposes as troches of TANNIC ACID (which see).

TROCHISCI GLYCYRRHIZÆ ET OPII, *U. S.*—Troches of Glycyrrhiza and Opium.

Licorice and opium lozenges, E.; *Pastilles de réglisse opiacées*, Fr.; *Opiumpastillen*, G.

Preparation.—Extract of glycyrrhiza, in fine powder, 15 Gm.; powdered opium, 0.5 Gm.; acacia, in fine powder, 12 Gm.; sugar, in fine powder, 20 Gm.; oil of anise,

0.2 Cc. ; water sufficient to make 100 troches. Rub the powders together until they are thoroughly mixed ; then add the oil of anise (equivalent to about 4 drops), and incorporate it with the mixture. Lastly, with water form a mass, to be divided into 100 troches.—U. S.

To make 25 licorice-and-opium lozenges use 58 grains of extract of licorice, 2 grains of powdered opium, 48 grains of acacia, 78 grains of sugar, and 1 drop of oil of anise.

The lozenges contain about $\frac{1}{12}$ grain of powdered opium. They are much used under the name of *Wistar's cough lozenges*, and are prepared of a cylindrical shape.

Uses.—These troches are excellent to allay the cough of bronchitis and inflammation of the throat. If taken too often they will cause constipation. 1 every hour or two usually suffices.

TROCHISCI GUAIACI.—Troches of Guaiac.

Trochiscus guaiaci resinæ. — Guaiacum resin lozenge, Br. ; *Tablettes de résine de gayac*, Fr. ; *Guajakharzpastillen*, G.

Preparation.—Guaiacum resin, 3 grains or 0.1944 Gm. Mix with the fruit basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—This is a useful expectorant lozenge.

TROCHISCI IPECACUANHÆ.—Troches of Ipecac.

Trochiscus ipecacuanhæ.—Ipecacuanha lozenge, Br. ; *Tablettes d'ipecacuanha*, Fr. Cod. ; *Brechwurzelpastillen*, G.

Preparation.—Ipecacuanha root, in powder, ¼ grain or 0.0162 Gm. Mix with the fruit basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—Troches of ipecac are useful in laryngeal and bronchial inflammation before secretion has been established. If taken too often nausea will result.

TROCHISCI KRAMERIÆ, *U. S.*—Troches of Krameria.

Trochiscus krameriæ.—Krameria lozenge, Rhatany lozenge, Br. ; *Tablettes de ratanhia*, Fr. ; *Ratanhiapastillen*, G.

Preparation.—Extract of krameria, 6 Gm. ; sugar, in fine powder, 65 Gm. ; tragacanth, in fine powder, 2 Gm. ; orange-flower water, a sufficient quantity to make 100 troches. Rub the powders together until they are thoroughly mixed ; then with orange-flower water form a mass, to be divided into 100 troches.—U. S.

To make 25 rhatany lozenges use 25 grains of extract of rhatany, 250 grains of sugar, and 8 grains of powdered tragacanth.

Extract of krameria, 1 grain or 0.0648 Gm. Mix with the fruit basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—Krameria lozenges may be used, like those of tannic acid and gambir, to constringe the mucous membranes of the mouth, pharynx, and larynx, and to check diarrhœa.

TROCHISCI KRAMERIÆ ET COCAINÆ.—Troches of Krameria and Cocaine.

Trochiscus krameriæ et cocainæ.—Krameria and cocaine lozenge, Rhatany and cocaine lozenge, Br. ; *Tablettes de ratanhia et de cocaine*, Fr. ; *Ratanhia und Cocainpastillen*, G.

Preparation.—Extract of krameria, 1 grain or 0.0648 Gm. ; cocaine hydrochloride $\frac{1}{20}$ grain or 0.00324 Gm. Mix with the fruit basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—These lozenges are indicated when much pain accompanies inflammation of the throat.

TROCHISCI MENTHÆ PIPERITÆ.—Troches of Peppermint.

Tablettes de menthe, Fr. Cod.; *Rotulæ menthæ piperitæ*, P. G.—*Peppermint lozenge*, E.; *Pastilles de menthe anglais*, Fr.; *Pfefferminzplätzchen*, G.

Preparation.—Oil of peppermint, 10 Gm.; powdered sugar, 1000 Gm.; mucilage of acacia, 100 Gm. Prepare a lozenge paste in the usual manner, having previously triturated the oil of peppermint with $\frac{1}{10}$ of the total weight of sugar. Divide into lozenges weighing 1 Gm. each.—Fr. Cod.

The directions of the German Pharmacopœia are somewhat different, and correspond to those of the French Codex given for PASTILLES DE MENTHE À LA GOUTTE. Plain sugar lozenges are first made by mixing 1000 Gm. of sugar with 125 Gm. of hot water until a semifluid, non-transparent mass results, which is then allowed to fall upon an iron plate in such a manner that small semicircular masses result. When these have become firm 1 Gm. of oil of peppermint, dissolved in 2 Gm. of alcohol, is sprinkled over 200 Gm. of the lozenges, and the whole is then exposed to the air for a short time to allow the alcohol to evaporate.

Uses.—Peppermint lozenges are used as a pleasant confection and to relieve nausea and flatulence.

TROCHISCI MORPHINÆ.—Troches of Morphine.

Trochiscus morphinæ.—Morphine lozenge, Br.; *Tablettes de morphine*, Fr.; *Morphinpastillen*, G.

Preparation.—Morphine hydrochloride, $\frac{1}{360}$ grain or 0.0018 Gm. Mix with the tolu basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—Each lozenge contains $\frac{1}{360}$ of a grain of morphine hydrochlorids. They are used chiefly to relieve the cough of laryngeal and bronchial irritation.

TROCHISCI MORPHINÆ ET IPECACUANHÆ.—Troches of Morphine and Ipecac.

Trochiscus morphinæ et ipecacuanhæ.—Morphine and ipecacuanhæ lozenge, Br.; *Tablettes de morphine et d'ipecacuanha*, Fr.; *Morphin und Brechwurzelpastillen*, G.

Preparation.—Morphine hydrochloride, $\frac{1}{360}$ grain or 0.0018 Gm.; ipecacuanha root, in powder, $\frac{1}{12}$ grain or 0.0054 Gm. Mix with the tolu basis to form a lozenge.—Br. (See general directions on page 1579.)

Uses.—These troches are used to allay cough and promote secretion in the early stage of bronchitis.

TROCHISCI POTASSII CHLORATIS, *U. S.*—Troches of Potassium Chlorate.

Trochiscus potassii chloratis.—Potassium chlorate lozenge, Br.; *Tablettes de chlorate de potasse*, Fr. Cod.; *Kaliumchloratpastillen*, G.

Preparation.—Potassium chlorate, in fine powder, 15 Gm.; sugar, in fine powder, 60 Gm.; tragacanth, in fine powder, 3 Gm. Mix the sugar with the tragacanth by trituration in a mortar; then transfer the mixture to a sheet of paper, and by means of a bone spatula mix with it the potassium chlorate, being careful to avoid trituration and pressure, to prevent the mixture from igniting or exploding. Lastly, with water form a mass, to be divided into 100 troches.—U. S.

To make 25 potassium chlorate lozenges use 58 grains of finely powdered potassium chlorate, 233 grains of sugar, and 12½ grains of tragacanth.

Potassium chlorate, 3 grains or 0.1944 Gm. Mix with the rose basis to form a lozenge.—Br. (See general directions on page 1579.)

The corresponding lozenges of the French Codex contain 0.10 Gm. (1½ grains) of potassium chlorate.

Uses.—These lozenges are extensively employed in the treatment of aphthous stomatitis and sore throat.

TROCHISCI SANTONINI, *U. S.*—Troches of Santonin.

Trochiscus santonini.—Santonin lozenge, Br.; *Tablettes de santonine*, Fr.; *Pastilli santonini*, P. G.; *Santoninpastillen, Santoninzeltchen*, G.

Preparation.—Santonin, in fine powder, 3 Gm.; sugar, in fine powder, 110 Gm.; tragacanth, in fine powder, 3 Gm.; stronger orange-flower water a sufficient quantity to make 100 troches. Rub the powders together until they are thoroughly mixed; then with stronger orange-flower water form a mass, to be divided into 100 troches. Santonin troches should be kept in dark, amber-colored bottles.

To make 25 santonin lozenges use 12 grains of santonin, 425 grains of sugar, and 12 grains of tragacanth.

Santonin, 1 grain or 0.0648 Gm. Mix with the simple basis to form a lozenge.—Br. (See general directions on page 1579.)

The official santonin lozenges of the U. S. contain about ½ grain of santonin, while those of the Br. contain 1 grain, and those of the P. G. nearly ½ grain (0.025 Gm., or $\frac{5}{13}$ grain).

Uses.—This is a very pleasant form in which to administer santonin. The dose is from 1 to 4 troches.

TROCHISCI SODII BICARBONATIS, *U. S.*—Troches of Sodium Bicarbonate.

Trochiscus sodii bicarbonatis.—Sodium bicarbonate lozenge, Br.; *Tablettes de bicarbonate de soude*, Fr. Cod.; *Pastilles de Vichy*, Fr.; *Natriumbicarbonatpastillen, Natronpastillen*, G.

Preparation.—Sodium bicarbonate, 18 Gm.; sugar, in fine powder, 54 Gm.; nutmeg, in fine powder, 1 Gm.; mucilage of tragacanth, a sufficient quantity to make 100 troches. Triturate the nutmeg with the sugar, gradually added, until they are reduced to a fine powder, and mix this intimately with the sodium bicarbonate; then, with the mucilage of tragacanth, form a mass, to be divided into 100 lozenges.—U. S.

To make 25 sodium bicarbonate lozenges use 68 grains of sodium bicarbonate, 216 grains of sugar, and 4 grains of nutmeg.

Sodium bicarbonate, 3 grains or 0.1944 Gm. Mix with the rose basis to form a lozenge.—Br. (See general directions on page 1579.)

The corresponding lozenges of the French Codex contain nearly ½ grain (0.025 Gm.) or $\frac{5}{13}$ grain of sodium bicarbonate.

Uses.—Troches of sodium bicarbonate are useful to correct acidity of the stomach and eructations.

TROCHISCI SULPHURIS.—Troches of Sulphur.

Trochiscus sulphuris.—Sulphur lozenge, Br.; *Tablettes de soufre*, Fr. Cod.; *Schwefelpastillen*, G.

Preparation.—Precipitated sulphur, 2500 grains; acid potassium tartrate, in powder, 500 grains; refined sugar, in powder, 4000 grains; acacia, in powder, 500 grains; tincture of orange, 500 minims; mucilage of acacia, 500 minims. Mix the tincture of orange with the powders, add the mucilage of acacia to form a suitable mass. Divide into 500 lozenges. Dry them in a hot-air chamber at a moderate temperature.—Br.

The corresponding lozenges of the French Codex contain 1½ grains (0.10 Gm.) of sulphur each, but no potassium bitartrate, and are flavored with orange-flower water, while the Br. lozenges contain 5 grains of sulphur each.

Uses.—Each lozenge contains 5 grains (0.30 Gm.) of sulphur. Dose, 1 to 6 lozenges.

TUBERCULIN.

Tuberculin is a glycerin extract of the soluble substances produced by the *Bacillus tuberculosis* when grown in 5 per cent. glycerin-beef bouillon.

R. Koch, 1882, showed that tuberculosis was a disease produced by a bacillus, which he named *Bacillus tuberculosis*. The same investigator several years later announced the discovery of a product derived from cultures of tubercle bacilli, which, when injected in minute, gradually increasing doses, produced curative action in patients suffering from

consumption, lupus, and other diseases produced by the germ. Extensive experiments in nearly all countries of the world showed that the application of the remedy was attended with considerable danger and but little benefit to the patient. While tuberculin did not prove a success as a curative agent, it was soon discovered that it produced a characteristic febrile reaction in tubercular patients which did not occur in those not infected with the germ. Likewise, it was found that the reaction was constant for the lower animals, especially cattle, and soon it came to be extensively used for the purpose of detecting tuberculosis in milch cows, being employed almost exclusively for this purpose at the present time.

Various methods have been employed for producing tuberculin, but the following is the one generally employed: Cultures of *Bacillus tuberculosis* are grown in 5 per cent. glycerin-beef bouillon (see ANTITOXINS), kept at body temperature, the growth being very slow and taking place mainly on the surface. After several months the cultures are removed from the incubator, examined microscopically, concentrated to one-tenth their volume by heat, and filtered. The resulting dark-brown syrupy fluid constitutes the tuberculin generally found upon the market. This is sometimes called "crude tuberculin." A purified product may be obtained by precipitating the crude product with 94 per cent. alcohol.

Uses.—Occasionally tuberculin is employed for diagnosis, and very rarely for the treatment of tuberculosis in human beings, being diluted sufficiently with sterile normal saline solution, so that a dose of 0.5 milligram or more is contained in about 1 Cc. of fluid. Tuberculin is employed mainly for the purpose of diagnosing tuberculosis in cattle in doses of 0.25 or more of the crude product diluted to a 10 per cent. solution with 0.5 per cent. carbolic acid, or sterilized normal saline solution. The temperature of the animals is taken before the tuberculin is injected, and repeatedly after injection. A rise in temperature of more than 1½ degrees F. is to be taken as evidence of tuberculosis.

Tuberculin is a fairly stable product, but should not be exposed to light. The value of tuberculin in aiding in the diagnosis of obscure tuberculosis in human beings is still *sub judice*. Some practitioners believe its use to be most valuable, while others believe that reaction sometimes takes place in non-tubercular patients, and that in some cases its use is followed by symptoms too severe to justify its employment.

TUSSILAGO.—Coltsfoot.

Horse-, Ass-, Foal-, or *Bull's-foot, Horse-hoof, Coughwort, Clay-weed, British Tobacco, Dove-dock,* etc., E.; *Huflattig, Rosshuf,* G.; *Tussilage, Pas d'ane,* Fr.; *Tusilago una de Caballo,* Sp.

The dried plant *Tussilago Farfara* L. (Fam. *Compositæ*). The leaves are used separately as *Folia farfaræ* or *tussilaginis,* and the rhizomes as *Radix* or *Rhizoma farfaræ* or *tussilaginis.*

The drug is official in none of the leading pharmacopœias, but it is very extensively used, especially in domestic practice.

Origin and Description.—The plant is a perennial, somewhat succulent, white-floccose herb, spreading by long fleshy rhizomes, which are usually deeply buried in clay or sand, especially in moist places. It is native of Europe and northern Asia, and is somewhat naturalized in northeastern North America. The rhizome is creeping, 30 to 45 Cm. (12–18 In.) long, branching, about 3 Mm. (⅛ In.) thick, with joints about 5 Cm. (2 In.) long, annulate on the nodes, and of a grayish-white or pale-brownish color. It is fragile when dry, has a thick bark, with whitish section, yellowish porous wood-wedges, and a prominent pith, is inodorous, and has a mucilaginous, bitterish, and astringent taste. The leaves appear after the flowers, and are radical, long-petiolate, about 10 Cm. (4 In.) long and broad, roundish heart-shaped, angular-toothed, dark green and smooth above, and white-tomentose beneath. They are rather fleshy while fresh, and fragile after drying. The flower-heads (*Tussilage capitule,* Fr. Cod.) are smaller than those of dandelion, make their appearance in early spring upon scaly scapes, and have a cylindrical involucre of lance-linear scales in a single row, numerous yellow narrowly ligulate pistillate ray-florets in several rows, and about 20 tubular staminate disk-florets. The pappus is long, silky-hairy, and white. The dried flowers and leaves are inodorous and have a mucilaginous, bitterish, and somewhat astringent taste.

Constituents.—All parts of the plant contain a bitter, water-soluble glucoside, a little tannin, resin, gum, and one or more aromatic principles. From the leaves have

been obtained a small amount of an acrid volatile oil, wax, caoutchouc, and 17 per cent. of ash. The odor of the drug indicates the presence of a volatile constituent other than the volatile oil above referred to, which, reasoning by analogy, may be supposed to result from decomposition, probably of the glucoside.

Fig. 455.

Tussilago: rhizome (Nat.).

Fig. 456.

Tussilago: leaf (½ Nat.).

Action and Uses.—Coltsfoot is demulcent and slightly tonic. It is popularly used in the treatment of bronchitis and other pulmonary affections, taken usually in decoction or infusion (1 ounce to the pint [30 Gm: 480 Cc.]). The dried root is sometimes smoked by the natives of Germany and Sweden for the relief of cough. The dose of the decoction is from ½ to 1 ounce (16–30 Cc.). The expressed juice is also employed.

Allied Products.—Several species of the closely related genus *Petasites* are similarly used. In Japan, the flower-shoots of *P. Japonica* Miq. are used in decoction for treating heavy colds, under the name *Makayo*.

U.

ULMUS, *U. S.*—Elm; Slippery Elm.

Ulmi cortex, Cortex ulmi interior.—Elm-bark, Red, Sweet, Moose, or *Rock Elm,* E.; *Ulmeurinde, Rüsterrinde,* G.; *Orme fauve, Orme champêtre,* Fr.; *Olmo,* Sp.; *Ulmeiro,* Port.

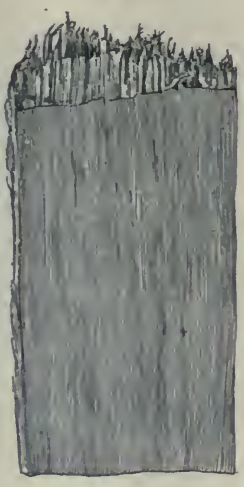
The bark of *Ulmus fulva* Mx. (Fam. *Ulmaceæ*), deprived of its periderm.

The French Codex recognizes also that of *U. campestris* L. of Europe.

Origin.—The Red elm is a tree of eastern and central North America, growing usually in rocky soil, and reaching an extreme height of about 25 M. (75 to 80 Ft.) and a trunk diameter of 1 M. (3 Ft.). It is distinguished by the rough-hairy twigs and leaves, the red wood, which is much less tough and durable than that of the American elm, and the mucilaginous inner bark. The whole of the outer bark should be removed. The inner bark of the trunk and large branches is usually dried under pressure, to preserve its flat or "slab" form. Sometimes the bark of smaller branches is torn off in strips, with the outer bark imperfectly removed.

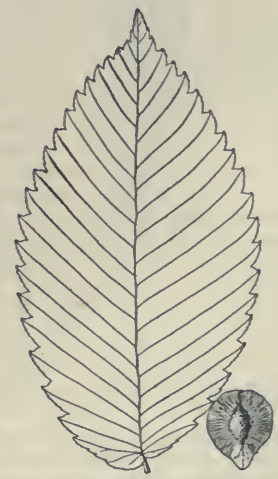
Description.—In flat pieces, varying in length and width, 3 to 4 Mm. thick; outer surface light brown, with occasional dark-brown patches of the periderm; inner surface yellowish brown; fracture fibrous and somewhat mealy; odor slight but distinct; taste mucilaginous. Ground elm contains a few nearly spherical starch grains from 0.005 to 0.010 Mm. in diameter. It should be nearly free from cork-cells. Ground elm-bark is very largely subject to

FIG. 457.



Ulmus (Nat.).

FIG. 458.



Ulmus leaf (½ Nat.); fruit (⅔ Nat.).

adulteration with damaged flour and other starchy substances. *European elm-bark,* chiefly from *U. campestris* L., but occasionally from the *European Black elm, U. effusa* Willd., is of a darker cinnamon-brown on both surfaces and is less mucilaginous, and bitterish and somewhat astringent.

Constituents.—The only important constituent of elm-bark is its large quantity of gum, forming a mucilage which is precipitated by lead acetate, but from which alcohol separates a gelatinous liquid. There is very little starch. The European varieties contain a glucosidal tannin, a bitter principle, and no starch. There appears to be a slight amount of tannin in the official elm-bark also, but not enough to be of practical importance. The ash should not exceed 10 per cent. and is usually less than 9 per cent.

Action and Uses.—Slippery elm bark is demulcent and somewhat nutritious. Made into lozenges with sugar, it is employed to relieve the irritation and cough of

pharyngitis, laryngitis, and bronchitis. In diarrhœa, dysentery, and inflammations of the urinary passages, the mucilage of slippery elm will frequently act as a soothing, diuretic draught. In some parts of the United States slippery elm poultices are popular in the treatment of abscesses, felons, and other local inflammations. It has been asserted to be a remedy in tape worm. The bark, either whole or shredded, and made into tents, has been used to dilate the os uteri, fistulæ of the rectum and other fistulous openings. The mucilage is given in the dose of from ½ to 2 ounces (16–60 Cc.).

The family *Ulmaceæ*, or *Elm family*, is of little economic importance outside of the genus *Ulmus*.

The bark of various species of *Celtis* is rich in tannin and is used as an astringent, and the fruits of one or two species are barely edible.

UMBELLIFERÆ (The Parsley Family).

This is a very large and important family of plants, comprising about 180 genera and more than ten times that number of species, mostly inhabiting temperate regions. The family is chiefly distinguished for its aromatic properties. Outside of their medicinal uses, these aromatic constituents are considerably employed in perfumery, and impart agreeable flavor and wholesomeness to such edible products as carrots, celery, parsley, parsnips, and the delicious but little known Andean rhacachi. Except for these uses, the economic value of the Umbelliferæ is almost wholly medicinal. Although the medicinal properties are in no instance of first rank, yet the number of species which have been employed is very large, and their historic interest is both ancient and great. A few species contain poisonous, bitter constituents, either alkaloids or amaroids, and have been considered under CONIUM. Elsewhere, the medicinal constituents are volatile oils, oleo-resins, variously associated with one another and with gum. The general nature and properties of these constituents have been considered under AJOWAN, AMMONIACUM, ANETHUM, ANGELICA, ANISUM, ASAFŒTIDA, CARUM, CORIANDRUM, CUMINUM, FŒNICULUM, GALBANUM, LEVISTICUM, and SUMBUL, and in our general article on VOLATILE OILS. Of the large number of secondary drugs, the properties and uses agree so closely with those of the preceding, chiefly as carminatives and diuretics, that they are specially interesting from the standpoint of identification and constituents. Every now and again one of them is introduced to pharmaceutical literature with strong claims to the possession of special properties, as was recently the case with the "Osha, or Colorado cough cure," only to fall later to the level of the aromatic stimulants of the family in general. The following unofficial drugs of this family are worthy of special notice:

Thapsia, Fr. Cod. (*Thapsia*, G.; *Faum fenouil*, Fr.; *Tapsia*, Sp.), is the resin of *Thapsia garganica* L., a stout, yellow-flowered perennial of the Mediterranean region. The name is also applied to the root, which is sometimes used under the name *Spanish Turpeth-root*. There is some question whether the African *T. Silphium Viv.* is a distinct species, as we believe to be true. Its resin is more active than that of the former. The fresh root acts as a cutaneous poison, and its collectors suffer severely from symptoms similar to those of rhus-poisoning. The activity resides chiefly in the bark, which is largely collected separately for native use. *T. maxima* Lam. and *T. villosa* Mill., of the same region, are similarly employed. The root is sometimes nearly a yard in length, tapering from a thickness of 2 or 3 inches, and little branched. It is whitish internally. Commercial thapsia resin varies exceedingly in physical properties, according to the method of preparation and consequent degree of purity. The undried root should be washed with cold water, dried, powdered, and extracted with alcohol, which is then evaporated to obtain the crude resin. This is repeatedly washed with boiling water to remove the gum, then again dissolved in alcohol, and the latter evaporated. It should be of a golden-yellow color, softening at a temperature of about 60° F.(15.5° C.) It consists of two acids, a liquid one (*coprylic* or *octoxic*) and a crystalline one (*thapsic*), which is probably an oxidation product of the former. In many samples there is found a third substance, intensely irritant. The powdering of the bark and preparation of the resin usually cause intense cutaneous irritation to the operators. The crude resin yields a highly aromatic volatile oil, which imparts a blue color to ether.

Opopanax, Fr. Cod. (*Hercules' All-heal*, E.; *Opoponaso*, Sp.), is an oleo-gum-resin, obtained from incisions made in the root and stem-base of *Opopanax Opopanax* (L.) Lyons (*Pastinaca O.*—L., *Ferula O.* L.; *O. Chironium* Koch), a large, perennial, yellow-flowered, and yellow-juiced herb of southern Europe.

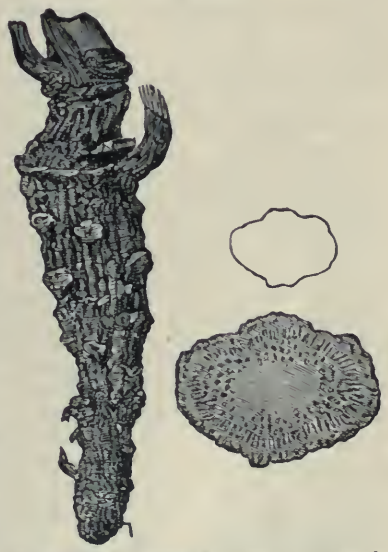
The best quality of opopanax is in irregular, angular, or subglobular pieces, from the size of a pea to that of a waluut, red brown or yellowish brown, friable, breaking with a flat, somewhat waxy fracture, and frequently with vegetable fragments adhering. It has a strong, unpleasant odor, a balsamic bitter taste, yields with water a yellowish emulsion, and when heated softens and exhales a peculiar, not unpleasant, sometimes slightly alliaceous odor. It consists of about one-third gum and nearly one-half resin, with a small quantity of wax and

volatile oil. The volatile oil yields a light portion smelling like lovage oil, a heavier blue portion, and a white, crystalline, sublimable body, *oponal* ($C_{20}H_{10}O_7$), melting at 133° to 134° C. (271.4°–273.2° F.). Genuine opopanax is now rare in commerce, being replaced, according to Holmes, by a myrrh-like substance from *Commiphora Kataf* (Kunth) Engler. This yields up to 10 per cent. of a greenish-yellow lævogyre volatile oil of a specific gravity of 0.870 to 0.905, the "opopanax oil" of commerce. Opopanax had many uses among the ancients, but is now only occasionally employed, then much like ammoniac.

Sagapenum is a similar oleo-gum-resin, obtained in Persia from *Ferula Persica* Willd. It is met with in yellowish-brown, somewhat translucent small tears, and is frequently agglutinated to larger pieces, of a bitter, acrid taste, and a faint, alliaceous odor, which becomes prominent in heating. Cake sagapenum is soft, adhesive, brown, nearly free from tears, mixed with foreign matters. A mixture of galbanum and asafœtida is sometimes sold in place of sagapenum. Pelletier and Brandes found in sagapenum 50 to 54 per cent. of gum, with small quantities of volatile oil, bassorin, etc.

Imperatoria (*Rhizoma imperatoriæ, ostruthii* or *astrantiæ; Masterwort, Felonwort,* E.; *Meisterwurz, Kaiserwurz, Ostranz,* G.; *Imperatoire,* Cod.) is the rhizome of *Imperatoria Ostruthium* L. (*Peucedanum O.*—Koch; *Oreoselinum officinale* Link) of Europe. The drug is dark gray brown, 5 to 10 Cm. (2 to 4 In.) long, up to 1.5 Cm. ($\frac{3}{5}$ In.) thick, tapering, heavily wrinkled longitudinally, finely annulate, heavily scarred; internally whitish, the bark thin, the pith large, the yellowish wood-bundles small, in a loose circle, the bark and pith containing numerous brown resin-cells. Imperatoria is aromatic and of a bitter and pungent taste. The drug contains crystalline ostruthin and imperatorin, and 0.75 per cent. of volatile oil composed of a hydrocarbon and an oxygenated body, probably angelic aldehyd. *Ostruthin* ($C_{18}H_{20}O_3$), when fused with caustic potash, yields a resorcin and acetic and butyric acids. *Imperatorin* occurs in shining crystals, which are generally tasteless, but acquire a pungent taste when dissolved in alcohol.

Fig. 459.



Imperatoria Ostruthium Linné: root-stock (Nat.): transverse section (Nat.).

Peucedanum officinale L., similarly employed, is a root. It is darker without and within, and contains resin-cells in the medullary rays of the wood. More than a dozen other of the 160 species of *Peucedanum* have similar properties, of some the roots, of others the fruits, being employed.

Pimpernel or *Pimpinella* (*Radix Pimpinellæ,* P. G.; *Burnet saxifrage, Small saxifrage* or *Pimpernel, Breakstone,* E.; *Pimpernell, Bibernell,* G.; *Grand Boeage,* Fr.) is the dried rhizome and root of *Pimpinella Saxifraga* L. or of *P. magna* L., of Europe. It tapers from a thickness of about 1 to 1.5 Cm. ($\frac{2}{5}$–$\frac{3}{5}$ In.). It is brownish, wrinkled, and above somewhat annulate. The wood is yellowish and nearly as thick as the whitish bark. It is aromatic, sweetish, pungent, and bitterish. It contains considerable resin and volatile oil. The latter is of a golden yellow, has a specific gravity of 0.959, a disagreeable odor, and a bitter and somewhat acrid taste.

Black Pimpinella (*P. nigra* Willd.) yields a blue oil which turns green in the sunlight.

Eryngium or *Eryngo* (*Button-* or *Corn-snakeroot, Rattlesnake-master, -flag* or *-weed*) is the rhizome of *Eryngium aquaticum* L. (*E. yuccæfolium* Mx.) of the eastern and central United States. The plant grows in rather low grounds. It bears a dense tuft of radical leaves which are 1 or 2 feet long, linear, tapering, pungently serrate-toothed and pale green. The stout stem is 2 or 3 feet high, clothed with similar leaves, which are successively smaller upward, and terminates in a panicle of dense ovate heads of greenish-white flowers. The rhizome is 6 to 12 Mm. ($\frac{1}{4}$–$\frac{1}{2}$ In.) long, with numerous short branches, terminating with a more or less deeply cup-shaped scar. A transverse section exhibits a large whitish central pith and several short wood-wedges, separated from the bark by a brown cambium-line. Below, the root-stock is divided into a large number of nearly simple roots from 5 to 8 Cm. (2–3 In.) long, containing a rather thick and soft whitish meditullium. Button snakeroot has a dark-brown color externally, a slight but rather heavy aromatic odor, and a sweetish and somewhat acrid and aromatic taste, recalling that of parsnip. Its constituents are unknown, but it doubtless contains volatile oil, resin, and bitter substances.

The genus *Eryngium* contains probably 175 species, nearly a score of which have been medicinally employed, especially *E. campestre* L., the European *Eryngo* (*Mannstren, Buchdistil,* G.; *Chardon-Roland, Penicant,* Fr.), the root of which is cylindrical, about 2.5 Cm.

(1 In.) thick and a foot or two long, several headed, dark brown, the thick bark white internally, the wood yellowish.

Laserpitium, Laserwort, White Gentian, or *Herb Frankincense* (*Radix gentianæ albæ* or *R. Cervariæ a.*—*Weisser Enzian, Laserkraut,* G.) is the root of *Laserpitium latifolium* L., an European perennial herb. In shape it resembles gentian root, but it is externally brownish white, internally white, and contains yellow resin-cells in the thick spongy bark. Kutz (1883) isolated from it bitter *laserpitin* ($C_{15}H_{22}O_4$), which separates from hot benzine in monoclinic crystals, and is easily soluble in chloroform, ether, benzol, and carbon disulphide.

Sanicula or *Sanicle* (*Black Snakeroot, Pool-root,* E.; *Sanikel,* G.; *Sanicle,* Fr.; *Sanicula,* Sp.) is the root of *Sanicula Marilandica* L., and of other species of *Sanicula,* which have been collected for or with it. The genus is composed of perennial herbs with palmately divided and coarsely serrate radical leaves and irregular or compound umbels, having polygamous, rather capitate flowers, and few-leaved involucels. The fruit is nearly globular, and has the mericarps closely united, without prominent ribs, covered with hooked prickles, and containing 5 oil-tubes. *S. Marilandica* has the radical stem-leaves 5- or 7-parted and the divisions rather narrow. The staminate flowers are numerous and on slender pedicels (the variety *Canadensis* has few and short-pedicelled sterile flowers) and the perfect flowers have elongated and recurved styles. The blackish root and the leaves are nearly inodorous, and have a somewhat bitter and persistent acrid taste. The sanicles were important aboriginal remedies and appear to have rather active aromatic bitter properties. European sanicle is the rhizome and roots of *S. Europæa* L. The term "Black sanicle" is applied to the root of *Astrantia major* L., which is also called *Radix imperatoriæ nigræ.* The oblique rhizome is about 10 Cm. (4 In.) long, and 6 Mm. (¼ In.) thick, blackish brown, annulated and wrinkled, internally whitish. The roots are shrivelled and fragile. Several other species of Astrantia are also used.

Osha, or *Colorado Cough-cure,* is the root of *Ligusticum filicinum* Wats., a perennial herb of Colorado, Utah, and the adjacent region, and is a highly prized expectorant among the aborigines. The entire root is about 1 foot in length, but usually comes in short pieces, sometimes ½ or even ¾ of an inch in diameter. It is usually simple, but occasionally has one or more small parallel branches. It is very dark brown, strongly wrinkled, and somewhat annulate above, where it often presents several crowns. The thick bark is yellow, the wood pale yellow or whitish. The root is highly aromatic and of a pungent taste. Nearly a dozen species of *Ligusticum* are employed for their similar aromatic properties.

Petroselinum or *Parsley* (*Petersilie,* G.; *Persil,* Fr.; *Peregil,* Sp.) is the root of the well-known parsley, *Petroselinum Petrosolinum* (L.) Lyons (*Apium P.*—L.; *Carum P.*—Benth.; *P. sativum* Hoffm.). One of its cultivated varieties produces a large conical root, resembling a carrot. This is cut lengthwise into two or four sections and dried. The entire dried root often exceeds 2.5 Cm. (1 In.) in thickness at the crown, and is 15 to 20 Cm. (6 to 8 In.) long. It is wrinkled, above annulate, and bears transverse corky ridges. In damp weather it is flexible, but when dry it is brittle, with a short fracture, exhibiting a very thick whitish bark, with an inner zone consisting of a dense radiation of rows of resin-cells, with a brown cambium line separating it from the yellow, obscurely radiate meditullium. It is aromatic, sweetish, and somewhat pungent. Besides gum, starch, sugar, and ordinary constituents, parsley root contains a very little volatile oil and *apiin* ($C_{24}H_{28}O_{13}$), which is extracted by hot water or alcohol, becomes gelatinous on cooling, and when dry is converted into a white, tasteless, and odorless powder. Parsley root has little medicinal activity. When fresh it is boiled and eaten as a vegetable. The herbage of the plant is somewhat more aromatic, and is of a greenish-yellow color, a specific gravity of 0.900 to 0.925, and is dextrogyre. It contains little apiol.

FIG. 460.

Parsley root; transverse section (× 3).

Parsley Fruit ("Parsley Seed") is a cremocarp, about 2 Mm. ($\frac{1}{12}$ In.) long and nearly as broad, of a dark brown-gray color, when freshly dried having a greenish tinge. It is ovate, laterally compressed, and each mericarp bears five pale-brown, slender ribs, except for which they are smooth. Each contains 2 vittæ in the face, 4 in the back. The fruit is hard, or slightly gritty between the teeth, and is aromatic, pungent, and slightly sweetish. Parsley fruit has a different taste and odor from the leaves, and the root is much more active. The same is true of its oil, which is sometimes yielded to the extent of 5 or 6 per cent. The oil is thick, greenish yellow, heavier than water (specific gravity 1.05 to 1.10) and slightly lævogyre. Its important constituent is a large but variable amount of apiol, associated with a terpene, and probably pinene. Apiol is also obtained from *Anethum,* but this is not identical with that from parsley, and is more specifically designated as dill-apiol.

More or less confusion exists in regard to the substances commercially known as apiol. True apiol, or parsley camphor, as it is also called, is a crystallizable compound first obtained in 1823 from the volatile oil of parsley seed by Stange, of Basel, Switzerland. Its true chemical character and properties were carefully studied by Ciamician and Silber in 1888 and

1890, and it was shown to be the dimethoxy-methylene ether of allyl-tetraoxybenzene. Its formula is $C_{12}H_{14}O_4$ or $C_3H_5.H\langle\begin{matrix}O\\O\end{matrix}\rangle CH_2.(OCH_3)_2$. Apiol may be obtained from the distilled oil of parsley seed by exposing the same to low temperatures; the German oil frequently being so rich in apiol as to cause it to assume a semifluid condition at ordinary temperature. It occurs in brittle, white, needle-shaped crystals, which melt at 30° C. (86° F.) and boil at 294° C. (561.2° F.), are insoluble in water, but readily soluble in alcohol or ether. It has a slight parsley-like odor and an aromatic burning taste, and is not easily volatilized with the vapor of boiling water. When treated with potassium permanganate, apiol is converted into *apiolic acid*, $C_{10}H_{10}O_6$, which melts at 175° C. (347° F.). Boiling alcoholic solution of potassium hydroxide converts apiol into its isomer, *isoapiol*, melting at 56° C. (132.8° F.) and boiling at 304° C. (579.2° F.).

In 1852 Homolle and Joret applied the name apiol to a liquid obtained by them from an alcoholic extract of parsley seed by means of ether, and subsequently freed from fat by treatment with lead oxide. According to H. C. Whitney, this liquid consists of volatile oil holding a soft resin and true apiol in solution. It is of yellowish color, has a specific gravity of 1.078, and is immiscible with water. It does not congeal even if cooled to —12° C. (22.4° F.).

It is evident that the name apiol should be applied only to the chemical compound described above, and not to the liquid mixture.

A greenish-yellow liquid, said to be obtained by saponification and subsequent distillation of crude oil of parsley seed, has been placed on the market under the name *apiolin*, and is used as an emmenagogue.

Apium or Celery fruit ("Celery Seed," *Fructus apii, Selerie, Eppich*, G.; *Ache celeri*, Fr.; *Apio silvestro*, Sp.) is the fruit of *Apium graveolens*, L., a European biennial herb, well known in cultivation. It is about 1–1.5 Mm. ($\frac{1}{25}$ to $\frac{1}{16}$ In.) long, roundish-ovate, laterally flattened, brown, with lighter-colored ribs, and smooth; the mericarps are usually separate, somewhat curved, flat on the face, and contain about 12 thin oil-tubes; odor and taste agreeably aromatic. The fruit yields 2 or 3 per cent. of a colorless volatile oil, having the characteristic odor and taste of the plant, dextrogyre, and of a specific gravity of 0.870 to 0.895. It is of complex composition, and its characteristic odorous principle is not well known. There is in the market an oil of the fresh herbage which is of more pleasant odor and taste than that of the fruit. Four other species of Apium are reported as in medicinal use.

Carota or *Carrot* (*Fructus carotæ* or *daucæ; Mohre, Gelbe Rübe*, G.; *Carrote*, Fr.; *Zanahoria*, Sp.) is the fruit of *Daucus Carota* L., a biennial herb of Europe and Asia, and the origin of the cultivated vegetable of that name. The fruit is, for medicinal purposes, chiefly collected from wild plants. The plant is a widely diffused and troublesome weed in the eastern United States, covering wide areas of neglected meadowland until the surface is completely white during the flowering period. The strong incurving of the marginal rays of the fruiting umbel has given the name of *Birds'-nest plant*. The fruit is about 3 Mm. ($\frac{1}{8}$ In.) long, oval, dorsally compressed, and grayish brown; each mericarp has five hispid filiform primary ribs, two of which are lateral, the remaining three upon the back; between these are four secondary ribs, two lateral and two upon the back, each beset with long, spiny bristles, and covering one small oil-tube, two additional oil-tubes being upon the nearly flat face. The fruit has a slight aromatic odor and a pungent aromatic taste. It is said to yield up to 1.5 per cent. of a pale-yellow or colorless volatile oil, which is lævogyre, has a specific gravity of 0.870 to 0.923, and a carrot-like odor and taste. It consists chiefly of pinene.

Carrot-root, except for its edible properties, is chiefly valuable for its yellow coloring-matter, *carotin*, which is inert, and is largely used for coloring butter, cheese, and other foods. The root yields 0.011 per cent. of volatile oil, fixed oil, crystallizable and uncrystallizable sugar, mannite, starch, pectose, and malic acid, besides *carotin* ($C_{15}H_{24}O$), which is a peculiar ruby-red, tasteless, and odorless neutral principle occurring in crystals in the root and soluble in ether, chloroform, and soap solution, and with difficulty in water, and *hydrocarotin* ($C_{18}H_{30}O$), in silky, colorless, tasteless crystals.

Fig. 461.

Fruit of phellandrium (× 4½).

Phellandrium (*Fructus phellandrii; Semen fœniculi aquaticæ; Waterdropwort fennel*, E.; *Wasserfenchel, Rossfenchel, Pferdfenchel*, G.; *Pfellandrie aquatique, Fenouil d'eau*, Fr.) is the fruit of *Œnanthe Phellandrium* Lam. (*Phellandrium aquaticum* L.), a biennial herb of Asia and Europe, where it grows in wet places. The fruit (see Fig. 461) is 3 to 5 Mm. ($\frac{1}{8}$–$\frac{1}{5}$ In.) long, ovate-oblong in shape, scarcely compressed, and narrowed above. The three dorsal ribs are broad and obtuse, the two lateral ones larger, the four grooves narrow, each with a single oil-tube, and two additional oil-tubes in the face of each mericarp. It is of a brown, and when collected in an unripe state, of a blackish-brown color, and has an unpleasant odor, recalling that of caraway, and a bitterish, somewhat acrid taste.

It yields up to 2.5 per cent. of a volatile oil, of a light-yellow to a brownish color, according to age, a strong and penetrating odor and burning taste. It has a specific gravity of 0.85 to 0.89, is dextrogyre, and consists chiefly of phellandrene.

Hydrocotyle (*Water* or *Indian Pennywort, Shilling-grass, Fairy tables,* E.; *Wassernabel,* G.; *Bevilacqua,* Fr.; *Hydrocotila,* Sp.) is the herbage of *Centella Asiatica* (L.) Urban (*Hydrocotyle Asiatica* L.; *H. repanda* Pers.), an herb of wet places in most tropical and subtropical regions. The stem is creeping, the leaves smooth, situated in tufts on the nodes of the stem, have petioles with a sheathing base, are roundish-reniform in outline, with a somewhat crenate margin, about 25 Mm. (1 In.) broad, rather thick, radiately veined, and dark green. The pink-colored flowers are in small umbellate clusters of about 3, and produce small, laterally flattened, suborbicular fruits without oil-tubes. The plant is inodorous, but in bruising the fresh leaves a peculiar odor is developed; the taste is bitterish and pungent. The active principle is supposed to be *villerin,* an oily liquid having a bitter taste, a strong, peculiar odor, becoming viscous on exposure, insoluble in potassa solution, and soluble in ammonia, diluted alcohol, and ether. A dozen species of the closely related genus *Hydrocotyle* have similar uses in various countries.

Heracleum or *Cow-parsnip, Madness* or *Madnep,* is the leaves and root of *Heracleum lanatum* Mx., a gigantic perennial woolly herb of North America, which possesses acrid and poisonous properties. The root is many-headed, fleshy, nearly simple, or composed of many thinner branches, 12 Mm. ($\frac{1}{2}$ In.) or less in diameter, brownish yellow externally, white internally, with a rather thick bark containing resin-cells. The leaves are large, ternately dissected, on very broad and sheathing petioles, the segments often 25 Cm. (10 In.) long, the middle one usually three-lobed. The umbels are from 30 to 38 Cm. (12–15 In.) broad, with an involucre of oblong-lanceolate leaves and involucels composed of 5 to 8 lanceolate, slender, acuminate leaves. The flowers are white. The fruit is 8 Mm. ($\frac{1}{3}$ In.) long, oval, flattened on the back, broadly winged on the margin, each mericarp with 5 slender ribs, the lateral ones being close to the margin, and in upper half with 6 clavate oil-tubes, 2 of which are in the commissure. All parts of it have a rank odor and a pungently acrid taste. In their fresh state the leaves and also the root, applied to the skin, may produce vesication, and have been used as counter-irritants. Some of the European species are still more irritant, and contain a juice which has been applied to warts as an escharotic. The American plant has been used with alleged curative effect in epilepsy, apparently depending upon gastro-intestinal irritation. It is given both in substance and in infusion, and is thought to correct dyspeptic disorders. 1 drachm (4 Gm.) of the root or its equivalent in infusion may be taken several times a day. The *European Cow-parsnip* (*Bärenklaue,* G.; *Berce, Fausse acanthe,* Fr.), having similar properties, is *H. spondylium* L.

Selinum or *Marsh-parsley* (*Radix olsnitii; Sumpfsilge, Elsinich,* G.; *Selin de marais,* Fr.), the root of *Selinum palustre* L. (*Thysselinum p.*—Hoffm.; *Peucedanum p.*—Moench), of wet lands in Europe, has quite similar properties to those of Heracleum, and the fresh juice is similarly vesicant. The root is about 15 Cm. (6 In.) long, in the upper part nearly 25 Mm. (1 In.) thick, 1- or several-headed, annulate above, with deep longitudinal wrinkles, grayish brown, and with scattered whitish suberous warts. The bark is thick, spongy, and brown, and contains a circle of rather large laticiferous vessels; the meditullium is soft and often radially cleft. The root has a strong, disagreeable, somewhat terebinthinate odor and a pungent and acrid taste.

The root of *S. Benthami* Watson is used in Japan under the name *Seng-kin.* More than 100 other species of this family, chiefly in the genera *Lichtensteinia, Bupleurum, Ammi, Sium, Scandix, Anthriscum, Chærophyllum, Prangos, Æthusa, Seseli, Athamanta, Thaspium, Pastinaca, Caucalis,* and *Bifora,* might be named as possessing similar constituents, properties, and uses, either among medical men or by aborigines.

UNGUENTA.—Ointments.

Pommades, Onguents, Fr.; *Salben,* G.; *Unguentos,* Sp.

Ointments are unctuous preparations of such consistence as to permit of their application to the skin by friction or inunction; in contact with the body they are gradually liquefied.

In the preparation of ointments it is of importance that perfectly smooth, homogeneous mixtures be obtained, and that the fatty vehicle be absolutely free from rancidity, since they are often applied to tender excoriated surfaces, and would otherwise prove a source of irritation instead of a soothing application.

Ointments should be preserved in well-glazed, covered porcelain jars, and kept in a dry, moderately cool place. The true porcelain jars, although somewhat expensive, are to be preferred, as they are strictly impermeable to grease and can be thoroughly cleaned with hot water and lye whenever empty. Glass stock jars are offered at a much lower

price, but will often crack while being cleaned, particularly with hot water, yet they are vastly superior to the ordinary white china or queensware covered jar, since the glazing of the latter soon becomes full of fine cracks, through which the fat permeates and, gradually turning rancid, contaminates the contents of the jar; moreover, no amount of washing will remove the rancid grease entirely from the pores of the jars, hence they soon become unfit for use. The sweet condition of ointments cannot be preserved without proper care and cleanliness.

Ointments may be conveniently divided into distinct classes in regard to their therapeutic effect, thus: 1. Protective ointments, which are non-absorbable in character and act strictly epidermatically—that is, on the outer skin or cuticle. 2. Emollient ointments, which have nutritive or absorbefacient properties and act endermatically or by penetrating into the skin. 3. Ointments which produce systemic or constitutional effects, and must therefore be absorbable, penetrating not only into, but through, the skin. This difference in the therapeutic effects desired necessitates careful selection of the vehicle intended for exhibition of the medicinal agents. Non-absorbable ointments intended to produce some medicinal effect on the outer skin, such as astringent, counterirritant, antiseptic germicidal or similar effect, or possibly as protective agents, may therefore be made with petrolatum or a mixture of the same with hard paraffin, which latter combination is to be preferred in warm weather on account of its higher fusing-point. (See UNGUENTUM PARAFFINI.) For emollient ointments designed to penetrate the skin for the purpose of producing a deeper local effect, such as anodyne, stimulant, resolvent, etc., preference should be given to lard, lard mixed with wax, lard and oil, oil and wax, or oil, wax, and spermaceti. The lard to be used for ointments should be free from water and other impurities. The absorbent properties of these bodies permit the admixture of medicinal agents in the form of solution either in water, alcohol, glycerin, oleic acid, or oil. In the last group of ointments, which are intended to produce systemic or constitutional effects, vehicles should be employed which penetrate not only into, but through, the skin, thereby permitting the absorption of the remedial agent present. No substance is known to possess these properties to a greater degree than wool-fat and its official representative, lanolin, which is itself closely related to the fat secreted by the sebaceous glands of the human body. Lanolin can readily be combined with its own weight of water and even larger quantities, whereas lard takes up only about ½ of its weight of water and soft paraffins not more than 10 per cent.

The official glycerite of starch is sometimes used by physicians under the name of *plasma* or *plasma glycerini* as a vehicle for ointments, in place of lard or petrolatum. It possesses the advantage of not being of a fatty nature, and hence easily removed by washing with water, and never becoming rancid; but as it is somewhat hygroscopic it must be preserved in well-closed jars.

As regards the mode of preparation of ointments, three distinct methods are followed, namely, by fusion, by incorporation of the medicinal agent with a suitable vehicle, and by chemical action. When ointments are to be made by fusion, those constituents having the highest fusing-point, as wax and spermaceti, should be heated first, and when nearly melted the lard or oil added, bearing in mind that as long as some of the particles remain unmelted there is no danger from the continued application of heat, which should, however, be withdrawn in time to avoid a rise in temperature of the melted fats. Fusion of ointments is preferably performed on a water-bath, in round-bottom pans or evaporating-dishes, and if dirt be present the melted mixture may be decanted, or, if necessary, strained through cheesecloth into a previously warmed dish or mortar; the liquid should then be stirred until a homogeneous soft mass results, after which it may be set aside and allowed to stiffen by further gradual cooling. The stirring of melted fats while cooling is essential to insure a perfectly smooth product, since fats are composed of solid and liquid bodies, which, during the cooling process, become partially separated, producing a granular solid on congealing, if allowed to cool at perfect rest, as may be seen in the case of plain lard; moreover, in a mixture of melted fats those having a higher fusing-point would naturally congeal earlier than the rest; therefore, unless an intimate mixture be kept up by constant stirring, separation would ensue and a lumpy ointment result. The point of danger may be said to have been passed when the melted ointment has so far cooled under continued stirring that a uniform thick, creamy mass is obtained; for stirring, a broad wooden spatula will be found advantageous. When large quantities of aqueous liquids are to be incorporated with melted fats, as in the case of rosewater

ointment, the liquid should be warmed and then slowly added, with constant trituration, to the mixed fats previously somewhat cooled; otherwise the less fusible constituents will be chilled by the cold liquid and separate in granular form, thus preventing a smooth ointment.

Ointments prepared by incorporation of medicinal agents with an appropriate vehicle comprise by far the larger number of official ointments, and practically all those prescribed extemporaneously. Benzoinated lard and simple ointment are alone directed by the Pharmacopœia as vehicles, although physicians frequently use petrolatum or the commercial products known as vaseline and cosmoline; when absorption of the ointment is desired, wool-fat, known as lanolin, is decidedly to be preferred. All substances to be mechanically incorporated in an ointment must be in the form either of solution or an impalpable powder; the latter condition, in the case of vegetable substances, can be attained only by passing the powder through a fine bolting-cloth sieve (about No. 120). The incorporation may be effected either in a mortar or on a heavy glass slab by means of a broad spatula, the finely powdered substance being first mixed with a small quantity of the vehicle, and, when a smooth mixture has been obtained, the remainder added; while an ointment slab is, as a rule, preferred in this country, the mortar is used almost exclusively in Europe, and for some ointments is in fact indispensable, particularly when solutions are to be added.

When the quantity of powder to be added is large, it will prove advantageous to melt some of the vehicle and mix this with the powder, in a warm mortar, before adding the remainder. Some substances can be conveniently brought into a smooth condition by triturating with a little olive, or expressed almond, oil, such as calomel, lead carbonate, bismuth subnitrate, zinc oxide, etc., as well as certain crystallizable bodies, like mercuric chloride and silver nitrate; for the latter a little oil is decidedly better than water, since upon the gradual evaporation of the latter a return to the crystalline state is probable, giving rise to the presence of minute gritty particles which would cause irritation. Opium should be rubbed smooth with about an equal weight of water, and then at once incorporated with the fatty vehicle before the paste begins to dry. Some salts may be dissolved in water, provided they are very soluble, as potassium iodide, while others must be reduced to an impalpable condition by trituration, as lead acetate, tartar emetic, zinc sulphate, etc. Red mercuric oxide, iodoform, naphthalene, and boric acid may be triturated with a few drops of alcohol, in a mortar, until rendered impalpable; camphor should be powdered, by the aid of alcohol, just before it is to be used, and added to the ointment after all other ingredients have been incorporated, since it is soluble in the fat and materially softens its consistence, which, in the case of solid extracts, would interfere considerably with their perfect admixture.

Whenever extracts, such as belladonna, opium, stramonium, and the like, are to be exhibited in ointments, the pilular extracts are to be preferred, for, after having been softened with a small quantity of water or diluted alcohol, they are readily incorporated with the fatty vehicle, producing a perfectly smooth mixture free from gritty particles. For the extracts of belladonna leaves and of opium, water is to be preferred; but for extract of stramonium leaves diluted alcohol should be used; and in every case an excess of solvent must be avoided, for if the extract be converted into a fluid it cannot be well mixed with the fat; the consistence of a paste resembling honey or thick syrup is best. Another important point in the admixture of solid extracts with ointments is to mix the former with a small portion of the vehicle immediately after they have been softened, and not to allow them to remain on the ointment slab, so as to avoid the drying out of the paste around the edges, which would cause separate particles to appear in the finished products.

Iodine, before admixture with fats, is preferably dissolved in a small quantity of water, with the aid of a little potassium iodide, as it cannot readily be rubbed into a very fine powder by itself.

Substances which are wholly or partly soluble in fats, such as menthol, salol, chrysarobin, benzoic and carbolic acids, aristol, naphthol, and the like, should be triturated in fine powder form with a portion of the vehicle liquefied by heat, and, after addition of the remainder, the mixture must be continually stirred until cold. If chloral, thymol, naphthol, or salol be ordered, together with camphor, in an ointment, the two substances must be triturated together until an oily fluid results, which can then be readily incorporated with the vehicle.

Alkaloidal salts may be incorporated in ointments in solution in water or, if present in large quantity, may be added in the form of a very fine powder; but whenever pure alkaloids are ordered by physicians these should be triturated with a small quantity of warm oleic acid before they are mixed with the fatty vehicle, as more intimate distribution is thus effected than if the alkaloids be merely rubbed into a smooth paste with olive or almond oil.

Glycerin should never be used in place of oil or water to produce a smooth paste with vegetable or mineral powders, because, although derived from fats, it can be incorporated with them permanently only with difficulty. When glycerin in considerable quantity is ordered to be added to an ointment consisting chiefly of lard or a mixture of lard or oil with wax, the addition of a small proportion of anhydrous wool-fat, in place of a like quantity of the regular vehicle, will overcome all difficulty of incorporation. A similar expedient will prove most valuable when large quantities of aqueous fluids are to be incorporated in ointments, or in the case of alcoholic liquids, which ordinarily mix with fats with great difficulty. The pharmacist, in preparing ointments containing fluids, must so combine the constituents that a permanent homogeneous mixture results, from which the fluids will not separate on standing.

Whenever substances likely to attack metal are ordered in ointments, the incorporation with the fatty vehicle should never be made with steel spatulas, but always with horn or rubber-coated ones; the latter can now be had quite pliable, and are admirably adapted for ointments containing salicylic acid, tannic acid, iodine, mercuric chloride, etc.

Ointments should always be dispensed in glass or porcelain jars provided with suitable covers; if the latter be of metal or wood, a disk of heavy paraffin paper should be inserted, to avoid contact with the fatty substance. The compressible tubes used by artists have been found very desirable for dispensing soft ointments. Under no circumstances, *except when intended for immediate use*, should ointments be put up in wood boxes, as the fat will readily penetrate the material and thus become exposed to oxidation by the air. When ointment jars are returned to be refilled, they should be carefully wiped out with soft paper and washed thoroughly before the new ointment is put in; a fresh disk of paraffin paper should also be inserted, and a new label be put on the jar if the old one has become soiled.

To clean the apparatus in or on which ointments have been prepared, the best plan is first to wipe off all remaining grease with clean sawdust of soft paper, and then to wash it well with warm water and lye or soap. In the case of iodoform ointment a few drops of oil of turpentine will readily remove the characteristic odor.

UNGUENTUM, *U. S.*—Ointment.

Unguentum cereum, P. G.; *Unguentum simplex; Unguentum adipis.—Pomade simple*, Fr.; *Simple ointment*, E.; *Wachssalbe*, G.

Preparation.—White wax, 200 Gm.; benzoinated lard, 800 Gm. Melt the white wax, add the benzoinated lard, and heat gently until liquefied; then stir the mixture until it congeals.—U. S.

Simple ointment of the German Pharmacopœia consists of 30 per cent. of yellow wax and 70 per cent. of olive oil.

Uses.—White wax has been substituted for yellow in the present Pharmacopœia. Simple ointment is used as an emollient application to excoriations and sores, but more frequently as a base for other substances intended for local application.

UNGUENTUM ACIDI BORICI, *U. S., Br., P. G.*—Ointment of Boric Acid.

Pommade de l'acide borique, Fr.; *Borsalbe*, G.

Preparation.—Boric acid, in fine powder, 100 Gm.; paraffin, 100 Gm.; white petrolatum, 800 Gm. Melt the paraffin, add the white petrolatum, and heat gently for 10 minutes. Then gradually add the hot liquid to the boric acid, contained in a warm mortar, triturating thoroughly, and stir the mixture until it congeals.—U. S.

To make 1 troyounce of the ointment, melt 48 grains of paraffin, add 384 grains of white petrolatum, and heat gently for 10 minutes; gradually add the warm liquid to 48 grains of very finely powdered boric acid and stir until cold.

The British and German pharmacopœias both direct 1 part of finely powdered boric acid to be mixed with 9 parts of paraffin ointment.

Uses.—This is a mildly antiseptic ointment, to be used in burns, abrasions, inflammations of the eyelids, etc.

UNGUENTUM ACIDI SALICYLICI, *Br.*—Salicylic Acid Ointment.

Pommade de l'acide salicylique, Fr.; *Salicylsalbe*, G.

Preparation.—Salicylic acid, in powder, 10 grains; paraffin ointment, 490 grains. Mix.—Br.

Uses.—This preparation may be applied to skin eruptions in which salicylic acid will be of benefit.

UNGUENTUM ACIDI TANNICI, *U. S.*—Ointment of Tannic Acid.

Pommade de tannin, Fr.; *Tanninsalbe*, G.

Preparation.—Tannic acid, 20 Gm.; glycerin, 20 Gm.; ointment, 60 Gm. Dissolve the tannic acid in the glycerin, with the aid of a gentle heat, and mix the solution thoroughly with the ointment in a mortar, avoiding the use of iron utensils.—U. S.

To make a troyounce of the ointment, dissolve 96 grains of tannic acid in 96 grains of glycerin and incorporate the solution with 288 grains of ointment.

Uses.—The addition of glycerin in this formula enhances the effect of the tannic acid. The ointment is of service in hemorrhoids, prolapse of the rectum, chronic vaginitis, and sluggish ulcers.

UNGUENTUM ACONITINÆ, *Br.*—Aconitine Ointment.

Pommade d'oléate d'aconitine, Fr.; *Akonitinoleatsalbe*, G.

Preparation.—Aconitine, 10 grains; oleic acid, 80 grains; lard, 410 grains. Rub the aconitine with the oleic acid and gently warm; when solution has been effected, add the lard and mix.—Br.

It would seem proper to designate this preparation as ointment of aconitine oleate, the alkaloid to the extent of 2 per cent. being held in solution by an excess of the acid.

Uses.—Ointment of aconitine is a powerful local anæsthetic, used chiefly for the relief of supraorbital neuralgia. If applied to the mucous membranes or abraded skin surfaces, enough aconitine may be absorbed to produce symptoms of poisoning.

UNGUENTUM ADIPIS LANÆ, *P. G.*—Wool-fat Ointment.

Pommade de gras de laine, Fr.; *Wollfetssalbe*, G.

Preparation.—Anhydrous wool-fat, 20 parts; water, 5 parts; olive oil, 5 parts. Melt the wool-fat with the aid of gentle heat and incorporate the oil and water.—P. G.

Uses.—This ointment corresponds to Adeps Lanæ Hydrosus, U. S. P. (which see).

UNGUENTUM ANTIMONII ET POTASSII TARTRATIS.—Antimonial Ointment.

Pommade stibiée, Fr. Cod.; *Unguentum tartari stibiati*, P. G.; *Ointment of tartrated antimony*, E.; *Pommade d'Autenrieth*, Fr.; *Brechweinsteinsalbe, Pockensable*, G.

Preparation.—Antimony and potassium tartrate, in very fine powder, 2 parts; paraffin ointment, 8 parts. Mix.—P. G.

The ointment of the French Codex is somewhat stronger than the German, being made by mixing 1 part of the finely powdered tartar emetic with 3 parts of benzoinated lard.

Uses.—Antimonial ointment may be employed whenever a powerful counterirritant effect is desired, but the painful ulcers and sloughs it sometimes occasions have caused its use to be generally abandoned.

UNGUENTUM AQUÆ ROSÆ, *U. S., Br.*—Ointment of Rose Water.

Cold Cream, Fr. Cod.; *Unguentum leniens*, P. G.; *Unguentum emolliens.*—*Cold Cream*, E., Fr., G.

Preparation.—Spermaceti, 125 Gm.; white wax, 120 Gm.; expressed oil of almond, 560 Gm.; sodium borate, in fine powder, 5 Gm.; stronger rose water, 190 Gm.; to make about 1000 Gm. Reduce the spermaceti and the white wax to fine shavings and melt them at a moderate heat, add the expressed oil of almond and stir, continuing the heat until the mixture is uniform; then gradually add the stronger rose water, previously warmed, in which the sodium borate has been dissolved, stirring the mixture rapidly and continuously until it congeals and becomes of uniform consistence.

When this ointment is to be used as a vehicle for metallic salts, the sodium borate should be omitted.—U. S.

To make 1 pound of cold cream use 2 avoirdupois ounces of spermaceti, 835 grains of white wax, 8 avoirdupois ounces and 420 grains of expressed oil of almond, 3 avoirdupois ounces and 18 grains of stronger rose water, and 40 grains of sodium borate.

Both the British and German pharmacopœias omit the sodium borate and use a larger proportion of water. The former directs that 1½ ounces each of spermaceti and white wax be melted with 9 ounces of almond oil, the mixture poured into a warmed mortar and 7 fluidounces of rosewater and 8 minims of oil of rose then incorporated therewith. The German directions are to melt together 7 Gm. of white wax, 8 Gm. of spermaceti, and 57 Gm. of oil of almond, add 28 Gm. of water, beat the whole to a creamy consistence and add 2 drops of oil of rose.

Uses.—This elegant preparation enjoys deserved popularity as a soothing, cooling application for chapping of the hands and face, abrasions, and other superficial lesions of the skin.

UNGUENTUM ATROPINÆ, *Br.*—Atropine Ointment.

Pommade d'oléate d'atropine, Fr.; *Atropinoleatsalbe*, G.

Preparation.—Atropine, 10 grains; oleic acid, 40 grains; lard, 450 grains. Rub the atropine with the oleic acid and gently warm; when solution has been effected, add the lard and mix.—Br.

As in the case of aconitine ointment, the alkaloid is here held in solution in an excess of oleic acid, and the name ointment of atropine oleate appears more appropriate. The ointment contains 2 per cent. of atropine.

Uses.—This preparation is preferable to belladonna ointment in superficial neuralgias and other local pains because a smaller quantity is necessary to produce results.

UNGUENTUM BELLADONNÆ, *U. S., Br.*—Belladonna Ointment.

Pommade belladonée, Fr. Cod.; *Belladonnasalbe*, G.

Preparation.—Extract of belladonna leaves, 10 Gm.; diluted alcohol, 5 Cc.; hydrous wool-fat, 20 Gm.; benzoinated lard, 65 Gm., to make about 100 Gm. Triturate the extract with the diluted alcohol until a smooth mixture is obtained; with this incorporate the hydrous wool-fat; then add the benzoinated lard and mixtho roughly.—U. S.

Using the above proportions in grains and multiplied by 5 will produce a little over a troyounce of the official belladonna ointment.

Liquid extract of belladonna, 2 fluidounces; benzoinated lard, 2¼ ounces. Evaporate the liquid extract of belladonna on a water-bath until it is reduced to ¼ ounce; add the lard and mix.—Br. This ointment should contain $\frac{6}{10}$ per cent. of the alkaloids of belladonna root.

Uses.—This ointment may be employed when the sedative effect of belladonna is desired in the treatment of painful conditions, especially of the rectum, urethra, and vagina.

Allied Ointment.—UNGUENTUM POPULEUM.—*Pommade de bourgeon de peuplier, Onguent populeum*, Fr. Cod. Digest the fresh leaves of belladonna, hyoscyamus, black nightshade, and poppy, of each 5 parts, in lard, 40 parts; when the moisture has completely evaporated, add poplar buds, 8 parts; digest for a day, express, and strain.

UNGUENTUM CANTHARIDIS, *Br.*—Ointment of Cantharides.

Unguentum cantharidum, P. G.; *Pommade épispastique*, Fr. Cod.; *Unguentum irritans, Unguentum ad fonticulos.—Spanischfliegensalbe*, G.

Preparation.—Cantharides, bruised, 1 ounce; benzoinated lard, 10 ounces. Melt the lard, add the cantharides, and digest at a temperature of about 48.9° C. (120° F.) for 12 hours. Strain through calico and press the residue gently; stir until cold.—Br.

Coarsely powdered cantharides, 3 parts; olive oil, 10 parts; digest for 10 hours in a corked flask on a water-bath, with repeated agitation, express and filter. To 12 parts of the filtrate add 8 parts of yellow wax.—P. G.

Uses.—The preparation of this ointment in the present British Pharmacopœia differs from that in the preceding one, which directed the flies to be digested in olive oil. It is not powerful enough to be employed as a vesicant, but is intended to prolong the effect of a previously applied blister, or to act as a rubefacient upon sound skin when blistering is not desired.

UNGUENTUM CAPSICI, *Br.*—Capsicum Ointment.

Pommade de piment des jardins, Fr.; *Spanisch-Pfeffersalbe*, G.

Preparation.—Capsicum fruit, bruised, 120 grains; spermaceti, 60 grains; olive oil, 1 ounce. Digest on a water-bath for 1 hour, occasionally stirring; then strain and set aside to cool without stirring.—Br.

Uses.—Capsicum ointment may be used as a counterirritant in place of a mustard poultice or capsicum plaster.

UNGUENTUM CHRYSAROBINI, *U. S., Br.*—Chrysarobin Ointment.

Pommade de chrysarobine, Fr.; *Chrysarobinsalbe*, G.

Preparation.—Chrysarobin, 6 Gm.; benzoinated lard, 95 Gm., to make about 100 Gm. Triturate the chrysarobin with the benzoinated lard, previously melted, and heat the mixture on a water-bath, with occasional stirring, for 20 minutes; then strain and stir until it congeals.—U. S.

To make 1 troyounce of the ointment use 30 grains of chrysarobin and 460 grains of benzoinated lard.

The British Pharmacopœia directs 20 grains of chrysarobin to be triturated with 480 grains of benzoinated lard, previously melted by heat; the heat is to be continued until the chrysarobin is dissolved, and the solution then stirred until cold.

In our experience none of the chrysarobin to be found on the market is perfectly soluble in melted lard, nor in boiling chloroform. It is, therefore, necessary to strain the mixture before stirring. The amount of insoluble matter has been found to be about 20 or 25 per cent.

Uses.—The uses for this ointment are discussed under CHRYSAROBINUM (which see).

UNGUENTUM COCAINÆ, *Br.*—Cocaine Ointment.

Pommade d'oléate de cocaine, Fr.; *Cocainoleatsalbe*, G.

Preparation.—Cocaine, 20 grains; oleic acid, 80 grains; lard, 400 grains. Rub the cocaine with the oleic acid, and gently warm until dissolved; add the lard and mix.—Br.

This ointment is practically an ointment of cocaine oleate and contains 5 per cent. of the alkaloid in combination.

Uses.—This ointment may be employed as a local anæsthetic over inflamed nerves and in painful conditions of the rectum, urethra, nose, and eye.

UNGUENTUM CONII, *Br.*—Conium Ointment.

Pommade de grande ciguë, Fr.; *Schirlingsalbe*, G.

Preparation.—Juice of conium, 2 fluidounces; hydrous wool-fat, ¾ ounce. Evaporate the juice of conium on a water-bath to ½ its volume, at a temperature not exceeding 60 C. (140 F.); add the hydrous wool-fat and mix by trituration.—Br.

Uses.—The applications of conium in ointment are described on p. 485.

UNGUENTUM CREOSOTI, *Br.*—Ointment of Creosote.

Pommade crêosotée, Fr.; *Kreosotsalbe*, G.

Preparation.—Creosote, 1 ounce; hard paraffin, 4 ounces; soft paraffin, 5 ounces. Add the creosote to the paraffins previously melted together, and stir until cold.—Br.

Uses.—Creosote ointment is stimulant and antiseptic, and is used as an application to chilblains, sluggish ulcers, especially those with fungous granulations, and to various cutaneous eruptions as eczema, sycosis, prurigo, etc.

UNGUENTUM DIACHYLON, *U. S., P. G.*—Diachylon Ointment.

Unguentum plumbi Hebræ.—Hebra's lead ointment, E.; *Onguent diachylon*, Fr.; *Bleipflastersalbe, Diachylonsalbe*, G.

Preparation.—Lead plaster, 50 Gm.; oil of lavender flowers, 1 Gm.; olive oil, 49 Gm. Melt the lead plaster by applying a gentle heat, add the olive oil, and mix thoroughly; then allow the mixture to cool, add the oil of lavender flowers, and stir the ointment until it congeals. It should be prepared extemporaneously.—U. S.

To make 1 troyounce of the ointment, use 240 grains of lead plaster, 5 drops of oil of lavender flowers, and 235 grains of olive oil.

The German Pharmacopœia directs that equal weights of lead plaster and olive oil be melted together and the mixture then stirred until cold.

Uses.—Following the recommendation of Hebra, diachylon ointment is largely employed in eczema, and to some extent in fetid or profuse sweating of the feet and hands.

UNGUENTUM EUCALYPTI, *Br.*—Eucalyptus Ointment.

Pommade d'eucalypte, Fr.; *Eukalyptussalbe*, G.

Preparation.—Oil of eucalyptus, 1 ounce; hard paraffin, 4 ounces; white soft paraffin, 5 ounces. Melt the hard and soft paraffins together; add the oil of eucalyptus and stir until cold.—Br.

Uses.—Eucalyptus ointment is sometimes applied to slugglish skin diseases and ulcers.

UNGUENTUM GALLÆ, *U. S., Br.*—Nutgall Ointment.

Gall ointment, E.; *Pommade de noix de galle*, Fr.; *Galläpfelsalbe*, G.

Preparation.—Nutgall, in No. 80 powder, 20 Gm.; ointment, 80 Gm.; to make 100 Gm. Rub the nutgall with the ointment, gradually added, until they are thoroughly mixed.—U. S.

Each troyounce of nutgall ointment contains 96 grains of nutgall and 384 grains of ointment; the nutgall is preferably passed through a bolting cloth before adding the lard.

The British Pharmacopœia directs that 1 ounce of very finely powdered nutgall be mixed with 4 ounces of benzoinated lard.

Uses.—Ointment of nutgall is used like ointment of Tannic Acid (which see).

UNGUENTUM GALLÆ CUM OPIO, *Br.*—Ointment of Galls and Opium.

Preparation.—Take of ointment of galls 925 grains; opium, in powder, 75 grains. Mix thoroughly.—Br.

Uses.—This ointment is considered of especial value in painful hemorrhoids.

UNGUENTUM HAMAMELIDIS, *Br.*—Hamamelis Ointment.

Pommade de hamamélis, Fr.; *Hamamelissalbe*, G.

Preparation.—Liquid extract of hamamelis, ½ fluidounce; hydrous wool-fat, 2½ ounces. Mix.—Br.

Uses.—This ointment is nearly if not quite devoid of active medicinal virtue. It may be used in hemorrhoids.

UNGUENTUM HYDRARGYRI, *U. S., Br.*—Mercurial Ointment.

Pommade mercurielle à parties égales, Fr. Cod.; *Unguentum mercuriale, Unguentum neapolitanicum.— Onguent napolitain, Onguent mercuriel double*, Fr.: *Quecksilbersalbe*, G.

Preparation.—Mercury, 500 Gm.; oleate of mercury, 20 Gm.; prepared suet, 230 Gm.; benzoinated lard, 250 Gm., to make 1000 Gm. Triturate the oleate of mercury in a warm mortar, add the mercury gradually by means of a pipet, and when the globules are completely divided and distributed, set it aside for about 15 minutes. Melt the lard and suet, allow the mixture to partially cool, and add about 25 Gm. of it to the mercurial mixture, and continue the trituration until globules are no longer visible under a lens magnifying 10 diameters. Then add the remainder of the lard and suet and mix thoroughly.

Assay of Mercurial Ointment.—Weigh 10 Gm. of mercurial ointment in a tared dish, melt it, then remove it from the fire and add 50 Cc. of warm petroleum benzin. Stir the mixture well, allow the mercury to settle completely, and decant the petroleum benzin. Wash the residue with successive portions of 10 Cc. each of warm petroleum benzin until it is entirely free from fatty matter, carefully retain all of the separated mercury in the dish, and allow all traces of the benzin to evaporate. Add to the residue 10 Cc. of diluted hydrochloric acid, heat it gently, and stir with a glass rod until the mercury collects in a large globule. Pour off the acid, warm the mercury with a little distilled water, dry the globule on bibulous paper, and weigh. The mercury should weigh not less than 4.9 Gm.—U. S.

Each troyounce of mercurial ointment contains 240 grains of pure mercury, 120 grains of lard, 115 grains of suet, and 5 grains of mercuric oleate.

The British Pharmacopœia directs that 1 pound each of mercury and lard be triturated together with 1 ounce of prepared suet until metallic globules are no longer visible. The ointment thus obtained is of nearly the same strength as the above, containing 1 part of mercury in $2\frac{1}{16}$ parts of finished product.

The French Codex directs that 500 Gm. of mercury be uniformly mixed with an equal weight of benzoinated lard. The extinguishment of the mercury by this method is a very tedious operation.

Uses.—Ointment of mercury is used in syphilis for the purpose of influencing the general system, either alone where mercury is not well borne by the stomach, or in combination with the internal administration of the medicine when it is desired to secure a rapid, powerful mercurial effect. In these cases it should be thoroughly rubbed into the skin of various parts of the body successively, as the axillæ, groins, abdomen, etc. If applied to the same area too often it is apt to cause decided irritation of the skin. This treatment is usually instituted by two inunctions a day of 1 drachm (4 Gm.) each of the ointment, the quantity to be increased if necessary to produce the desired effect, or diminished if symptoms of mercurialism appear. If the patient be able he should apply the ointment himself; if not, the hands of the attendant who makes the application should be protected by rubber gloves. In infantile syphilis the ointment may be applied as above directed, or spread upon a flannel binder kept constantly in position around the body. In addition to this employment of mercurial ointment, it is useful to reduce inflammatory enlargements, especially of glandular tissue, whether due to syphilis or other inflammatory processes. It has been highly recommended as an application to the papules of small-pox upon the face, to prevent their maturing and forming unsightly scars. Subacute and chronic arthritis from any cause is sometimes benefited by wrapping the joint in cloths spread with the ointment. Its use in erysipelas is of doubtful value. It will destroy pediculi and other parasites that infest the region of the genitalia, but, while efficacious, its use for this purpose is obnoxious to many individuals, and can be successfully supplanted by almost any fixed or volatile oil.

UNGUENTUM HYDRARGYRI AMMONIATI, *U. S., Br.*—Ointment of Ammoniated Mercury.

Unguentum hydrargyri album, P. G.—*Ointment of white precipitate*, E.; *Pommade de mercure précipité blanc*, Fr.; *Weisse Quecksilbersalbe*, G.

Preparation.—Ammoniated mercury, in a very fine powder, 10 Gm.; white petrolatum, 50 Gm.; hydrous wool-fat, 40 Gm., to make 100 Gm. Rub the ammoniated

mercury with an equal weight of melted white petrolatum, then add the remainder of the melted white petrolatum, mix thoroughly with the hydrous wool-fat, and stir the mixture until it congeals.—U. S.

To make 1 troyounce of the ointment, use 48 grains of ammoniated mercury, 240 grains of white petrolatum, and 192 grains of hydrous wool-fat.

Both the British and German Pharmacopœias direct white precipitate ointment to be made with paraffin ointment in the proportion of 1 part of ammoniated mercury to 9 parts of the ointment.

Uses.—Ointment of ammoniated mercury is used as a stimulant application in sluggish cutaneous affections, as psoriasis, indurated eczema, and in those of parasitic origin, as ringworm and petyriasis versicolor. It is sometimes applied to tubercular syphilitic eruptions.

UNGUENTUM HYDRARGYRI COMPOSITUM, *Br.*—Compound Ointment of Mercury.

Pommade mercurielle composée, Fr.; *Kampher-Quecksilbersalbe*, G.

Preparation.—Take of ointment of mercury 10 ounces; yellow wax, olive oil, each 6 ounces; camphor, 3 ounces. Melt the wax with a gentle heat, and add the oil; then, when the mixture is nearly cold, add the camphor in powder and the ointment of mercury, and mix the whole thoroughly together.—Br.

The ointment has a greenish tint, and is softened by the camphor.

Uses.—The addition of camphor to this formula increases the absorption of the mercury, but is apt to produce irritation of the skin if the ointment is used by inunction to obtain the constitutional effect of mercury.

UNGUENTUM HYDRARGYRI DILUTUM, *U. S.*—Blue Ointment.

Pommade mercurielle faible, Fr. Cod.; *Unguentum hydrargyri cinereum*, P. G.; *Unguentum hydrargyri mite.—Onguent mercuriel simple, Onguent gris*, Fr.; *Graue Quecksilbersalbe*, G.

Preparation.—Mercurial ointment, 670 Gm.; petrolatum, 330 Gm. Mix them thoroughly.—U. S.

Other pharmacopœias direct: Mercury, 100 parts; anhydrous wool-fat, 15 parts; olive oil, 3 parts; lard, 112 parts; suet, 70 parts.—P. G. Mercurial ointment, 100 Gm., benzoinated lard, 300 Gm.—Fr. Cod.

Blue ointment is identical in mercury strength with the preparation formerly known as mild mercurial ointment. The different pharmacopœias prescribe the same strength, namely, 33⅓ per cent. of metallic mercury, with exception of the French Codex, which directs only 12½ per cent.

Uses.—The uses of blue ointment do not differ from those of the stronger mercurial ointment.

UNGUENTUM HYDRARGYRI IODIDI RUBRI, *Br.*—Ointment of Red Iodide of Mercury.

Pommade d'iodure mercurique, Fr.; *Jodquecksilbersalbe*, G.

Preparation.—Take of mercuric iodide, in fine powder, 20 grains; benzoinated lard, 480 grains. Mix thoroughly.—Br.

Uses.—This ointment is used to stimulate indolent syphilitic and scrofulous ulcers, and to resolve tuberculous adenitis. A similar preparation is employed in India for the cure of goitre, by rubbing a quantity of the ointment over the tumor and exposing the patient for several hours to the sun's rays.

UNGUENTUM HYDRARGYRI NITRATIS, *U. S., Br.*—Ointment of Mercuric Nitrate.

Pommade citrine, Fr. Cod.; *Unguentum hydrargyri citrinum, Unguentum citrinum.—Citrine ointment*, E.; *Onguent citrin*, Fr.; *Quecksilbernitratsalbe*, G.

Preparation.—Mercury, 70 Gm.; nitric acid, 175 Gm.; lard, free from water, 760 Gm. To make about 1000 Gm. Heat the lard in a capacious glass or porcelain vessel

to a temperature of 105 C. (221 F.), then withdraw the heat and gradually add 70 Gm. of nitric acid. When the reaction moderates, reapply the heat until effervescence ceases, and allow the mixture to cool to about 40° C. (104 F.). Having dissolved the mercury in the remainder of the nitric acid, with the aid of sufficient heat to prevent the solution from crystallizing, add this solution to the lard mixture. When the mass begins to stiffen, stir it thoroughly with a wooden spatula until it is of bright citrine color. Contact with metallic utensils should be avoided.—U. S.

To make 4 avoirdupois ounces of citrine ointment, use 123 grains of mercury, 306 grains of nitric acid, and 1330 grains of lard: 123 grains of the acid are used for treatment of the lard, and the remainder for the solution of the mercury. It is important that the nitric acid should be of official strength, and that the oxidation of the fat be completed before the addition of the mercurial solution, so as to avoid reduction of the mercurial salt and consequent discoloration. When carefully made the ointment is of a bright lemon-yellow color and keeps well, gradually, however, darkening somewhat in color.

The directions of the British Pharmacopœia are entirely different: 1 ounce of mercury is dissolved in 3 fluidounces of nitric acid without the aid of heat, forming a solution of mercurous nitrate; 4 ounces of lard and 7 ounces of olive oil are then heated together on a sand-bath to a temperature of 143.3° C. (290° F.); the cold mercurial solution is then added very gradually, stirring constantly to promote liberation of fumes. After frothing has ceased, the mixture, which should have a temperature of not less than 93.3° C. (200° F.), must be stirred until it is cold.

On mixing melted fats with a solution of mercuric nitrate containing free nitric acid, a very complicated reaction takes place, resulting, on the one hand, in the oxidation of the fat and the evolution of nitric oxide (nitrogen dioxide) and nitrogen tetroxide, and, on the other hand, in the conversion by the latter of the olein contained in the fat into solid elaidin. The products of oxidation of the fat contain various volatile fatty acids, but must necessarily vary with the nature of the fat, the amount of free nitric acid, and the degree of the heat. Should the nitric acid be insufficient in quantity or the temperature rise to too high a degree, the oxidation is effected in part at the expense of the mercuric nitrate, which is thereby reduced to mercurous salt. In our experience an equally good and permanent ointment is obtained by heating both the mercuric solution and the fat to about 70° C. (158° F.) before mixing them; and even a lower degree of heat, about 50° C. (122 F.), will produce good results if the reaction is completed before the ointment is permitted to cool. All difficulties are, however, overcome by following the process adopted by the U. S. P. The French Codex directs 1 part of mercury and 2 parts of nitric acid to 20 parts of fat composed of equal weights of lard and olive oil; this salve is firm, and is sold in the form of square cakes.

Citrine ointment should be prepared in glass or porcelain vessels, and should not be brought into contact with iron or other metal.

Uses.—Ointment of mercuric nitrate is a very stimulating application, useful in chronic and parasitic skin diseases, as psoriasis, indurated eczema, ringworm of the scalp, pityriasis; in indolent syphilitic and scrofulous ulcers, and in fissures of the lips and anus. It generally requires dilution with lard unless a very active effect is desired. It may occasion salivation if used too freely.

Allied Ointment.—Unguentum Hydrargyri Nitratis Dilutum, Br. Mix nitrate-of-mercury ointment 1 ounce with soft paraffin 4 ounces.

UNGUENTUM HYDRARGYRI OLEATIS, *Br.*—Mercuric Oleate Ointment.

Pommade d'oléate mercurique, Fr.; *Quecksilberoleatsalbe*, G.

Preparation.—Mercuric oleate, 1 ounce; benzoinated lard, 3 ounces. Mix.—Br.

Since the official mercuric oleate of the British Pharmacopœia is the normal oleate, representing about 26.23 per cent. of mercury, this ointment may be considered as a 25 per cent. ointment of mercuric oleate.

Uses.—The properties of this preparation closely resemble those of mercurial ointment. It is considered to be more readily absorbed by the skin and to more rapidly produce constitutional effects.

UNGUENTUM HYDRARGYRI OXIDI FLAVI, *U. S.*—Ointment of Yellow Mercuric Oxide.

Pommade d'oxyde jaune de mercure, Fr.; *Gelbe Quecksilberoxydsalbe*, G.

Preparation.—Yellow mercuric oxide, in very fine powder, 10 Gm.; distilled water, 10 Gm.; hydrous wool-fat, 40 Gm.; petrolatum, 40 Gm.; to make 100 Gm. Triturate the yellow mercuric oxide with the water until the mixture is perfectly smooth and absolutely free from gritty particles, then add the petrolatum and the hydrous wool-fat in divided portions, and incorporate them thoroughly, avoiding contact with metallic utensils.—U. S.

To prepare 1 troyounce of the ointment, 48 grains of yellow oxide of mercury should be triturated with an equal weight of distilled water until perfectly smooth, and then incorporated with 192 grains each of petrolatum and hydrous wool-fat in divided portions.

Other pharmacopœias direct: Yellow mercuric oxide, 10 grains; soft paraffin (yellow), 490 grains.—Br. Yellow oxide of mercury, 1 Gm.; vaseline, 15 Gm.—Fr. Cod.

The object of triturating the oxide with distilled water is to insure reduction to an impalpably fine powder, and the hydrous wool-fat facilitates the incorporation of the petrolatum in the presence of the water. Only glass, porcelain, and horn utensils should be used, and the ointment should be protected against direct sunlight and high temperatures.

Uses.—This ointment is better than that of the red oxide in the treatment of blepharitis and conjunctivitis, and to abort styes, because the oxide is in a finer state of division, and is less apt to irritate the conjunctiva. It is too strong for ordinary use, and should be diluted from 5 to 10 times.

UNGUENTUM HYDRARGYRI OXIDI RUBRI, *U. S., Br.*—Ointment of Red Mercuric Oxide.

Unguentum hydrargyri rubrum, P. G.; *Pommade d'oxyde rouge de mercure*, Fr. Cod.; *Unguentum precipitati rubri.—Pommade de Lyon, Baume ophthalmique rouge*, Fr.; *Rothe Quecksilbersalbe*, G.

Preparation.—Red mercuric oxide, in very fine powder, 10 Gm.; distilled water, 10 Gm.; hydrous wool-fat, 40 Gm.; petrolatum, 40 Gm.; to make 100 Gm. Triturate the red mercuric oxide with the water until the mixture is perfectly smooth and absolutely free from gritty particles, then add the petrolatum and the hydrous wool-fat in divided portions, and incorporate them thoroughly. Contact with metallic utensils should be avoided.—U. S.

To prepare 1 troyounce of the ointment, 48 grains of red mercuric oxide should be triturated with an equal weight of distilled water until perfectly smooth, and then incorporated with 192 grains each of petrolatum and hydrous wool-fat in divided portions.

Other pharmacopœias direct: Red mercuric oxide, ¼ ounce; paraffin ointment (yellow), 2¼ ounces.—Br. Red oxide of mercury, 1 Gm.; vaseline, 15 Gm.—Fr. Cod. Red oxide of mercury, 1 part; paraffin ointment, 9 parts.—P. G.

The comments made under the previous preparation apply also to this ointment.

Uses.—This ointment is applied as a stimulant to sluggish ulcers, particularly those of syphilitic origin. If spread over too large a surface, enough mercury may be absorbed to produce characteristic effects of the drug upon the system. In the treatment of chronic inflammations of the eyelids it has been supplanted by the ointment of the yellow oxide.

UNGUENTUM HYDRARGYRI SUBCHLORIDI, *Br.*—Mercurous Chloride Ointment.

Unguentum calomelanos.—Calomel ointment, E.; *Pommade de chlorure mercureux, Pommade de calomel*, Fr.; *Quecksilberchlorürsalbe*, G.

Preparation.—Take of mercurous chloride ¼ ounce; benzoinated lard, 2¼ ounces. Mix thoroughly.—Br.

Calomel, 1 part, benzoinated lard, 9 parts.—Fr. Cod. This ointment, being known in France also as *pommade au précipité blanc*, should not be confounded with the ointment of ammoniated mercury.

Uses.—Calomel ointment is the least irritating of the mercurial preparations intended for external use. It is used for the same purpose as the others, but is less efficacious.

UNGUENTUM IODI, *U. S.*, *Br.*—Iodine Ointment.

Unguentum iodinii.—Pommade d'iode, Fr.; *Jodsalbe*, G.

Preparation.—Iodine, 4 Gm.; potassium iodide, 4 Gm.; glycerin, 12 Gm.; benzoinated lard, 80 Gm., to make 100 Gm. Triturate the iodine and potassium iodide in a glass mortar with the glycerin until dissolved, then gradually incorporate the benzoinated lard and mix thoroughly, avoiding the use of a metallic spatula. This ointment should be freshly made when required.—U. S.

Each troyounce of iodine ointment contains 19¼ grains each of iodine and potassium iodide, 58 grains of glycerin, and 383½ grains of benzoinated lard.

The directions of the British Pharmacopœia are identical with the above, except that plain lard instead of the benzoinated is ordered.

Uses.—Iodine ointment is employed to reduce the swelling occurring in subacute or chronic inflammation of glandular tissues, as of the tonsils, thyroid and lymphatic glands. It sometimes promotes the absorption of the inflammatory effusions of arthritis, pericarditis and pleurisy, and it enjoys quite a reputation as a remedy in chilblains.

UNGUENTUM IODOFORMI, *U. S.*, *Br.*—Iodoform Ointment.

Pommade d'iodoforme, Fr.; *Jodoformsalbe*, G.

Preparation.—Iodoform, in very fine powder, 10 Gm.; lard, 90 Gm., to make 100 Gm. Rub the iodoform with the lard, gradually added, until they are thoroughly mixed.—U. S.

Each troyounce of the ointment contains 48 grains of iodoform and 432 grains of lard. An impalpable powder of iodoform is readily obtained by trituration with alcohol.

Iodoform, ¼ ounce; paraffin ointment (yellow), 2¼ avoirdupois ounces.—Br.

The ointment should be perfectly smooth and free from grittiness; it has a light-yellow color and the peculiar odor of iodoform.

Uses.—For the applications of this ointment see IODOFORMUM.

UNGUENTUM PARAFFINI, *Br.*, *P. G.*—Paraffin Ointment.

Pommade de paraffin, Fr.; *Paraffinsalbe*, G.

Preparation.—Hard paraffin, 3 ounces; soft paraffin, 7 ounces. Melt together in a shallow evaporating dish; as the liquid cools triturate constantly until, when cold, a uniform plastic ointment is produced.—Br.

The German Pharmacopœia directs that 1 part of hard paraffin and 4 parts of liquid paraffin be melted together. The resulting ointment is white, and should melt between 40° and 50° C. (104° and 122° F.).

The two ointments differ from each other merely in degree of firmness, that of the Br. P. having the higher melting point.

Uses.—This is a simple, emollient ointment resembling petrolatum in its properties.

UNGUENTUM PHENOLIS, *U. S.*—Ointment of Phenol.

Unguentum acidi carbolici, Br., U. S., 1890.—*Phenol ointment, Ointment of carbolic acid*, E.; *Pommade de phénol, Pommade phéniquée*, Fr.; *Phenolsalbe, Karbolsalbe*, G.

Preparation.—Phenol, 3 Gm.; white petrolatum, 97 Gm. To the melted white petrolatum add the phenol, and stir the mixture until it begins to congeal.—U. S.

To prepare 1 troyounce of phenol ointment, add 14½ grains of phenol to 465½ grains of white petrolatum previously melted.

The British Pharmacopœia directs that ½ ounce of phenol be dissolved in 1½ ounces of glycerin and the solution mixed with 10½ ounces of white paraffin ointment.

The present official ointment of carbolic acid is only ⅗ as strong as that of 1890, which contained 5 per cent. of phenol. The British ointment contains 4 per cent. of phenol.

Uses.—This is an antiseptic preparation largely employed in domestic practice as an application to burns, superficial wounds, sores, etc.

UNGUENTUM PICIS LIQUIDÆ, *U. S., Br.*—Tar Ointment.

Pommade de goudron, Fr. Cod.; *Theersalbe*, G.

Preparation.—Tar, 500 Gm.; yellow wax, 125 Gm.; lard, 375 Gm.; to make 1000 Gm. Melt together the yellow wax and the lard at a moderate heat. Then incorporate the tar, previously warmed, strain the mixture through muslin, and stir the ointment until it is cool.—U. S.

Each troyounce of tar ointment contains 240 grains of tar, 60 grains of yellow wax, and 180 grains of lard.

Tar, 5 ounces; yellow wax, 2 ounces; melt the wax with a gentle heat, add the tar, and stir the mixture briskly while it cools.—Br. Tar, 1 part; lard, 9 parts. Mix.—Fr. Cod.

Uses.—Tar ointment is largely employed as an application in psoriasis and other scaly and sluggish eruptions, and in eczema rubrum after the liquid secretion has ceased. In ringworm, especially of the scalp, its use is frequently attended by happy results.

UNGUENTUM PLUMBI ACETATIS.—Lead Acetate Ointment.

Pommade d'acétate de plomb, Fr.; *Bleizuckersalbe*, G.

Preparation.—Lead acetate, in fine powder, 20 grains; paraffin ointment (white), 480 grains. Mix.—Br.

Uses.—The uses of this ointment are similar to those of the CERATUM PLUMBI SUBACETATIS, U. S. P.

UNGUENTUM PLUMBI CARBONATIS, *Br.*—Lead Carbonate Ointment.

Unguentum cerussæ, P. G.; *Ointment of white lead*, E.; *Pomma de carbonate de plomb, Pommade de céruse, Onguent blanc de Rhazès*, Fr.; *Bleiweissalbe*, G.

Preparation.—Lead carbonate, in fine powder, ½ ounce; paraffin ointment (white), 2½ ounces. Mix.—Br.

The ointment of the German Pharmacopœia is 3 times as strong as that of the British, but is made with the same vehicle. The French Codex directs 10 Gm. of lead carbonate to be mixed with 50 Gm. of benzoinated lard.

Uses.—This ointment is particularly serviceable as a soothing application to recent superficial burns. It may also be applied to wounds and inflamed surfaces.

Allied Ointment.—UNGUENTUM CERUSSÆ CAMPHORATUM.—*Camphorated Ointment of Lead Carbonate*, E.; *Kampherhaltige Bleiweissalbe*, G.

This ointment is prepared by incorporating 1 part of very finely powdered camphor with 19 parts of ointment of lead carbonate.

UNGUENTUM PLUMBI IODIDI, *Br.*—Lead Iodide Ointment.

Pommade d'iodure de plomb, Fr.; *Jodbleisalbe*, G.

Preparation.—Lead iodide, in fine powder, ½ ounce; paraffin ointment (yellow), 2½ ounces. Mix.—Br.

The French Codex directs lead iodide, 10 Gm., to be mixed with 90 Gm. of benzoinated lard.

Uses.—The uses of this ointment are considered under PLUMBI IODIDUM (which see).

UNGUENTUM PLUMBI TANNATIS.—Ointment of Lead Tannate.

Unguentum plumbi tannici, P. G.; *Pommade de tannate de plomb*, Fr.; *Gerbsäure-Bleisalbe*, G.

Preparation.—Tannic acid, 1 part; solution of lead subacetate, 2 parts; lard, 17 parts. Add the tannic acid to the solution of lead subacetate and triturate until a perfectly smooth magma results, which is then incorporated with the lard. The ointment should be prepared fresh when called for.—P. G.

Uses.—This ointment may be used with benefit in hemorrhoids and other conditions in which a local astringent effect is desired.

UNGUENTUM POTASSII IODIDI, *U. S., Br.*—Ointment of Potassium Iodide.

Unguentum kalii iodati, P. G.; *Pommade d'iodure de potassium*, Fr. Cod.; *Jodkaliumsalbe*, G.

Preparation.—Potassium iodide, 10 Gm.; potassium carbonate, 0.6 Gm.; water, 10 Gm.; benzoinated lard, 80 Gm.; to make about 100 Gm. Dissolve the potassium iodide and potassium carbonate in the water by trituration, then gradually add the benzoinated lard and incorporate thoroughly. This ointment should be prepared extemporaneously.—U. S.

To prepare 1 troyounce of the ointment, dissolve 48 grains of potassium iodide and 3 grains of potassium carbonate in 50 minims of water, and gradually incorporate the solution with 381 grains of benzoinated lard.

Other pharmacopœias direct: Potassium iodide, 50 grains; potassium carbonate, 3 grains; distilled water, 47 grains; benzoinated lard, 400 grains.—Br. Potassium iodide, 10 Gm.; water, 10 Gm.; benzoinated lard, 80 Gm.—Fr. Cod. Potassium iodide, 20 parts; sodium thiosulphate, ¼ part; water, 15 parts; lard, 165 parts.—P. G.

The object of adding potassium carbonate or sodium thiosulphate to the ointment is to prevent discoloration of the same by free iodine.

Uses.—It is proposed to employ this preparation like ointment of iodine to resolve glandular inflammations, but to our mind it is greatly inferior to the latter for this purpose.

UNGUENTUM ROSMARINI COMPOSITUM, *P. G.*—Compound Rosemary Ointment.

Onguent de romarin composé, Fr.; *Rosmarinsalbe*, G.

Preparation.—Suet, 8 parts; yellow wax, 2 parts; lard, 16 parts; expressed oil of nutmeg, 2 parts; oil of rosemary, 1 part; oil of juniper, 1 part. Melt the suet, wax, lard, and expressed oil of nutmeg together, strain, and stir until cool; then while still soft incorporate the oils of rosemary and juniper.—P. G.

Uses.—An aromatic, emollient ointment which may be applied to slight inflammations of the skin.

UNGUENTUM STAPHISAGRIÆ, *Br.*—Stavesacre Ointment.

Onguent de staphisaigre, Fr.; *Stephanskörnersalbe*, G.

Preparation.—Stavesacre seeds, 2 ounces; yellow wax, 1 ounce; benzoinated lard, 8½ ounces. Crush the stavesacre seeds and digest with the benzoinated lard for 2 hours on a water-bath; strain and express; add the wax and heat gently until the wax is melted, then stir until cold.—Br.

Uses.—Stavesacre ointment is useful to destroy pediculi or other vermin that might infest the body.

UNGUENTUM STRAMONII, *U. S.*—Stramonium Ointment.

Pommade de stramoine, Fr.; *Stechapfelsalbe*, G.

Preparation.—Extract of stramonium, 10 Gm.; diluted alcohol, 5 Gm.; hydrous wool-fat, 20 Gm.; benzoinated lard, 65 Gm.; to make 100 Gm. Triturate the extract with the diluted alcohol until a smooth mixture is obtained; with this incorporate the hydrous wool-fat, then add the benzoinated lard and mix thoroughly.—U. S.

To make 1 troyounce of stramonium ointment, rub 48 grains of extract of stramonium with 30 minims of diluted alcohol into a smooth paste, and with this incorporate 96 grains of hydrous wool-fat; then add 312 grains of benzoinated lard and mix thoroughly.

The present official stramonium ointment differs from that of 1890 in being made with extract of stramonium leaves, and it will therefore have a deep-green color. Stramonium seed and the extract made therefrom are no longer recognized.

Uses.—Stramonium ointment may be used like belladonna ointment as a local anodyne in case of hemorrhoids, cancer of the rectum, irritable ulcers and fissures, etc.

UNGUENTUM SULPHURIS, *U. S.*, *Br.*—Sulphur Ointment.

Pommade soufrée, Fr. Cod.; *Pomatum sulfuratum; Unguentum sulfuratum simplex. Schwefelsalbe*, G.

Preparation.—Washed sulphur, 150 Gm.; benzoinated lard, 850 Gm.; to make 1000 Gm. Rub the sulphur, with the benzoinated lard gradually added, until they are thoroughly mixed.—U. S.

Each troyounce of the ointment contains 72 grains of washed sulphur and 408 grains of benzoinated lard.

Sublimed sulphur, 1 ounce; benzoinated lard, 4 ounces.—Br. Washed sulphur, 10 parts; almond oil, 10 parts; benzoinated lard, 80 parts.—Fr. Cod.

Uses.—Sulphur ointment is a specific for scabies, and is useful also in certain chronic skin diseases. For its mode of application in scabies see SULPHUR SUBLIMATUM.

Allied Ointments.—UNGUENTUM SULPHURIS ALKALINUM. *Alkaline sulphur ointment*, E.; *Helmerich's Salbe*, G.—Washed sulphur, 20 parts; potassium carbonate, 10 parts; water, 5 parts; benzoinated lard, 65 parts; to make 100 parts. Rub the sulphur with the potassium carbonate and the water, gradually add the benzoinated lard, and mix thoroughly.

UNGUENTUM SULPHURIS IODIDI, *Br.*—Ointment of Iodide of Sulphur.

Pommade d'iodure de soufre, Fr.; *Jodschwefelsalbe*, G.

Preparation.—Sulphur iodide, 20 grains; glycerin, 20 grains; benzoinated lard, 460 grains. Triturate the sulphur iodide and glycerin in a slightly warmed mortar to a smooth paste, then add the lard gradually, and stir until the ointment is cold.—Br.

Uses.—This ointment may be applied with good results in some cases of chronic skin lesions, as psoriasis, lepra, acne, and in eczema and impetigo after the stage of secretion.

UNGUENTUM TEREBINTHINÆ, *P. G.*—Turpentine Ointment.

Onguent térébenthine, Fr.; *Terpentinsalbe*, G.

Preparation.—Turpentine, 1 part; yellow wax, 1 part; oil of turpentine, 1 part. Melt the turpentine and wax together, strain and cool, and while still soft incorporate the oil of turpentine.—P. G.

Uses.—The uses of this ointment resemble those of the CERATUM RESINÆ COMPOSITUM, U. S. P. (which see).

Allied Ointment.—UNGUENTUM DIGESTIVUM SIMPLEX.—*Onguent digestif simple*, Fr. Cod.—Venice turpentine, 40 Gm.; yolk of egg, 20 Gm.; olive oil, 10 Gm. Mix the yolk of egg and Venice turpentine in a mortar, and little by litle incorporate the olive oil.—Fr. Cod.

UNGUENTUM VERATRINÆ, *U. S.*, *Br.*—Veratrine Ointment.

Pommade de vératrine, Fr.; *Veratrinsalbe*, G.

Preparation.—Veratrine, 4 Gm.; expressed oil of almonds, 6 Gm.; benzoinated lard, 90 Gm., to make 100 Gm. Rub the veratrine with the expressed oil of almond, then gradually add the benzoinated lard, and mix thoroughly.—U. S.

To make 1 troyounce of the ointment, rub 20 grains of the veratrine with 30 grains of expressed oil of almond perfectly smooth, and gradually add 430 grains of benzoinated lard.

Veratrine, 10 grains; oleic acid, 40 grains; lard, 450 grains. Rub the veratrine with the oleic acid and gently warm the mixture until dissolved; then add the lard and mix.—Br.

The U. S. P. ointment is about twice as strong as the British, and, besides, the latter contains the veratrine in combination as oleate.

Uses.—The uses of this ointment are described under VERATRINA (which see).

UNGUENTUM ZINCI OLEATIS, *Br.*—Zinc Oleate Ointment.

Pommade d'oléate de zinc, Fr.; *Zinkoleatsalbe*, G.

Preparation.—Zinc sulphate, 2 ounces; hard soap, 4 ounces; boiling distilled water, white soft paraffin, of each a sufficient quantity. Dissolve the zinc sulphate in 4 fluidounces of the water, and the soap in 40 fluidounces of the water. Mix the solutions; collect the precipitated zinc oleate and wash with hot water until little or no reaction for sulphate is obtained; dry on a water-bath and mix with an equal weight of previously melted soft paraffin.—Br.

Since in the above operation normal zinc oleate is formed, the finished product constitutes a 50 per cent. ointment of the same. In order to secure a perfectly smooth ointment it will be found advantageous to melt the zinc oleate after drying, then to add the melted paraffin, and stir the mixture until cold.

Uses.—The properties of this preparation are similar to those of the ointment of zinc oxide.

UNGUENTUM ZINCI OXIDI, *U. S.*—Ointment of Zinc Oxide.

Unguentum zinci, Br., P. G.—*Zinc ointment*, E.; *Pommade d'oxyde de zinc*, Fr.; *Zinksalbe*, G.

Preparation.—Zinc oxide, in very fine powder, 200 Gm.; benzoinated lard, 800 Gm. Rub the zinc oxide, which must be free from gritty particles, with an equal weight of the melted benzoinated lard, and with this incorporate the remainder of the benzoinated lard previously melted; if necessary, strain the ointment while warm, and stir thoroughly until it congeals.—U. S.

To make 1 pound of zinc ointment, use 3 avoirdupois ounces and 88 grains of zinc oxide, and 12 avoirdupois ounces and 350 grains of benzoinated lard.

The British Pharmacopœia directs that 3 ounces of zinc oxide be mixed with 17 ounces of benzoinated lard. The German Pharmacopœia orders zinc oxide, 1 part; and lard, 9 parts.

It is important that the zinc oxide be in impalpably fine powder, and for this purpose it should be passed through a fine (No. 100) bolting-cloth sieve.

Uses.—This mildly astringent and stimulant ointment is extensively employed as a soothing, protective agent in superficial burns, ulcers, fissures of the nipples and anus, excoriations, and for the local eruptions of eczema, herpes, impetigo, and other skin lesions.

UNGUENTUM ZINCI STEARATIS, *U. S.*—Ointment of Zinc Stearate.

Pommade de stéarate de zinc, Fr.; *Zinkstearatsalbe*, G.

Preparation.—Zinc stearate, in fine powder, 50 Gm.; white petrolatum, 50 Gm. To the white petrolatum, melted on a water-bath, add the zinc stearate. Continue the heat until the mixture becomes smooth, then stir while cooling until it congeals.—U. S. This preparation represents a 50 per cent. ointment of zinc stearate, the latter salt being preferred by many to zinc oleate on account of its greater permanency.

Uses.—Ointment of zinc stearate is feebly antiseptic and astringent. The indications for its use are practically those for which the ointment of zinc oxide will be found of service.

URANIUM.—Uranium.

Urane, Fr.; *Uran*, G.

Symbol, U. Atomic weight, 236.7. Valence, 2 to 8.

History.—Uranium is one of the less abundant elements, occurring chiefly in the mineral known as pitchblende or uraninite, which is found in Bohemia, Saxony, Cornwall, Colorado, Utah, etc. Several other minerals, which are rarer than pitchblende, also contain uranium. Pitchblende is practically the only source of uranium salts on the market; it is a very complex mixture, containing, besides uranium oxide, U_3O_8, as chief constituent, smaller or larger quantities of oxides of many other metals, as lead, barium, bismuth, iron, zinc, radium, polonium, etc. Uranium compounds were first isolated by Klaproth in 1789 from pitchblende. For a long time the iron-gray crystal-

line uranous oxide, UO_2, was thought to be an element, and Péligot was the first to succeed in obtaining the metal in 1841 as a grayish-black powder, and in 1856 as a bright compact mass. Uranium is obtained as nitrate from pitchblende by treating the finely powdered mineral with concentrated nitric acid, and removing from the solution by various treatments the numerous other metals. The nitrate is the starting-point for the other compounds of uranium. When heated it is decomposed, leaving the trioxide, UO_3. If this be mixed with charcoal and heated to a high temperature in an atmosphere of chlorine, the tetrachloride, UCl_4, is formed. To obtain the metal, the chloride is reduced by sodium under a cover of molten sodium chloride, or, better, by igniting in a crucible a mixture of uranium oxide and aluminum powder wetted with one-third its volume of liquefied air.

Properties.—Uranium is a very heavy and very hard metal, with a color and lustre like that of nickel or iron, but black in a finely divided state. At white heat it burns in air with great brilliancy. It has the density 18.4, and dissolves in dilute acids with evolution of hydrogen. Marked characteristics of the element are its variable valence, and the fact that it has the highest atomic weight; also the fact that it is radio-active (see also RADIUM). Soluble uranium compounds are poisonous, and produce, especially when injected subcutaneously, even in small doses, symptoms of diabetes.

Chlorides.—Uranium forms three chlorides; the *trichloride*, UCl_3, a brownish-red mass obtained by reduction of UCl_4 with hydrogen, is unstable and oxidized by water; the *tetrachloride*, UCl_4, brilliant, dark-green crystals, soluble in water, and obtained as described above; the *pentachloride*, UCl_5, obtained in the same way as the tetrachloride and separated from it by its greater volatility, is a brown crystalline substance, decomposed in water into chlorine and the tetrachloride.

Oxides.—Four oxides are known. *Uranous oxide*, UO_2, is a gray or reddish-brown powder, obtained by reduction of the trioxide with hydrogen. *Urano-uranic oxide*, U_3O_8, is the last product of the action of oxygen on uranium or the other oxides when these are heated in the air. It also occurs naturally as the chief constituent of pitchblende. When it is dissolved in nitric acid, it is converted into uranyl nitrate, $UO_2(NO_3)_2$, which is a derivative of the higher oxide, UO_3. *Uranium trioxide*, UO_3, is a yellow powder obtained by heating the nitrate, which at higher heat loses oxygen and leaves the oxide, U_3O_8. *Uranium tetroxide*, UO_4, is known only in combination, in peruranic acid.

Action and Uses.—Uranium is not used medicinally. Its salts, some of which have been given in disease, are all powerful, corrosive poisons, producing in poisonous doses severe gastro-enteritis, retardation in the reduction of oxyhæmoglobin in the blood, degeneration of blood-vessels and the viscera, especially the kidney. The urine is increased in quantity and specific gravity and contains albumin and glucose, the last being perhaps the result of the lessened oxidation. Uranyl acetate has been recommended in coryza, being used either as a snuff after dilution with some inert powder, or in solution as a nasal douche. Uranyl nitrate has been used in diabetes in the dose of $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.01–0.015 Gm.).

SALTS OF URANIUM.

Ammonium diuranate, $(NH_4)_2U_2O_7$, is also manufactured in large quantity. It is soluble in ammonium carbonate, which fact is utilized in analysis to separate uranium from other metals.

Sodium diuranate, $Na_2U_2O_7$, is a fine yellow powder, and is manufactured and sold under the name *uranium yellow*. It is precipitated when an excess of sodium hydroxide is added to a solution of uranyl nitrate. It is used to color glass, etc., light yellow; at the same time a brilliant greenish fluorescence is produced. Uranous salts produce a black color, and are used to paint porcelain ware.

Uranous salts are derived from quadrivalent uranium, and may be obtained by dissolving the metal, or the dioxide in acids, or by reduction of the uranyl salts. They are green and are oxidized in solution by the air. Not many salts of this order are known, the best-known one being the sulphate, $U(SO_4)_2.4H_2O$. With alkalies they precipitate brown uranous hydroxide, $U(OH)_4$.

Uranyl acetate, $UO_2(C_2H_3O_2)_2+2$ or $3H_2O$, may be obtained by heating anhydrous uranium nitrate to redness until all nitric acid has been dissipated, and then dissolving the residuary uranium oxide in 30 per cent. acetic acid. The resulting solution is evaporated and set aside to crystallize. If allowed to crystallize from dilute solutions, the salt will contain 3 molecules of water, but if crystallized from concentrated hot solutions it contains only 2. It occurs in rhombic crystals of yellow color, which are readily soluble in water. Should the salt contain basic uranyl acetate, a perfectly clear solution will result only after addition

of a little acetic acid. Solutions of uranyl acetate undergo decomposition when exposed to light, or if allowed to stand in a warm place for some time.

Uranyl nitrate, $UO_2(NO_3)_2 + 6H_2O$, is obtained from pitchblende, as already described. It crystallizes in large, greenish-yellow, fluorescent prisms, which are soluble in water and alcohol. It is used in quantitative analysis to titrate phosphates. Uranyl forms in phosphoric acid the salt $(UO_2)HPO_4$, or when ammonium salts are present the double salt, $(UO_2)NH_4PO_4$, both of which are insoluble in acetic acid, in which medium the titration is carried out. The end-point is shown by the intense brownish-red color given by the least excess of the uranium reagent with potassium ferrocyanide as indicator.

Uranyl salts are derived from the trioxide, UO_3, which has the peculiar property of acting like a base toward strong acids, and like an acid toward strong bases. The compounds with acids have a structure similar to that of the bismuthyl salts, in that the complex divalent group or radical, UO_2, called uranyl, takes the place of two hydrogen atoms of the acid; thus $UO_2(NO_3)_2$, $(UO_2)SO_4$, etc. They are regarded as derived from the yellow hydroxide, $UO_2(OH)_2$, as shown by the reaction $UO_2(OH)_2 + 2HNO_3 = UO_2(NO_3)_2 + 2H_2O$. Uranyl forms salts with nearly all organic acids, of which the oxalate is the most interesting. This is very sensitive to light, especially direct sunlight, in which it evolves carbon monoxide and carbon dioxide and forms a precipitate of uranyl hydroxide. Similar decompositions occur with other salts. When UO_3 or $UO_2(OH)_2$ acts as an acid toward strong bases, salts are formed of an acid, $H_2U_2O_7$, which may be called *diuranic acid*, as it is analogous in composition to dichromic acid, $H_2Cr_2O_7$.

Uranyl sulphate, $(UO_2)SO_4 + 3H_2O$, is obtained by decomposing the nitrate with sulphuric acid, as lemon-yellow needles. It forms a double salt with ammonium sulphate, $(UO_2)SO_4.(NH_4)_2SO_4 + 2H_2O$, which is difficultly soluble in water and crystallizes in yellow prisms. The corresponding potassium salt was used by Becquerel when he discovered the radio-activity of uranium (see under RADIUM).

UREA.—Urea.

Carbamide.—Urée, Fr.; *Harnstoff, Carbonylamid,* G.

Formula, $CH_4N_2O = CO(NH_2)_2$. Molecular weight, 59.65.

Origin.—Urea was discovered in urine by Rouelle (1773), and, in the impure condition in which he obtained it, designated as *extrait savonneux de l'urine.* Fourcroy and Vauquelin (1799) prepared it in the pure state. It has been found in the urine of mammals, more particularly in that of the Carnivora, in the urine of birds and other animals, and in many animal fluids. Human urine contains from 2 to 4 per cent. of urea. The transformation into urea of ammonium cyanate by evaporating its aqueous solution, as observed by Wöhler (1828), was the first instance in which an organic compound produced in the living organism was artificially formed. Urea has also been artificially prepared from other cyanogen compounds.

Preparation.—Urine is evaporated to a syrupy consistence, allowed to cool, and the residue mixed with an equal volume of nitric acid. The nitrate of urea, which crystallizes in scales and prisms, is purified by washing with cold water and by recrystallization, and is then decomposed by boiling with water and barium carbonate; the filtrate is evaporated and the residue exhausted with alcohol. Oxalic acid and calcium carbonate may be substituted in this process for nitric acid and barium carbonate.

Urea may be prepared by fusing an intimate mixture of 100 parts of dry potassium ferrocyanide and 37.5 parts of potassium carbonate, adding 187.5 parts of dry litharge to the cooled mass and again fusing for 10 to 15 minutes. The clear molten mass is poured upon sheet-iron, cooled, dissolved in about 200 Cc. of water, and the solution filtered direct into a concentrated aqueous solution containing 100 Gm. of ammonium sulphate, and then evaporating the mixture to a small volume whereby the ammonium cyanate formed undergoes transformation into its isomer urea. Potassium sulphate is first removed from the solution by crystallization, and the urea recovered from the concentrated mother liquor by extraction with alcohol and purified by recrystallization from alcohol. (Hager).

Properties.—Urea crystallizes in colorless and inodorous four-sided prisms, which have a cooling saline taste, and are permanent in dry air. It melts at 132.5° C. (270.5° F.), and when heated to 150–160° C. (302–320 F.) it evolves ammonia and decomposes with the formation of *biuret,* $C_2H_5N_3O_2$, and at higher temperatures with the formation of ammonium cyanate, melanuric acid, cyanuric acid, and cyanic acid. Urea dissolves in its own weight of water, more readily in hot water, and is soluble in 5 parts of cold 90 per cent. alcohol, in 1 part of boiling alcohol, but insoluble in chloroform or

ether. Heated with water under pressure urea is converted into ammonium carbonate. In contact with nitrogen trioxide, chlorine, bromine, hypochlorites, hypobromites, and acidulated solution of potassium permanganate, urea undergoes decomposition into carbon dioxide, water, and *nitrogen*. Dissolved in pure water urea keeps unchanged for a long time, but in the presence of putrifiable matter it is rapidly decomposed, yielding ammonia and carbon dioxide. Urea forms crystallizable compounds with acids, with metallic oxides, and with many neutral salts. *Urea hydrochloride* is very deliquescent. *Urea nitrate*, $CH_4N_2O.HNO_3$, is soluble in 8 parts of cold water and in 10 parts of cold alcohol, and nearly insoluble in nitric acid; it contains 48.78 per cent. of urea. *Urea oxalate* $(CH_4N_2O)_2.H_2C_2O_4$, crystallizes in scales which dissolve at 15° C. (59° F.) in 23 parts of water, but require a much larger quantity of solution of oxalic acid; it contains 57.14 per cent. of urea. The amount of urea in urine is frequently determined by forming the compound either with nitric or oxalic acid. Urea is identifiable by the biuret reaction, and the crystalline form of the nitrate and oxalate of urea. It is estimated by the volume of nitrogen evolved as per the reaction $3NaBrO + CH_4N_2O = 3NaBr + 2H_2O + CO_2 + N_2$. (See Allen's Hypobromite Process, Allen's Commercial Analysis, Vol. III., Part III., pp. 273–274.)

Action and Uses.—Urea injected into the veins of animals increases the secretion of urine and the output of urea. Because of this action it was proposed to be given by the mouth as a diuretic in man, and although its value is questionable it has been occasionally employed. Its dose is from 2 to 5 grains (0.12–0.30 Gm.) several times a day.

Allied Compound.—Formamide, $CH_3NO = CHO.NH_2$. It is produced on the dry distillation of ammonium formate, on heating a mixture of this salt and urea to about 140° C. (284° F.), on heating ethylformate and ammonia, and by various other processes. It is a colorless oily liquid, which in vacuo distils without decomposition below 150° C. (302° F.), and which is soluble in water and alcohol in all proportions, but is insoluble in ether. It is of interest as uniting with certain compounds and forming valuable remedial agents; see Chloralformamidum, p. 405, and Hydrargyrum Formamidatum, p. 785.

URTICACEÆ (The Nettle Family).

This is a peculiar family of some 41 genera and 500 species. They are mostly tropical or warm-temperate plants, of weedy character. The family is distinguished for the possession of many members having very tough bast-fibers, and others bearing stinging trichomes, like the nettles. In some tropical American Ureras, these trichomes become slender, piercing needles, several inches in length, very brittle, and producing a serious inflammation when piercing the skin in large numbers, frequently leaving fragments in the tissues. The irritating constituent is, at least in part, free formic acid. Medicinally, the family is noted for its general, powerful, and peculiar diuretic properties, the systematic study of which has been too long neglected.

Fig. 462.

Urtica dioica (½ Nat.).

Urtica or *Nettle* (*Brennessel*, G.; *Ortic brulante*, Fr.; *Ortigo*, Sp.) is the herbage of *Urtica dioica* L. and *U. urens* L., both common weeds of temperate Europe and Asia, and freely naturalized in the United States. The appearance of the first-named is here illustrated. *U. urens* has leaves about half as large, thinner, paler, 5-nerved and more deeply serrate, and the small and loose flower-clusters in axillary pairs. Notable quantities of ammonia have been distilled, and the distillate appears to possess the diuretic properties. The presence of a crystalline alkaloid has been reported. Several of the nettles are cooked as pot-herbs.

Parietaria officinalis L., and other species of *Parietaria* (*Wall pellitary*, E.; *Glaskraut*, G.; *Pariétaire, Perce-muraille*, Fr.; *Parietaria*, Sp.), is used similarly, but is not stinging.

UVA URSI, *U. S.*—Uva Ursi.

Uvæ ursi folia, Br.; *Folia uvæ ursi*, P. G.; *Folia arctostaphyli*, Ph. Nor.—*Bearberry, Barren myrtle, Rockberry, Mountain-box, Kinnikinnic*, E.; *Bärentraubenblätter*, G.; *Busserole, Feuille de raisin d'ours*, Fr.; *Uva ursina*, It.; *Gayuba*, Sp.; *Uva ursina, Buxubo*, Port.

The dried leaves of *Arctostaphylos Uva-ursi* (L.) Spreng. (*Arbutus U.*—L.; *A. officinale* Wim.—Fam. *Ericaceæ*).

Uva ursi is official in nearly all pharmacopœias, several of which use the name Arbutus. Most caution against mistaking the similar leaves of *Vaccinium Vitis-Idæa* L., *V. uliginosum* L., or *Arctostaphylos alpina* Spreng. Several require the red and violet reaction for gallic acid in the cold maceration treated with ferrous sulphate.

Origin.—The bearberry plant grows throughout most of the North Temperate Zone, in dry localities, either rocky or sandy, and especially in sandy pine woods. It is an evergreen shrub, the creeping stems often covering large patches to the exclusion of other plants. Its habit is shown in the accompanying illustration. The flowers are white or purplish white, the 5-seeded drupes bright red. The leaves are gathered in the autumn.

FIG. 463.

Arctostaphylos Uva-Ursi Sprengel.

Description.—Obovate or oblong-spatulate, 15 to 30 Mm. long, obtuse, slightly revolute on the margin, tapering into a very short and stout petiole, coriaceous; upper surface dark green, finely reticulate; lower surface slightly pubescent; odor slight; taste strongly astringent and somewhat bitter.

FIG. 464.

Uva ursi (Nat.).

The leaves of *Vaccinium Vitis-Idæa* L., the *Mountain cranberry* or *Cow-berry*, having much the same range as Uva ursi, can be distinguished by the presence of fine, blackish, bristly points on their lower surface. Those of *V. uliginosum*, the *Bog-bilberry*, are much thinner, and pubescent underneath.

Constituents.—The important constituents of bearberry are arbutin, ericolin, ericinol, ursone, 5 to 7 per cent. of tannin, giving a blue-black reaction with ferric salts, and a little gallic acid, all of which are common in related plants. A little resin and sugar are also present. *Arbutin*, $(C_{12}H_{16}O_7)_2 + H_2O$, is obtained from the decoction of the leaves by precipitating it with lead subacetate, treating the filtrate with hydrogen sulphide, and evaporating to crystallize. It forms neutral, colorless, silky needles, of a bitter taste, freely soluble in hot water and in alcohol, and sparingly soluble in ether. An aqueous solution of arbutin, rendered alkaline by ammonia or potassa, acquires a deep azure-blue color on the addition of phosphomolybdic acid. On being dissolved in strong nitric acid, arbutin yields, after the addition of alcohol, pale-yellow needles of *dinitro-arbutin*. By emulsin or by hot diluted sulphuric acid arbutin is decomposed into glucose and *hydroquinone* or *arctuvin*, $C_6H_6O_2$, and *methylhydroquinone*, $C_7H_8O_2$. Hydroquinone crystallizes in colorless, fusible, and sublimable prisms, is easily soluble in water, alcohol, and ether, and is also produced from kinic acid by destructive distillation. On oxidizing hydroquinone or arbutin with manganese dioxide and sulphuric acid, *quinone* is formed.

The mother liquor from the preparation of arbutin contains the yellow glucoside *ericolin*, $C_{34}H_{56}O_{21}$, which yields the volatile oil *ericinol*, $C_{10}H_{16}O$. Ericolin is brown yellow, odorless, bitter, hygroscopic, and soluble in water, alcohol, and alcoholic ether, nearly insoluble in ether, chloroform, and benzin, and is not precipitated by lead salts.

Ursone ($C_{20}H_{34}O_2$) is extracted by boiling alcohol from the residue left after washing the alcoholic extract with water and ether. It occurs in silky, tasteless, fusible, and sublimable needles, insoluble in water, dilute acids, and alkalies, sparingly soluble in ether and cold alcohol.

Pharmaceutical Preparations.—Fluidextract of Uva Ursi, U. S. P.; Infusion of Uva Ursi, Br.

Action and Uses.—Uva ursi combines diuretic, tonic and astringent properties. Its diuretic effect is thought to be due to the stimulating action of the arbutin upon the renal epithelium. A small portion of the arbutin is decomposed either in the intestines or in the tissues into glucose and hydroquinone, the latter acting as an antiseptic and preservative of the urine and imparting to it color varying from light green to dark brownish-green. This discoloration becomes more marked when the urine is exposed to the air and the hydroquinone undergoes oxidation. When decomposition of the urine occurs in the bladder, as in cystitis, the urine may be a very dark green color when voided.

Uva ursi is employed in subacute and chronic inflammations of the urinary organs. It is given with less benefit in disease of the secreting epithelium of the kidney than in inflammation of the mucous membrane of the pelvis of the kidney and of the urinary passages below. It is therefore less serviceable in nephritis than in pyelitis and cystitis. It relieves the incontinence, dysuria, and strangury of these affections, especially of the calculous varieties, by retarding decomposition of the urine and supposedly by obtunding the sensibility of the mucous membrane.

Uva ursi has also been used as a remedy in chronic bronchitis, diarrhœa, leucorrhœa, amenorrhœa, and uterine hemorrhage. In overdose it may cause nausea, vomiting, and diarrhœa. The dose of uva ursi is from 20 to 60 grains (1.30–4 Gm.), given preferably in fluidextract, although a decoction or infusion is sometimes used.

Arbutin may be substituted for uva ursi, though it was generally considered as efficacious as the crude drug. From 10 to 15 grains (0.60–1 Gm.) a day is the amount usually given.

Allied Drugs.—The genus *Arctostaphylos* contains about a score of species, a half dozen of which are similarly employed, especially *A. glauca* Lindl., the large-fruited *Manzanita* of western North America. These leaves are about 3.5 to 5 Cm. (1½–2 In.) long and two-thirds or more as broad, ovate-oval, acutish, entire, the base mostly rounded, pale green and glaucous. It contains more tannin than Uva ursi. It is said that the extract of the fruit of *A. arguta* Zucc., of Mexico, is given in doses of 1 to 1.5 grains as a hypnotic, and that it is recognized there as a narcotic poison. If this is true, it is perhaps due to the presence of andromedotoxin (see Ericaceæ).

Epigæa or *Trailing arbutus* (*Mayflower, Gravel-plant, Ground-laurel*) is the leaves of *Epigæa repens* L., a creeping, hairy, evergreen undershrub of eastern and northern North America, much beloved for the very early appearance of its pretty and fragrant flowers. The thin woody stem is covered with a brown bark. The evergreen leaves are alternate, about 5 Cm. (2 In.) long, petiolate, coriaceous, and reticulated ; their shape is ovate, the margin entire, the base heart-shaped, and the apex tipped with a short point. The flowers are in small axillary clusters, rose-colored or whitish, fragrant, have a deeply 5-parted bracted calyx, a salver-form corolla with the tube hairy inside, 10 stamens, and produce 5-lobed and 5-celled capsules containing numerous seeds. The leaves are inodorous, and have a bitterish and astringent taste. Its constituents, properties, and uses are nearly identical with those of Uva ursi and Chimaphila.

V.

VACCINE.

Vaccin, Fr.; *Impfstoff*, G.

Definition.—Cowpox vaccine, which is employed as a prophylactic against smallpox, consists of the material obtained from the vesicles appearing on animals of the bovine species which have been artificially infected with cowpox.

History.—During, and previous to, the eighteenth century the civilized countries of the world, particularly those of Europe, were overrun by numerous and devastating outbreaks of smallpox. Reports indicate that in some towns nearly one-tenth of the people died from this loathsome disease. It was observed by many that persons coming in contact with cattle, as dairymaids, etc., often contracted cowpox and were not susceptible to smallpox, but it remained for Jenner to recognize the importance of this fact, and to demonstrate the value of artificial inoculations with humanized cowpox virus as a means of protecting against the more dangerous disease, smallpox. After devoting more than twenty years to the study of the question, on the memorable day, May 14th, 1796, he vaccinated a boy, James Phipps by name, with material from the cowpox vesicles found on the hands of one of his father's milkmaids, Sarah Nelwes, who had become accidentally infected with cowpox from one of her master's cows. Some weeks later Jenner repeatedly inoculated the boy with smallpox virus, but was unable to produce the disease. Then he successfully vaccinated many other persons with the cowpox virus which he obtained from this boy, later testing them to see whether they could be inoculated with smallpox, but again he was unsuccessful in producing the disease, and soon the new method of protecting against smallpox was well established as a sanitary measure of the greatest importance.

Origin.—Since Jenner's time many attempts have been made to determine the original source of infection in cowpox. Two theories have been held, viz.: 1. That cowpox is a distinct disease that spontaneously attacks animals. 2. That cowpox is only modified smallpox.

Those believing the first theory have been able to show by directly inoculating many animals that it is very difficult to produce vesiculation by applying material from the vesicles of smallpox patients; and in those cases where a successful result follows the application of the smallpox material, typical smallpox or varioloid results when the material is transferred back from the animal to susceptible human beings.

Those holding the second view claim that the smallpox virus becomes modified by passage through a series of animals, and that typical vaccinia can be produced in bovine animals by vaccinating monkeys with smallpox virus, and then applying the material from the vesicles developing on the monkey to the heifers; and, as a further proof of the identity of the two diseases, they have found that children vaccinated with the material collected from the heifers develop typical vaccinia, and that they are protected from smallpox. We shall probably ultimately be able to trace the relation of the two diseases and show that they are but modifications of the same disease, or that they are very closely allied.

Many researches have been made to discover the vaccine organism; in fact, several experimenters have announced that they had actually found the bacterium or parasite producing the disease. So far none of the reports has been confirmed beyond controversy, but most authorities are inclined to believe that the disease is due to a parasite similar to that producing malaria.

Preparation.—Until recent years the arm-to-arm vaccination introduced by Jenner was performed—*i. e.*, the vaccine was taken from the vesicles forming on the arm of a child and employed for vaccinating other children. So many objections were raised against this method of vaccinating on account of the possibility of transmitting certain diseases, as syphilis, etc., that bovine lymph, obtained from artificially vaccinated heifers, came into use instead. In America the bovine vaccine was generally found on the market in the form of ivory points, the tips of which had been dipped into or moistened with the lymph as it exuded from the skin of the animal after the vaccine vesicles had been removed. Later it was found that the vaccinating principle contained in the cowpox vesicles was not harmed by glycerin, while bac-

teria accidentally gaining entrance to the material during the propagation and collection were destroyed. Still more recently it was found that the greater part of the vaccinating principle resided in the pulp of the vesicles instead of in the lymph which exuded from the skin after the vesicles had been removed. In fact, the lymph, which had been previously employed, simply washed off, and held in suspension the comparatively small amount of vaccinating material that remained after the pulp and crust covering had been removed and thrown away.

ANIMALS.—Nearly all ages and both sexes of bovine animals are employed, the choice mainly depending upon the ease with which propagators can obtain the different classes. Generally, however, in this country preference is given to those animals under three years of age. Some producers hold that young calves are particularly desirable. Judging from the results obtained by the use of vaccine in different countries, prepared from animals of different sexes and ages, it seems to make little difference which are employed.

LABORATORY.—A laboratory properly arranged for the propagation of vaccine should be divided into several sections:

1. A well-equipped, thoroughly aseptic bacteriological laboratory, divided into several rooms for grinding, testing, bottling, etc.

2. There should be an entrance ward into which the animals can be taken, subjected to careful veterinary examination, and tested with tuberculin before they are taken to the laboratory proper. This ward should be carefully isolated from other portions of the plant, in order that any diseased animals which may accidentally gain entrance to it may not contaminate the other sections.

3. A wash-room, where the animals may be properly prepared for vaccination.

4. Operating-room, fitted up with suitable tables, sterilized water, antiseptic solutions, and special appliances to be employed for the application of the vaccine to the animals and the collection of the ripe material.

5. Propagation ward, in which the animals are placed after vaccination. This should have stanchions, stalls, etc., of metal, stone, or other impervious material, in order that the animals may be kept in the cleanest possible condition.

6. An exit ward, into which the animals may be taken and kept for such time as is deemed advisable after the vaccine has been collected. There should be in connection with this room facilities for carrying on post-mortem examinations.

Vaccination of the Animal.—The animals which have been passed by the veterinarian are taken to the wash-room, thoroughly cleansed with soap and water, or in some cases also with antiseptics, and then taken to the operating-room, where the animal is placed upon a suitable table, the head and feet being fastened, so as not to injure the operator or contaminate the field of operation. The desired part of the body is then prepared for the reception of the seed vaccine. Usually in this country a large portion of the posterior part of the abdomen and inner surface of the thighs are shaved, scrubbed with soap, and disinfected with some antiseptic; finally the field of operation being rinsed thoroughly with sterilized water to remove all traces of antiseptic. Over the surface to be vaccinated linear incisions about half an inch apart are made with a sharp knife, just deep enough to wound the true skin, or a similar result is attained by cross-hatching small patches on the surface of the skin, or scraping off the cuticle in small spots. When the surface has been properly prepared for planting, as indicated, the seed vaccine is applied and rubbed in thoroughly, in order that the vaccinating organisms may come in direct contact with the living cells of the integument. After the vaccinated surface has dried for a short time, the animal is removed from the table, with or without the application of an aseptic dressing, and taken to the propagating-room, where it is kept for about five days, or until the vaccine is ripe, the strictest care being taken to keep everything pertaining to the animal scrupulously clean, it being necessary to keep an attendant constantly on duty day and night. Then the animal is taken to the operating-room again, placed upon the table, the vaccinated surface carefully cleansed with soap, water, and disinfectant, and dried spontaneously or with sterilized towels. The fully matured vaccine vesicles are carefully removed with a sterilized Volkmann spoon and placed in sterilized containers. After the entire crop has been removed, the wounded surface of the skin is treated with suitable antiseptics, and the animal is returned to the exit or detention ward, where it may be kept under observation; or in some laboratories the animal, as soon as it is removed from the table, is slaughtered and a post-mortem

examination made. The vaccine pulp taken from the animal is then sent to the laboratory proper, where every precaution is taken to conduct the subsequent operations as nearly aseptic as possible. This pulp is ground in a suitable machine with the requisite amount of glycerin, then emulsified by shaking. Sometimes it is necessary to pass the ground product through a fine sieve to remove large particles, etc. Before the vaccine is taken to the bottling-room it should be given a careful bacteriological examination and tested upon animals, in order to make certain by every possible means that no pathogenic contaminating bacteria are present; likewise it should be tested upon animals to determine whether it possesses the proper vaccinating properties. When these tests are completed the vaccine is stored in the refrigerator for a variable length of time, when it is taken to the bottling-room and put up in the aseptic tubes or placed upon the ivory points, which should be placed in a protecting glass envelope for the finished product as it appears upon the market.

Preservation of Vaccine.—Many different opinions have been expressed as to the keeping qualities of vaccine, but it is now well established that the product undergoes deterioration sooner or later, depending upon the conditions under which it is kept. Most propagators believe that the product should remain active for not less than three months from the time it has been marketed. In exceptional cases the vaccine may become inert shortly after it leaves the laboratory. High temperatures are particularly liable to destroy the preparation; consequently the custom has become recognized that vaccine, like similar biological products, should be kept in a refrigerator, or other very cool place, as much as possible until it is needed for use.

Physiological Action.—Little need be said under this heading, as it has already been indicated that the exact relation between smallpox and vaccine has not been clearly worked out. Certain it is that during the past hundred years or more it has been thoroughly proven that successful vaccination prevents in the vast majority of cases the development of smallpox. Many methods of applying vaccine are in use: however, in most cases it is applied by scarification, sometimes with the end of the ivory point, sometimes with the bistoury. Considerable difference in the results obtained are dependent upon the care with which the operation is carried out.

Blackleg Vaccine.—Blackleg vaccine consists essentially of the dried, powdered, and attenuated infected muscle of cattle dying from symptomatic anthrax.

Symptomatic Anthrax (*Charbon Symptomatique*, Fr.; *Rauschbrand*, G.) is known by the popular names of Blackleg, Black Quarter, Quarter Evil, Carbuncular Fever, etc., the point of attack being most often the muscles of the leg, which become dark and brawny, much swollen from the production of gas by the infecting bacteria, and give forth a crackling sound on pressure.

Bollinger and Fesor, 1878, discovered that this disease is caused by a bacillus which they called bacillus of symptomatic anthrax. Arloing, Cornevin, and Thomas a few years later determined its principal characteristics.

Symptomatic anthrax is a disease which attacks cattle and sheep, and should not be confounded with anthrax which attacks horses, mules, cattle, sheep, etc., and sometimes man. Arloing finally succeeded in the early eighties in preparing by drying, powdering, and attenuating the diseased muscles of animals dying from the disease a vaccine that proved extremely successful as a preventive of the disease. Arloing's original vaccine was a double-powdered vaccine, two strengths of virus being provided, of which the weaker was to be injected first, followed in about eight days by the stronger. This vaccine was soon supplanted by Kitt's single vaccine, which was of medium strength, requiring but one injection. Both of these products contained considerable inert material, as connective tissue, etc., which the stockman was obliged to filter out before using. These vaccines in turn were supplanted by an improved product, which could be employed by simply diluting the powder with sterile water just before using. Another attempt to simplify the product resulted in a small cotton cord saturated with the vaccinating material, a piece of the string being drawn through and a portion being left under the skin. Finally, the vaccine came to be put up in the very convenient form of blacklegoids (small pills), which can be injected with great rapidity with a special instrument designed for the purpose, which at one stroke of the needle deposits and leaves a blacklegoid underneath the skin, in the tissues of the animal.

The following is a brief description of the method of preparing the vaccine: The diseased muscles of animals dying from symptomatic anthrax are examined microscopi-

cally, ground, dried, connective tissue, etc., being removed so far as possible, attenuated, and powdered by heat, the degree of attenuation depending upon the virulency of the undried muscle. The double vaccines, as already intimated, consist of two injections of different degrees of virulency, while the single vaccine possesses a virulency of medium strength.

Blackleg vaccine is used only as a prophylactic against blackleg in cattle and sheep. It is never administered to horses, and must not be confounded with anthrax vaccine.

VALERIANA, *U. S.*—Valerian.

Valerianæ rhizoma, Br.; *Radix valerianæ*, P. G.; *Radix valerianæ minoris, R. v. sylvestris, R. v. montanæ.*—*Valerian-root, Common, Garden, Cat's, or Great Wild Valerian, Summer Heliotrope, All-heal, Herb Bennet, Vandal-root*, E.; *Baldrian*, G.; *Valériane officinale*, Fr.

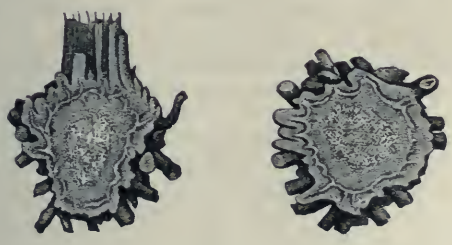
The dried rhizome and roots of *Valeriana officinalis* L. (*V. angustifolia* Tausch; *V. sambucifolia* Mikan.—Fam. *Valerianaceæ*).

Valerian is official in all pharmacopœias. The Portuguese gives it "*V. altissima* Mikan" (properly *V. exaltata* Mikan). Several specify that it be collected in dry places; the Portuguese, in moist places. The British and some others require autumn collection; several, spring collection. Several forbid the application of water in cleaning it after collection.

Origin.—Valerian is a native of Europe from the Mediterranean northward, and of Northern Asia, and is cultivated to some extent in Holland and England, and in this country in New England and New York. It is an herbaceous perennial, and grows in both wet and dry situations. It varies considerably in size and in foliage, and several of the varieties have been regarded by some botanists as distinct species. The plant is easily propagated from short horizontal runners. It is 0.6 to 1.2 M. (2–4 Ft.) high, branching at the top, has opposite, clasping, long-petiolate and oddly pinnate leaves, with from four to ten pairs of oval or lance-linear, entire or toothed, sessile, and smooth leaflets, and bears compound symes composed of numerous small, pinkish, fragrant, triandrous flowers. The fruit is an ovoid, compressed akene, crowned by a plumose pappus.

When collected, the drug is without the characteristic odor that it possesses when dried.

Fig. 465.



Longitudinal and transverse section of rhizome of valerian (Nat.).

Fig. 466.

Valerian (¾ Nat.).

Description.—Rhizome from 2 to 4 Cm. (about 1–1½ In.) long, and 1 to 2 Cm. (about ½ to nearly 1 In.) thick, upright, subglobular or obconical, truncate at both ends, often with a short horizontal branch attached, light brown or yellowish brown, internally whitish or pale brownish, with a narrow circle of white wood under the thin bark; roots numerous, rather coarse, brittle, brown, with a thick bark and slender, ligneous cord; odor peculiar, becoming stronger and unpleasant on keeping; taste camphoraceous and somewhat bitter.

When collected on dry soil, the drug is smaller, relatively shorter, lighter-colored, has more and smaller roots, and is less frequently cut to facilitate drying. A large amount of soil is likely to remain attached to the drug.

Admixtures.—Although valerian is readily distinguished from other medicinal roots, it has been sometimes observed sophisticated with poisonous drugs somewhat resembling valerian in appearance, and from contact with the latter having acquired to

some extent its peculiar odor. *Cynanchum Vincetoxicum* (p. 299) was noticed by Charbonnier (1877), *Veratrum album* (see below) by Holmes (1877), and *Sium latifolium* (p. 477) by Bernbeck (1880).

Constituents.—The most important constituent of valerian is its volatile oil (see below), which varies in proportion, variously stated as between about ½ and 3 per cent., the rhizome from dry soil, soon after drying, yielding the larger amount. Cultivated valerian seems to be less rich in volatile oil. Recent valerian on being distilled with water yields a distillate which, according to Schoonbroodt (1868), is neutral, or nearly so. Free isovalerianic acid does not exist in fresh valerian, but is generated from the volatile oil on exposure. The relative proportions of the volatile oil and isovalerianic acid must therefore vary with the age of the drug. Aschoff (1846) found in the root also malic, acetic, and formic acids. The constituents which are of less medicinal importance are tannin, extractive, sugar, starch, mucilage, resin, etc. It is believed that the large amount of manganese existing in the ash of valerian plays an important part in the conversion of the oil into the acid. A minute amount of the alkaloid *chatanine* has been reported, but little is known regarding it.

Oil of valerian, when freshly distilled, is a thin mobile liquid of yellowish-green or brownish-yellow color, a slight acid reaction, and a penetrating, characteristic, but not unpleasant odor. In the course of time the oil becomes more viscid and the color changes to dark brown; the acid reaction is intensified and the odor becomes decidedly unpleasant, owing to the increased formation of valerianic acid. The specific gravity of the oil ranges from 0.930 to 0.960, and its optical rotation varies from —8° to —12°. Its composition is rather complex; among the esters present are bornyl valerate (about 9.5 per cent. according to Gerock), and the formate, acetate, and butyrate of the same radical. Other constituents found are camphene, pinene, borneol, a sesquiterpene, and an alcohol, $C_{15}H_{26}O$, all of the lævorotatory variety. According to Flückiger, the highest boiling fraction of the oil contains an oil of blue color boiling at 300° C. (572° F.).

Pharmaceutical Preparations.—Ammoniated Tincture of Valerian, Fluidextract of Valerian, Tincture of Valerian, U. S. P.

Action and Uses.—The medicinal virtues of valerian reside in the volatile oil. While it is a feeble sedative to the nervous system, its quieting effect is considered to result largely from the psychic influence of its characteristic odor and taste. In large doses it causes a sense of warmth in the stomach, a slight quickening of the pulse, and sometimes nausea and vomiting. Still larger amounts produce purging and mental hebetude. Valerian is used as a quieting agent in hysteria and functional nervousness. It seems to be of particular service for the palliation of the nervous symptoms which occur at the menopause. It will sometimes benefit the delirium and ataxic symptoms which appear during exhausting fevers. The dose of valerian is from 10 to 60 grains (0.60–4 Gm.). The ammoniated tincture in the dose of 20 to 60 minims (1.30–4 Cc.) is most largely prescribed. The simple tincture and fluidextract are also efficient preparations. The dose of the volatile oil is from 3 to 5 minims (0.20–0.30 Cc.).

Allied Drugs.—The genus *Valeriana* L. contains probably not far from 200 species, and a large number of them possess apparently the composition and properties of the official.

V. Phu L. is a tall perennial of Western Asia and Southern Europe, and is occasionally cultivated. The root was known as *radix valerianæ majoris*, and consists of an oblique rhizome which is 10 to 15 Cm. (4–6 In.) long, about 12 Mm. (½ In.) thick, is distantly annulated, of a brown color, on the lower side furnished with numerous yellowish roots, and has a much weaker odor and taste than official valerian.

Indian Valerian (from *V. Wallichii* DC. ?) appears to be about equal in constituents and properties with the official, as is also true of *Mexican Valerian*, from *V. Mexicana* DC. and *V. Tolucana* DC.

Nardus Spica Celtica is the rhizome of *V. Celtica* L. of the Alps. It is thin, about 7.5 Cm. (3 In.) long, densely covered with brown scaly leaf-remnants, has long, simple roots on the lower side, and possesses a strong odor and taste of valerian.

Nardus Indica, Spica Nardi, or true *Spikenard*, formerly much employed, is obtained from *Nardostachys Jatamansi* DC. (*Valeriana* J.—Roxb.), of the same family, native of India. It is about 6 Mm. (¼ In.) thick, densely beset with numerous fibrous remnants of leaf-stalks, and has a bitter and aromatic taste and penetrating odor resembling that of serpentaria.

Japanese Valerian, credited to *Patrinia scabiosifolia* Link., is known in Japan as *Kesso*. It resembles Valerian in appearance, odor, and taste, but has a short rhizome, not more than 8 Mm. (⅓ In.) thick, and this is densely covered with dark-brown, scaly roots, which are 5 to 10 Cm. (2 to 4 In.) long.

VANILLA, *U. S.*—Vanilla.

Fructus (or *Siliqua*) *Vanillæ*, Ger. and Swed.; *Vanille*, Fr.; *Capsulæ Vanillæ*, Russ.; *Vaniglia*, It.; *Vainilla*, Sp.; *Baunilha*, Port.

The prepared nearly ripe fruit of *Vanilla planifolia* Andrews (*V. aromatica* Sw.; *Epidendrum Vanilla* L.; *Myrobroma fragrans* Salisb.; *V. sativa* Schiede.—Fam. *Orchidaceæ*).

Official in nearly all pharmacopœias.

Origin.—This species of vanilla is native of the tropical, forested valleys of the eastern Mexican Andes, where also it is cultivated upon a vast scale. The fruit was in use by the natives for flavoring their chocolate at the time of the discovery of America, but the time of the beginning of its cultivation is not known. Living plants were taken to Java in 1819, to Réunion in 1836, and thence to Mauritius, but culture was not successful until about 1850, when the process of artificially pollinating the flower was learned. Now it is cultivated in nearly all tropical countries where there is abundant moisture and a temperature which does not fall below 65° F. The commercial article is almost all, and the official wholly, the product of cultivated plants. The plant runs along the ground, but quickly climbs some neighboring tree by the aid of rhizoids or non-absorbing roots, which fasten into the bark. After a time the base usually rots. The stem is about as thick as the finger and very succulent, as are the oblong, thick leaves. In from 2 to 4 years, the leafy branches which have reached out into the light and air begin to flower and fruit, and the plant continues in bearing for 10 years, or even much longer. The growth of the season only is fruitful. The creamy-yellow flowers grow in racemes, and the pollination has to be effected by insects, or by hand, as usually practised. The fruit is fully grown in about 2½ months, but then takes twice as long to mature. There are from 3 to 10, or sometimes more in a cluster, and they resemble bananas in shape, but are several times more slender. Their weight averages about 40 to 45 pounds to the thousand. Their yellow color is a sign of approaching maturity, and they are at once gathered. If left upon the vine they would ultimately begin to turn brown at the tip and then to split into three valves, the dust-like seeds falling out. If not picked soon enough, this change will occur in curing them, and they must be sold at a lower price (though probably not inferior) as "splits." Those which are missed in picking are gathered, in poor condition, at a supplemental harvest, and are cut up into short lengths and sold as "cuts." More often the crop is gathered too soon, either by thieves or by the owner to prevent theft. While equally large, these immature fruits have not the quality, strength, or keeping properties of the others. The grower, or a middleman, sells the green fruits to the curer. They then have no aroma, the aromatic principle being developed by the curing process from the glucoside coniferin, secreted by internal hair-like fibrillæ which project into the central cavity. Lecomte has demonstrated that this coniferin is converted by a hydrolizing process into coniferic alcohol and glucose, and that the former is then converted by an oxydase into vanillin. Various methods for curing are employed in different countries, but the object of all is to drive the moisture out upon the surface and then to dry this portion, repeating the process as long as required. The first sweating is usually done in a sweating-box or by steaming, the following ones by heating them under woollen covers, and alternately exposing them to the sun or drying in ovens. They are sometimes dried over calcium chloride. They finally assume the appearance described below, and, if well-matured and carefully cured, are likely to form a superficial efflorescence of the crystals of vanillin. Such a coating is liable to be given them artificially, or such may be substituted for the natural one, which is first removed. The assorting of the cured fruits into classes depending upon imperfections of all kinds demands high skill. They are then bundled, all in a bundle being of uniform length and quality, from 50 to 75 in a bundle. In the anxiety not to overdry the fruits, resulting in loss of weight, there is danger of underdrying them, with the result of having them mould inside of the bundle or under the string.

Description.—From 15 to 25 Cm. (6–10 In.) long, and about 8 Mm. (⅓ In.) thick, linear, narrowed and bent or hooked at the base, rather oblique at the apex, wrinkled, very dark brown, glossy-leathery, the integument very thin, frequently coated with crystals, 1-celled, and containing a blackish-brown pulp, with numerous minute seeds, and more or less acicular crystals; odor and taste peculiar, very agreeable.

FIG. 467.

Vanilla (reduced ⅓): *a*, fresh fruit, Mex.; *b*, Mexican; *c*, Bourbon; *d*, Mauritius; *e*, Tahiti; *f*, Vanillons; *g*, Vanillons braided.

Varieties.—Of the official vanilla, aside from its commercial grades, we have a number of distinct varieties, named according to the producing countries. Mexican vanilla has been greatly preferred by the American consumer until recently, when the Bourbon variety has come to enjoy almost as good a repute. The former only occasionally reaches or exceeds 9 inches in length, and when of first quality is of a dark-chocolate color, otherwise of a very dark brown. It is thin-skinned, glossy and pliable, and usually bears no crystals, though it formerly did so. It has a prominent hook at the upper end. The Bourbon or Réunion fruit is very similar, but usually crystal-covered. The crystals are sometimes, as in Fig. 467, *c*, fine and downy, at others laminar, as in Fig. 467, *d*. The Mauritius is very similar. Seychelles vanilla looks similar, but the odor is usually distinctly less fine. Guadeloupe looks like Mexican, but has a harder or dryer skin and coarser furrows, and a much inferior odor. Java vanilla is short and small, but of excellent quality. It is seldom imported to the United States. The prices of the different sorts in the New York market, January 1, 1901, ranged about as follows: Mexican, $8.50–$13; Guadeloupe, $6.50–$7.50; Java, $4–$4.75; Seychelles, $4–$8; Bourbon, $4.50–$8.50; Comores, $4–$4.50; Mauritius, $4–$7; Tahiti, $1.50–$2; Vanillons, $1.25–$1.75.

There are few cases in which the highest economy is so well subserved by the pharmacist who has a discriminating patronage as in purchasing one of the better

vanillas, even at the higher price. Inferior fruits or even fictitious substitutes may yield a stronger odor, but never so fine nor permanent, nor so agreeable to the cultivated taste as an amount of the better sorts representing the same value.

Constituents.—The important odorous and flavoring constituent of vanilla is *vanillin*, which exists in official vanilla to an extent varying from 1.5 to 3 per cent. That this is not the only essential is clear, however, from the fact that no pure artificial vanillin has been found to yield so agreeable or permanent a product as a preparation of the fruit itself. This odor is attributed partly to a small amount of a peculiar balsam, and also to a resin, though the latter by most is considered as detrimental to the finest flavor. Leutner's analysis also showed the presence of about 10 per cent. of sugar, 6.6 per cent. of gum, 4 per cent. of resin, 4.7 per cent. of ash, and a little wax, tannin, oxalic, and other acids.

The constituent which causes the inflammation upon the hands of workers in vanilla is yet unknown. It has been attributed to a parasitic insect, and also to the use of cardol for coloring inferior vanillas, though the symptoms are not satisfactorily accounted for by either.

The quantitative determination of vanillin may be effected by the following method proposed by E. Schmidt: 3 to 5 Gm. of vanilla are triturated with well-washed and dried sand (preferably sea-sand) until a light pulverulent mass is produced. This mixture is exhausted with ether in a Soxhlet apparatus, and the ethereal extracts are united and shaken out with successive portions of 5 Cc. of a saturated solution of sodium acid sulphite diluted with an equal volume of water. The united aqueous liquids are treated with diluted sulphuric acid until the acid is in excess, the resulting sulphur dioxide being removed by a current of carbon dioxide. Finally the liberated vanillin is shaken out with ether, the latter evaporated at a low temperature, 35° to 45° C. (95° to 113° F.), and the residue dried over sulphuric acid to constant weight.

Pharmaceutical Preparation.—Tincture of Vanilla, U. S. P.

Action and Uses.—Vanilla possesses no active medicinal properties. It is employed as a flavoring agent for confections, pastry, etc.

Unofficial Vanillas.—Unofficial vanillas are those which, coming from the official plant, do not yet correspond with the official description, and also some derived from other species. To the former class belong the *splits* and *cuts* referred to under *Origin*, as well as several thick-skinned varieties, apparently from wild plants, called in the native *cimarrona*, *mestiza*, *puerca*, etc. To the latter class belong the *pompona*, derived from *V. pompona* Scheide, wild and cultivated in the same region as the other, and believed by the natives to be the ancestor of *V. planifolia*, they regarding the latter as a cultivation derivative of it; also the vanillas (see Fig. 467, *f* and *g*) derived from one or more uncultivated species. The pods of both are short, thick, rough, and tough, and the odor rankly fruity, or pruney, in the latter respect quite resembling the Tahiti variety.

Vanillin has been reported in the flowers of several *Orchidaceæ*, especially in *Habenaria nigra* R. Br. (*Nigritella suaveolens* Koch). It has also been reported in the fruits of one or more plants of the same family.

VANILLINUM, *U. S.*—Vanillin.

Vanilline, Fr. Cod.; *Vanillin, Vanillekampher, Protocatechualdehydmethylæther*, G.

Methylprotocatechuic aldehyde, occurring naturally in vanilla, or made artificially from several orthodihydroxybenzene derivatives.

Formula, $C_8H_8O_3$ or $C_6H_3.OH.OCH_3.COH$. Molecular weight, 150.92.

Preparation.—For commercial purposes vanillin is manufactured on a large scale, both in this country and abroad, synthetically by one of the following processes; preferably perhaps from the first-named:

From Eugenol: This, the chief constituent of oil of cloves, having been separated from the latter, is boiled with acetic anhydride, whereby it is converted into acetyl-eugenol, $C_{10}H_{11}(C_2H_3O)O_2$. A dilute solution of acetyl-eugenol is next oxidized by means of a slightly warmed weak solution of potassium permanganate, whereby acetyl-vanillin is formed, the mixture is filtered, and the filtrate made alkaline with potassium hydroxide, after which it is evaporated to a small volume, by which treatment the newly-formed acetyl-vanillin is converted into vanillin. After acidulation with sulphuric acid, the liquid is shaken out with ether, which takes up the vanillin and yields the same upon

subsequent evaporation at a low temperature. By this method vanillic acid and vanilloylcarbonic acid are also formed, which are removed by appropriate methods of purification.

From Coniferin: This glucoside, $C_{16}H_{22}O_8 + 2H_2O$, obtained from the cambium sap of pines and similar trees, is dissolved in warm water, and then added in the form of a concentrated solution slowly to a moderately warm mixture of potassium dichromate, sulphuric acid and water, the mixture being finally heated to boiling for 3 hours with the aid of a reflux condenser. The reactions resulting in the formation of vanillin by this method include the hydrolysis of the coniferin, through the agency of the acid, into dextrose and coniferyl alcohol, and the oxidation of the latter into vanillin with elimination of aldehyde, thus: $C_{16}H_{22}O_8 + H_2O = C_6H_{12}O_6 + C_{10}H_{12}O_3$; $C_{10}H_{12}O_3 + O = C_8H_8O_3 + C_2H_4O$. The vanillin may be recovered direct by passing steam through the mixture or it may be extracted with successive portions of ether, after filtration of the liquid, and the ether recovered, leaving the vanillin in the form of a yellowish oily liquid, which congeals to a crystalline mass after a few days and may be purified by solution in warm water and treatment with animal charcoal, and final recrystallization.

Properties and Tests.—Vanillin occurs in fine white, crystalline needles, having the odor and taste of vanilla, and having an acid reaction. Soluble in about 100 parts of water at 25° C. (77° F.), and in 15 parts at 80° C. (176° F.). It is easily soluble in alcohol, ether, glycerin, or chloroform. When heated to between 80° and 81° C. (176° and 177.8° F.), it melts, and at 285° C. (545° F.) it can be distilled without decomposition in a current of carbon dioxide, leaving no residue. It is easily soluble in aqueous solutions of alkali hydryoxides, and from the combinations thus formed it is precipitated at once by the addition of acids. An aqueous solution of vanillin gives, with ferric chloride test solution, a blue color; if the mixture be boiled, the blue color changes to brown, and on cooling a white precipitate of dehydro-divanillin separates. Vanillin is extracted completely from its solution in ether by shaking with a saturated aqueous solution of sodium bisulphite, from which solution it is precipitated by the addition of sulphuric acid. An aqueous solution of vanillin will give, on the addition of lead acetate test-solution, a white precipitate of a lead compound of vanillin soluble in hot water, and crystallizing, on cooling, in scales. On warming 0.1 Gm. of vanillin with concentrated alcoholic solution of sodium hydroxide, adding chloroform and again warming, it should not give an odor of phenyl-isocyanide (absence of acetanilide).—U. S.

Vanillin partakes both of phenolic and aldehydic characters and unites with bases to form saline compounds. By action of nascent hydrogen it is converted into vanillin-alcohol, $C_8H_{10}O_3$, and by oxidizing agents into vanillic acid, $C_8H_8O_4$, both of which crystallize in the form of colorless needles, and melt at 115° C. (239° F.) and 207° C. (404.6° F.) respectively. If fused together with potassium hydroxide, vanillin is converted into protocatechuic acid, $C_6H_3(OH)_2COOH$.

Vanillin has at times been extensively adulterated, and even recently accounts have been published of gross sophistication. Benzoic acid, especially prepared for that purpose, acetanilide, boric acid, terpin hydrate, and coumarin have been employed, and adulteration to the extent of 50 per cent. has been frequent, and at times even as high as 90 per cent. Acetyl-isoeugenol has also been met with in commercial vanillin. The latter may be detected by the abnormal crystals revealed under the microscope and the beautiful red color developed with sulphuric acid instead of the characteristic lemon-yellow color found in the case of pure vanillin.

Since vanillin is largely used for the manufacture of vanilla extracts, the addition of coumarin has often been made for the purpose of cheapening the product, and may be detected by the method suggested by Prescott and Hess (*Jour. Am. Chem. Soc.*, 1899), as follows: 25 to 100 Gm. of the suspected extract are evaporated at about 80° C. (176° F.) in an evaporating dish, adding water from time to time to keep the volume constant. After removal of the alcohol add normal lead acetate solution drop by drop until no further precipitation occurs, filter through asbestos, and wash the precipitate with a few Cc. of hot water. The cooled filtrate is then extracted with repeated portions of ether or chloroform and the combined ether-extracts shaken out with successive portions of dilute ammonia (strong ammonia 1 part and water 2 parts) until the last portion used is not colored yellow. The ammoniacal solution extracts the vanillin, the latter as an aldehyde entering into combination with the ammonia, forming aldehyde-

ammonia, which is very soluble in water. The ether solution is then washed with 2 Cc. of water and evaporated spontaneously or in a desiccator. The residue is exhausted with ligroin (fraction of petroleum boiling between 30° and 40° C. (86° and 104° F.), and the residue obtained on evaporation of the same, dried at a temperature not exceeding 45° C. (113° F.) and weighed as coumarin. Coumarin may by this method also be detected in commercial vanillin, as it will not be extracted from an ether solution of the suspected article by ammonia-water.

Vanillin has been used in connection with phloroglucin as a test for free hydrochloric acid in gastric juice. The reaction, better known as *Günzburg's reaction*, is very sensitive and capable of detecting as little as $\frac{1}{20}$ per cent. of the acid. Two solutions are used, the one consisting of phloroglucin (2 Gm.) and alcohol (15 Gm.), and the other of vanillin (1 Gm.) and alcohol (15 Gm.). The test is made by mixing 3 drops of each of the solutions with 5 drops of gastric juice in a porcelain dish and warming while rotating the dish gently. In the presence of free hydrochloric acid an intensely red mirror is produced.

Action and Uses.—Vanillin is largely employed in the manufacture of vanilla extracts and perfumes. It was proposed as a remedy in atonic dyspepsia, but is rarely used. The dose is from $\frac{1}{4}$ to 1 grain (0.015–0.06 Gm.).

VERATRINA, *U. S., Br.*—Veratrine.

Veratrinum, P. G.; *Vératrine*, Fr. Cod.; *Veratrin*, G.

A mixture of alkaloids obtained from the seed of *Asagræa officinalis* (Chamisso and Schlechtendal) Lindley (Fam.—*Liliaceæ*).—U. S.

An alkaloid or mixture of alkaloids prepared from cevadilla, the dried ripe seeds of *Schœnocaulon officinale*.—Br.

Preparation.—The British Pharmacopœia directs that cevadilla seed, having been freed from the capsules and powdered, be moistened with 90 per cent. alcohol and percolated with that menstruum until exhausted. The resulting tincture is concentrated until precipitation just begins, and poured, while hot, into 12 times its volume of cold distilled water, whereby resin, fat, and some coloring-matter are precipitated. After filtration through calico the residue on the strainer is washed with water until ammonia-water ceases to cause precipitation in the filtrate. Upon addition of ammonia-water to the filtrate the alkaloids are precipitated and then washed with water to remove impurities. The moist alkaloidal precipitate is suspended in water and dissolved by adding sufficient hydrochloric acid, the solution decolorized with animal charcoal and again precipitated with ammonia. Finally, the precipitate is collected on a filter, washed with cold water to remove ammonium chloride, and dried, first on bibulous paper and then by warming.

The directions of the French Codex are similar. The powdered seed are to be exhausted with 80 per cent. alcohol containing a little sulphuric acid, and the alkaloids liberated with slaked lime. The alkaloids are then dissolved in very dilute sulphuric acid, treated with animal charcoal, precipitated with ammonia-water, and finally dried.

Properties and Tests.—The commercial article, officially recognized as veratrine, occurs as a white, or grayish-white, amorphous powder, odorless, but causing intense irritation and sneezing when even a minute quantity reaches the nasal mucous membrane; having an acrid taste, and leaving a sensation of tingling and numbness on the tongue. It should be tested with great caution. Slightly hygroscopic in moist air. Soluble in 1750 parts of water, 2.2 parts of alcohol, 3 parts of ether, and in 1 part of chloroform at 25° C. (77° F.); soluble in 1300 parts of water at 80 C. (176° F.); very soluble in benzene and amyl alcohol; insoluble in petroleum benzin. When heated to 145° C. (293° F.) it softens, and melts at 152° C. (305.6° F.). Upon ignition it is consumed, leaving no residue. Its alcoholic solutions are alkaline to red litmus-paper. On triturating veratrine with sulphuric acid, in a glass mortar, the yellow or orange-red solution exhibits, by reflected light, a greenish fluorescence, which becomes more intense upon the addition of an equal volume of acid. Upon standing, the solution gradually assumes a deep-red color. Sulphuric acid, when heated with veratrine, gives a cherry-red color. Sulphuric acid containing a trace of selenous acid produces a brownish-green color. Sulphuric acid added to a mixture of 1 part of veratrine and 6 parts of sugar produces a green color, changing to blue, and the mixture then becomes colorless.—U. S. Soluble in 3 parts of 90 per cent. alcohol (4 parts.—P. G.) or chloroform

(2 parts.—P. G.), in 6 parts of ether at 15.6° C. (60° F.), and in dilute acids, leaving slight traces of an insoluble brown resinous matter. It forms a yellow solution with nitric acid. Warmed with hydrochloric acid it dissolves with production of a blood-red color lasting several days. Heated with access of air, veratrine melts to a yellow liquid and finally burns away leaving no appreciable residue.—Br. An alcoholic solution of veratrine must not be precipitated by platinic chloride solution.—P. G.

Composition.—As the term "veratrine" has been applied to several distinct substances, that of Couerbe and Wright and Luff is now called *veratridine*, and that of Merck, Bosetti, Ahrens and others is called *cevadine*. The veratrine of the pharmacopœias is a mixture consisting chiefly of cevadine and veratridine. Many investigators have studied the alkaloids, but with little uniformity in their findings. Allen (1895–96), however, has confirmed Wright and Luff's (1878) widely accepted three alkaloids, *cevadine*, *cevadilline*, and *veratridine*, and the two new alkaloids of Merck (1891), *sabadine* and *sabadinine*. Keller's *sabatrine* is thought to have been a mixture, and his *sabadilline* is probably identical with cevadilline.

Cevadine, $C_{32}H_{49}NO_9$, separates from alcohol in anhydrous needles, which melt at 205° C. (401° F.), become opaque and white on exposure to air, and dissolve in chloroform, acetone, carbon disulphide, acetic ether, and amylic alcohol, but with difficulty in petroleum spirit. Its solutions are optically inactive. By saponification with alcoholic solution of sodium hydroxide it yields methylcrotonic acid and *cevine*, $C_{27}H_{43}NO_8$, with nitric acid it is wholly oxidized, and with alkaline potassium permanganate yields acetic and oxalic acids. It is exceedingly toxic and very irritating to the nasal mucous membrane. A solution of cevadine in nitric acid upon being warmed assumes a violet color, which changes to scarlet red on boiling. It yields a yellow solution with cold sulphuric acid, the color changing to blood red upon warming. "The facility with which cevadine undergoes hydrolysis is the cause of the formation of much amorphous alkaloid and other products in the extraction of the sabadilla alkaloids."—(Allen). It is the most abundant alkaloid in sabadilla seeds, and is said to occur also to a slight extent in the rhizome of veratrum viride.

Veratridine, also known as veratrine, and so called by its discoverers, Wright and Luff, $C_{37}H_{53}NO_{11}$, occurs as an amorphous resinous mass, melting at 180° C. (356° F.), which dissolves in concentrated sulphuric acid, with a yellow color, soon changing to deep red. The solution does not, like that of cevadine, show a dark-green fluorescence. It is rendered horny and insoluble by dilute nitric acid. In sulphuric acid it dissolves readily, forming salts which crystallize in fine needles, and, on drying, unite to form a horny, translucent mass. By saponification it yields veratric acid and *verine* or *veratroïne* $C_{23}H_{45}NO_8$, a substance closely allied to cevine.

Cevadilline, $C_{34}H_{53}NO_8$, is an amorphous alkaloid insoluble in water and ether, and yielding on saponification cevadic acid and *cevilline*. It is not sternutatory. *Sabadine*, $C_{29}H_{51}NO_8$, occurs in crystals which melt at 238° to 240° C. (360.4–464 F.), and are soluble with difficulty in water and ether, and insoluble in petroleum spirit. In warm, but not in cold, solution it is precipitated by alkalies, alkaline carbonates, or ammonia. It is "not sternutatory" (Merck), "moderately sternutatory" (Allen). *Sabadinine*, $C_{27}H_{48}NO_8$, crystallizes in hair-like needles, which melt at 160° C. (320 F.), and decompose if heated above this temperature. It is moderately soluble in water, very slightly in ether, and readily in alcohol and chloroform. It is not sternutatory. The hydrochloride is crystallizable and soluble in water.

Pharmaceutical Preparations.—Oleate of Veratrine, Veratrine Ointment, U. S. P.

Action and Uses.—Veratrine has a bitter and acrid taste, and a minute portion of it placed upon the tongue produces a peculiar and persistent numbness and tingling with irritation of the throat and salivation. Introduced into the nostrils it causes intense irritation in the nasal mucous membrane, and when applied to the skin in alcoholic solution it causes tingling and irritation followed by a sense of numbness. If in concentrated solution, it causes vesication and may be absorbed in sufficient quantities by the skin to produce poisoning. The drug has been used internally as a remedy for neuralgic pains of all kinds, but owing to its very poisonous properties and the feeble curative effects which follow its use, it is now rarely employed. It has also been given internally in acute articular rheumatism and in palpitation of the heart. Externally it

has been used as a counterirritant, in the form of the ointment (Unguentum Veratrina), over neuralgic nerves and swollen joints. Such an ointment must be applied with caution, lest the drug be absorbed by the skin and produce systemic effects. In cases of poisoning by the drug the stomach should be emptied by an emetic or the stomach pump. Tannic acid should be given as a chemical antidote, and the heart and respiration should be supported by ammonia, ether, strychnine, digitalis, and the use of artificial respiration.

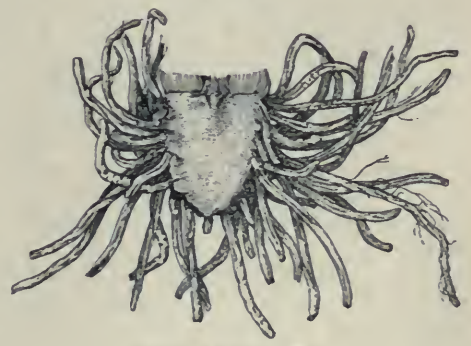
VERATRUM, *U. S.*—Veratrum.

Veratri rhizoma (*radix*).—*Hellebore.*

The dried rhizome and roots of *Veratrum viride* Aiton (*V. album viride* Baker; *Helonias v.*—Ker.; *Melanthium virens*—Thunb.), American or Green ("Am. White") Hellebore, or of *V. album* L., the European or White Hellebore (Fam. *Liliaceæ*).

Origin.—*V. viride* (*Swamp, Big* or *False veratrum* or *hellebore, Indian poke, Crow poison, Itch-weed, Tickle-weed,* E.; *Vératre vert,* Fr.; *Grüner Germer,* G.; *Vedegambre Elebero verdo,* Sp.; *Veratro* or *Hellebero verde* or *Americano,* Port.) should not be confused with the *European Green Hellebore* (*Helleborus viridis* L.—Fam. *Ranunculaceæ*), and it is always well to specify it as *American Green Hellebore.* It is a stout, luxuriant, perennial herb of rich swamp lands throughout eastern North America. It grows to a height of 2 to 4 feet, and is densely leafy, the lower leaves often more than a foot in length, broadly oval, acute, stiff, and strongly ribbed and plaited, by which it is well distinguished from the less tall skunk's-cabbage which usually grows with it. The upper leaves become successively smaller and narrower, and the stem terminates in a long, narrow panicle of small, yellowish-green, rigid, persistent 3-merous flowers. The herbage withers rather early, after which the rhizome is gathered. Through gross ignorance or carelessness the herbage has occasionally been collected, cooked, and eaten for American cowslip (*Caltha*), with poisonous results. Bare-legged boys often suffer from a mild itching by coming into contact with the plant, whence two of its common names. It is said to have been used both as an ordeal poison and as a medicine by the Indians, whence the name "Indian Poke." *V. album* grows in similar locations, almost throughout Europe and Asia, to Japan, and is of closely similar appearance, its flowers yellowish white.

FIG. 468.



Veratrum viride (½ Nat.).

Description.—*V. viride.*—Rhizome upright, ovoid, or obconical, 2.5 to 7 Cm. (1–3 In.) long and ⅔ as broad, externally light, to dark, brown or blackish, frequently bearing at the summit some coarsely fibrous remains of leaf-bases, densely clothed at the sides with coarse roots; internally grayish, or yellowish, white, exhibiting numerous short, irregular wood-bundles; roots about 10 to 20 Cm. (4–8 In.) long and about 1 or 2 Mm. ($\frac{1}{25}$—$\frac{1}{12}$ In.) thick, light yellowish brown, much shrivelled, the surface somewhat reticulate-wrinkled; inodorous, but the powder highly sternutatory; taste bitterish and very acrid.

V. album is of very similar appearance, and is frequently indistinguishable, though if carefully and recently dried its roots are paler, or nearly white.

The powders cannot be distinguished by structure, and the cheaper V. album has been largely employed to adulterate V. viride. Denniston reports that concentrated sulphuric acid turns the *viride* powder orange red, the *album* bright brick red, but it may be doubted whether this distinction would hold good for all lots, differently collected and preserved for different periods. The question is of little interest, except technically, since what evidence we have indicates the practical identity of the two as medicinal agents, which consideration has induced their union in one definition, instead of restricting the latter to V. viride, as was done in the preceding edition of the Pharmacopœia. V. album has been adulterated with asphodel, but the latter is distinguished by the greater length and slenderness of its rhizome, and the clubbed or fusiform appearance of its roots.

Constituents.—While at one time much confusion existed regarding the constituents of the two varieties (green and white) of veratrum, careful investigation by Wright and Luff (1879) and Salzberger (1885–1890) has shown that they are practically identical, although Wright and Luff claim that cevadine (see VERATRINA) is present in *veratrum viride* but not in *veratrum album.* Besides fat, resin, gum, and starch, several alkaloids are known to be present, of which the most important, from a physiological point of view, is undoubtedly protoveratrine (about 0.03 per cent.); then follow jervine (about 0.10–0.13 per cent.), rubijervine (about 0.005 per cent.), and pseudojervine; a bitter glucoside, veratramarin, and jervic acid, $C_7H_4O_6 + H_2O$, identical with chelidonic acid, are also present. Protoveratridine, likewise reported, has been shown to be a decomposition-product. Veratralbine and veratroidine, which were formerly looked upon as distinct alkaloids, are not now so considered. Their true character has not yet been established, and they are probably mixtures of amorphous bases.

According to Salzberger, two methods, designated respectively as the baryta method and the phosphoric acid method, may be employed for isolation of the alkaloids. The baryta method: The rhizome, in moderately fine powder, is intimately mixed with $\frac{1}{8}$ of its weight of powdered barium hydroxide and $\frac{1}{2}$ its weight of water then added. The mixture is then treated with 3 successive portions of ether, the ethereal liquids being subsequently mixed and distilled in a current of hydrogen at low temperature. The resulting dark-green syrupy residue gradually deposits wedge-shaped crystals of jervine, which are filtered and washed with ether until the latter runs off colorless. By treating the crude jervine with absolute alcohol, insoluble protoveratridine is removed, and the clear solution containing jervine and rubijervine may then be crystallized. The crystalline mass is digested on a water-bath with diluted sulphuric acid, whereby the sparingly soluble jervine sulphate is easily separated from the readily soluble rubijervine sulphate. By decomposing jervine sulphate with sodium carbonate, the alkaloid jervine is liberated and may be recrystallized from alcohol. The solution of rubijervine sulphate upon addition of ammonia-water yields rubijervine in the form of a gelatinous precipitate.

The phosphoric acid method: After treatment of the powdered rhizome with ether or petroleum benzin, for the removal of fat and resin, it is exhausted with 80 per cent. alcohol, and the resulting tincture is distilled in vacuo. The residue left after recovery of the alcohol is then treated with water acidulated with acetic acid, insoluble matter being removed by filtration, and the filtrate treated with metaphosphoric acid as long as precipitation occurs. Jervine and rubijervine are thus removed as insoluble compounds. After filtration the clear solution is rendered alkaline by addition of ammonia-water and then shaken out with ether. Upon evaporation of the ethereal solution protoveratrine crystallizes out, and may be further purified by recrystallization from 90 per cent. alcohol. By shaking the alkaline liquid, already treated with ether, out with chloroform, pseudojervine may be isolated and recovered upon evaporation of the chloroformic solution.

PROTOVERATRINE, $C_{32}H_{51}NO_{11}$.—This, the most important of the veratrum alkaloids, occurs in colorless shining crystals belonging to the monoclinic system, which are permanent in the air, and melt at 245° to 250° C. (473°–477° F.). It is insoluble in water, benzene, and petroleum benzin, and dissolves with difficulty in most other solvents. Chloroform and boiling 96 per cent. alcohol are the best solvents. Its alcoholic solution rapidly changes red litmus-paper to blue. It forms a greenish-colored solution with concentrated sulphuric acid, which gradually changes to blue and finally to violet. If dissolved in diluted alcohol, it will usually be obtained in the form of a colored syrupy residue upon evaporation of the solvent, only a small portion crystallizing.

JERVINE, $C_{26}H_{37}NO_3$.—This alkaloid constitutes somewhat more than $\frac{1}{2}$ of the total alkaloidal content of the drug. When repeatedly crystallized from alcohol, it occurs in shining satiny, prismatic crystals, which melt at 238° to 240° C. (460.4°–464° F.). Jervine frequently separates from concentrated solutions in wedge-shaped crystals. It is readily soluble in ethyl, methyl, and amyl alcohol, chloroform and acetone, but difficultly in ether, and is insoluble in benzene and petroleum benzin. It is apparently not affected by boiling hydrochloric acid or alcoholic solution of potassium hydroxide. Jervine dissolves in concentrated hydrochloric acid, producing a yellowish color which soon changes to green. Its sulphate, nitrate, and hydrochloride are difficultly soluble, but the acetate and phosphate are readily soluble. The addition of ammonia-water to solu-

tions of the salts precipitates the alkaloid in the form of delicate needles. Jervine is only feebly toxic.

RUBIJERVINE, $C_{26}H_{43}NO_2 + H_2O$.—When recrystallized from hot alcohol this base is obtained in well-formed long prisms, which melt at 240° to 246° C. (464°–468.8° F.). It is easily distinguished from jervine by the ready solubility of its sulphate and nitrate. It yields a yellow solution with concentrated sulphuric acid, gradually changing to orange and finally to dark red. If warmed with hydrochloric acid, a reddish-violet color is produced. Rubijervine is physiologically inert.

PSEUDOJERVINE, $C_{29}H_{43}NO_7$.—Discovered by Wright and Luff in 1879 and its existence subsequently confirmed by Salzberger. It crystallizes from alcohol in thin, broad, hexagonal plates, which melt at 300° to 305° C. (572°–578.6° F.). It is difficultly soluble in alcohol and benzene, and almost insoluble in petroleum benzin, ether, and toluene. Its alcoholic solution changes the color of red litmus-paper to blue. Concentrated sulphuric acid forms a green-colored solution with pseudojervine. It is precipitated from solutions of its salts in the form of curdy flocculi. Like the preceding base, it is physiologically inert.

PROTOVERATRIDINE, $C_{26}H_{45}NO_8$.—According to Salzberger, who first isolated this base, it does not preëxist in the drug, but is the result of decomposition of protoveratrine by action of barium hydroxide, in proof of which he states that it is not met with when the phosphoric acid method for isolating the alkaloids is employed. Being almost insoluble in alcohol, it is left behind when crude jervine is treated with that solvent, as stated above. It may be obtained in the form of colorless square plates, which melt at 265° C. (509° F.). The solutions of its salts have an intensely bitter taste. In contact with concentrated sulphuric acid the base produces a violet color, changing to cherry-red. Protoveratridine is non-toxic and possesses no sternutatory properties.

Pharmaceutical Preparations.—FLUIDEXTRACT OF VERATRUM, TINCTURE OF VERATRUM.—U. S. P.

Action and Uses.—Veratrum is a powerful sedative to the nervous, respiratory, and circulatory systems. Because it is prone to produce vomiting when taken in poisonous dose it frequently fails to destroy life, since emesis takes place so early that the greater part of the ingested drug is expelled before it is absorbed. Because of its powerful sedative influence upon the heart, medicinal doses slow the pulse and diminish arterial tension. The action on the heart is chiefly exercised by the alkaloid, jervine, but the slowing of the pulse is due to a powerful stimulant influence exercised by the alkaloid, protoveratrine, upon the pneumogastric nerves. Not only does the jervine in veratrum lower arterial tension by depressing the heart, but it also powerfully depresses the vasomotor centre. Indeed, aside from the nitrites, such as nitroglycerin, it is the most powerful drug for reducing arterial tension that we have. Much difference of opinion exists as to the real value of veratrum as a medicinal agent. Certain practitioners of large experience use it for many conditions, and claim excellent results in the early stages of acute inflammation, while others rarely if ever employ it. There seems to be, however, a general consensus of opinion that the drug exercises its best effects in the treatment of puerperal eclampsia. Whether this result is produced by its sedative influence upon the spinal cord or upon some other portion of the body we do not know, since the pathology of this condition is still but little understood. The dose to be efficacious must be far larger than that commonly employed for other purposes, 20 to 30 minims (1.3–2.0) of the fluid extract must be given hypodermically and followed by 5-minim doses every fifteen or twenty minutes until the pulse is reduced to approximately its normal rate. The drug is contraindicated in those cases of puerperal eclampsia which have a feeble circulation. The employment of veratrum as a circulatory sedative in the early stages of acute sthenic inflammation is much less popular at present than it has been in times past, perhaps because we now know that many of these inflammations are due to specific infections. It should not be employed in fevers, except in their earliest stages, in the presence of a full-bounding pulse, and this rule of course limits its application to the first 24 or 48 hours of most of the acute infectious inflammations.

Veratrum is sometimes employed in cases of palpitation of the heart with hypertrophy to relieve cerebral congestion in plethoric individuals, or those with a high arterial tension. In cases of high arterial tension associated with chronic contracted kidney it usually cannot be employed, because at the same time that it lowers blood-pressure it

also depresses the heart, which in many of these cases needs support. The drug does not lend itself to the treatment of children because of its tendency to produce nausea and vomiting in this class of patients, in whom aconite is usually much more serviceable.

Other Species.—It is not certain whether the California plant so-called is a variety of *Veratrum viride*, or a distinct species.

The genus *Veratrum* is credited with some 9 species, which, however, are not well differentiated. Most of them have a local repute as poisons, or are used medicinally. The "*V. parviflorum Mx.*," with quite an extended domestic medical history, is now classed as *Melanthium p.* (Mx.) Watson.

VERBENACEÆ.—The Verbena Family.

This is a family of about 70 genera and nearly 1000 species, mostly of tropical or warm temperate regions, and presenting nearly all habits of growth. Economic interest pertains chiefly to the ornamental features of such genera as *Verbena*, *Lantana*, *Callicarpa*, *Vitex*, and *Clerodendron*. A number of dye-stuffs are yielded by the family. *Tectona grandis* L. f. (*Theka g.*—Lam.) yields the celebrated teak-wood. Its leaves are used in India as an astringent and its flowers as a diuretic. From a medical point of view the family is unimportant, notwithstanding that the verbenas were formerly regarded as very important drugs, and a number of species of the family contain powerful alkaloids and glucosides and some valuable volatile oils.

Verbena or *Vervain*, as a drug, is usually understood to be the rhizome and roots of *V. hastata* L. (*V. paniculata* Lam.) the *American blue vervain*, *Purvain*, *Wild hyssop*, or *Simpler's joy*. The entire flowering plant is also employed. The plant is a native of central and eastern North America, being exceedingly common and abundant along roadsides and in waste places. It is a roughish-hairy perennial herb, reaching a height of about 1 M. (3–4 Ft.), sparingly branched above, bearing opposite leaves and panicled erect spikes of small, deep-blue flowers. The leaves are 5 to 10 Cm. (2–4 In.) long, lanceolate or lance-ovate, acute, sharply (usually doubly) serrate, and the base frequently hastate. The spikes often reach a length of 15 Cm. (6 In.), are rather stout, and densely flowered. The flowers are sessile, in bracts nearly as long as the calyx, which is 2.5 Mm. ($\frac{1}{10}$ In.) long, 5-lobed, the lobes broad and acute. The corolla is about 4 Mm. ($\frac{1}{6}$ In.) broad, somewhat unequally 5-lobed, pubescent below. The 4 included stamens are borne on the corolla. The fruit consists of 4 smooth nutlets, borne in the base of the calyx. The rhizome is short and woody, and bears numerous slender fibrous roots. The drug is bitter, astringent, and disagreeable. Its constituents have not been investigated, but its taste and activity are extracted by water. Vervain has properties somewhat resembling those of EUPATORIUM. It was formerly largely used as an antiperiodic, but this action is weak and uncertain. It is a nauseating expectorant and diaphoretic, and is emetic in large doses. An alcoholic preparation is a fairly good bitter tonic. As a diaphoretic and expectorant, the best preparation is a 5 per cent. infusion, in doses of 2 to 4 ounces. Of the fluidextract, the dose is 1 to 2 fluidrachms. *V. urticifolia* L., the *White* or *Nettle-leaved vervain*, is sometimes used instead, and has gained some repute in the treatment of rhus-poisoning. It grows with the other, but more sparingly. It is much more slender and branches more freely and widely. Its leaves are broader and thinner, and its spikes very slender, their smaller, white flowers not contiguous. A bitter glucoside has been extracted from it. *V. officinalis* L., of Europe, the ancient *Herba columbariæ* or *sanguinalis*, *Vervain* (*Berbine*) *Enchanter's herb*, *Herb of grace*, *Juno's tears* (E.); *Eisenkraut*, *Stahlkraut*, *Venusblut* (G.); *Vervaine officinelle* (Fr.) was in ancient times highly esteemed, and sometimes used as a tea-substitute. It somewhat resembles *V. hastata*, but is shorter and more branched. It has become considerably naturalized in the warmer parts of America. *V. littoralis* Kunth., of the Pacific coast of South America, is very similar and is similarly employed. *V. bracteosa* Mx. is employed in the central and western United States, *V. erinoides* Lam. in Peru, and *V. supina* L. in southern Europe and in China. In Mexico, *V. callicarpifolia* Kunth is used as a substitute for sage.

Oleum Verbenæ or *Verbena oil* is not the product of a true *Verbena*, but of *Lippia triphylla* (L'Herit.) Lyons (*Verbena t.*—L'Herit.; *Aloysia citriodora* Ort.; *Lippia citriodora* Kunth), the common *Lemon* or *Sweet verbena*, or *Herb Louisa*, *Vervenie odorante* (Fr.), introduced from Chili to garden cultivation. It is very similar to lemon-grass oil, containing about 35 per cent. of citral. It is soluble in 1 to 5 volumes of 90 per cent. alcohol, and has a specific gravity of 0.90. *Lippia*, of which genus a dozen species are used, is noted for its fragrant volatile oils. The drug *Lippia Mexicana* is the leaves of *L. dulcis* Trev. var. *dulcis*, of Mexico and Central America. These leaves are 2 to 4 Cm. (1 to 1½ In.) long, ovate, narrowed into the petiole, acute, serrate above, veiny and glandular-hairy. They have a peculiar, sweet, and very delightful aromatic odor and taste, and have been used as a stimulating expectorant. *L. graveolens* H. & B. is similarly employed in Mexico, where it is known as *Yerba dulce*. In the same country, *L. origanoides* Kunth. is used as a substitute for origanum. *L. nodiflora*

Mx. is employed in India under the names *Buccan*, *Vahkan*, *Ratolia*, etc. In Chili the last is called Yerba de la Santa Maria. In Brazil *L. pseudo-thea* Schauer is used as a substitute for tea, and its fruit is eaten.

Valerianodes Medic. (*Stachytarpheta* Vahl.) contains a number of species closely similar in their properties to Lippia, containing similarly fragrant volatile oils, as well as bitter principles.

Of *Lantana* L., a dozen species are employed like Verbena. *L. Camara* L. (*L. Antillana* Raf.; *L. mutabilis* Salisb., the common lantana of the garden, is known in the West Indies as *Wild sage* or *Sage-tree*, *Bahama tea* or *Cailleau*, is used as a substitute for tea, and is an antispasmodic. It contains the quinine-like alkaloid *lantanine*. In Brazil *L. brasiliensis* Link. is similarly employed, and contains the same alkaloid. *L. trifolia* L. is also used as a tea-substitute in the West Indies.

A number of species of *Callicarpa* L. are quite active diuretics and purgatives in tropical America. In the East Indies the leaves of *L. longifolia* Lam. are chewed as Betel leaves.

Agnus-Castus is the fruit of *Vitex Agnus-castus* L., the *Chaste-*, *Hemp-*, or *Monk's pepper-tree*, *Abraham's balm* or *Kausehlanum* (Ger.), of southern Europe and Asia. They contain the bitter body *viticin* or *castin*, but are valued for their pungent and acrid oil, on account of which they are employed as a general stimulant and antispasmodic, an emmenagogue, and aphrodisiac. *V. trifolia* L. and *V. leucoxylon* L. are used as antirheumatics in the East Indies. *V. altissima* L. and *V. pubescens* Vahl. are used in Ceylon as yellow dyes, under the name *Mail-Elon*. More than a dozen species of this genus are employed. The bark of *Premna Taitensis* Schauer, of the Fiji Islands and East Indies, mixed with the root of *Raphidophora Vitiensis* (Fam. *Araceæ*) formed the drug *Tonga*, which was recommended for neuralgia. Several other species of this genus are used in India as antispasmodics and diuretics, as are a number of species of the related genus *Gmelina*.

Under the name *Mancoa*, the root of *Avicennia officinalis* L. is employed as an emmenagogue and aphrodisiac.

Of *Clerodendron*, nearly a dozen species are employed in medicine. *C. neriifolium* Wall. (*Volkameria inermis* L. f., of India, *C. infortunatum* Gaert (*Khiri* or *Bhant*), *C. villosum* Bl. and *C. trichotomum* Thunb., are used as anthelmintics, as well as purgatives and diuretics.

VIBURNUM OPULUS, *U. S.*—Viburnum Opulus (Cramp-bark).

Cranberry-tree bark, E.; *Ecorce d'obier*, Fr.; *Wasserholderrinde*, G.

The dried bark of *Viburnum Opulus* L. (*V. trilobum* Marsh.—Fam. *Caprifoliaceæ*).

Cramp-bark is official in no other pharmacopœia.

Origin.—Viburnum Opulus, the Cranberry-tree, High-bush-cranberry, Guelder-rose, White dogwood, White, Red, Rose, or Water elder, Garter-tree, Pincushion-tree, Witch-hobble (E.), Wasserholder or Wasserschwelke (G.), Obier (Fr.), is a large shrub or small tree, distributed through most of the northern part of the north temperate zone, and represented in cultivation by the common Snow-ball tree of our lawns. The bark is collected chiefly in northern Europe.

Description.—In somewhat transversely curved pieces, occasionally in quills of variable length, 0.5 to 2 Mm. ($\frac{1}{50}$—$\frac{1}{12}$ In.) thick; outer surface grayish brown, longitudinally wrinkled, with large brown lenticels and brownish-black fruit-heads of a lichen; inner surface light brown, longitudinally striate; fracture uneven, fibrous; transverse sections showing several bands of bast fibres; odor slight; taste somewhat astringent and bitter.

The powder is yellowish gray and very fibrous, the fibres white and elongated. It contains numerous stone-cells, which are nearly all wall, and reach a diameter of 15 mikrons; rather few small starch-grains, a few red resin-cells, and a great variety of crystals of calcium oxalate.

Constituents.—So far as known, the constituents of cramp-bark are identical with those of *V. prunifolium*, though there is only a third as much resin.

Pharmaceutical Preparation.—Fluidextract of Viburnum Opulus, U. S. P.

Fig. 469.

Viburnum opulus, outer and inner surfaces (Nat.).

Action and Uses.—Viburnum opulus is considered to possess in a lesser degree the properties of viburnum prunifolium. It is recommended as an antispasmodic in asthma, hysteria, puerperal convulsions, and dysmenorrhœa. It may be given in the dose of 20 to 60 grains (1.30–4 Gm.), but is usually used in form of the fluidextract.

VIBURNUM PRUNIFOLIUM, *U. S.*—Black Haw.

Nanny-berry, Sheep-berry, Stag-bush.

The dried bark of the root of *Viburnum prunifolium* L. or of *V. Lentago* L. (Fam. *Caprifoliaceæ*).

Viburnum prunifolium is not recognized in any other pharmacopœia.

Origin.—Both species are large shrubs or small trees of eastern and central North America, and are very abundant, especially the first named, in hedge-rows and borders of forests, having similar habits to those of the hawthorn in England. They are densely branched, opposite-leaved, and many of the branches bear thorny branchlets. The flowers are very abundant, in terminal corymbs, white, very showy and fragrant in late spring. They are succeeded by small flattish-oval drupes which, after frost, are purple black, glaucous, sweet and somewhat edible. The second named is distinguished from the first by its ovate or oval, long-acuminate (instead of obovate and obtusish) leaves, and its sessile or nearly sessile corymbs. Its leaves, corymbs, flowers, and fruits are somewhat larger than those of the former.

FIG. 470.

a *b* *c*

Viburnum prunifolium, inner and outer surfaces: *a*, young stem-bark; *b*, trunk-bark; *c*, root-bark (Nat.).

Description.—In irregular or quilled pieces, rarely exceeding 4 Mm. ($\frac{1}{6}$ In.) thick; externally dingy brown, shallowly fissured and slightly scaly; inner surface rust brown and having short, broad, oblique striæ; fracture weak, short, and uneven, the inner layer pale brown, the middle rust brown, the outer dark brown; odor slight, peculiar; taste bitter, that of the root-bark very bitter, somewhat astringent.

The powder is of a darker color than that of cramp-bark. Its bast-fibres are fewer and much shorter, and its stone-cells far more numerous and several times larger. Red resin-cells are much more abundant. Otherwise, it is much like that of cramp-bark.

Bark from branches or young stems is externally very dark purple, somewhat glossy, and bears scattered warts, which increase in number as it grows older. Clusters of minute black specks are often seen. That from old stems is blackish, often with gray patches, and is roughly fissured and more or less scaly. The inner surface is whitish or pale brown, and its striæ short and broad, often resembling elongated blisters. In the powder of the stem-bark bast-fibres are much more numerous than in that of the root-bark, though never so conspicuous as in that of cramp-bark.

It appears as though a large part of the bark collected in the Southern States must come from *V. rufotomentosum* Small, a species until recently confused with *V. prunifolium*. This bark has not been studied, but that supposed to be referable to it is thicker, darker, and softer, and has a very strong and different odor. It may be equal, or even superior, to the other, but this is conjectural.

Constituents.—With starch, a little tannin, much ash, and about 2.5 per cent. of resin, Viburnum contains a bitter, water-soluble glucoside, which has not been studied, but is probably the source of the valerianic acid which appears to be the important constituent.

Pharmaceutical Preparation.—Fluidextract of Viburnum Prunifolium, U. S. P.

Action and Uses.—The virtues attributed to viburnum prunifolium are as feeble as they are numerous. It has been used as a nervine, astringent, diuretic, and tonic and is said to possess a powerful influence as an uterine sedative and preventive of abortion. It is an ingredient of many proprietary preparations, vaunted as uterine sedatives, but the experience of most physicians fails to justify a belief in the qualities claimed for it. The dose of viburnum prunifolium is from 20 to 60 grains (1.30–4 Gm.), given in fluidextract or decoction.

Other Species.—The genus *Viburnum* L. contains more than 100 species of the north temperate zone, and extending into subtropical regions. More than a dozen species are employed medicinally. A number of species grow in the *V. prunifolium* region, and it is not unlikely that some are collected for it; indeed, we have seen in commerce what we believed to be the bark of *V. dentatum*. It is in the form of strips, like cramp-bark, but darker externally. *V. fœtidum*, Wall., cultivated in India under the name *Narvil* or *Naruval*, is used for the same purposes as *V. prunifolium*. The bark of *V. Lantana* L. (*V. tomentosum*, Lam.), Giddy-berry (E.), Schwindelbeere (Ger.), of Europe, is said to be vesicant. The berries of *V. Tinus* L. (*V. laurifolius* Borkh.), *False Laurel-berry* or *Laurierthym*, of the Mediterranean region, are purgative. The flowers of the Chinese species, *V. odoratissimum* Ker. (*V. Chinensis* Zeyh) are used as a tea substitute.

VINA MEDICATA.—Medicated Wines.

Vins medicinaux, Œnolés, Fr.; *Medicinische Weine*, G.

Medicated wines are preparations analogous to tinctures, but differ from them in the menstruum, which contains a much smaller and a somewhat variable quantity of alcohol and a certain proportion of extractive matter and acid potassium tartrate. The menstruum directed for the medicated wines is either dry white wine (Fr. Cod., P. G.), a mixture of white wine and alcohol (U. S., Fr. Cod.), sherry wine (Br., P. G.), dry red wine (U. S.), or Lunel, Grenache, Malaga, and other wines (Fr. Cod.). Since even the strongly alcoholic official wines cannot be kept unaltered for an indefinite period if exposed to the air, the medicated wines, which necessarily contain various principles subject to gradual decomposition, should be kept in well-stoppered bottles.

The presence of appreciable quantities of tannin in wine is decidedly objectionable if the wine is to be used in connection with iron and other metallic salts; moreover, tannin is incompatible with alkaloids, and hence wine not deprived of its tannin should never be used as a menstruum for alkaloidal drugs. The process of detannating wine is a very simple operation. One-half ounce of gelatin in No. 40 powder is added to a gallon of wine, and the whole agitated occasionally during 24 or 48 hours; then filter. The operation should be carried out during cold weather or in a cold apartment, as heat will cause the gelatin to dissolve, and maceration must be continued until a small portion of the wine shows no darkening of color upon addition of a few drops of ferric chloride solution.

VINUM ALBUM, *U. S.*—White Wine.

Vinum generosum album.—*Vin blanc*, Fr.; *Weisswein*, G.; *Vino blanco*, Sp.

An alcoholic liquid made by fermenting the unmodified juice of the fresh fruit of *Vitis vinifera*, Linné (Fam. Vitaceæ), freed from seeds, stems, and skins, and subjected to the usual cellar treatment for fining and aging. When white wine is prescribed without further specification, it is recommended that dry white wine of domestic production be employed. White wine should be preserved in well-closed, full casks or in well-stoppered bottles in a cool place.—U. S.

Origin.—American wines are mostly obtained from the fruit of cultivated varieties of *Vitis Labrusca*, Linné, and more particularly from Catawba, Concord, and Isabella grapes. The Clinton grape is a variety of *V. æstivalis*, Michaux; the Delaware grape is derived from *V. cordifolia* or *V. riparia*, Michaux; and the Scuppernong grape from *V. vulpini*, Linné. The European grape was introduced into California at an early

period, and large quantities of wine are now manufactured from the different varieties. All European wines are prepared from the fruit of *Vitis vinifera*, Linné, which is a native of Western Asia and has been cultivated for many centuries; it is not unlikely that this species originated from two or three different plants, supposed by some botanists to be indigenous to India, and by others to be still found in the wild state in Eastern countries and in Southern and Central Europe.

Manufacture of Wine.—In addition to grape sugar and acid potassium tartrate, vegetable albumen, glutinous matter, pectin, and various extractive matters are found in the juice of grapes, and occasionally racemic acid, either in the free state or partly combined with bases. Besides tartrates, the saline constituents are potassium sulphate, sodium chloride, calcium phosphate, magnesia, alumina, and silica. The relative amount of these principles varies considerably, depending on the nature of the soil and on atmospheric conditions during the growth and ripening of the fruit, when the free acid is gradually diminished and the sugar considerably augmented in quantity. The sugar varies in amount between 12 and 30 per cent., the larger quantity being produced in warm climates. It is obvious from this that the treatment of the grape-juice for the production of wine must vary under different circumstances and in different countries. The grapes are crushed and the juice fermented in the presence of the husks, or the juice, called *must*, is fermented by itself, in which case a light-colored wine is obtained. Red wines are made by fermenting with husks and seeds, called the *marc*, of red or purple grapes. In a short time after the must has been pressed, fermentation commences, and continues for two or three weeks, when the liquid becomes somewhat clear, and is removed from the precipitate into another vessel, where a slow fermentation, called the after-fermentation, proceeds for several weeks or months, requiring the occasional removal of the liquid from the sediment formed, until it is fit to be transferred into casks, where it is allowed to "ripen." The best wines are usually bottled some time after they have become perfectly clear, the complete clarification being effected by gelatin, which, in combining with the tannin present, forms an insoluble compound, carrying down with it all the traces of yeast and other matters held in suspension. The "bouquet" of wine is much improved after bottling, and red wines, which do not contain a large amount of tannin, become darker, while wines rich in tannin form a deposit in the bottle and become lighter in color.

In the presence of the numerous constituents of grapes odorous principles are generated during fermentation, to which wines owe their peculiar aroma or bouquet. If the must contains a moderate quantity of sugar, this is entirely or nearly decomposed into alcohol and carbon dioxide, resulting in a dry wine. But in a strongly saccharine must fermentation ceases before the sugar is completely consumed, and the product is a sweet wine (*vin de liqueur*, Fr.). In some cases the amount of sugar in the juice is increased by exposing the cut ripe grapes for some time to the sun until a portion of the water has evaporated, or by concentrating a portion of the juice before fermentation. As the alcohol increases during the fermentation of the must, the acid potassium tartrate becomes less soluble and is gradually deposited, the deposition continuing for some time after the storing of the wine in casks.

If wine is bottled before it has undergone the after-fermentation, a sparkling wine will be obtained. The fermentation will slowly proceed in the bottle, which is placed upside down, so that the precipitate which forms may settle in the neck, and may be finally withdrawn by carefully removing the stopper and quickly replacing it. The effervescence of sparkling wines is produced by the carbon dioxide confined in the bottle.

Properties.—The U. S. Pharmacopœia describes white wine as a pale, amber- or straw-colored liquid, having a pleasant odor free from yeastiness, and a fruity, agreeable, slightly spirituous taste without excessive sweetness or acidity. Its specific gravity at 15.6° C. (60° F.) should be not less than 0.990 nor more than 1.010.

Sherry wine (*Vinum Xericum*, Br.) has a rather deep amber color, an agreeable vinous odor, and a warm and very slightly acid taste. Its specific gravity range is between 0.978 and 0.995, and its average alcoholic strength 20.34 volumetric per cent.; the sugar and extractive averages 3.27 (highest 5.3) per cent. Similar wines are produced in various parts of Spain, Portugal, the Canaries, and Madeira, several of which are met with in our commerce. Lisbon wine has a density of about 0.990, and contains 19 or 20 per cent. of alcohol. Teneriffe wine closely resembles the preceding in proper-

ties. A stronger wine is Madeira, which usually contains between 19 and 22 per cent. of alcohol; it has a different somewhat nutty flavor.

Wines of similar strength in alcohol are also made in Italy (Marsala), Greece (*vino santo*), and the Cape Colony (Constantia). Southern France produces wines containing 14 to 16 per cent. of alcohol, of which those of Lunel and Grenache are ordered by the Codex. Burgundy wines are of about the same strength. Very sweet wines, rich in alcohol are, among others, Tokay (Hungary), Lachrymæ Christi (Italy), and Malaga (Spain).

The white Rhenish wines are known here as hock (from Hochheimer). They have a more acidulous taste than the preceding wines, from the presence of acid potassium tartrate and the nearly total absence of sugar. They are of a pale-yellow color, and usually contain between 8 and 10 per cent. of alcohol. Moselle wine is nearly of the same strength. The French wines, both white and red, are required to contain about 10 per cent. of alcohol (Fr. Cod.).

The white wines of the Mississippi and Ohio Valleys and the California wines resemble those of Central and Southern Europe in appearance, flavor, and alcoholic strength; the weaker varieties of the latter, which are known as California hock, have not the fine bouquet of the better qualities of Rhenish wines, but the quality of American wines has considerably improved of late years.

The sparkling champagne wines contain between 10 and 12 per cent. of alcohol.

Constituents.—The principal constituents of all wines are water and alcohol. The amount of the latter present in different wines has been given above. The acidulous taste of wine is due to acid potassium tartrate, and small quantities of acetic acid are met with in old wines, resulting from the spontaneous oxidation of alcohol. A somewhat larger proportion of acetic acid is usually present in the wine of the Eastern section of the United States. The amount of sugar varies considerably; while the weaker dry wines contain none or but very little, it is found in sherry to the extent of from 1 to 5 per cent., increases in champagne sometimes to 5 or 6 per cent., in port wine to 6 or 7 per cent., and in the sweet wines, like Malmsey Madeira, to 11 or 15 per cent. or more. The "body" of wine has been ascribed by Fauré to a principle which he named œnanthin, and which is probably of the nature of gum or dextrin. Tannin seems to be present in all wines—in minute proportion in the white, and in larger proportion in the red wines. The coloring-matter of wine varies for causes stated above; the color of red grapes is not soluble in water, but is extracted during fermentation as the alcohol increases. The aroma of wine is doubtless due to the presence of various compound ethers formed in the juice while fermenting. These exist in very minute quantities, and have for this reason not been accurately examined; but the following have been stated to contribute to the aromatic odor of wine: acetic, butyric, caprylic, caproic, œnanthic, pelargonic, capric, and propionic ethers, besides aldehyde, acetal, and probably other compounds. The inorganic constituents of wine are the same as those of grape-juice, except that calcium tartrate and the greater portion of acid potassium tartrate have been deposited; the ash varies between about 0.1 and 0.5 per cent.

The U. S. Pharmacopœia not only permits, but encourages, the use of native wines, provided they be pure and contain between 7 and 12 per cent. by weight of absolute alcohol. From causes explained before, the composition of wines made from the same variety of grape grown in different localities, or from different vintages in the same locality, must be expected to vary to some extent; every quantitative analysis of wine, therefore, refers only to the sample examined.

Changes.—Like other weak alcoholic liquids, wine is apt to undergo acetic fermentation, which is prevented by excluding atmospheric oxygen. Mucous fermentation causes wine to become ropy; white wines are subject to this change more than red wines, caused by the presence of insufficient tannin in the must for precipitating all the albuminoids. Some wines, like Burgundy, are liable to acquire a bitter taste, and occasionally wine becomes mouldy. Scrupulous cleanliness of the vessels in which wine is kept and exclusion of air will prevent most of these changes.

Tests.—With the exception of the U. S. P., none of the pharmacopœias give any tests for determining the quality of wine, which is directed to be ascertained as follows: "If a portion of white wine be evaporated, the residue, when dried during 12 hours on a water-bath, should amount to not less than 1.5 nor more than 3 per cent.; this residue ignited at a low temperature and burned gradually to whiteness, moistened with a small

portion of ammonium carbonate test-solution, and again carefully ignited, should weigh not less than 0.14 Gm. nor more than 0.26 Gm. for each 100 Cc. of white wine tested. To neutralize 50 Cc. of white wine should require not less than 3 nor more than 5.2 Cc. of normal potassium hydroxide solution (limit of free acid), litmus test-solution being used as indicator. If 10 Cc. of white wine be diluted with an equal volume of water, and treated with 5 drops of ferric chloride test solution, only a faint greenish-brown color should make its appearance (absence of more than traces of tannic acid). If 75 Cc. of white wine be acidified with 5 Cc. of diluted sulphuric acid (1 in 3), and thoroughly shaken in a separator with a mixture of equal parts of petroleum benzin and ether, and if the solvent, after separation, be transferred to a porcelain dish, allowed to evaporate spontaneously, and the residue dissolved in 3 Cc. of water, the solution should not have a sweet taste (absence of saccharin), nor should it give a violet color upon the addition of a diluted solution of ferric chloride (1 in 200) (absence of salicylic acid). Tested by the following method white wine should be found to contain not less than 7 nor more than 12 per cent. by weight (equivalent to from 8.5 to 15 per cent. by volume) of absolute alcohol: Take the specific gravity (to four decimals) of a sufficient portion of the white wine carefully measured at the temperature of 15.6° C. (60° F.), evaporate the wine in a tared dish to one-third of its original weight, cool, and add water until the liquid measures its original volume at 15.6° C. (60° F.); then take the specific gravity (to four decimals) again. The difference between the two specific gravities deducted from 1.0000 corresponds to the specific gravity of an alcohol containing the same percentage of absolute alcohol, by weight or volume, as the wine under examination, the corresponding percentage being ascertained by referring to the alcohol tables."—U. S.

Action and Uses.—The physiological action of wine depends almost entirely upon the alcohol contained (see ALCOHOL). Consumed in moderate quantity it is devoid of injurious effects, but its habitual use in excessive amounts tends to induce gout, cirrhotic conditions of the liver and kidneys, sclerosis of the blood-vessels, nervous affections, etc. These results do not so frequently follow over-indulgence in the light, dry wines as in the strong, sweet wines. White wine contains a much smaller per cent. of tannin than does red wine, and for this reason is more readily absorbed from the stomach and is preferred when a rapid, stimulating effect is desired. On the other hand, red wine is better adapted in the convalescence from acute diseases and in states of general debility. Wine may be employed in the treatment of disease when an alcoholic stimulant is deemed advisable, but because it is comparatively weak in alcohol it is not so well adapted to grave, adynamic fevers in adult males as it is in females, children, and the aged. The indications for the use of wine in typhoid fever and in other febrile affections which assume the typhoid state are weakness of the first sound of the heart, low, muttering delirium, stupor, carphology, etc.; its employment in large quantity in typhus fever and in some cases of tetanus has been followed by happy results. Wine is an admirable remedy to be used in the convalescence from exhausting fevers, acting as it does as a mild exhilarant, an aid to digestion, and a tonic to the nervous system. Of the white wines, a pure sherry, if such can be obtained, is to be preferred for the convalescing patient on account of its slight acidity and freedom from a large quantity of saccharine matters. The sweet wines are not so serviceable, as they are apt to derange digestion. Champagne, aside from its stimulating qualities, will often be found of great value to allay nausea and irritability of the stomach in the low states of fevers and following ether-anæsthesia. A useful method in which to administer wine is in wine whey, prepared by adding to 1 pint of boiling milk from 2 to 8 ounces of wine, straining off the whey without pressure, and sweetening it to suit the taste.

VINUM ANTIMONII, *U. S.*—Wine of Antimony.

Vinum antimoniale, Br.; *Vinum stibiatum*, P. G.—*Antimonial wine*, E.; *Vin émétique, Vin antimonié, Vin stibié*, Fr.; *Brechwein*, G.

Preparation.—Antimony and potassium tartrate, 4 Gm.; boiling distilled water, 65 Cc.; alcohol, 175 Cc.; white wine, a sufficient quantity to make 1000 Cc. Mix the alcohol with 725 Cc. of white wine. Dissolve the antimony and potassium tartrate in the boiling distilled water, and add the solution to the mixture. When the liquid is

cold filter it through paper, and add enough white wine, through the filter, to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of wine of antimony use 29¼ grains of antimony and potassium tartrate, 1 fluidounce of boiling distilled water, 2¾ fluidounces of alcohol, and sufficient white wine to make 16 fluidounces of solution.

Each Cc. of finished product contains 0.004 Gm. (or 1 fluidrachm, about ¼ grain) of tartar emetic.

Nearly the same proportions are the following: Tartarated antimony, 40 grains; boiling distilled water, 1 fluidounce; sherry, sufficient to make 1 pint (imperial).—*Br.* Tartar emetic, 1 part; sherry wine, 249 parts.—*P. G.*

If made with good wine and judiciously preserved antimonial wine will keep unaltered for a long time.

Uses.—Wine of antimony may be employed whenever it is desired to administer tartar emetic (see ANTIMONII TRIOXIDUM). Its dose as an expectorant and circulatory sedative is from 10 to 30 minims (0.60–2 Cc.). As an emetic from ½ to 1 drachm (2–4 Cc.) may be given to children and 1 to 2 drachms (4–8 Cc.) to adults.

VINUM AURANTII, *Br.*—Orange Wine.

Wine made by the fermentation of a saccharine solution to which the fresh peel of the bitter orange has been added.—*Br.*

It is a vinous liquid, having a gold-sherry color and a taste and aroma derived from the bitter orange-peel. It contains about 10 or 12 per cent. of alcohol, and is but slightly acid to test-paper.

Uses.—This agreeable, aromatic wine is used solely as a flavoring ingredient of mixtures.

VINUM CAMPHORATUM, *P. G.*—Camphorated Wine.

Vin camphré, Fr.; *Kampherwein*, G.

Preparation.—Camphor, 1 part; alcohol, 1 part; mucilage of acacia, 3 parts; white wine, 45 parts. Dissolve the camphor in the alcohol, slowly incorporate with the mucilage, constantly stirring, and finally add the wine in the same manner.—P. G.

Camphorated wine is whitish and turbid, and should be shaken before using.

Uses.—Camphorated wine is an efficient preparation for the internal administration of camphor, especially in cholera and choleraic diarrhœa. Its dose for a child from 2 to 6 years of age is about 1 drachm (4 Cc.). Adults may take from 4 to 8 drachms (16–80 Cc.).

VINUM CHINÆ, *P. G.*—Wine of Cinchona.

Vin de quinquina, Fr. Cod.; *Vinum cinchonæ.*—*Œnolé de quinquina*, Fr.; *Chinawein*, G.

Preparation.—Red cinchona, in coarse powder, 40 parts; gelatin, 1 part; sugar, 100 parts; tincture of bitter orange peel, 2 parts; sherry wine, 1000 parts. Dissolve the gelatin in 10 parts of hot water and add the sherry wine to the warm solution. Now add the cinchona and allow maceration to go on with frequent agitation for 8 days; strain and express, and in the liquid dissolve the sugar and add the tincture of bitter orange peel. Set aside for 2 weeks in a cool place and filter.—P. G.

Uses.—This is an agreeable, aromatic, bitter wine, useful as a stimulant to the appetite and digestion. The dose is from 2 to 4 drachms (8–16 Cc.).

VINUM COCÆ, *U. S.*—Wine of Coca.

Vinum erythroxyli.—*Vin de coca*, Fr.; *Cocawein*, G.

Preparation.—Fluidextract of coca, 65 Cc.; alcohol, 75 Cc.; sugar, 65 Gm.; red wine, a sufficient quantity to make 1000 Cc. Dissolve the sugar in 500 Cc. of red wine, add the alcohol and fluidextract of coca, and enough red wine to make the liquid measure 1000 Cc. Set the mixture aside for 2 days; then filter through paper, in a well-covered funnel.—U. S.

To make 1 pint of wine of coca, dissolve 475 grains of sugar in 8 fluidounces of red wine, add 1 fluidounce and 58 minims of alcohol and 1 fluidounce and 20 minims of fluidextract of coca, and finally enough red wine to bring the volume up to 16 fluidounces. After 2 days filter.

Each Cc. of wine of coca represents 0.065 Cc., or 1 fluidrachm about 4 minims of fluidextract of coca.

Uses.—This preparation combines the stimulant effects of coca with those of the menstruum. It has become very popular with the laity as a remedy in mental and physical fatigue. It may be administered whenever the effects of the drug are desired. The dose is from 2 to 8 drachms (9–30 Cc.).

VINUM COLCHICI, *Br.*—Colchicum Wine.

Vinum colchici radicis; Vin de bulbe de colchique, Fr. Cod.—*Wine of colchicum root*, E.; *Œnolé de bulbe de colchique*, Fr.; *Zeitlosenknollenwein*, G.

Preparation.—Colchicum corm, in No. 20 powder, 4 ounces; sherry, 1 imperial pint. Macerate for 7 days with occasional agitation, express and filter.—Br.

The French Codex directs that 100 Gm. of fresh colchicum bulbs be macerated with 1000 Gm. of strong wine (vin de Grenache).

Uses.—This preparation, no longer official in the U. S. P., is used as is the VINUM COLCHICI SEMINIS (see below). The dose is from 10 to 30 minims (0.60–2 Cc.).

VINUM COLCHICI SEMINIS, *U. S.*—Wine of Colchicum Seed.

Vinum colchici, P. G.—*Vin de semence de colchique*, Fr.; *Zeitlosensamenwein*, G.

Preparation.—Fluidextract of colchicum seed, 100 Cc.; alcohol, 150 Cc.; white wine, 750 Cc. Mix and set aside for 2 days; then filter.—U. S.

To make 1 pint of the wine mix 1 fluidounce and 288 minims of fluidextract of colchicum seed, 2 fluidounces and 172 minims of alcohol, and sufficient white wine to bring the volume up to 16 fluidounces.

The German Pharmacopœia directs 1 part of coarsely powdered colchicum seed to be macerated for 8 days with 10 parts of sherry wine.

Uses.—In this form colchicum is most largely administered. The strength of the preparation has been decreased one-third. The dose is from 20 to 60 minims (1.30–4 Cc.).

VINUM CONDURANGO, *P. G.*—Wine of Condurango.

Vin de condurango, Fr.; *Condurangowein*, G.

Preparation.—Condurango bark, finely cut, 1 part; sherry wine, 10 parts. Macerate for 8 days, express, and filter.—P. G.

Uses.—Condurango wine is a useful stimulant to the stomach, and in moderate quantity an aid to digestion; recommended especially in gastric cancer. The dose is from 1 to 4 drachms (4–16 Cc.).

VINUM DIGITALIS COMPOSITUM.—Compound Wine of Digitalis.

Vin de digitale composé de l'Hôtel-Dieu, Fr. Cod.; *Vinum diureticum. Trousseau's diuretic wine*, E.; *Vin de Trosseau*, Fr.; *Trosseauscher Wein, Zusammengesetzter Digitaliswein*, G.

Preparation.—Digitalis, in coarse powder, 5 Gm.; squill, bruised, 7.50 Gm.; juniper berries, bruised, 75 Gm.; potassium acetate, 50 Gm.; white wine, 900 Gm.; alcohol, 100 Gm. Mix the alcohol and white wine and pour the mixture over the digitalis, squill, and juniper berries, contained in a vessel provided with a good stopper; macerate for 10 days with occasional agitation. Strain with expression, and dissolve the potassium acetate in the expressed liquid; finally filter.—Fr. Cod.

Uses.—Compound wine of digitalis is designed as a diuretic to be used in dropsy due to chronic renal or cardiac disease. The dose is from 2 to 4 drachms (8–16 Cc.).

VINUM ERGOTÆ, *U. S.*—Wine of Ergot.

Vin de seigle ergoté, Fr.; *Mutterkornwein*, G.

Preparation.—Fluidextract of ergot, 200 Cc.; alcohol, 50 Cc.; white wine, 750 Cc. Mix. Set the mixture aside for 2 days; then filter through paper, in a well-covered funnel.—U. S.

To make 1 pint of wine of ergot, mix 3 fluidounces and 96 minims of fluidextract of ergot with 6½ fluidrachms of alcohol and sufficient white wine to bring the volume up to 16 fluidounces.

Each Cc. of wine of ergot represents 0.20 Gm.; of each fluidrachm about 12 grains of ergot.

Uses.—The strength of this wine has been increased from 15 to 20 per cent. of ergot. It is less frequently employed than the other preparations of the drug. The dose is from 1 to 4 drachms (4–16 Cc.).

VINUM FERRI, *U. S.*—Wine of Iron.

Vinum ferri citratis, Br., U. S., 1890; *Vin chalybé*, Fr. Cod. *Vinum chalybeatum.*—*Wine of iron citrate*, E.; *Vin ferrugineux, Œnolé ferrugineux*, Fr.; *Eisenwein*, G.

Preparation.—Iron and ammonium citrate, 40 Gm.; tincture of sweet orange peel, 60 Cc.; syrup, 100 Cc.; white wine, a sufficient quantity to make 1000 Cc. Dissolve the iron and ammonium citrate in 700 Cc. of white wine. Add to this the tincture of sweet orange peel and the syrup, and, lastly, enough white wine to make the product measure 1000 Cc. Set the mixture aside for several days, then filter, and pass enough white wine through the filter to restore the original volume.—U. S.

To make 1 pint of wine of iron dissolve 292 grains of iron and ammonium citrate in 11 fluidounces of white wine; add 1½ fluidounces of tincture of sweet orange peel, 1¾ fluidounces of syrup, and sufficient white wine to make 16 fluidounces of solution.

The British Pharmacopœia directs wine of iron citrate to be prepared by dissolving 160 grains of iron and ammonium citrate in sufficient orange wine to form 1 imperial pint (20 fluidounces) of solution.

Since the title of this preparation has been changed in the recent revision of the U. S. Pharmacopœia, it must be borne in mind that a different preparation is known by the same name, *Vinum Ferri—Wine of Iron*, in the British Pharmacopœia. The latter is made by placing iron wire, 1 ounce, in a closed vessel containing 1 imperial pint of sherry wine, in such a way that the wire is almost but not entirely immersed in the wine; the mixture is allowed to stand for 30 days with frequent agitation, the stopper being occasionally removed to allowed the escape of the liberated hydrogen. It is finally filtered. The amount of iron taken up depends wholly on the acidity of the wine, and in a good preparation will average about $\frac{1}{5}$ per cent.

The chalybeate wine of the French Codex is a much weaker preparation, containing in 1000 parts only 5 parts of iron and ammonium citrate.

Uses.—This is a mild chalybeate remedy, useful in chlorotic anæmia when the stomach is irritable. Its dose is from 1 to 4 drachms (4–16 Cc.).

VINUM FERRI AMARUM, *U. S.*—Bitter Wine of Iron.

Vinum chinæ ferratum.—Vin de quinquina ferrugineux, Fr.; *Chinaeisenwein*, G.

Preparation.—Soluble iron and quinine citrate, 50 Gm.; tincture of sweet orange peel, 60 Cc.; syrup, 300 Cc.; white wine, a sufficient quantity to make 1000 Cc. Dissolve the soluble iron and quinine citrate in 500 Cc. of white wine. Add to this the tincture of sweet orange peel and the syrup, and, lastly, enough white wine to make the product measure 1000 Cc. Set the mixture aside for several days, then filter, and pass enough white wine through the filter to restore the original volume.—U. S.

To make 1 pint of bitter wine of iron dissolve 365 grains of soluble iron and quinine citrate in 8 fluidounces of white wine; add 1½ fluidounces of tincture of sweet orange peel, 5 fluidounces of syrup, and sufficient white wine to make 16 fluidounces of solution.

Each Cc. of the finished product contains 0.05 Gm. (or 1 fluidrachm, nearly 3 grains) of the soluble citrate of iron and quinine.

Uses.—Bitter wine of iron is an efficient tonic in convalescence from exhausting fevers or in cases of general debility. The dose is from 1 to 4 drachms (4–16 Cc.).

VINUM IPECACUANHÆ, *U. S.*, *Br.*, *P. G.*—Wine of Ipecac.

Vin d'ipécacuanha, Fr.; *Brechwurzelwein*, G.

Preparation.—Fluidextract of ipecac, 100 Cc.; alcohol, 100 Cc.; white wine, 800 Cc. Mix. Set the mixture aside for 2 days; then filter through paper in a well-covered funnel.—U. S.

To make 1 pint of wine of ipecac mix 1 fluidounce and 288 minims each of fluidextract of ipecac and alcohol with sufficient white wine to bring the volume up to 16 fluidounces.

The British Pharmacopœia directs that 1 fluidounce of liquid extract of ipecac be mixed with 19 fluidounces of sherry wine, and the mixture filtered after 48 hours.

Wine of ipecac represents in each Cc. the active virtues of 0.10 Gm., or in each fluidrachm of about 6 grains of ipecac root. The German preparation is of about the same strength, being made by macerating 1 part of finely cut ipecac root in 10 parts of sherry wine.

Uses.—Wine of ipecac may be employed whenever the emetic, expectorant, diaphoretic, or other virtues of the drug are desired (see IPECACUANHÆ). As an emetic, its dose in the adult is about 1 ounce (30 Cc.); in an infant 2 or 3 years of age, 1 drachm (4 Cc.), repeated every 15 minutes until it has produced vomiting. Its dose as an expectorant and diaphoretic is from 10 to 30 minims (0.60–2 Cc.).

VINUM OPII, *U. S.*—Wine of Opium.

Vinum opii compositum, Fr. Cod.; *Tinctura opii crocata*, P. G.; *Laudanum liquidum Sydenhami.—Sydenham's laudanum*, E.; *Laudanum de Sydenham, Vin d'opium composé*, Fr.; *Safranhaltige Opiumtinktur*, G.

Preparation.—Powdered opium, 100 Gm.; Saigon cinnamon, in No. 60 powder, 10 Gm.; cloves, in No. 30 powder, 10 Gm.; alcohol, 150 Cc.; white wine, a sufficient quantity to make 1000 Cc. Mix the alcohol with 850 Cc. of white wine. Macerate the opium, Saigon cinnamon, and cloves in a stoppered container, in a moderately warm place, with 750 Cc. of this menstruum, during 7 days, with occasional agitation; then filter through purified cotton, in a well-covered funnel, returning the first portions until the filtrate passes perfectly clear, and finally pass enough menstruum through the residue to make the liquid measure 1000 Cc.—U. S.

To make 1 pint of wine of opium use 730 grains of powdered opium and 73 grains each of cloves and Saigon cinnamon; macerate for 7 days with 12 fluidounces of the menstruum (alcohol 15 volumes, white wine 85 volumes). After filtration pass enough menstruum through the filter to bring the volume up to 16 fluidounces.

Each Cc. represents 0.1 Gm. (or 1 fluidrachm—about 5.7 grains) of opium.

The wine has been replaced in the P. G. by a diluted alcohol. The other formulas are: Opium, 200; saffron, 100; Ceylon cinnamon, 15; cloves, 15; wine, 1600 Gm.—Fr. Cod. Opium, 30; saffron, 10; Chinese cinnamon, 2; cloves, 2; alcohol (68½ per cent.), and water, 140 parts.—P. G. That of the French Codex, being made with a sweet wine, is denser (sp. gr. 1.05 to 1.07) than the other preparations. On keeping, this wine deposits some extractive matter and occasionally some narcotine.

LAUDANUM DE ROUSSEAU, Fr. Cod., contains about one-fourth its weight of opium, and is therefore considerably stronger than the preceding; it is made by fermenting a mixture of opium, 200 Gm.; honey, 600 Gm.; water, 3 liters; and beer-yeast, 40 Gm.; the filtered liquor is then evaporated to 600 Gm. and mixed with alcohol (sp. gr. 0.913) 200 Gm.

Uses.—Wine of opium is considered to be superior to the tincture of opium as an internal remedy, because it is less apt to cause nausea. Its dose is from 5 to 20 minims (0.30–1.30 Cc.).

VINUM QUININÆ, *Br.*—Quinine Wine.

Vin de quinine, Fr.; *Chininwein*, G.

Preparation.—Quinine hydrochloride, 20 grains; orange wine, 1 imperial pint. Dissolve; set aside; filter if necessary.—Br.

This is a weak solution of quinine, containing 1 grain of the salt in each fluidounce.

Uses.—The dose of this feeble, bitter tonic wine is from 4 to 8 drachms (16–30 Cc.).

VINUM RUBRUM, *U. S.*—Red Wine.

Vin rouge, Fr.; *Rothwein*, G.; *Vino tinto*, Sp.

An alcoholic liquid made by fermenting the unmodified juice of the fresh, colored fruits of Vitus vinifera (Fam. *Vitaceæ*) in presence of their skins, and subjected to the usual cellar treatment for fining and aging. When red wine is prescribed without further specification, it is recommended that a dry red wine of domestic production be employed. Red wine should be preserved in well-closed, full casks or in well-stoppered bottles in a cool place.—U. S.

Origin and Description.—The fruits of most cultivated varieties of the American grapevines and of numerous varieties of the European species have either an amber color or are purple, dark-blue, or nearly black. The juice of these grapes is colorless or nearly so, and if fermented alone yields a white wine, but if fermented with the pericarp or skins the coloring matter of the latter is extracted, and the wine has a red color, varying in shade with the variety of grapes, with the quantity of skins, the length of time they have been in contact with the fermenting liquid, and with the amount of alcohol and acid present. Although many white wines contain tannin, taken up from the pericarp of the fruit or from the seeds, the quantity is usually minute as compared with that present in red wines, and which comes from the same sources. It is obvious, therefore, that red wine agrees in properties and composition with white wine, except so far as these are modified by the red coloring matter and the tannin, the most striking differences being the deep-red color, the distinctly astringent taste, and the effect produced by alkalies, ferric chloride, lead acetate, and other reagents, either changing the color of, or producing precipitates with, tannin and the coloring principle.

Vinum Portense.—*Port Wine*, E.; *Vin d'Oporto*, Fr.; *Portwein*, G.—This is the product of the grape cultivated in the district near the river Douro in Portugal, and is chiefly exported from Oporto. When recently made it is of a red color, which by age changes to a deep reddish-brown, while at the same time a considerable portion of altered astringent matter is deposited and the wine acquires its full flavor. Port wine is considered to be best when about eight or ten years old. As exported from Portugal, it is always mixed with a certain quantity of spirit, which is added for the purpose of better preservation; its alcoholic strength is thereby increased from 18 to 22 per cent. Ripeness and strength are said to be imparted to new wine by adding brandy toward the end of fermentation, and the product, particularly the cheaper varieties of port wine, is often artificially colored with preparations containing the juice of elderberries. Port wine has a pleasant vinous odor and an agreeable, warm, sweetish, and slightly astringent taste. In the place of true port wine a variety of French wine, known in commerce as Burgundy port wine, is much used in the United States; it resembles port wine in appearance and flavor, and contains about 14 or 16 per cent. of alcohol. California port wine is very similar, and is the product of grapevines originally obtained from the port-wine district of Portugal, and chiefly cultivated in Los Angeles County. Similar wines are also made in other parts of the United States.

Claret is the English name of dry red wines containing a moderate amount of alcohol, and was originally used for French red wines (*vin clairet*, clarified wine), but is now applied to many wines of American growth from California, as well as from the Mississippi Valley and eastward to the Atlantic coast. Some of the most esteemed red wines of France are produced in Gironde and exported from Bordeaux, and the red wines produced in other sections of France have, like the former, been known in Europe as Bordeaux wines. Much of the wine exported is more or less artificial, and the handsome red color is sometimes due to maqui-berries, the fruit of *Aristolelia* Maqui, L'Héritier (Fam. *Tiliaceæ*).

Constituents.—In addition to the constituents mentioned elsewhere (see Vinum Album), red wine contains tannin, partly derived from the casks, but mainly from the seeds and integuments of the grape, and giving with ferric salts green-brown or green-black precipitates. The red coloring matter, œnolin or œnolic acid, is a red-brown or purplish-red powder, which is nearly insoluble in water, in carbon disulphide, and in chloroform, but soluble in dilute acids and in alcohol; it is not unlikely that the coloring principles of different grapes vary, and are more or less modified by the constituents and treatment of wine.

Properties and Tests.—"Red wine occurs as a deep red liquid, having a pleasant odor, free from yeastiness, and a fruity, moderately astringent, pleasant, and slightly acidulous taste, without excessive sweetness or acridity. The specific gravity at 15.6°C. (60°F.) should be not less than 0.989 nor more than 1.010. If a portion of red wine be evaporated, the residue, when dried during twelve hours on a water-bath, should amount to not less than 1.6 per cent. nor more than 3.5 per cent.; this residue, ignited at a low temperature and burned gradually to whiteness, moistened with a small portion of ammonium carbonate test-solution, and again carefully ignited, should weigh not less than 0.22 Gm. nor more than 0.34 Gm. for each 100 Cc. of red wine tested. To neutralize 50 Cc. of red wine should require not less than 3 Cc. nor more than 5.2 Cc. of normal potassium hydroxide solution (limit of free acid), litmus test-solution being used as indicator. If 10 Cc. of red wine be diluted with an equal volume of water, and treated with 5 drops of ferric chloride test-solution, the liquid should acquire a brownish-green color (presence of tannic acid). With lead acetate test-solution, red wine forms a heavy precipitate which may vary in color from bluish-green to green. If 50 Cc. of red wine be treated with a slight excess of ammonia water, the liquid should acquire a green or brownish-green color; if it be then well shaken with 25 Cc. of ether, the greater portion of the ethereal layer removed, and evaporated in a porcelain dish with an excess of acetic acid and a few fibres of uncolored silk, the latter should not acquire a crimson or violet color (absence of red aniline colors). If 25 Cc. of red wine, heated to about 45°C. (113°F.), be well agitated with 25 Gm. of manganese dioxide, the liquid filtered off and acidulated with hydrochloric acid, it should not acquire a red color (absence of acid fuchsine). If 75 Cc. of red wine be acidified with 5 Cc. of diluted sulphuric acid (1 in 3) and thoroughly shaken in a separator with a mixture of equal parts of petroleum benzin and ether, and if the solvent after separation be transferred to a porcelain dish, allowed to evaporate spontaneously, and the residue dissolved in 3 Cc. of water, the solution should not have a sweet taste (absence of saccharin), nor should it give a violet color upon the addition of a diluted solution (1 in 200) of ferric chloride (absence of salicylic acid). Tested by the following method, red wine should be found to contain not less than 7 per cent., nor more than 12 per cent by weight (equivalent to 8.5 per cent. to 15 per cent. by volume), of absolute alcohol: Take the specific gravity (to four decimals) of a sufficient portion of the red wine accurately measured at the temperature of 15.6°C. (60°F.), evaporate the wine in a tared dish to one-third of its original weight, cool, and add water until the liquid measures its original volume at 15.6° C. (60°F.); then take the specific gravity (to four decimals) again. The difference between the two specific gravities deducted from 1.0000 corresponds to the specific gravity of an alcohol containing the same percentage of absolute alcohol, by weight or volume, as the wine under examination, the corresponding percentage being ascertained by referring to the alcohol tables."—U. S.

Action and Uses.—Red wine differs from white wine chiefly in containing a larger quantity of tannic acid than the latter. Because the tannic acid somewhat retards the absorption of the alcohol, red wine is preferred in convalescence where more of a tonic and less of an excitant effect is desired, and, on the other hand, is less serviceable as a remedy in low febrile states where a rapid, stimulating action is necessary. It is of particular benefit if slight laxity of the bowels occurs during convalescence.

VIOLA TRICOLOR.—Viola Tricolor.

Herba violæ tricoloris, P. G.; *Herba jaceæ.*—*Pansy, Heart'sease*, E.; *Pensée sauvage*, Fr. Cod.; *Stiefmütterchen, Freisamkraut, Dreifaltigkeitskraut*, G.; *Trinitaria*, Sp.

The dried wild-grown flowering herb of *Viola tricolor* L. (Fam. *Violaceæ*).

Origin.—The violets are mostly perennial, or rarely annual or biennial herbs, with alternate stipulate leaves, and with axillary flowers having five persistent auriculate sepals, five unequal petals, of which the lower one is saccate or spurred, five strongly connivent stamens, of which the two lower ones bear a spurred nectary upon the back, and one superior pistil with three placentæ, ripening into a 3-valved, many-seeded capsule; the globular or ovate seeds have a small caruncle and hard testa, and contain a straight embryo imbedded in fleshy albumen. The species official in the Pharmacopœia of 1880 is an annual or biennial indigenous to Europe and northern Asia, naturalized in the United States, and frequently cultivated in many varieties as an ornamental plant.

Description.—Pansy has a thin, spindle-shaped root and an erect or ascending angular and branching, nearly smooth stem, 10 to 20 Cm. (4–8 In.) high. The leaves vary between roundish cordate and oval, between crenate and nearly entire, are about 25 Mm. (1 In.) long, petiolate, and have prominent, leaf-like, lyrately pinnatifid stipules. The flowers are on long peduncles, and have the corolla partly yellowish, blue, and purple, or occasionally variegated and longer than the calyx (variety *vulgaris* Koch), or the corolla scarcely exceeds the calyx, and is yellowish or occasionally partly purplish (var. *arvensis*). The last form is the only one recognized by the French Codex; it is frequent in sandy fields of North America, and apparently indigenous. The dry herb is inodorous and has a bitterish, mucilaginous, and slightly acrid taste, the acridity residing mainly in the root.

Fig. 471.

Viola tricolor (¾ Nat.).

Constituents.—V. tricolor contains much gum, a little sugar resin, potassium nitrate, a small and variable amount of free salicylic acid and the yellow coloring matter *viola-quercitrin*, which yields 3 molecules of water, 1 of quercetrin, and a fluorescent body.

Action and Uses.—Viola tricolor was formerly employed as a "blood-purifier" and as a remedy in chronic affections of the lungs and intestines and in many cutaneous diseases, but is no longer used in scientific medicine. The alkaloid violine found in the roots of sweet violet (*V. odorata*) and in other members of the species resembles emetine in its effect, causing nausea, vomiting, and purging. A decoction of the root was used in the treatment of pulmonary diseases, and like ipecac in dysentery. A syrup of violets, made from the plants and flowers, is occasionally given as a mild laxative to children.

Other Species.—*Viola* L. contains more than 200 species, of which a score or more have been medicinally employed.

V. odorata L. (*Violette odorante*, Fr. Cod.; *Sweet* or *English violet*, E.; *Märzveilchen*, Ger.; *Violeta*, Sp.) is indigenous to Europe and northern Asia, is frequently cultivated, and grows to a certain extent spontaneously in various parts of North America. It has an oblique rhizome and produces long, filiform runners. The leaves are reniform or heart-shaped, obtuse, and crenate. The flowers are dark blue or sometimes whitish, bearded, and have a very agreeable odor. For pharmaceutical purposes the dark-blue flowers alone are collected, deprived of the calyx, and only the corolla is used, in the fresh state, for preparing Syrupus Violæ Odoratæ, *Fr. Cod.* Fresh violet-petals, 10 parts; boiling water, 20 parts; in 21 parts of the infusion dissolve 38 parts of sugar. V. odorata contains, especially in its rhizome, the alkaloid *violine*, which is obtained by removing from the alcoholic extract chlorophyll and fat by means of ether, boiling the residue with diluted sulphuric acid, adding to the filtrate lead oxide, evaporating, and exhausting the residue with strong alcohol. Violine is a yellowish, bitter, and fusible powder, which is more readily soluble in water than emetine, but less so in alcohol; is insoluble in ether, and appears to combine with acids to form not well-defined saline compounds. It merits further investigation. The blue coloring matter of violets turns green, and afterward yellow, with alkalies.

The flowers of this plant yield the highly fragrant body ionone.

V. pedata L., the Bird's-foot violet of the central and eastern United States, has been extensively used, and was at one time official.

Violaceæ, the *Violet Family.*—Many members of this family, especially in the genus *Hybanthus* Jacq. (more commonly known as *Ionidium* Vent.), possess ipecac-like properties similar to those of the violets, which are probably referable to the alkaloid violine. It chances also that the roots of a number of them resemble ipecac in appearance and have been used as substitutes for it. Among them, besides the "Ionidiums," are *Anchietea salutaris* St. Hil., the *Sipó* or *Sumá*, of Brazil, and several species of *Corynostylis*.

VITACEÆ.—The Vine or Grape Family.

This family comprises only about a dozen genera and 500 species of tendril-bearing shrubs. Its economic importance is great, through its production of grapes, raisins, wine, and brandy. Its medical importance relates chiefly to the last two, considered elsewhere. Unfermented grape-juice, containing very small proportions (1–1.5 per cent.) of alcohol, has of late years been extensively introduced. The following is also of some pharmaceutical importance:

Uvæ (Br.), *Uva passæ* (U. S., 1870), *Passulæ, Raisin* (Fr. Cod.).—*Raisins*, E.; *Rosinen, Zibelen*, G.; *Pasas*, Sp.

The dried ripe fruit of *Vitis vinifera* L. This species is indigenous to western Asia and probably to northern Africa, and has been cultivated in Europe from a very early period; it has been introduced into North America, chiefly on the Pacific coast, and into other temperate countries. A large number of varieties have been produced, differing in the shape, size, and color of their berries and in other characters. Some botanists refer the different varieties of grapevine to three or four species. The grapes commonly cultivated in the open air in central and eastern North America are cultivated varieties of native species, mostly of *V. Labrusca* L.

Until recently the world was chiefly dependent for its raisin supply upon southern Europe, especially Spain; but California has now come to occupy first place, at least so far as the United States is concerned. Between 1876 and 1900 the exportation of Malaga raisins to the United States decreased more than 95 per cent. When the grapes are ripe their stalks are cut half through, or a portion of the bark is removed, and the grapes are allowed to remain upon the vines for a few weeks, and then cut off, sometimes steeped for a short time in a weak lye to remove the waxy bloom, and then completely dried; or the ripe grapes are cut off, spread out upon a hard clay floor, and dried by exposure to the sun, which requires a week or two. In rainy weather artificial heat is used for drying them.

The ripe berry of the grapevine is one-celled from the obliteration of the cell-wall, and is globular or oblong in shape. After drying it is shrivelled and flattened, more or less orbicular, of a brownish color, and somewhat translucent. When long kept, raisins become more opaque, owing to the crystallization of the sugar and cream of tartar. Raisins are produced in southern Europe, and in commerce are distinguished generally by the ports of exportation.

Malaga raisins (*Uvæ malacensis*, Fr. Cod.; *Passulæ majores*) are the ordinary large raisins of southern Europe. Valencia raisins are removed from the bunch, while Muscatel raisins are sold upon it. Sultana raisins are smaller and are seedless. They formerly came from Asia Minor, but are now produced also in California. Corinthian raisins (English, Greek, or Zante currants; *Uvæ Corinthiacæ*, Fr. Cod.; *Passulæ minores*) are a small variety produced in Greece, sold after being removed from the bunch, and pressed together in hard, dark masses. The skin of ripe grapes contains tannin and coloring-matter. The chief constituents of the pulp are grape-sugar and acid potassium tartrate, besides gummy matter, calcium tartrate, and a small quantity of malic acid. The seeds contain about 5 per cent. of tannin, green resin, and over 10 per cent. of a bland oil.

The tender branchlets (*Pampini vitis*) with the leaves are sometimes employed for their agreeable acidulous flavor. The unripe berries (*Agresta*) contain a considerable amount of tartaric acid, and yield, when expressed, a very acerb juice (*Omphacium*), which after fermentation is *Suc de verjus* (Fr. Cod.).

Ampelopsis (*Virginia creeper, False Grape, American* or *Five-leaved ivy*, E.; *Vigne vierge*, Fr.; *Wilder Wein, Amerikanisher Epheu*, G.) is the bark and young branches of *Parthenocissus quinquefolia* (L.) Planch. (*Hedera q.*—L.; *Ampelopsis q.*—Mx.; *Cissus q.*—Pers.; *Vitis hederacea* Willd.), a very common and abundant woody climber, resembling a grapevine, of central and eastern North America, and extending into the West Indies. It climbs by means of sucking disks at the ends of its tendrils, and also by means of rhizoids. It is commonly cultivated for decorative purposes, the autumn foliage being very showy. It has digitate leaves composed of five oblong lanceolate, somewhat serrate leaflets, and cymose clusters of greenish flowers with five unconnected deciduous petals, and produces two-celled and two- or four-seeded acidulous blue-black berries of the size of a pea. The herbage is acidulous, from the presence of tartaric acid and its salts, and has been used as a refrigerant and diuretic. Other members of the family are used similarly.

VITELLUS OVI.—Yolk (Yelk) of Egg.

Jaune d'œuf, Fr.; *Eidotter, Eigelb*, G.; *Yema de huevo*, Sp.

The yolk of the egg of *Gallus Bankiva*, var. *domestica* Temminck (*Phasianus Gallus* L.—Order *Gallinæ*).

Origin.—The domestic fowl originated from the red jungle-fowl, *G. Bankiva*, which inhabits Japan and the adjacent islands, Northern India, Cochin China, and the Philippines. At the present time numerous varieties of it are found in all civilized countries. The egg (*Ovum*, U. S., 1870, *Ovum gallinaceum; Egg*, E.; *Œuf de poule*, Fr.; *Ei*, G.; *Huevo*, Sp.) consists of the shell and lining membrane 10.7 parts, albumen 60.4 parts, and yelk 28.9 parts (Prout, 1822).

Description and Composition.—The yolk of egg is a viscid yellow or reddish-yellow opaque liquid, which is without odor, has a bland taste, an alkaline reaction, and must be regarded as a dense emulsion consisting of oil suspended in water by

means of albumen. When triturated with water a whitish emulsion is obtained; the addition of alcohol causes it to coagulate, and when agitated with ether it separates a white mass and yields to ether an orange-yellow fat. Yolk is coagulated by heat. It contains 48 to 55 per cent. of water, 16 to 18 per cent. of vitellin (which is probably a proteid closely related to casein, and mixed with about one-fourth of albumen), 29 to 31 per cent. of fat (21.3 parts of which are olein and margarin, according to Gubley), 1.5 per cent. inorganic salts, coloring-matter, a small portion of sugar, and 0.42 of colesterin. Gubley has separated from the ethereal extract of yolk a substance which he named lecithin, and which on boiling with baryta yields neurine and stearic and phosphoglyceric acids. The fat obtained by expressing the coagulated yolk or by exhausting it with ether is occasionally used under the designation of oleum ovi (*oil of eggs*, E.; *huile d'œufs*, Fr.; *Eieröl*, G.).

Preservation.—Eggs may be preserved for a considerable length of time by covering the shell with a substance impervious to water, thus closing the pores so as to exclude the air. This may be done by wax, fat, paraffin, gum, or by similar substances. Packing them with the small end downward in dry salt, milk of lime, etc., has likewise been recommended.

Pharmaceutical Uses.—The yolk of egg is employed for emulsionizing fixed and volatile oils and camphors. It has no medicinal properties. The glycerite of yolk of egg (glyceritum vitelli ovi, U. S. P., 1890), also known as *glyconin*, is no longer official.

W.

WINTERA.—Winter's Bark.

Cortex winteranus.—Magellan Canella, Winter's cinnamon, E.; *Écorce de Winter*, Fr. Cod.; *Cannelle de Magellan*, Fr.; *Winter's Zimmt*, G.; *Corteza Winterana*, Sp., *Casca de Anta* or *de Tapir*, Port.

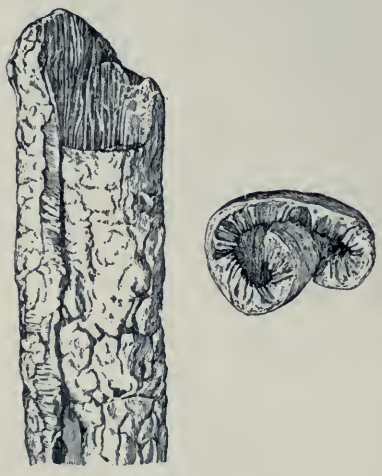
The dried bark of *Drimys Winteri* Forster (*Wintera aromatica* Murr.—Fam. *Magnoliaceæ*).

The prevailing view of systematic botanists is that all the forms of this plant growing from Mexico to Cape Horn should be included in the above species, which would thus reduce to synonyms the names *D. mexicana* Moc. et Sessé, *D. chilensis* DC., *D. granatensis*, L. f., and many others. From a study of the barks alone we should be led to reject this view, and we anticipate the separation of these forms into a group of species. Reports of analyses and other investigations should therefore be rigidly scrutinized as to the botanical source of the drug represented before being applied to the species here considered.

Description.—The bark occurs in very closely curled quills, occasionally as large as a man's wrist, and is distinguished by the great thickness of the bark, sometimes reaching 1 Cm. (nearly ½ In.). Externally it is dark gray, brown, or blackish, though the color is mostly concealed by a dense growth of whitish or gray lichens. The inner surface is of a deep rust brown and traversed by bast striæ in the form of strongly projecting blade-like ridges, separated by narrow, deep grooves, more prominent than in any other medicinal bark. The fracture is short and earthy, deep-red brown, coarsely mottled with whitish sclerenchyma, in tangentially elongated groups toward the cork, radially elongated toward the inner edge, and elsewhere scattered. Abundant resin-cells are visible, chiefly in the outer or inner zones. The odor is fragrant, the taste bitter and aromatic and bitingly pungent.

Origin.—These plants grow in the vicinity of the Cape as shrubs or dwarf trees, so gregariously that it is said to be less difficult for forest animals to travel over the surface of the mass than among the stems. Toward the north their growth becomes less dense, and their habitat is at a higher altitude, until, in the tropics, they are found only in the higher Andes. The typical plant appears to grow only in the extreme south.

FIG. 472.



Winter's bark (Nat.).

The properties of Winter's bark were made known by Captain Winter, of the British Navy, who, while cruising about the Cape, became storm-bound, ran out of supplies, and found his men dying of scurvy, of which they were cured by this bark, the properties of which he learned from the aborigines.

This most excellent aromatic bitter and anti-scorbutic has suffered greatly in reputation owing to the common substitution of a number of other barks for it, chiefly canella alba, cinnamodendron corticosum, and even cusparia. The bark of *D. granatensis*, which has come under our observation, has not the sharp bast ridges nor is it so pungent.

Constituents.—Winter's bark yields 0.65 per cent. of crude volatile oil, of which the essential part is *winterene* ($C_{15}H_{24}$), which distils between 255° and 260° C. (491°–500° F.), and has a specific gravity of about 0.935. Upon exposure it readily oxidizes and becomes yellow. The ethereal extract is a dark-brown viscid substance, containing a peculiar essence, fatty compounds, resins, and waxy matter, and showing no crystals on long stand-

ing. The alcoholic extract yields reddish uncrystallizable resins. The bark contains no citric acid, little or no tannin, and no ferric oxide, which have been reported in it. The bark of *D. granatensis* contains crystalline *drimin* ($C_{13}H_{14}O_4$). An attempt has been made to connect this variety with coto, but Hesse has shown that it contains no cotoin, and it certainly is not related. The leaves yield a wax alcohol, *drimol* ($C_{28}H_{58}O_2$). The Australian species, *D. axillaris* Forst and *D. lanceolata* have likewise pungently aromatic barks, and the fruit of the latter is used like pepper.

Action and Uses.—Winter's bark has aromatic properties resembling those of cascarilla. It is used as a tonic to the digestive organs, increasing the appetite and improving the digestion. The dose is from 20 to 30 grains (1.30–2 Gm.), given in powder or infusion.

X.

XANTHORRHŒA.—Acaroides Resin.

Resina lutea.—Acaroid, Yellow, Botany-Bay, Black-boy or Grass-tree Resin or *Gum.*

The solid balsam exuding from several species of *Xanthorrhœa*, Smith (Fam. *Liliaceæ*).

Origin and Description.—These plants are stout shrubs or small trees, with crooked terminal masses of grass-like leaves, native of dry regions in Australia. The resin is collected in the form of lumps or tears which concrete among the leaf-bases after spontaneous exudation. The head of leaves is chopped to pieces, and the resin threshed off. A large plant may yield more than 50 pounds. There are two varieties, known respectively as the red, chiefly from *X. arborea* R. Br., and the yellow, chiefly from *X. hastilis* R. Br. The latter, here described, is much the more fragrant and active, and is to be understood by the title, in the absence of other specification. The red is more commonly understood by the term "Black-boy Resin." A third variety, of orange-yellow color, from *X. tateana*, is of intermediate quality.

These resins occur, like dragon's-blood (see RESINA DRACONIS), in various forms, mostly in irregular, rough, brittle lumps, the color varying with the variety, as above defined. The odor is more or less benzoin-like.

Constituents.—The composition of the red and yellow varieties differs considerably. Tschirch and Hildebrand state that the yellow consists chiefly of resin which is mostly paracumaric ether of the resin alcohol xantoresinol ($C_{43}H_{46}O_{10}$). Xantoresinol yields much benzene and toluene. Vanillin, styracin, paracumaric, and cinnamic acids and the phenol-propyl ester of the latter occur. Of the red variety, the resin alcohol is called erythroresinotannol ($C_{40}H_{40}O_{10}$), and its paracumaric ether comprises most of the resin. There is much paracumaric but no cinnamic acid in this variety.

Action and Uses.—Acaroides resin has similar virtues to balsam of Tolu and storax. It is rarely used in medicine, but the red variety is employed to impart its color to varnishes.

XANTHOXYLUM, *U. S.*—Prickly Ash.

Toothache-tree, Suterberry-tree, Angelica-tree, or *Pellitory Bark*, E.; *Zahnwehrinde, Zahnwehholzrinde*, G.; *Clavalier, Frêne épineux*, Fr.

The dried bark of *Xanthoxylum Americanum* Miller (*X. fraxineum* Willd.), the *Northern Prickly Ash*, or of *Fagara Clava-Herculis* (L.) Small (*Xanthoxylum* C.—L.; *X. Carolinianum* Lam.), the *Southern Prickly Ash* (Fam. *Rutaceæ*).

Xanthoxylum is not official in any other pharmacopœia.

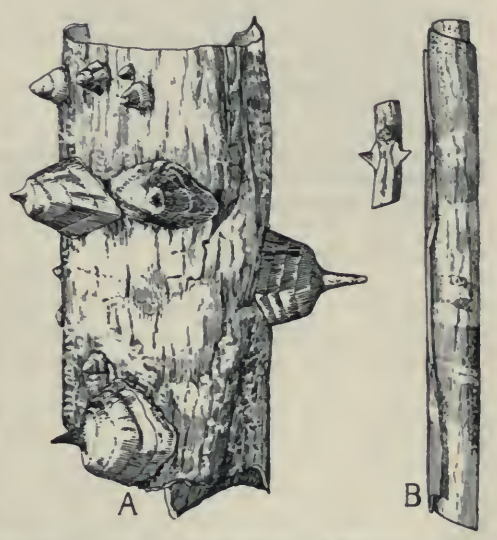
Origin.—These two genera of plants, so long confused with one another, are well distinguished by the absence of a corolla from the flowers of *Xanthoxylum*, while it is present in *Fagara.*

The Northern Prickly Ash occurs as a prickly shrub or very small tree throughout eastern and central North America, where the bark has been commonly used medicinally from aboriginal times. The Southern Prickly Ash varies from the size of a shrub to that of a tree, with a trunk diameter of 1 or 2 feet. It grows mostly in the Atlantic and Gulf States, from Virginia southward and westward. The trunk is prickly when young, afterward losing the prickles, but retaining the large corky warts upon which they were borne.

Description.—NORTHERN PRICKLY-ASH BARK occurs in small curved or quilled fragments, about 5 Cm. (2 In.) or less long, mostly about 1 Mm. ($\frac{1}{25}$ In.) thick, and occasionally mixed with pieces nearly 3 Mm. ($\frac{1}{8}$ In.) thick; corky layer very thin, of a brown-gray color, nearly smooth or faintly furrowed longitudinally, occasionally superficially fissured transversely, marked with some scattered warts, becoming transversely elongated, and usually bearing irregular whitish patches, numerous minute, black, and shining hemispherical dots, which are the perithecia of a lichen, probably a species of *Verrucaria*, and few brown,

glossy spines about 6 Mm. (¼ In.) long, straight, two-edged, and having a narrow linear base about 18 Mm. (¾ In.) long; outer bark, beneath the corky layer, of a green color, the inner bark whitish or yellowish; inner surface smooth, or finely striate if obtained from older branches; quite brittle, breaking with a short, non-fibrous fracture, and exhibiting upon transverse section a somewhat tangential arrangement of the tissue; inodorous, and of a slightly aromatic, bitterish, and strongly pungent taste.

Fig. 473.



Xanthoxylum bark: *A*, Southern; *B*, Northern (⅓ Nat.).

Southern Prickly-ash Bark occurs in very large quills or sheets, 1 to 2 Mm. ($\frac{1}{25}$–$\frac{1}{12}$ In.) thick, externally of a light purplish gray, with large silvery-gray patches, and marked by many large corky projections, often 2 Cm. (nearly 1 In.) high, many of them bearing stout brown spines; otherwise like the northern.

The cross-section exhibits narrow, nearly straight medullary rays, numerous scattered oil cells and calcium oxalate cells.

The bark of *Aralia spinosa* L. is known by the same common names as *xanthoxylum*, and is said to be occasionally substituted for it, doubtless by accident. It is transversely ridged, these ridges commonly bearing slender spines. Its taste is much less bitter and biting than that of xanthoxylum.

Constituents.—Although not absolutely identical, the two xanthoxylum barks are very similar in their composition. Both contain small amounts of volatile oil, fat, sugar, gum, acid resin, a bitter alkaloid believed to be berberine, and a colorless, tasteless, inert crystalline body, slightly different in the two barks, that of the northern having been named *Xanthoxylin*. Starch is wanting. Both barks yield a large amount of ash (12 per cent. or more), about a fifth of it water-soluble, the rest soluble in hydrochloric acid.

Xanthoxylum Fruits (*Prickly-ash Berries*).—The fruits of both the official species are used similarly to the barks. Each fruit consists of from 1 to 3, or occasionally 5 follicles, each about 5 to 8 Mm. in length, and about two-thirds as broad. In the northern species the follicles are separated, each on a short thecaphore; in the southern they are contiguous and sessile. The pericarp is dry, greenish gray-brown and roughish without, paler and smooth within, and contains one, or occasionally two, black seeds. Both pericarp and seeds are aromatic, pungent, and bitter, though the taste of the two is quite different. Their constituents have not been investigated, but they apparently agree in a general way with those of the bark.

Fig. 474.

Xanthoxylum, fruits and seeds: *A*, Southern; *B*, Northern.

Pharmaceutical Preparation.—Fluidextract of Xanthoxylum.—U. S. P.

Action and Uses.—The medicinal qualities of xanthoxylum are not well defined. It has mild diaphoretic properties, due, perhaps, to its feeble stimulant action upon the circulation and nervous system. Locally it is an irritant, and has been used as a sialagogue and as a topical application to influence deep-seated inflammation. Its employment as a remedy in chronic constitutional syphilis and rheumatism is based upon the resemblance of its virtues to those of mezereon and guaiac. It has also been used as an emmenagogue. The dose of prickly ash is from 20 to 60 grains (1.30–4 Gm.), administered in fluidextract or decoction. As a counterirritant, the decoction may be applied on compresses.

Other Species.—The genus *Fagara*, L., comprises, according to Engler, about 130 species, distributed through all warm and tropical regions; *Xanthoxylum*, L., about 9 species,

of temperate Asia and North America. Almost wherever these plants occur they have important uses, based on their aromatic, bitter, pungent, stimulating, and alterative properties. *F. Caribæa* (Lam.) Krug et Urb. (*X. Caribæum* Lam.), of the West Indies and northern North America, has been found to contain an alkaloid fatal to frogs and guinea-pigs. The fruits of *F. alata* Eckl. et Zeyh. (*X. alatum* Steud.) and of *Xanthoxylum piperitum* DC. are used in Japan as substitutes for pepper, and their barks for poisoning fishes.

F. Xanthoxyloides Lam. (*Xanthoxylum Senegalense* DC.) is the *Artar-root*, and contains two alkaloids, one named *artarine* ($C_{21}H_{23}NO_4$). In the Philippines, the bark of *F. oxyphylla* Edgew. is known as *Kayertana*. In Paraguay, that of *F. hyemalis* (St. Hil.) Engl. (*Xanthoxylum h.*—St. Hil.) is called *Tembotary Hu*, and in Brazil, that of *F. Tinguassiba* (St. Hil.) (*Xanthoxylum T.*—St. Hil.) is called *Casca de Tinguacibo*. *F. Retza* Roxb. (*Xanthoxylum R.*—DC.) is the *Rhetsa-Maram* of India, the root used as a purgative. *F. Budrunga* Roxb. is the East Indian *Budrang*. More than 30 species of these two genera are recorded as being medicinally employed.

Z.

ZEA, *U. S.*—Zea; Corn-silk.

Stigmata maydis.—Filament de mais, Fr.; *Maispistille*, G.; *Estyletes (Barbas) de Milho*, Port.

The styles and stigmas of *Zea Mays* L. (Fam. *Gramineæ*).

Origin.—The Indian Corn, or Maize plant, native of tropical America, and cultivated in all warm-temperate and tropical countries, is too well known to require description. The "corn silk" of the ear, the female inflorescence, constitutes the drug. There seems good reason to believe that its properties are more active in the fresh than in the dry condition, allowing for the loss of about 80 per cent. in weight.

It forms a loose, filamentous, tangled mass, green and usually partly reddish toward the summits of the filaments, drying of a dark reddish-brown. The styles are about 15 Cm. (6 In.) long, soft-silky, and very finely plumose, longitudinally delicately veined. It has a faint odor and a sweetish taste.

Constituents.—The only specific constituents of corn silk which are definitely known, and upon which its activity may depend, are its *resin* and *maizenic acid*. The latter is crystalline and soluble in both alcohol and water, as well as ether. Although the attempt to obtain volatile oil was unsuccessful, there is some volatile substance, since the drug has a distinct odor. Hillan, by treating it with an alkali and then distilling, obtained a very small amount of a substance which was basic and afforded alkaloidal reactions. Rademacher and Fischer obtained 5.25 per cent. of fixed oil, but it is probable that this percentage would vary considerably with the relative maturity. Small amounts of sugar, gum, and other ordinary plant principles were encountered. The ash amounts to about 12 per cent.

Action and Uses.—Corn-silk has diuretic and mild anodyne virtues. Its use is directed toward the alleviation of strangury, vesical pain, tenesmus, and other symptoms of the urinary tract, especially those due to phosphatic and uric-acid gravel. By French physicians it was highly esteemed as a diuretic in cardiac and renal dropsy. It appears to act more favorably in chronic than acute disorders of the urinary organs. The best preparation to administer is the infusion (2 ounces to the pint [60 Gm: 480 Cc.]), given in wine-glassful doses several times a day. The dose of the fluidextract is from ½ to 2 drachms (2–8 Cc.).

ZINCI ACETAS, *U. S.*, *Br.*—Zinc Acetate.

Zincum aceticum, P. G.; *Acétate de zinc*, Fr. Cod.; *Zinkacetat, Essigsaures Zinkoxyd, Essigsaures Zink*, G.; *Acetato de zinc*, Sp.

Formula, $Zn(C_2H_3O_2)_2 + 2H_2O$. Molecular weight, 217.82.

The Br. P. gives $Zn(C_2H_3O_2)_2 + 3H_2O$, but it has been proven that only 2 molecules of water are present.

It should contain in the uneffloresced condition not less than 99.5 per cent. of the pure salt, and should be kept in well-stoppered bottles.—U. S.

Preparation.—Digest for some time commercial zinc oxide (or carbonate), 2 parts, in acetic acid and distilled water, each 5 parts; then heat to the boiling-point, filter while hot, and set aside to crystallize. Drain the crystals in a funnel, and dry them upon bibulous paper. An additional quantity of crystals may be obtained by evaporating the mother-liquor to one-half, slightly acidulating with acetic acid and crystallizing.

On digesting zinc oxide or carbonate with acetic acid, the zinc is dissolved, in the latter case with the evolution of carbon dioxide; $ZnO + 2HC_2H_3O_2$ yields $Zn(C_2H_3O_2)_2 + H_2O$. An excess of the zinc compound is used to avoid loss of acetic acid, and is removed by filtration. The mother-liquor should be evaporated without boiling, so as to avoid loss of acetic acid and the formation of basic salt; acidulating the concentrated mother-liquid with a little acetic acid will restore the normal from the basic acetate, should the latter have been formed.

Properties.—Zinc acetate crystallizes in soft white pearly 6-sided tablets or scales, which on exposure to the air lose their transparency from the evaporation of some acid and water of crystallization, and have a slight acid reaction, a slight acetous odor, and a sharp metallic taste. The salt melts readily in its water of crystallization, and on continuing the heat parts with the same, the loss amounting to 22.8 per cent., which is gradually reabsorbed in a moist atmosphere. On dry distillation acetic acid, carbon dioxide, acetone, and empyreumatic products pass over, a white pearly sublimate is formed, and zinc oxide, mixed with a little charcoal, remains behind; when strongly heated in the air upon a porcelain plate, the salt is decomposed and burns with a greenish light and the production of a white smoke of zinc oxide. At 25° C. (77° F.) the salt dissolves in 2.5 parts of water and in 36 parts of alcohol; in 1.5 parts (2 parts, P. G.) of boiling water and in 0.6 part of boiling alcohol. Treated with sulphuric acid, it is decomposed with the evolution of acetic acid. The aqueous solution of the salt acquires a dark-red color with ferric salts, the color being discharged on the addition of hydrochloric acid, and yields white precipitates with potassium ferrocyanide, hydrogen sulphide, ammonium sulphide, ammonium carbonate, and potassium hydroxide, the precipitates with the last two reagents being completely soluble in an excess of the precipitant, and the colorless solution giving again a white precipitate with hydrogen sulphide.

Tests.—10 Cc. of the aqueous solution of the salt (1 in 20), acidified with 1 Cc. of hydrochloric acid, should not be colored or made turbid when mixed with an equal volume of hydrogen sulphide solution, and kept corked at 35° C. (95° F.) for at least half an hour (absence of arsenic, cadmium, lead, and copper). A 5 per cent. aqueous solution, acidified with diluted nitric acid, should remain clear on adding solution of barium chloride (absence of sulphate) or silver nitrate (absence of chloride). Five Cc. of the aqueous solution (1 in 10) should not respond to the modified Gutzeit's test for arsenic given under ARSENI TRIOXIDUM.—U. S.

Action and Uses.—Zinc acetate is used locally as an astringent and irritant. A solution containing 1 to 2 grains (0.06–0.12 Gm.) to 1 ounce (30 Cc.) of water is employed as a collyrium in conjunctivitis, and as an injection in gonorrhœal urethritis and vaginitis after the acute symptoms have subsided.

A mixture of 1 part of zinc acetate and 4 parts of aluminum naphtholsulphonate (alumnol) has been recommended as an antiseptic and placed on the market under the name *Zinol.*

ZINCI BROMIDUM, *U. S.*—Zinc Bromide.

Zincum bromatum.—*Bromure de zinc*, Fr.; *Zinkbromid*, G.; *Bromuro de zinc*, Sp.

Formula, $ZnBr_2$. Molecular weight, 223.62.

It should be kept in small glass-stoppered bottles, and should contain, when anhydrous, at least 97 per cent. of the pure salt.—U. S.

Preparation.—This salt is most conveniently prepared by digesting granulated zinc in hydrobromic acid, in which it dissolves with the evolution of hydrogen; the solution (filtered through asbestos or powdered glass) is carefully concentrated, acidulated with a little hydrobromic acid, and dried by the heat of a water-bath.

Properties.—Zinc bromide crystallizes with difficulty from its aqueous solution, and is therefore usually obtained in the form of a white granular powder. The salt is very deliquescent, has a slight acid reaction, is inodorous, and has a sweet and styptic metallic taste in diluted solution. It is freely soluble in water and in alcohol, and is also soluble in ether. Its aqueous solution yields with silver nitrate a white curdy precipitate, which is insoluble in dilute nitric acid and nearly insoluble in ammonia; it gives pure white precipitates of zinc compounds with the reagents mentioned under ZINC ACETATE. The salt melts on heating to 394° C. (741.2° F.), with partial decomposition, to a colorless or yellowish liquid which boils near 700° C. (1292° F.), and sublimes in white needles.

Tests.—If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, then chlorine water previously diluted with an equal volume of water, cautiously drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint (absence of iodide). On adding ammonium carbonate test-solution to the aqueous solution of the salt, a white precipitate is produced, which should completely redissolve in an

excess of the reagent. This test shows the absence of iron, aluminum, calcium, etc. The aqueous solution (1 in 20), to which sufficient hydrochloric acid has been added to insure a clear solution, should not be affected by hydrogen sulphide when treated as described under ZINCI ACETAS (absence of arsenic, cadmium, lead, and copper). Another portion of this solution should not be changed by addition of barium chloride test-solution (absence of sulphate). 5 Cc. of the aqueous solution (1 in 10) should not respond to the modified Gutzeit's test for arsenic given under ARSENI TRIOXIDUM. If 1 Gm. of the salt be dissolved in 50 Cc. of acetic acid, 2 Gm. of lead oxide (free from chloride) be added, and the mixture evaporated in a small beaker to at least 10 Cc., then the residue, diluted with 10 Cc. of distilled water and filtered, should give not more than a slight turbidity on the addition of 2 Cc. of nitric acid and a few drops of silver nitrate test-solution (limit of chloride). The object of this test is to get rid of the bromine by oxidation with the lead dioxide, thus, $PbO_2 + 2HBr + 2HC_2H_3O_2 = Pb(C_2H_3O_2)_2 + 2H_2O + 2Br$, lead acetate being formed. Chloride is not affected under the same conditions. If 0.3 Gm. of the anhydrous salt be dissolved in 10 Cc. of water, and 2 drops of potassium chromate test-solution be added, it should require not less than 26 Cc. nor more than 26.8 Cc. of tenth-normal silver nitrate solution to produce a permanent red color, corresponding to not less than 97 per cent. of the pure salt.—U. S. Each Cc. of the silver nitrate solution corresponds to 0.011181 Gm. of pure $ZnBr_2$, hence 0.3 Gm. of the pure salt would require theoretically 26.83 Cc. of the silver nitrate solution, and this is practically the same as the upper limit in the official titration, 26.8 Cc., which therefore represents almost 100 per cent. purity. The lower limit, 26 Cc. of silver solution, represents 0.2907 Gm. of $ZnBr_2$, or 96.9 per cent. If the upper limit of silver solution be overstepped appreciably, it would indicate an excess of chloride in the bromide which would also be apparent in the lead dioxide test for chloride.

Action and Uses.—Zinc bromide was proposed as a remedy in epilepsy, but is not used at present. If it be given in sufficient quantity to produce a bromide effect, enough of the zinc base would be ingested to cause symptoms of poisoning. The dose is stated to be from 1 to 2 grains (0.06–0.12 Gm.).

ZINCI CARBONAS PRÆCIPITATUS, *U. S.*—Precipitated Zinc Carbonate.

Zinci carbonas, Br.; *Zincum carbonicum.—Carbonate (sous-) de zinc hydraté, Hydrocarbonate de zinc*, Fr.; *Zinkcarbonat, Kohlensaures Zinkoxyd*, G.

Formula, $2ZnCO_3.3Zn(OH)_2$ (?). Molecular weight, 544.88 (?).

The British Pharmacopœia gives $ZnCO_3.2Zn(OH)_2.H_2O$, which is also found in nature.

Hydrated zinc carbonate, which, upon ignition, should yield not less than 72 per cent. of zinc oxide.—U. S.

Preparation.—Add a solution of 30 parts of crystallized zinc sulphate in 150 parts of water slowly from a dropping funnel to a filtered solution of 32 parts of crystallized sodium carbonate in 180 parts of water heated to boiling, and stir constantly. After boiling for 15 minutes, the flocculent precipitate becomes more granular and readily subsides. Decant the liquid and wash the precipitate with hot water, first by decantation and finally on the filter until the filtrate no longer gives a precipitate with barium chloride solution (sulphate). Press the filter and dry at 50° C. (122° F.).

The composition of the precipitated carbonate is variable, depending on the conditions of precipitation, as temperature, concentration, and drying of the salt. It contains 5 to 7 ZnO to $2CO_2$, but the proportion of water is variable. The formula given above is that formerly recognized by the U. S. P., while $3ZnCO_3.5Zn(OH)_2.H_2O$ is given by the French Codex. On mixing cold solutions of sodium carbonate and zinc sulphate, neutral zinc carbonate is precipitated; $Na_2CO_3 + ZnSO_4$ yields $Na_2SO_4 + ZnCO_3$. The gelatinous precipitate rapidly undergoes decomposition, carbon dioxide being evolved; and this renders another portion of the precipitate soluble. But if the mixture is boiled, the carbon dioxide is expelled from the liquid and the whole of the zinc is precipitated. Adding the solution of zinc sulphate to that of sodium carbonate while boiling hot keeps the precipitate free from sodium compound, and the sodium sulphate which is formed at the same time is readily removed by washing with water. Potassium carbonate is not so well adapted for this process as the sodium salt, because the resulting potassium

sulphate is less freely soluble in water; and ammonium carbonate is unsuitable, since a complete precipitation of the zinc cannot be affected.

Properties.—Zinc carbonate is a soft, impalpable, white, inodorous, and tasteless powder, permanent in the air, insoluble in water and other simple solvents, but dissolving readily in acetic and dilute mineral acids, with the evolution of carbon dioxide, and soluble also in aqueous solutions of ammonium salts. When heated in a crucible to redness it parts with its water and carbon dioxide and leaves oxide of zinc, which is yellow while hot, but white when cold.

Tests.—A small quantity of the salt, when moistened with a drop of cobaltous nitrate test-solution and heated before the blow-pipe, assumes a vivid green color (test for zinc). For tests of identity and purity, a solution is prepared by digesting 1.25 Gm. of the salt with 10 Cc. of diluted sulphuric acid and 10 Cc. of water, and, after action ceases, filtering off the excess of undissolved salt. In a portion of this solution a white gelatinous precipitate is produced by potassium ferrocyanide solution, and a pure white precipitate by ammonium sulphide solution. A coloration in these tests would indicate other metals. Another portion of the solution, acidulated with hydrochloric acid and mixed with an equal volume of hydrogen sulphide solution, should be unaffected after standing corked at 35° C. (95° F.) for at least ½ hour (absence of arsenic, cadmium, lead, and copper). Another portion of the solution should yield, with ammonium carbonate test-solution, a white precipitate which should dissolve completely in an excess of the reagent (absence of aluminum, calcium, etc.). If 1 Gm. of the salt be placed in a flask with 10 Cc. of boiling water and 2 drops of phenolphthalein test-solution be added, not more than one Cc. of tenth-normal hydrochloric acid solution should be required to discharge the red color (limit of alkali). One Gm. of the salt, after strong ignition in a porcelain crucible, should leave a residue of zinc oxide weighing not less than 0.72 Gm.—U. S.

Action and Uses.—Zinc carbonate is employed in ointment chiefly as a protective and mild astringent to abraded surfaces, superficial burns, and sluggish ulcers. As a dusting-powder, it allays the irritation of intertrigo.

ZINCI CHLORIDUM, *U. S., Br.*—Zinc Chloride.

Zincum chloratum, P. G.—*Chlorure de zinc*, Fr. Cod.; *Zinkchlorid, Chlorzink*, G.; *Cloruro de zinc*, Sp.

Formula, $ZnCl_2$. Molecular weight, 135.26.

It should contain, when anhydrous, not less than 99.5 per cent. of pure salt, and be kept in small glass-stoppered bottles.—U. S.

Preparation.—The directions for preparing Liquor Zinci Chloridi (p. 921) may be followed, except that the last filtrate is to be evaporated in a porcelain basin until a portion of the liquid, withdrawn on the end of a glass rod and cooled, forms an opaque white solid; the liquid is then poured into proper molds, and when the salt has solidified, but before it has cooled, it is placed in closely-stoppered bottles.

The reactions occurring in the preparation and purification of zinc chloride are explained on page 921. Since zinc chloride destroys vegetable fibre and transforms cellulose and starch into soluble modifications, its solution should not be filtered through paper, but through asbestos or powdered glass; otherwise the fused salt will be black. Toward the close of the evaporation of the solution the heat should be regulated so as not to decompose the salt, and in case the fused mass should become opaque from the separation of basic salt a little hydrochloric acid should be added. If the salt is desired for solution in water, the liquid is evaporated and continually stirred until a granular powder remains, a few drops of hydrochloric acid being added toward the close of the process.

Properties.—Zinc chloride is either in the form of a white crystalline powder or in opaque tablets or rods. It is inodorous, has a strongly caustic and metallic taste, is very deliquescent on exposure, has an acid reaction, and when heated to a little over 100° C. (115° C. = 239° F., U. S.) it melts to a colorless liquid which congeals to a white mass; at a higher heat it is partly volatilized, forming white fumes, and leaves a yellowish residue of zinc oxide, but when heated in a current of chlorine gas the salt sublimes in acicular crystals. Zinc chloride is soluble in 0.4 part of water at 25° C. (77° F.), but usually yields with water an opalescent solution from the presence of a little oxychloride, which

is readily dissolved by a few drops of hydrochloric acid; the solution dissolves starch, paper, and other organic compounds. Zinc chloride dissolves also freely in alcohol, and somewhat less freely in ether. In contact with sulphuric acid it is converted into zinc sulphate. Its solutions yield white precipitates with ammonium sulphide, ammonia, and with silver nitrate, the last two being readily soluble in an excess of ammonia. On mixing a concentrated solution of zinc chloride with zinc oxide a plastic mass of zinc oxychloride is obtained, which soon hardens, and is used as a cement in dentistry.

Zinc chloride forms well-crystallized double salts with ammonium chloride and derivatives of ammonia, as aniline, alkaloids, etc. The zinc ammonium chloride in solution is used to dissolve the coat of oxide on surfaces to be soldered, and is prepared by dissolving 10 parts of zinc in 50 parts of commercial hydrochloric acid, diluting with 10 parts of water, and adding 10 parts of ammonium chloride.

Tests.—The pharmacopœial requirements for the purity of zinc chloride are as follows: The aqueous solution (1 to 20) should be clear, or at most only very slightly opalescent, and, if it be mixed with an equal volume of alcohol, a single drop of hydrochloric acid should suffice to render 10 Cc. of the mixture perfectly clear (limit of oxychloride). It should not respond to tests for heavy metals, arsenic, calcium, etc., when applied as directed under ZINC BROMIDE, nor should the aqueous solution be rendered turbid by the addition of barium chloride test-solution (absence of sulphate). Dissolve 0.5 Gm. of the salt in 200 Cc. of boiling pure water, add about 5 drops of phenolphthalein test-solution, and then sufficient sodium carbonate test-solution, with constant stirring, to cause the solution to assume a permanent red color; transfer the resulting precipitate to a plain filter, wash it with boiling distilled water until all soluble matter has been removed, then dissolve it in a sufficient quantity of nitric acid, evaporate the solution to dryness, and ignite the salt until it ceases to lose weight; the residue should weigh not less than 0.297 Gm.—U. S. The steps involved are conversion of the chloride into carbonate, this into nitrate, and the latter into oxide, that is, $ZnCl_2$ becomes ZnO. 80.78 parts of ZnO correspond to 135.26 parts of $ZnCl_2$, hence 0.297 Gm. of ZnO represent 0.49729 Gm. of $ZnCl_2$ in the 0.5 Gm. taken for assay, or 99.46 per cent.

Pharmaceutical Uses.—CAUSTIQUE AU CHLORURE DE ZINC, Fr. Cod.—*Chloride-of-zinc pencils*, E.; *Pâte de Canquoin*, Fr.—Dissolve zinc chloride 32 Gm. in cold distilled water, 4 Gm.; add zinc oxide, 8 Gm., previously mixed with well-dried wheat flour, 24 Gm.; triturate so as to obtain a paste, and form this into cylinders or other shaped pieces, which are to be completely dried in an air-bath at a temperature gradually raised from 50° to 100° C. (122°–212° F.).

Action and Uses.—Applied locally zinc chloride is a powerful and painful caustic, ranking with potassium hydroxide and arsenic. Its action is confined to the area of application, no constitutional poisoning occurring as occasionally happens from arsenic through absorption of the drug. The severity of its effect is in proportion to the degree of its dilution with inert substances, to the quantity employed and the duration of its contact. The eschar formed by zinc chloride is white, thick and bloodless, sometimes called mummified, possesses little odor of sloughing tissue and falls away in from 8 to 12 days, leaving a healthy, granulating surface beneath. Zinc chloride may be used as a caustic for the destruction of cutaneous cancers, nævi and other tumors, and rodent ulcer when the timidity of the patient or his abhorrence for surgical procedures will not permit of excision of the growth. The pain attendant upon the employment of the caustic is no less, in fact is frequently more severe than that caused by the knife, and the healing process is prolonged. For cauterant purposes the zinc chloride is mixed with flour, gluten, zinc oxide, calcium sulphate or other inert substance and sufficient water or glycerin added to make a paste. The proportion of the chloride to the vehicle is 1 to 2, 3, 4 or five parts according to the degree of corrosion desired. The paste should be freshly prepared and a layer of it applied to the growth, covered with absorbent cotton and allowed to remain for from 3 to 6 hours. If the skin be intact over the tumor it should be removed by a blister before the caustic is applied. Of late years the employment of zinc chloride by cataphoresis for the cure of deep-seated tumors has been advocated by G. B. Massey and others, but this method has not met with the approval of the best minds in the profession. In the treatment of inoperable cancer of the vagina and uterine cervix, relief from hemorrhage and the sickening odor of the sloughing mass may be obtained by curetting away as much of the growth as can be safely done and applying a 50 per cent. solution of zinc chloride to the base. A solution containing 1

grain (0.06 Gm.) to an ounce (30 Cc.) of distilled water is used as an injection in the second stage of gonorrhœa, and a weaker solution, 1 grain to 4 ounces (0.06 Gm. –120.0 Cc.), as a collyrium in conjunctivitis, especially that variety known as "pink-eye." Zinc chloride is of no value as an internal remedy, although it has been recommended as an antispasmodic in epilepsy and chorea.

ZINCI IODIDUM, *U. S.*—Zinc Iodide.

Zincum iodatum.—Iodure de zinc, Fr.; *Zinkjodid*, G.; *Ioduro de zinc*, Sp.

Formula, ZnI_2. Molecular weight, 316.7.

It should be kept in small, glass-stoppered bottles, protected from light, and should contain, when anhydrous, not less than 98 per cent. of the pure salt.—U. S.

Preparation.—This salt may be prepared by dissolving zinc oxide or carbonate in hydriodic acid, or, according to Doepp (1839), by digesting in a flask 3 parts of granulated zinc, 10 parts of iodine, and 20 parts of water until the liquid has become colorless, when it is filtered through asbestos or powdered glass, and rapidly evaporated to dryness at a moderate heat. The yield is 12½ parts. The salt should be at once put into vials, which are to be kept carefully stoppered.

Properties.—Zinc iodide resembles zinc chloride and bromide, is a white graular, crystalline, inodorous powder, and has a sharp, saline, and metallic or in diluted solution a sweetish and styptic taste and an acid reaction. On exposure it is very deliquescent, and gradually becomes colored by, and acquires the odor of, free iodine. It is freely soluble in water and alcohol, and the solution on being largely diluted with water separates a gelatinous precipitate of zinc hydroxide (Rammelsberg). It readily forms basic compounds, an oxyiodide, soluble in warm and insoluble in cold water, being produced by the prolonged digestion of iodine and zinc with water. The iodide melts when carefully heated to 446° C. (834.8° F.) to a colorless liquid, and may be sublimed in quadrangular needles, but on being heated in the air is decomposed into iodine and zinc oxide. The aqueous solution gives white precipitates with ammonium sulphide, potassium ferrocyanide, ammonia, and potassium hydroxide, the last two being soluble in an excess of the precipitants, and it yields a scarlet-red precipitate with mercuric chloride, a bright-yellow one with lead acetate, and a pale-yellow one with silver nitrate, the latter being insoluble in ammonia and in nitric acid. The salt, warmed with strong sulphuric acid, liberates iodine and sulphur dioxide, zinc sulphate being formed at the same time.

Tests.—The absence of foreign metals is ascertained in precisely the same manner as in zinc chloride and bromide, and the absence of sulphate by the solution not producing a precipitate with barium chloride. If 1 Gm. of the salt be mixed with 5 Cc. of distilled water, and sufficient ammonia water be added to redissolve the precipitate formed, followed by a solution of 1.5 Gm. of silver nitrate in 10 Cc. of water, then, after shaking and filtering, the filtrate should not be rendered more than slightly turbid by the addition of an excess of nitric acid (limit of chloride). If 0.5 Gm. of the dry salt be dissolved in 20 Cc. of water, and if 35 Cc. of tenth-normal silver nitrate solution, 5 Cc. of nitric acid, and 3 Cc. of ferric ammonium sulphate test-solution be added, and the mixture well shaken, then the addition of not less than 3.4 Cc. nor more than 4 Cc. of tenth-normal potassium sulphocyanate solution should be required to give a permanent reddish-brown tint to the solution.—U. S. The volume of silver nitrate solution actually uniting with the zinc iodide is 31 (35 — 4) Cc. or 31.6 (35 — 3.4) Cc. As each Cc. of the silver nitrate solution corresponds to 0.015835 Gm. of pure ZnI_2, 0.5 Gm. of the pure salt would require theoretically 31.58 Cc. of the silver nitrate, this being practically equal to 31.6 Cc. allowed in the titration, which latter figure therefore represents 100 per cent. purity. If more than 31.6 Cc. of silver solution were required in the titration it would indicate an excess of chloride. The lower limit, 31 Cc., represents 0.4908 Gm. of ZnI_2, or 98.16 per cent.

Action and Uses.—Like other zinc salts, the iodide was recommended as a sedative in hysteria and chorea, and, like them, has fallen into disuse for this purpose. It was used as a mild caustic to enlarged tonsils, in solution of 10 to 30 grains (0.60–2 Gm.) to the ounce (30 Cc.). A solution containing 1 to 3 grains (0.06–0.20 Gm.) to the ounce (30 Cc.) of water is sometimes injected in subacute gonorrhœal urethritis and vaginitis. The dose of zinc iodide is from ½ to 2 grains (0.03–012 Gm.).

ZINCI OXIDUM, *U. S., Br.*—Zinc Oxide.

Zincum oxydatum, P. G.; *Flores zinci.—Oxyde de zinc*, Fr.; *Zinkoxyd*, G.; *Oxido de zinc*, Sp.

Formula, ZnO. Molecular weight, 80.78.

It should contain not less than 99.5 per cent. of pure zinc oxide.—U. S.

Preparation.—Place zinc carbonate in a loosely-covered Hessian crucible, and expose it to a dull-red heat until a portion, taken from the centre of the contents of the crucible and cooled, no longer effervesces when dropped into diluted sulphuric acid. Let the crucible cool, and transfer the product to stoppered bottles.

Nearly identical is the process of the French Codex for *oxyde de zinc par voie humide.* When heated, zinc carbonate parts with its water and carbon dioxide, leaving zinc oxide behind. A dull red heat is not necessary for this purpose. Mohr observes that a temperature of 280° C. (536° F.) is sufficient for obtaining the oxide, and, according to Hager, all carbon dioxide is expelled at 250° C. (482° F.). With quantities of from 6 to 12 ounces of zinc carbonate the operation is conveniently performed in a glass flask placed in a sand-bath and heated by means of gas or on a stove. The capacity of the flash should be about double the volume of the powdered carbonate. If the zinc carbonate is not previously powdered, a higher heat and a longer time are required for expelling all the carbon dioxide. If the carbon dioxide be driven off below a red heat, or if the heating to dull redness has not been prolonged unnecessarily, the cold zinc oxide has a white color, but after having been exposed to a full red heat it will retain after cooling a more or less decided yellow tint.

The French Codex recognizes also an *oxyde de zinc par voie sèche*, which is made by melting pure zinc in an inclined crucible in contact with air to a bright-red heat, when it takes fire and burns to oxide, which condenses in the upper part of the crucible or in suitable vessels suspended over it, and after cooling is passed through a fine sieve. The same product, though less pure, was recognized by the U. S. P., 1870, as ZINCI OXIDUM VENALE (zinc-white); *Zincum oxydatum crudum*, P. G.; *Flores zinci, Pompholix, Nihil album, Lana philosophica.* This was recommended by Courtois (1780) as a pigment in place of white lead, but began to be used as such about 1844, after Leclair had elaborated a process for making it at a sufficiently low rate. At present it is usually prepared directly from zinc ores by processes identical with or similar to those recommended by W. J. Taylor (1861) and G. Darlington (1862). A mixture of zinc ore and coal is packed in a suitable furnace upon a layer of coke, previously ignited, and heated by means of a blast, and the vapors of zinc oxide, which are at first more or less mixed with particles of charcoal, are conducted into a chamber, where they condense as a gray powder. As soon as the condensing product has a white color the vapors are passed into another chamber, where they condense as zinc-white The gray product is identical with the impure oxide of zinc, which was formerly used in medicine under the names of *tutia, cadmia fornacum*, or *tutty.*

Properties.—Zinc oxide is a soft, inodorous and tasteless, pale-yellowish, nearly white powder, which on being heated acquires a deep lemon-yellow color, and on cooling becomes again nearly white. When obtained by combustion of the metal, it is perfectly white. After having been heated to a bright redness it continues for some time to emit light in the dark. It dissolves in dilute acetic and other acids without effervescence, is completely insoluble in simple solvents and in saccharine liquids, and is without action on test-paper. It is soluble in caustic alkalies, but not in their carbonates; also in ammonia water and solution of ammonium carbonate. On exposure to the atmosphere it slowly absorbs water and gradually also carbon dioxide.

Tests.—A small portion of the oxide, moistened with a drop of cobaltous nitrate test-solution, and heated before the blow-pipe, assumes a vivid green color (test for zinc). For making tests of identity and purity, digest 1 Gm. of the oxide in a mixture of 10 Cc. of diluted sulphuric acid and 10 Cc. of water until saturated; then remove the undissolved part by filtration. Separate portions of this solution should behave in all respects like the corresponding solution of zinc carbonate toward potassium ferrocyanide, ammonium sulphide, hydrogen sulphide, and ammonium carbonate test-solutions when treated as directed under ZINCI CARBONAS PRÆCIPITATUS. Another portion of the solution should not be affected by silver nitrate test-solution (absence of chloride). 1 Gm. of the oxide should respond to the test for limit of alkali given under ZINC CARBON-

ATE. If zinc oxide be dissolved in diluted hydrochloric acid, the solution should not become more than slightly opalescent after the addition of barium chloride test-solution (absence of sulphate). If 1 Gm. of freshly ignited zinc oxide be digested with 30 Cc. of normal hydrochloric acid until dissolved, and 2 drops of methyl-orange test-solution be added, not more than 5.4 Cc. of normal potassium hydroxide solution should be required for neutralization (each Cc. of the normal acid consumed corresponding to about 4 per cent. of zinc oxide). The normal potassium hydroxide solution should be added slowly with constant stirring, waiting until the precipitated zinc hydroxide has redissolved before adding further portions of the reagent.—U. S. From the reaction $ZnO + 2HCl = ZnCl_2 + H_2O$, it follows that each Cc. of the normal hydrochloric acid corresponds to 0.04039 Gm. of ZnO, which is practically 4 per cent. of 1 Gm. 24.6 Cc. of the acid, the minimum allowed in the assay, represents 0.9936 Gm. of ZnO, or 99.36 per cent.

Action and Uses.—Zinc oxide was formerly given internally in many diseases for which it is now rarely employed. As an antispasmodic it was thought to do good in epilepsy, chorea, hysteria, and spasmodic asthma. For its astringent and acid qualities it was administered in diarrhœa in 2-grain (0.12 Gm.) doses with gratifying results. Like zinc sulphate it is sometimes of benefit in colliquative sweats, 1 grain (0.06 Gm.) being given every hour for 3 or 4 hours before bedtime. In fine powder or ointment it is an excellent application to allay the itching of intertrigo, the pain of superficial burns, and to promote the healing of excoriations, sores, ulcers, fissures of the nipples and anus, and many cutaneous eruptions. The dose of zinc oxide is from 1 to 4 grains (0.06–0.25 Gm.).

ZINCI PHENOLSULPHONAS, *U. S.*—Zinc Phenolsulphonate.

Zinci sulphocarbolas, Br., U. S., 1890; *Zincum sulphophenolicum.—Zinc paraphenolsulphonate, Zinc sulphocarbolate*, E.; *Sulphophénate de zinc*, Fr.; *Phenolsulfosaures Zink, Sulfokarbolsaures Zink*, G.

Formula, $(C_6H_4(OH)SO_3)_2Zn + 8H_2O$. Molecular weight, 551.56.

It should contain, in uneffloresced crystals, not less than 99.5 per cent. of the pure salt, and should be kept in small, well-stoppered bottles.—U. S.

Preparation.—The barium salt of paraphenolsulphonic acid is first prepared as described under SODIUM PHENOLSULPHONATE (which see). A definite quantity of the barium salt is then decomposed in solution by the exact equivalent of zinc sulphate, whereby insoluble barium sulphate is precipitated while zinc phenolsulphonate remains in solution, and is obtained by evaporation and crystallization.

Properties.—The salt occurs in colorless, transparent prisms or tabular crystals, odorless, and having an astringent, metallic taste, and an acid reaction to litmus-paper. It is efflorescent and, when exposed to light and air, may become slightly pink. It loses 6 molecules of water at 100° C. (212° F.) and the remainder at 125° C. (227° F.); at a higher temperature it chars and emits inflammable vapors having the odor of phenol, and finally leaves a residue amounting to about 14.6 per cent. of the original weight. It dissolves in 1.7 parts of water or alcohol at 25° C. (77° F.) and in 0.3 part of boiling water and in 0.56 part of boiling alcohol.

Tests.—A dilute solution of the salt (1 in 100) is colored violet by ferric chloride solution. The aqueous solution of the salt (1 in 20) should respond to the tests for zinc and for absence of heavy metals, iron, aluminum, calcium, arsenic by the modified Gutzeit's test, and sulphate, as described under ZINCI BROMIDUM. The solution (1 in 20) should not be affected by silver nitrate test-solution (absence of chloride).

Action and Uses.—Zinc phenolsulphonate may be used in solution (3 to 5 grains [0.20–0.30 Gm.] to an ounce [30 Cc.] of water) as an astringent application in subacute and chronic inflammations of mucous membranes as urethritis, vaginitis, tonsillitis, etc. It is rarely given internally as an intestinal antiseptic and astringent in diarrhœa and dysentery. Its dose is from 1 to 4 grains (0.06–0.25 Gm.).

ZINCI STEARAS, *U. S.*—Zinc Stearate.

Stéarate de zinc, Fr.; *Zinkstearat, Stearinsaures Zinkoxyd, Talgsaures Zinkoxyd*, G.

Preparation.—Zinc stearate is usually made by mutual decomposition between sodium stearate and zinc acetate, both salts being used in boiling hot solutions. 100

parts of zinc acetate will require 279 parts of sodium stearate, which latter may be procured in an impure form, as animal or curd soap, but is better prepared by adding stearic acid to a hot solution of monohydrated sodium carbonate. The precipitated zinc stearate, having been thoroughly washed with hot water, is dried and finally reduced to powder and passed through a hair-cloth sieve.

Properties.—Zinc stearate occurs as a fine white tasteless powder, having a very faint odor, resembling that of fat, and should have a neutral reaction to litmus-paper. It contains a small but varying proportion of zinc palmitate, and is insoluble in water, alcohol, or ether. When heated the salt fuses, and at a higher temperature is decomposed, giving off inflammable vapors and the odor of burning fat, and finally leaves about 15.5 per cent. of residue, chiefly of zinc oxide.—U. S.

Tests.—If 0.5 Gm. of the salt be heated with a mixture of 9.5 Cc. of distilled water and 0.5 Cc. of hydrochloric acid, stearic acid will be liberated and float as an oily layer on the surface of the liquid. If, after filtering this liquid through a wetted filter, all of the zinc be precipitated by ammonium sulphide test-solution, the filtrate should leave no fixed residue on evaporation (absence of alkalies, alkali earths, etc.). If 0.5 Gm. of the salt be heated with a mixture of 9.5 Cc. of distilled water and 0.5 Cc. of nitric acid and filtered, the filtrate should not become more than slightly turbid upon the addition of silver nitrate solution (absence of more than a trace of chlorides). If 1 Gm. of the salt be boiled with 50 Cc. of distilled water containing 2 Cc. of nitric acid, and filtered through a wetted paper, after thoroughly washing the precipitate (stearic acid) with boiling water, the filtrate and washings, when evaporated to dryness and ignited, should leave a residue weighing not less than 0.14 Gm. and not more than 0.16 Gm. (zinc oxide).—U. S.

Action and Uses.—Zinc stearate is one of the newer preparations recommended as a soothing, mildly antiseptic application for intertrigo, eczema, acne, and other cutaneous affections. It may be used either alone or combined with other powders or made into ointment.

ZINCI SULPHAS, *U. S., Br.*—Zinc Sulphate.

Zincum sulfuricum, P. G.; *Vitriolum album.*—*White vitriol*, E.; *Sulfate de zinc, Vitriol blanc. Couperose blanche*, Fr.; *Zinksulfat, Schwefelsaures Zinkoxyd, Weisser Vitriol, Galitzenstein*, G.; *Sulfato de zinc*, Sp.

Formula, $ZnSO_4 + 7H_2O$. Molecular weight, 285.41.

It should contain, in uneffloresced crystals, not less than 99.5 per cent. of the salt, and should be kept in well-stoppered bottles.—U. S.

Preparation.—Dilute 5 parts of sulphuric acid with 5 to 6 times its weight of water in a porcelain dish, and add 4 parts of granulated zinc. When effervescence has nearly ceased, aid the action by a gentle heat until no more hydrogen gas is given off. An excess of zinc should always be present to precipitate any lead, copper, cadmium, and arsenic. Filter into a bottle or flask, and add gradually, with agitation, a solution of chlorine, until a permanent odor of chlorine is perceptible. Then add some zinc carbonate and agitate until a brown precipitate (iron hydroxide) appears; let it settle, filter, slightly acidify with dilute sulphuric acid, evaporate the filtrate till a pellicle forms on the surface, and set aside to crystallize. Dry the crystals by exposure to the air on filtering-paper placed on porous tiles. More crystals may be obtained by again evaporating the mother-liquor.

Zinc dissolves in dilute sulphuric acid with the evolution of hydrogen, forming zinc sulphate: $Zn + H_2SO_4$ yields $ZnSO_4 + 2H$. Arsenic, copper, and lead, which are sometimes present in commercial zinc, are removed by the continued digestion with an excess of the metal, as ordered in the above process; but iron will dissolve, together with the zinc, to ferrous sulphate. This is converted into ferric salt by chlorine-water, and ferric hydroxide is now precipitated on agitating the liquid with precipitated zinc oxide or carbonate. The filtered liquid is free from the metals named, and on being sufficiently concentrated will yield crystals of pure zinc sulphate.

The same salt is economically prepared on the large scale from zinc-white, or by roasting the native zinc sulphide, ZnS, called *blende*, whereby this compound is oxidized to sulphate; this is extracted with hot water, and the clear solution, evaporated, yields crude white vitriol, which should be purified by redissolving it in water, boiling with

zinc, treating with chlorine and zinc carbonate, filtering, and evaporating to crystallization; magnesium and alkali sulphates are not removed by this treatment.

Properties.—Zinc sulphate crystallizes readily in large transparent rhombic prisms, which are isomorphous with those of magnesium sulphate. As seen in commerce, it is in small prisms or prismatic needles, obtained by disturbed crystallization from concentrated solutions. On exposure the crystals become slowly opaque from the loss of water of crystallization. When rapidly heated the salt melts. At a higher temperature it is partly decomposed, losing both water and sulphuric acid. At red heat it gives off SO_3, SO_2 and oxygen, while nearly pure ZnO remains. When very gradually heated to 50° C. (122° F.) it loses 5 molecules of its water (31.2 per cent.) without melting. At 100° C. (212° F.) a sixth molecule is lost, while the last is removed, with decomposition of the salt, at about 240° C. (464° F.). Zinc sulphate is inodorous, and has a strongly styptic and nauseous metallic taste and an acid reaction. It is completely soluble in 0.53 part of water at 25° C. (77° F.) and in 0.2 part of boiling water; soluble in 3 parts of glycerin (0.86 part, Fr. Cod.), but insoluble in alcohol. Supersaturated solutions are easily obtained, particularly in contact with air which has been previously filtered through cotton. The aqueous solution of zinc sulphate yields white precipitates with barium chloride ($BaSO_4$), with ammonium sulphide (ZnS), and with potassium ferrocyanide ($Zn_2Fe(CN)_6$).

The crude commercial zinc sulphate occurs in regular white masses, looking somewhat like lump sugar, and often exhibits here and there yellow stains, due to ferric oxide. It contains less water of crystallization, hence is less soluble than the pure salt.

Tests.—Commercial or crude zinc sulphate is not sufficiently pure for medicinal purposes; it contains iron, occasionally also copper, aluminum, and calcium sulphate, and sometimes cadmium. These salts and the alkali sulphates cannot be removed by recrystallization. Lead cannot be present in this salt if completely soluble in water, owing to the insolubility of its sulphate; yet the Pharmacopœia mentions it among the possible impurities. A small portion of the salt, moistened with a drop of cobaltous nitrate solution and heated before the blow-pipe, assumes a vivid green color (test for zinc). If 1 Gm. of zinc sulphate be shaken for some time with 10 Cc. of alcohol, the filtrate should not redden moistened blue litmus-paper, showing the absence of free acid. If a large proportion of chloride be present, the salt will be hygroscopic; a 5 per cent. solution of the salt, acidulated with nitric acid, should not be rendered more than slightly turbid by silver nitrate solution (limit of chloride). Other possible impurities are detected as follows: The aqueous solution (1 in 20), on being acidulated with hydrochloric acid and treated with hydrogen sulphide, as described under ZINCI BROMIDUM, should yield neither a yellow, brown, nor black coloration or precipitate (cadmium, arsenic, copper, and similar metals). In case iron be present the solution will afford with a little potassium ferrocyanide a more or less deep-blue precipitate. An excess of ammonium carbonate added to the aqueous solution should yield a clear and colorless liquid; in the presence of copper the color of the solution would be blue, and iron and aluminum would remain undissolved. The solution of the salt, after having been precipitated by ammonium sulphide, or the ammoniacal solution after treatment with hydrogen sulphide, yields a filtrate which on evaporation to dryness and ignition should leave no fixed residue (potassium, sodium, magnesium, and calcium). This test has been dropped from the U. S. P., 1900.

Composition.—Zinc sulphate has the formula given above, and contains 43.9 per cent. of water, 28.22 per cent. of zinc oxide, and 27.88 per cent. of SO_3. The sulphate may also be obtained with less water by crystallizing from its solution above 30° C. (86° F.). The crude commercial salt contains 3 molecules of water of crystallization.

Action and Uses.—Zinc sulphate is employed as an astringent and emetic. While it is used almost entirely as a local remedy, it is sometimes of value in serous diarrhœa in doses of 2 grains (0.12 Gm.), particularly if it be combined with opium. Its employment in chorea, epilepsy, asthma, whooping-cough, and other disorders in which it was formerly esteemed has been abandoned. Its emetic action is peripheral and usually prompt. It is useful to empty the stomach of indigestible and poisonous food narcotic poisons. The emetic dose is from 10 to 30 grains (0.60–2 Gm.), which may be repeated if the first dose does not produce vomiting. If vomiting does not occur after such quantities, symptoms of poisoning may arise and consist in abdominal colic, diarrhœa, and general prostration. Death is rare even from enormous doses. The usual

treatment for irritant poisons suffices, viz.: Demulcent drinks, opium for the pain, and hypodermic stimulation by strychnine and atropine to counteract the depression. In weak solution (1 to 3 grains to the ounce [0.06–0.20 Gm: 30 Cc.]) it is used as an astringent injection in gonorrhœa, as a collyrium in conjunctivitis after the subsidence of the acute symptoms, and as a stimulating application to indolent ulcers and moist skin diseases. Sir James Simpson recommended a paste made of desiccated zinc sulphate (1 ounce, 30 Gm.) and glycerin (1 drachm, 4 Cc.) as a mild caustic application to ulcers of the uterine cervix and soft tumors of the vagina and anus. The dose of zinc sulphate is from ½ to 2 grains (0.03–0.12 Gm.); as an emetic 10 to 30 grains (0.60–2 Gm.) should be given.

ZINCI VALERAS, *U. S.*—Zinc Valerate.

Zinci valerianas, Br., U. S., 1890; *Zincum valerianicum. Valérianate (Valérate) de zinc*, Fr. Cod.—*Zinc valerianate*, E.; *Zinkvalerianat, Baldriansaures Zinkoxyd*, G.; *Valerianato de zinc*, Sp.

It should contain not less than 99 per cent. of the pure salt, and should be kept in small well-stoppered bottles.—U. S.

Formula, $Zn(C_5H_9O_2)_2 + 2H_2O$, U. S.; $Zn(C_5H_9O_2)_2$, Br.; $Zn(C_5H_9O_2)_2 + 12H_2O$, Fr. Cod. Molecular weight, 301.28.

Preparation.—Take of sodium valerate 5 ounces avoirdupois; zinc sulphate, 5½ ounces avoirdupois; distilled water, a sufficient quantity. Dissolve the salts separately, each in 2½ pints of distilled water; raise both solutions to near the boiling-point, mix them, cool, and skim off the crystals which are produced. Evaporate the mother-liquor at a heat not exceeding 93.3 C. (200° F.) to 4 fluidounces, cool again, remove the crystals which have formed, and add them to those which have already been obtained. Drain the crystals on a paper filter, and wash them with a small quantity of cold distilled water till the washings give but a very feeble precipitate with barium chloride. Let them now be again drained and dried on filtering-paper at ordinary temperatures.

The above process was originally proposed by Trommsdorff. On mixing hot solutions of sodium valerate and zinc sulphate the salts are mutually decomposed, resulting in the formation of sodium sulphate, which remains dissolved, and zinc valerate, which crystallizes partly on cooling, the remainder being obtained on concentrating the liquid.

The salt of the French Codex is obtained by adding freshly prepared moist zinc carbonate to valeric acid, diluted with 30 parts of water, and when the acid is nearly saturated warming the mixture slightly, filtering, and carefully evaporating the liquid.

Properties.—Zinc valerate crystallizes in soft white pearly scales, which are not deliquescent, and have a slight odor of valeric acid, and a sweet styptic and metallic taste. It has an acid reaction on litmus-paper, melts at about 140°C. (284°F.), at a higher heat gives off white inflammable vapors, and finally burns with a bluish flame, leaving zinc oxide. The salt is soluble in about 50 parts of water and in about 35 parts of alcohol at 25°C (77°F.); somewhat more soluble in absolute alcohol (U. S.); the salt used in France, which contains $12H_2O$, dissolves in 50 parts of cold water (Fr. Cod.); on being boiled with water it loses water of crystallization. On heating the solution moderately it becomes turbid, and clear again on cooling; but after the saturated solution has been boiled it does not become entirely clear after cooling, in consequence of the production of a basic salt, which is less freely soluble in water. When kept over sulphuric acid the salt becomes anhydrous, and when exposed to the air it slowly loses valeric acid.

Tests.—If 0.5 Gm. of the salt be dissolved in 0.5 Cc. of hydrochloric acid diluted with 9 Cc. of water, the liberated valeric (iso-) acid will float as an oily layer on the water. After filtering through a wetted paper, the clear liquid should not be colored or rendered turbid by an equal volume of hydrogen sulphide solution, when kept corked at 35° C. (95° F.) for at least ½ hour (absence of arsenic, cadmium, lead, copper, etc.) The salt should dissolve without residue in ammonium carbonate test-solution (absence of iron, etc.). If 0.5 Gm. of the salt be dissolved in a mixture of 0.5 Cc. of nitric acid and 4.5 Cc. of distilled water, and the mixture filtered through a wetted filter, the filtrate should remain clear upon addition of either barium chloride solution (absence of sulphate) or silver nitrate solution (absence of chloride). If 0.5 Gm. of the salt be heated with 9.5 Cc. of distilled water and 0.5 Cc. of hydrochloric acid and fil-

tered, the filtrate should not respond to the modified Gutzeit's test for arsenic (given under ARSENI TRIOXIDUM.). 0.5 Gm. of the salt, triturated with 3 Cc. of water, 0.2 Cc. of ferric chloride test-solution, should give a filtrate free from red color (absence of acetate). Concentrated aqueous solutions of the salt and of copper acetate, when mixed, should remain perfectly clear (absence of butyrate). Zinc butyrate resembles the valerate closely; it is detected, according to the British Pharmacopœia, by distilling the suspected salt with dilute sulphuric acid and adding the distillate to a solution of copper acetate, when, if the valerate be pure, it does not immediately affect the transparency of the fluid, but forms after a little time oily drops, which gradually pass into a bluish-white crystalline deposit. This is the test suggested by Larocque and Hurant, who first directed attention (1846) to the similar physical properties of the two salts. The U. S. P. has adopted Hager's test.

Action and Uses.—Zinc valerate is devoid of pronounced medicinal virtues. As a mild antispasmodic it is sometimes of benefit in the treatment of neuralgic pains and headache occurring in hysterical females. It has been proposed as a remedy in diabetes insipidus, whooping-cough, infantile convulsions, and other disorders, which experience has shown are not affected by its use. The dose of zinc valerate is from 1 to 5 grains (0.06–0.30 Gm.) or more.

ZINCUM, *U. S.*—Zinc.

Speltrum.—Zinc, Fr.; *Zink*, G.

Symbol, Zn. Atomicity, bivalent. Atomic weight, 64.9.

It should contain not less than 99 per cent. of the pure metal.—U. S.

Zinc bears a very close resemblance to magnesium in its properties; in fact, the latter metal is a connecting link between the alkaline earth group of metals, calcium, strontium and barium, and the zinc, cadmium, and mercury group, all of which are bivalent, except mercury, which also is univalent in mercurous compounds.

The metal zinc has been known in the isolated state only since about the beginning of the eighteenth century, when Stahl showed it to be obtainable from calamine; some of its compounds, however, have been long known. Brass was used in ancient times, but no other metal besides copper was supposed to exist therein. The oxide was likewise known at an early date, and, like the ore from which it was obtained, was called *cadmia*. White vitriol appears to have been prepared by Valentinus in the fifteenth century, who was also acquainted with blende, in which Brandt (1735) showed the presence of zinc, and Glauber (1648) prepared "oleum lapidis calaminaris" and studied some of the properties of zinc chloride.

The metal is rather abundant, and exists most generally in combination either as carbonate, $ZnCO_3$, known also as *calamine*, *smithsonite*, *galmei*, and *zinc spar;* as silicate, Zn_2SiO_4, or *siliceous calamine;* as sulphide, ZnS, known as *sphalerite* or *zinc blende*. It also occurs as oxide, ZnO, or *zincite*, *red zinc ore*; *gahnite*, $Zn(AlO_2)_2$; and *franklinite*, $Zn(FeO_2)_2$ with $Fe(FeO_2)_2$. Zinc ores have been found in Pennsylvania and Missouri, in Great Britain, Belgium, and different parts of Germany, particularly in Silesia. They are frequently associated with lead and other metals.

CALAMINA PRÆPARATA (Lapis calaminaris præparata), which was dropped from the British Pharmacopœia, 1898, is native zinc carbonate, calcined in a covered earthen crucible at a moderate temperature, powdered, and freed from gritty particles by elutriation. It is a pale pinkish-brown powder, almost entirely soluble with effervescence in acids. The mineral varies in color from whitish to reddish or greenish, and is sometimes crystalline, or more frequently amorphous.

Preparation.—On smelting lead and other ores containing zinc an impure zinc oxide is condensed in the cooler portions of the furnace. By the long-continued roasting of blende or calamine, oxide is likewise obtained. This is mixed with powdered charcoal, and the mixture heated nearly to whiteness in shallow iron retorts, when the zinc distils, and is collected in suitable condensers. The impure metal is purified by a descending distillation in crucibles furnished with an open tube reaching to the upper half of the crucible and passing through its bottom.

Crude zinc is liable to contain iron, lead, copper, arsenic, antimony, cadmium, phosphorus, sulphur, and carbon. Such zinc is known as *spelter*. By repeated distillation it can be obtained pure. Distilled under reduced pressure, it forms lustrous crystals, which are extremely complicated in form. Most of the objectionable impurities of crude

zinc can be removed by oxidizing the melted zinc with potassium nitrate and subsequently fusing with zinc chloride. Iron, lead, and copper are not removed thus.

Zinc dust is the fine deposit formed when vapors of zinc first strike the cool walls of the condensing chambers. It always contains zinc oxide, and often cadmium. Good zinc dust should contain 80 to 90 per cent. of zinc. It can also be obtained by powdering zinc heated to about 300° C. (572° F.).

Granulated zinc is prepared by pouring molten zinc into cold water. It is a convenient form for use.

Properties and Tests.—Zinc is a bluish-white metal, having a lamellar or a granular structure. Its density varies between 6.9 and 7.2, rolled zinc being the heaviest. Ordinarily it is rather brittle, but between 120° and 150° C. (248° and 302° F.) it is ductile, and may be rolled into sheets and converted into wire. Heated to 205° C. (401° F.) it becomes so brittle that it may be reduced to powder. It melts at about 415° C. (779° F.) and at 940° C. (1724° F.) it boils and volatilizes, and in the presence of air burns with a bluish-green flame to oxide. Melted zinc on congealing expands in volume 0.2 per cent. (Nies and Winkelmann, 1882), and afterward contracts considerably. On bending, zinc emits a slight cracking noise, weaker than that of tin. It has a bright metallic lustre, but on exposure becomes superficially tarnished. It is not much acted on by cold concentrated sulphuric acid, but on heating unites with it, evolving sulphur dioxide. Diluted sulphuric and hydrochloric acids dissolve impure zinc readily, with the evolution of hydrogen, but pure zinc is scarcely acted on by these acids. The action can be increased, however, by adding a few drops of platinic chloride or of copper sulphate. Zinc is also soluble in caustic alkalies, with formation of hydrogen and soluble zincates, for example, $Zn(OK)_2$. Nitric acid dissolves zinc, but the nascent hydrogen reduces some of the acid to oxides, nitrogen, or ammonia, according to the conditions. Zinc precipitates most of the heavy metals from their solutions, for example, gold, platinum, silver, copper, lead, mercury, cadmium, arsenic, but iron, manganese, cobalt, and nickel are not precipitated. A good quality of zinc should contain no more than traces of iron, lead, and copper, but no arsenic, antimony, and phosphorus, for which the following tests may be applied: If 1 Gm. of zinc be dissolved in diluted hydrochloric acid, the hydrogen gas which is evolved should not have any disagreeable odor, nor should it color a strip of paper moistened with lead acetate test-solution (absence of sulphur) or with silver nitrate test-solution (absence of arsenic, antimony, phosphorus). The resulting solution should be clear and colorless, and should yield a white gelatinous precipitate with solution of potassium ferrocyanide, and a white precipitate with ammonium sulphide solution (colored precipitates would show the presence of foreign metals, as iron, copper, lead, etc.). If 1 Gm. of zinc be dissolved in a mixture of 10 Cc. each of nitrohydrochloric acid and water, the solution evaporated to dryness, the residue moistened with 2 Cc. of hydrochloric acid and again evaporated, and the final residue dissolved in 10 Cc. of water, this solution, acidulated with hydrochloric acid, should not be affected when mixed with an equal volume of hydrogen sulphide solution and kept corked at 35° C. (95° F.) for at least ½ hour (absence of arsenic, cadmium, lead and copper).—U. S.

Zinc is extensively used in the arts for roofing and other purposes; melted together with copper it forms brass (20 of zinc to 80 of copper). It is useful in protecting surfaces of iron and copper from oxidation; iron having its surface coated with zinc is known as galvanized iron. Zinc dust is used as a reducing agent in chemical analysis and in the arts, either in acids or alkalies, or in dry distillations. Zinc readily combines with mercury to form zinc amalgam, and plates thus coated are used in electric cells. Amalgamated zinc is acted upon much more slowly than zinc itself, and hence is protected against too rapid corrosion.

The *salts of zinc* are usually colorless, soluble in water, have an acid reaction, and a disagreeable metallic taste, and by prolonged heating are mostly converted into oxide. Their aqueous solutions, acidulated with hydrochloric acid, are not precipitated by hydrogen sulphide, but they yield with ammonia-water and potassium hydroxide solution white precipitates soluble in an excess of the reagents. White precipitates are also obtained with ammonium sulphide, alkali carbonates, and potassium ferrocyanide; potassium ferricyanide yields an orange-red precipitate.

UNOFFICIAL ZINC SALTS.

Zinci Cyanidum.—*Zinc cyanide*, E. ; *Cyanure de zinc*, Fr. Cod. ; *Zinkcyanid, Cyanzink*, G. $Zn(CN)_2$.—It is obtained by precipitating a solution of zinc acetate with hydrocyanic acid, whereby acetic acid is liberated, which retains a portion of the zinc cyanide in solution ; the liquid should therefore be kept nearly neutral by the occasional cautious addition of an alkali. Zinc cyanide is a white, inodorous, and tasteless powder, which is insoluble in water and alcohol, but dissolves in potassium hydroxide, ammonia-water, and in dilute acids. When long kept it undergoes decomposition and acquires a sweetish and metallic taste. The properties of zinc cyanade are similar to those of hydrocyanic acid and the other cyanides. It has been used in epilepsy, chorea, and other convulsive affections ; also in gastralgia and cardiac neuroses. The dose is from $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008–0.03 Gm.) every 2 or 3 hours.

Zinci et Potassii Cyanidum. $K_2Zn(CN)_4$.—On dissolving zinc cyanide in a solution of pure potassium cyanide a slightly alkaline liquid is obtained, which on evaporation yields colorless or white octahedrons of a sweet and metallic taste. Small quantities of acids precipitate from its solution zinc cyanide. This salt is used like zinc cyanidum, and in the same dose.

Zinci Ferrocyanidum.—*Zinc ferrocyanide*, E.; *Ferrocyanure de zinc*, Fr.; *Zinkferrocyanid*, G. $Zn_2Fe(CN)_6 + 3H_2O$.—It is prepared by precipitating a soluble zinc salt with potassium ferrocyanide, and forms a white tasteless powder, which is insoluble in water, alcohol, and dilute acids, and evolves hydrocyanic acid on being heated with dilute sulphuric acid. It is insoluble in ammonia-water, but soluble in warm sodium hydroxide solution. Zinc ferrocyanide resembles the cyanide in its action and uses. The dose is from 1 to 4 grains (0.06–0.25 Gm.).

Zinci Lactas.—*Zinc lactate*, E. ; *Lactate de zinc*, Fr. Cod. ; *Zinklaktat, Milchsaures Zink*, G. $Zn(C_3H_5O_3)_2 + 3H_2O$.—It may be prepared by dissolving zinc carbonate in dilute lactic acid with the aid of heat. It crystallizes in short quadrangular crystals which have an acid reaction and an acidulous metallic taste. The salt is not fusible, requires about 58 parts of cold and 6 parts of boiling water for solution, and is nearly insoluble in alcohol. It yields 27.1 per cent. of oxide of zinc. This salt was substituted for zinc oxide in epilepsy and other affections because it is less apt to irritate the stomach. The dose is from $\frac{1}{2}$ to 1 grain (0.03–0.06 Gm.) several times a day.

Zinci Permanganas.—*Zinc permanganate*, E.; *Zinkpermanganat, Uebermangansaures Zink*, G. $Zn(MnO_4)_2 + 6H_2O$.—Obtained by exact precipitation of barium permanganate with zinc sulphate, filtering and evaporating at a moderate temperature. It forms almost black crystals, deliquescent. The aqueous solution decomposes in air, but will keep when corked in dark bottles. It gives up oxygen more easily than does potassium permanganate, hence great care should be taken in bringing it together with combustible bodies. Zinc permanganate may be used like potassium permanganate, as an antiseptic and astringent application.

Zinci Phosphas.—*Zinc phosphate*, E.; *Zinkphosphat, Phosphorsaures Zink*, G. $Zn_3(PO_4)_2 + 4H_2O$.—Obtained by interaction between zinc sulphate and sodium phosphate in hot solution. A white powder, soluble in dilute acids and ammonia-water.

Zinci Phosphidum.—*Zinc phosphide, phosphuret of zinc*, E. ; *Phosphure de zinc*, Fr. Cod.; *Phosphorzink*, G. Zn_3P_2.—It may be prepared by Proust's process (1869) thus : Nitrogen gas is evolved by heating ammonium nitrite, and the gas is passed through a bottle in which hydrogen phosphide is prepared by introducing calcium phosphide through a wide tube into diluted hydrochloric acid contained in the bottle. The mixed gases are passed through a wash-bottle into a porcelain tube in which zinc is heated to redness, when the metal will combine with the phosphorus and liberated hydrogen will escape together with the nitrogen. If the apparatus is filled with nitrogen gas before the hydrogen phosphide is generated, there is no danger of an explosion. Zinc phosphide is stated to be permanent in the air, but the slight phosphorus odor emitted by it indicates its gradual oxidation ; it should, therefore, be preserved in well-stoppered vials. It forms a gray crystalline or friable mass, having upon the fractured surface a bright metallic lustre. When powdered and freed by sifting from metallic zinc which may be present, it resembles iron reduced by hydrogen, has a blackish-gray color and a slight taste of phosphorus, is readily soluble in dilute sulphuric or hydrochloric acid, with the copious evolution of hydrogen phosphide, and by concentrated nitric acid is converted into zinc phosphate. It melts at a higher temperature than zinc, and volatilizes unchanged, condensing in needles if the air be excluded ; but when heated in contact with air it is oxidized to zinc phosphate. Pure zinc phosphide consists of 24.12 per cent. of phosphorus and 75.88 per cent. of zinc. 1.171 Gm. of zinc phosphide in contact with official hydrochloric acid should evolve 200 Cc. of hydrogen phosphide, which should be completely absorbed by a concentrated solution of copper sulphate.—Fr. Cod. This test proves the absence of metallic zinc, which would evolve hydrogen ; hydrogen phosphide produces in the copper solution a black precipitate of copper phosphide. Zinc phosphide may be used in nervous exhaustion and other disorders in which free phosphorus is thought to do good.

Because of its stability it is more easily administered than phosphorus. Each grain represents about $\frac{1}{5}$ grain of phosphorus. The dose is from $\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003–0.006 Gm.).

Zinci Salicylas.—*Zinc salicylate*, E.; *Zinksalicylat*, G. $Zn(C_6H_4.OH.COO)_2 + H_2O$.—It is obtained by boiling for a few minutes equivalent quantities of sodium salicylate and zinc sulphate in water, cooling, filtering the crystals, washing with a little cold water, and recrystallizing from hot water. The salt crystallizes in long satiny needles, has a sweet somewhat styptic and bitter taste, dissolves in about 20 parts of cold water, and is freely soluble in hot water, alcohol, ether, and methylic alcohol. Zinc salicylate is astringent and antiseptic. In solution of 1 to 5 grains to the ounce of distilled water it is used in the treatment of ophthalmia and gonorrhœa.

Zinci Sulphis.—*Zinc sulphite.* $ZnSO_3 + 2H_2O$.—Obtained by mixing aqueous solutions of zinc sulphate and sodium sulphite in the cold, filtering and washing the precipitate, and drying at low temperature. It is a white crystalline powder, soluble in about 600 parts of water. Boiling the salt with water converts it into a basic compound, with loss of sulphur dioxide.

Zinci Subgallas.—*Zinc subgallate.*—It is an odorless, greenish-gray, neutral powder, neither toxic nor irritating, and insoluble in ordinary solvents. It contains 56 per cent. of gallic acid and 44 per cent. of zinc oxide. Zinc subgallate is recommended internally, in the dose of $\frac{1}{2}$ to 5 grains (0.03–0.30 Gm.), as an astringent antiseptic in intestinal disorders arising from fermentation. Externally, it is applied in powder, or made into ointment for eczema, hemorrhoids, atorrhœa, etc.

ZINGIBER, *U. S.*, *Br.*—Ginger.

Rhizoma (Radix) zingiberis, P. A., P. G.—*Gingembre (gris et blanc*, Cod.), Fr.; *Ingwer*, G.; *Zenzero*, It.; *Zengibre*, Sp.; *Gengibre*, Port.

The dried rhizome of *Zingiber Zingiber* (L.) Rusby (*Amomum Z.*—L.; *Z. officinale* Roscoe.—Fam. *Zingiberaceæ*).

Ginger is official in all pharmacopœias, which are about equally divided as to requiring that it be peeled, not peeled, or partly peeled. The Italian specifies certain products (Chinese and Barbadoes) which it regards as most aromatic. Several specify that white-washed ("bleached") ginger shall not be used.

Origin and Preparation.—The Ginger plant is a rather tall, tufted, reed-like perennial, supposed to be native of tropical Asia, now known only in cultivation, and grown in nearly all tropical countries. It is propagated by planting small pieces of the rhizome. There is a blue- and a white-rhizomed form, the latter superior, but the former

Fig. 475.

Coated ginger.

Fig. 476.

Uncoated ginger.

productive upon soil that has become too poor to produce the white. Newly cleared forest soil produces the best ginger, as well as the largest crop, and the product of freshly rooted canes is superior to that from canes which have been growing for several years. Ginger grown and prepared with little care is called "Ratoon." The quality of ginger varies considerably in different countries and under different climates. The Fiji product is said to possess a peculiar lemon-like fragrance. The quality depends also largely upon the method of preparation. Strange to say, that upon which most time and care is bestowed, and which brings the highest price, namely, the Jamaica, is the least pungent of all, though presenting the most handsome appearance, and possessing

a flavor preferred by many persons. The rhizomes ("hands" or "races") are harvested after the herbage has completely withered, great care being taken not to bruise the surface, this resulting in discoloration. They are then allowed to dry sufficiently for the dirt to be easily and completely brushed or wiped off, or, if white ginger is to be produced, they are at once thoroughly washed. One of two courses may then be pursued in order that the ginger may dry promptly and safely. The first is the careful scraping off of the impervious integument, and subsequent gradual drying by repeated short exposures to the sun. This method results in the production of the handsome *white* or *peeled* ginger, which makes beautiful light-colored and fine-flavored preparations, but which has apparently lost much of its activity through this removal of the bark. The other method is the destruction of vitality by a 15-minutes' scalding in boiling water, the integument not being removed. The water is carefully watched, and is changed as soon as it becomes charged with the juices of the rhizome. By this method the starch is partly hydrated, afterward drying of a dark color, the product being known as *Black ginger*. Some unpeeled ginger is not dark colored or horny, and has apparently not been scalded. Unpeeled gingers are stronger and richer than those which are peeled.

Another form, called *Half-peeled*, is made by stripping off the bark upon the flat sides and then mildly scalding.

Description.—Peeled or White Ginger. From 5 to 10 Cm. (2–4 In.) long, flattened, 10 to 15 Mm. ($\frac{2}{5}$–$\frac{3}{5}$ In.) broad, and 4 to 8 Mm. ($\frac{1}{6}$ $\frac{1}{3}$ In.) thick, usually lobed or short-branched at one side, the branches thickened toward the end; deprived of the corky layer; pale buff-colored and strongly striate; breaking with a very starchy, rather fibrous fracture, and exhibiting numerous small scattered resin-cells and fibrovascular bundles enclosed within the endodermis; agreeably aromatic, pungent, and warming. The starch-grains are oval, oblong, or elliptical, flattened, have a small hilum, usually near the narrow end, and are finely annulate.

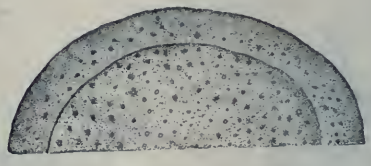
Coated or Black Ginger. In form and size similar to the last, but bearing the whole or a part of the integument, which is strongly, coarsely, and irregularly wrinkled, and varies from deep brown to blackish; fracture more or less dark and horny, otherwise the same as the peeled; granular starch more or less reduced in amount.

"Bleached" Ginger is commonly produced by dipping in chloride of lime, milk of lime, or gypsum, the object being sometimes to conceal defects in a badly cured product, sometimes to protect it against the attacks of insects, to which it is otherwise much subject. Some bleached ginger is produced by the action of sulphur fumes.

Fig. 477.

Ginger starch-granules.

Fig. 478.



Transverse section (× 3).

Varieties.—Aside from differences due to the methods of curing above described, various commercial varieties are recognized according to geographical sources. The Jamaican variety is characterized by our description. East Indian and African gingers are usually half-peeled and very closely resemble one another. They have a noticeably flat appearance, and the color ranges from dark gray to blackish. Chinese ginger is short, broad, and light colored. Cochin is similar to, but usually smaller than the Chinese, and the unpeeled parts are of a light reddish gray or brown.

Adulterants.—Adulteration of ginger in the entire condition is obviously not likely to occur frequently. The occurrence of a quantity of the limed rhizome mixed with nux vomica in the same condition, once reported, was doubtless accidental. Ground ginger is commonly adulterated, chiefly perhaps with that which has been exhausted of its active constituent. This is best detected by resulting variations in the active constituents and in the ash (see *Constituents*). Flour, curcuma, and various starchy matters are also used. To make up for the resulting loss of pungency, it is said that mustard and Cayenne pepper have been then incorporated. All these are readily enough detected by the aid of the microscope.

Constituents.—Besides a large amount of starch, a little gum and fat, and a variable amount of two resins, one acid, the other neutral, ginger contains two substances to which its activity is due. Volatile oil exists to the extent of from 1 to 3 per cent., and imparts the odor and flavor of the drug. Gingerol, which is not volatile or aromatic, but very pungent, exists in about half the amount of the oil. It is more viscid than the oil, colorless, neutral, and soluble in alcohol, ether, volatile oils, benzol, and carbon disulphide. Ether extracts from 4 to 8 per cent. of oleoresin. The ash amounts to about 4 or 5 per cent., and there are indications of the presence of an alkaloid.

The volatile oil of ginger consists of a thickish greenish-yellow liquid of 0.875 to 0.885 specific gravity, and requiring from 50 to 100 times its weight of 96 per cent. alcohol for solution. Its angle of rotation varies from —25° to —45°. It has the aromatic odor of ginger, but lacks the characteristic pungent taste of the drug. Thus far nothing is known regarding the source of the peculiar odor of oil of ginger. Among the constituents which have been isolated are dextro-camphene, having a specific rotation of + 63°13′ and occurring in the fraction distilling between 155° and 165° C. (311° and 329° F.), and phellandrene, distilling at about 170° C. (338° F.), and forming a nitrate melting at 102° C. (215.6° F.). The bulk of the oil boils between 256° and 266° C. (492.8° and 510.8° F.), and consists chiefly of a sesquiterpene, $C_{15}H_{24}$, which does not form a solid compound with hydrochloric acid.

Pharmaceutical Preparations.—Fluidextract of Ginger, Oleoresin of Ginger, Syrup of Ginger, Tincture of Ginger, U. S. P.

Action and Uses.—Ginger is a warm, stimulating carminative when taken internally, and when applied to the skin is an efficient rubefacient and counterirritant. When chewed it stimulates the secretion of saliva and if snuffed into the nostrils in powder it occasions sneezing. It relieves abdominal cramp due to flatus and is an useful addition to diarrhœa mixtures, bitter tonics, and to preparations given to correct indigestion. As a rubefacient it is made into a cataplasm either alone or in combination with other spices for the relief of colic, headache, myalgia, neuralgia, etc. The preparation most frequently employed for internal use is the tincture in the dose of ½ to 2 drachms (2–8 Cc.). The dose of powdered ginger is from 10 to 30 grains (0.60–2 Gm.). In domestic practice an infusion, "ginger tea" (½ ounce to 1 pint [16 Gm to 480 Cc.] of boiling water), is largely employed.

Other and Related Products.—*Preserved Ginger* consists of the rhizomes gathered and preserved long before maturity and while still tender. They are preserved in sugar by complicated processes, differing with the locality and the maker. The most highly esteemed is the Chinese, which seems not to be ginger at all, but the related rhizome of a species of Alpinia.

The genus *Zingiber* Adans. contains about 20 species, all Asiatic, and the rhizomes of about half of them are used as aromatics. The *Zerumbet Root* of Java is yielded by the *Z. Zerumbet* (L.) Roscoe (*Amomum Z.* L.), and that of *Z. amaricans* Noronha is also sold under this name. Zerumbet is tuberous, somewhat flattened, spongy, internally yellowish, with pale-brown fibrovascular bundles, and has an agreeable odor and a ginger-like, somewhat bitter taste.

The Cassumuniar-root of India is yielded by *Z. Cassumuniar* Roxb. It is about 5 Cm. (2 In.) in diameter, jointed, compressed, with numerous white fleshy radicles and some white tubers; it is externally scaly and light brown, internally yellow and rather woody, and has a camphoraceous odor and a hot, aromatic taste.

Zingiberaceæ.—The Ginger Family comprises 24 genera and about 300 species of plants, wholly tropical, chiefly in the Old World, and distinguished for their aromatic properties, like Ginger, Cardamon, Galanga, Curcuma, and Zedoary, all of which are elsewhere described. Many species of the genus *Costus* are used for their aromatic properties. The viscid, acrid, expressed juice of *C. discolar* Rosc. is used in Brazil as a local application in gonorrhœa, while the decoction of the plant is used internally as a genito-urinary stimulant. The Venezuelan Indians chew the stem of *C. spiralis* Rosc. as a stimulant on fatiguing journeys, especially when water is scarce.

Very closely related to this family are the *Marantaceæ*, yielding arrow-root, considered under *Amylum*, and the *Musaceæ* or *Banana-family*. The latter is of more interest for its nutrient than for its medicinal properties. Banana-root has some employment as an anthelmintic, and has been reported useful in reducing bronchocele. The young shoots of several species are cooked and eaten. The fibre of the mature leaves is used in cordage. The great importance of the family resides in the use of the unripe fruits as food, and to a much less extent in that of the ripe fruit. It has been estimated that, weight for weight, bananas on

plantations are more than 44 times as productive as potatoes. Allowing for the most extreme exaggeration in this statement, it yet fully explains why this is the favorite food-plant of the indolent natives of the tropics. The ordinary banana, red and yellow, is *Musa sapientum* L. Whether the plantain, which is larger, coarser, better adapted for use as a food, but less as a ripe fruit, is but a cultivation-form or a distinct species may always remain in dispute. The same is true of the most delicately flavored and delicious variety, the Green banana, of a pale-green color when ripe, and which has been referred to *M. Paradisiaca* L. Unripe bananas are eaten roasted, baked, boiled, fried, as an ingredient of soups and stews, and, in general, as potatoes are used, possessing thus, like the potato, only a slight or negative flavor and no sweetness. They are also dried and ground into flour as meal, to which Coppoch assigns the following composition: water 10.62, albuminoids 3.55, fat 1.15, carbohydrates 81.67 (more than two-thirds starch), fibre 1.15, phosphates 0.26, other salts 1.60. The sugar is chiefly cane-sugar.

ZYGOPHYLLACEÆ.—(The Guaiac Family.)

A peculiar little family of 21 genera and about 6 times as many species, mostly of tropical or warm countries. Medicinally, the family most resembles the RUTACEÆ, and is well represented by guaiac. Its active constituents are chiefly oleoresins.

Harmal or *Ispand* is the seeds of *Peganum Harmala* L. of India, used in that country as a genito-urinary stimulant and anthelmintic. They are also counted mildly narcotic, with properties somewhat resembling those of CANNABIS. The root is applied to the scalp as a parasiticide. The seeds are described by Hooker as about ⅛ inch long, irregularly angular, dull grayish brown, of a heavy narcotic odor when crushed, and a bitter taste. They yield a reddish oil and a carmine-colored soft resin, both nauseous, a little more than 1 per cent. of the alkaloid *harmine* ($C_{13}H_{12}N_2O$), and nearly 3 per cent. of *harmaline* ($C_{13}H_{14}N_2O$), besides yellow fluorescent coloring-matter. The latter is regarded as identical with *harmatol*, obtained from harmaline by treating it under pressure with hydrochloric acid. The crystalline yellow harmalinates are also highly fluorescent in solution. Harmine can be obtained by oxidation of harmaline, and is, on further oxidation by chromic acid, converted into harminic acid, in silky tufts. *P. erithmifolium* Retz. is used in Europe, and *P. Mexicanum* Gray in Mexico.

Hengam or *Gari*, sometimes known as Bombay colocynth or Egyptian myrobalans, is the unripe fruit of *Balanites Egyptiaca* Del., assuming this to be identical with *B. Roxburghii* Pl. of India. All parts of the plant appear purgative and anthelmintic, and are variously employed in different parts. Saponin appears to be the active constituent of the bark, and probably also of the pulp of the unripe fruit. The dried fruit, in general appearance, somewhat resembles a large walnut, being broadly oval, about 7 Cm. (2 In.) long, smoothish, 10-grooved, and brownish. The pulp is about ¼ inch thick, and contains a large pentagonal stone, containing a single oily exalbuminous seed. The seed yields 50 per cent. of a slow-drying yellowish oil, resembling peanut oil, which is devoid of special properties.

Various species of *Zygophyllum* are employed as anthelmintics, and *Z. spinosum* L. of the Cape is said to be poisonous. *Tribulus terrestris* L., the East Indian *Chota*, introduced into many warm regions, contains considerable tannin, and is used variously as an astringent and tonic. *Covillea tridentata* (DC.) Vail (*Larrea t.*—DC.; *L. Mexicana* Moric) and other species of *Covillea* of Mexico and the southwestern United States are known as *Creosote bush*, because of the peculiar odor exhaled. The herbage is very glutinous from the exuded oleoresin, and is strongly suggestive of medicinal properties. These it doubtless possesses, but they have never been investigated. Sonora gum or Arizona shellac is produced upon this plant.

APPENDIX.

LIST OF REAGENTS AND TESTS

Employed in Chemical Testing, according to the United States Pharmacopœia.

THE insertion of all the official methods as well as solutions, both for qualitative and quantitative tests, is rendered imperative by the frequent reference to the pharmacopœial requirements in the preceding pages.

Strictly pure (distilled) water is to be used in the preparation of the test-solutions as well as in the application of tests; the former should be perfectly transparent and kept in well-stoppered bottles, protected against extremes of temperature.

1. General Reagents and Test-solutions.

Absolute Alcohol.—Use the official absolute alcohol (see p. 124).

Acetic Acid.—Use the official acetic acid (see p. 30).

Albumen Test-solution.—Carefully separate the white of a hen's egg from the yolk, shake it thoroughly with 100 Cc. of water, and filter. This solution should be freshly made when required.

Alcohol.—Ethyl Alcohol, C_2H_5OH.—Use the official alcohol (*Alcohol*, U. S. P.). Alcohol of lower strength is prepared as follows:

Alcohol, 90 per cent.—Mix 51 Cc. of alcohol with 3 Cc. of distilled water. The specific gravity of the mixture should be 0.826 at 25° C. (77° F.), corresponding to 90 per cent., by volume, of absolute alcohol.

Alcohol, 80 per cent.—Mix 45.5 Cc. of alcohol with 9.5 Cc. of distilled water. The specific gravity of the mixture should be 0.856 at 25° C. (77° F.), corresponding to 80 per cent., by volume, of absolute alcohol.

Alcohol, 70 per cent.—Mix 38.6 Cc. of alcohol with 15 Cc. of distilled water. The specific gravity of the mixture should be 0.882 at 25° C. (77° F.), corresponding to 70 per cent., by volume, of absolute alcohol.

Aluminum.—Metallic aluminum in the form of foil, wire, or ribbon. It should be tested for arsenic by Fleitmann's method, when no color should be imparted to the silver nitrate within two hours.

Ammonia-water.—Use the official ammonia-water (see page 210).

Ammonium Carbonate Test-solution.—Dissolve 20 Gm. of ammonium carbonate, $NH_4HCO_3.NH_4NH_2CO_2$, in a mixture of 20 Cc. of ammonia-water and 70 Cc. of water, and add sufficient water to measure 100 Cc.

Ammonium Chloride Test-solution.—Dissolve 10 Gm. of pure ammonium chloride in enough water to make 100 Cc.

Ammonium Molybdate Test-solution.—Dissolve 15 Gm. of finely powdered ammonium molybdate, $(NH_4)_6Mo_7O_{24} + 4H_2O$, in 100 Cc. of distilled water, adding sufficient ammonia-water, if necessary, to effect solution. Then gradually pour the liquid into 100 Cc. of nitric acid (specific gravity 1.403 at 25° C. [77° F.]). The resulting solution, after being subjected to gentle heat for about two hours, should be decanted from any yellow sediment which may be deposited.

Alternative Method.

Solution No. 1.

Molybdic acid, H_2MoO_4	10 Gm.
Ammonia-water (10 per cent.)	42 Cc.

Solution No 2.

Nitric acid (specific gravity 1.403) } Water }	*āā* 63 Cc.

Pour Solution No. 1 into Solution No. 2 gradually, shaking repeatedly. After being subjected to a gentle heat for about two hours, the solution should be decanted from any yellow sediment which may be deposited.

Preserve the test-solution in the dark, and, if a sediment should form in it after some days, carefully decant the clear solution from it.

Ammonium Oxalate Test-solution.—Dissolve 4 Gm. of pure, crystallized ammonium oxalate in enough water to make 100 Cc. Or dissolve 4 Gm. of pure oxalic acid in 100 Cc. of water, add 15 Cc. of ammonia-water, boil to expel excess of ammonia, and bring the volume to 113 Cc.

On evaporating a portion of the test-solution and igniting the residue, it should be completely volatilized (absence of fixed impurities). The test-solution should not be rendered turbid by hydrogen sulphide nor by ammonium sulphide (absence of metals). The precipitate produced in it by silver nitrate or by barium chloride should dissolve without residue upon addition of nitric acid (absence of chloride and sulphate, respectively).

Ammonium Sulphate, $(NH_4)_2SO_4$.—This salt should respond to the following tests of purity: Three grammes should leave no appreciable residue upon ignition (absence of fixed impurities). The aqueous solution of the salt (1 in 10) should not respond to the time-limit test for heavy metals (see below).

Another portion of this solution should not become turbid upon the addition of nitric acid and silver nitrate test-solution (absence of chlorides). Another portion of this solution should not be colored red upon the addition of 2 drops of hydrochloric acid and 1 drop of ferric chloride test-solution (absence of sulphocyanate). This salt may be prepared by neutralizing pure sulphuric acid, which has been diluted with an equal volume of water, with ammonia-water, evaporating and crystallizing. During the evaporation the solution should be tested from time to time with litmus-paper, adding more ammonia, if necessary, to keep the liquid alkaline.

Ammonium Sulphide Test-solution.—Saturate 3 parts of pure ammonia-water with pure, washed hydrogen sulphide, and add to the solution (which now contains ammonium sulphhydrate) 2 parts of ammonia-water, which converts the greater portion of the ammonium sulphhydrate into ammonium sulphide. The solution should be perfectly clear and colorless, and, on being evaporated, leave no residue. It should not be rendered turbid either by magnesium sulphate (absence of free ammonia) or by calcium chloride (absence of ammonium carbonate). It should be protected against air and light by being kept in small, dark amber-colored bottles in a dark place. As soon as a notable deposit of sulphur has made its appearance in the solution, it should be rejected.

Ammonium polysulphide test-solution is occasionally required. This is a yellow liquid, prepared by dissolving a small quantity of pure sulphur in the preceding colorless ammonium sulphide test-solution.

Amyl Alcohol, $C_5H_{11}OH$.—A colorless, oily liquid having a penetrating characteristic odor, boiling at 131° C. (267.8° F.); soluble in 40 parts of water at 25° C. (77° F.); miscible with alcohol, ether, chloroform, carbon disulphide, petroleum benzin, benzene, and fixed and volatile oils.

Aniline (Phenylamine), $C_6H_5NH_2$.—When freshly distilled, aniline is a colorless, strongly refractive, oily liquid, having a peculiar aromatic odor, and a pungent, burning taste. Upon exposure to the light and air it rapidly assumes a reddish-brown color. Specific gravity 1.0214 at 25° C. (77° F.). Aniline should distil over completely between 183° and 184° C. (361.4°–363.2° F.). It is soluble in alcohol, ether, and the fixed and volatile oils. With acids, it forms soluble crystalline salts. When added to a solution of calcium or sodium hydrochlorite a blue or purple color is produced.

Arsenic Test, Bettendorf's.—(See p. 249.)

Arsenic Test, Fleitmann's.—Into a test-tube of at least 15 Cm. in length and 15 to 18 Mm. in diameter place a single, solid piece of zinc (see below), weighing about 1 to 1.25 Gm., and add about 5 Cc. of potassium hydroxide test-solution, both ingredients having previously been proven free from arsenic by having been subjected, *alone*, to the test about to be described, during at least two hours, with negative result. Now add the liquid to be tested, which must not contain any free acid nor very materially increase the volume of the contents of the test-tube. Immediately secure over the mouth of the test-tube a previously prepared cap made of 3 thicknesses of pure filter-paper free from dust, and apply to the upper filter-paper a drop of a saturated, aqueous solution of silver nitrate acidulated with nitric acid. (See Silver Nitrate Test-solution.) Then place the tube at once, upright, into a box containing sand heated to about 90° C. (194° F.), and fitted with a cover, so as to exclude light and dust, and permit the reaction to proceed for such a time as may be specially prescribed in each case. The presence of arsenic (but not of antimony) is revealed by the production, upon the moistened paper cap, of a brown or black stain. In absence of arsenic, if the test has been carefully conducted, the spot will remain colorless.

In place of zinc, metallic aluminum, best in form of wire cut into small pieces, may be employed (Gatehouse's modification). The method of testing and the results are the same as in Fleitmann's test.

Arsenic Test, Gutzeit's.—(See page 248.)

Barium Carbonate.—Purified barium carbonate, $BaCO_3$, is prepared by dissolving 12 parts of purified, crystallized barium chloride in 30 parts of boiling water, then adding 5 parts of ammonium carbonate, followed by 5 parts of ammonia-water; finally washing the precipitate thoroughly and drying.

Barium Chloride Test-solution.—Prepared from pure barium chloride. The aqueous solution of the salt should be perfectly neutral, and should not yield a precipitate with hydrogen sulphide or ammonium sulphide (absence of metals, etc.). The aqueous solution, after being precipitated by diluted sulphuric acid in slight excess, yields a filtrate which should not leave any permanent residue when evaporated and heated on platinum-foil (absence of other fixed bases and salts). Diluted alcohol, after remaining in contact with it for several hours, should, upon ignition, show a pure yellowish-green colored flame, without red streaks (absence of traces of strontium). To prepare the test-solution, dissolve 10 Gm. of the salt in enough water to make 100 Cc.

Barium Hydroxide Test-solution.—A saturated solution of barium hydroxide in water. This solution rapidly absorbs carbon dioxide from the air. It is preferably prepared freshly as wanted.

Barium Nitrate Test-solution.—Prepared from pure barium nitrate. This salt should respond to the same tests as barium chloride. In addition, its aqueous solution, slightly acidulated with nitric acid, should not be rendered turbid by silver nitrate (absence of chloride). To prepare the test-solution dissolve 10 Gm of the salt in water to make 100 Cc.

Benzin, or Petroleum Benzin.—Use the official purified petroleum benzin (*Benzinum Purificatum*, U. S. P.).

Benzene, or Benzol.—Benzene, C_6H_6, is a colorless, transparent liquid of a peculiar, aromatic odor, specific gravity 0.871 at 25° C. (77° F.), congealing at 5.2° C. (41.3° F.), and boiling at 80.4° C. (176.7° F.). It is insoluble in water, but soluble in 4 parts of alcohol, and in ether. When equal volumes of benzene and concentrated sulphuric acid are mixed, the latter should not become colored. On shaking 2 Cc. of benzene with 0.5 Cc. of sulphuric acid and 1 drop of fuming nitric acid, no green or blue tint should be produced (absence of thiophene).

Brazil-wood Test-solution.—See under Indicators.

Bromine-water (Bromine Test-solution).—An aqueous solution of bromine prepared by dissolving 1 Cc. of bromine in enough water to make 100 Cc.

Calcium Chloride Test-solution.—Dissolve 10 Gm. of crystallized calcium chloride in enough water to make 100 Cc.

Calcium Hydroxide Test-solution (Lime-water).—Use the official lime-water (see p. 889).

Calcium Sulphate Test-solution.—Introduce pulverized transparent crystals of native gypsum (selenite), $CaSO_4 + 2H_2O$, into a flask filled with water, agitate at intervals for 12 hours, and decant the

clear, saturated solution when required. 1 part of gypsum requires, at 25° C. (77° F.), 378 parts of water for solution.

Carbon Disulphide.—Use the official carbon disulphide (see p. 369).

Chlorine-water (Chlorine Test-solution).—Use the official chlorine-water. Since it rapidly deteriorates by keeping, it should be frequently renewed or freshly prepared when required.

Chloroform.—Use the official chloroform (see p. 410).

Cobaltous Nitrate Test-solution.—The crystallized, commercial salt is sufficiently pure if, after it is dissolved in water and the cobalt completely precipitated by ammonium sulphide, the filtrate leaves no residue on evaporation. To make the test-solution dissolve 1 Gm. of the salt in 10 Cc. of water.

Cochineal Test-solution.—See under INDICATORS.

Copper (Metallic Copper), in form of wire, foil, or turnings.

Cupric Ammonium Sulphate Test-solution.—A solution of cupri-tetrammonium sulphate, $Cu(NH_3)_4SO_4 + H_2O$. To copper sulphate test-solution add ammonia-water until the precipitate first formed is nearly, but not completely, redissolved; then filter. This solution should be freshly made when required.

Cupric Sulphate Test-solution.—Dissolve 10 Gm. of cupric sulphate in enough water to make 100 Cc.

Cupric Tartrate Test-solution.—See under VOLUMETRIC SOLUTIONS.

Diphenylamine Test-solution.—Prepared from diphenylamine, $(C_6H_5)_2NH$, which is in the form of grayish-white or colorless crystals of a peculiar, aromatic odor, melting at 54° C. (129.2° F.), slightly soluble in water, more soluble in acids. It is used either in the dry state, or in solution in diluted sulphuric acid, as a test for nitric acid (in sulphuric acid, water, etc.), or for chlorine (in hydrochloric acid). To test a solution for the presence of nitric acid, a small portion of it is mixed with 1 or 2 drops of diphenylamine test-solution, and then concentrated sulphuric acid, free from compounds of nitrogen, is poured in so as to form a layer beneath the solution. The presence of nitric acid is shown by a deep blue color at the zone of contact. A similar reaction is also produced by the presence of hypochlorites, chlorates, chromium trioxide, ferric salts, and similar oxidizing agents. The test solution is prepared by dissolving 0.1 Gm. of diphenylamine in 50 Cc. of diluted sulphuric acid. The solution should be colorless.

Ether.—Use the official ether. It should be strictly neutral to litmus-paper.

Ferric Ammonium Sulphate Test-solution.—Dissolve 10 Gm. of ferric ammonium sulphate in enough water to make 100 Cc.

Ferric Chloride Test-solution.—Dissolve 10 Gm. of ferric chloride in enough water to make 100 Cc.

Ferrous Sulphate Test-solution.—Dissolve a clear crystal of ferrous sulphate in about 10 parts of water previously boiled to expel air. This solution should be freshly prepared immediately before use.

Ferrous Sulphide.—A heavy solid, in form of black or brownish-black irregular masses or fused into sticks, soluble in sulphuric or hydrochloric acid with copious evolution of hydrogen sulphide.

Gelatin Test-solution.—Dissolve 1 Gm. of purified gelatin in 50 Cc. of water by the aid of a gentle heat, and filter if necessary. This solution should be freshly made when wanted for use.

Gold Chloride Test-solution.—The commercial chloride of gold, usually prepared by dissolving gold in nitro-hydrochloric acid and carefully evaporating to dryness, mostly consists of aurochloric acid, $HAuCl_4 + 2H_2O$, which is converted into neutral auric chloride, $AuCl_3$, by fusing it at a temperature not exceeding 150° C. (302° F.), moistening the residue (now consisting of auric and aurous chloride) with enough hot water to produce a syrupy liquid (whereby the aurous chloride is decomposed into auric chloride and metallic gold), and then pouring off the clear liquid from the precipitate. To prepare the test-solution dissolve the liquid finally obtained in the before-mentioned process in 20 volumes of water. Or dissolve 1 Gm. of dry auric chloride in 30 Cc. of water.

Hydrochloric Acid, Pure.—In addition to the tests prescribed for this acid by the Pharmacopœia, it is required to conform to the following more rigorous tests before it can be employed as a reagent: The addition of 1 Cc. of barium chloride test-solution to 1 Cc. of the acid diluted with 9 Cc. of water should cause no turbidity within 24 hours (absence of sulphuric acid). A crystal of diphenylamine dropped into the acid should not turn blue (absence of free chlorine). On substituting it for sulphuric acid in Gutzeit's test (see p. 248), no color should be imparted to the silver nitrate within 2 hours (absence of arsenic or antimony).

Hydrogen Sulphide.—A gas generated by treating ferrous sulphide with diluted sulphuric acid, and washing the gas by passing it through water.

Hydrogen Sulphide Test-solution (Hydrosulphuric Acid).—A saturated, aqueous solution of hydrogen sulphide. To prepare about 1000 Cc. of the solution, treat 20 Gm. of ferrous sulphide, in a suitable apparatus, with a mixture of 20 Cc. of sulphuric acid (U. S. P.), and 250 Cc. of water, pass the gas through a drying-tube filled with granulated calcium chloride, then from this through a tube of about 8 millimeters diameter and 40 centimeters in length, which contains about 5 Gm. of coarsely pulverized iodine mixed with spun glass (glass wool), and finally through a wash bottle which contains a small quantity of potassium iodide test-solution. The gas thus purified is conducted nearly to the bottom of a bottle of the capacity of about 1500 Cc., containing 1000 Cc. of cold water. The bottle should be shaken occasionally to facilitate the solution of the gas. When it is no longer absorbed, transfer the solution to small, dark amber-colored bottles, to be filled nearly to the top; pass a stream of hydrogen sulphide for a few minutes through each, and then at once stopper them tightly, and preserve them afterward in a cool and dark place. Before any of the solution is used it should be ascertained that it retains a strong odor of hydrogen sulphide, and that, when it is added to an equal volume of ferric chloride test-solution, a copious precipitate of sulphur is formed at once.

Indigo Test-solution.—Place 6 Gm. (3.3 Cc.) of fuming sulphuric acid into a beaker well cooled by immersion in water, and stir into it very gradually 1 Gm. of finely-powdered Bengal indigo. Set the mixture aside for 2 days, then pour it into 20 Cc. of water, and decant. Or dissolve 1 Gm. of commercial indigo-carmine (the sodium or potassium salt of sulphindigotic acid) in 150 Cc. of water.

Iodine Absorption Value of Fats and Oils.—The iodine value or number of a fat or an oil is a figure which indicates the percentage of iodine absorbed under certain conditions. It is determined as follows: To a solution of 0.3 Gm.[1] of the fat or oil in 10 Cc. of chloroform contained in a glass-stoppered bottle of

[1] 0.15 to 0.2 Gm. for linseed oil and 0.8 Gm. for oil of theobroma and similar fats.

250-Cc. capacity, add 25 Cc. of a mixture of equal volumes of alcoholic iodine test-solution, and alcoholic mercuric chloride test-solution, both of which have been measured from a burette. After having been securely stoppered, the bottle is set aside in a cool place, protected from the light, for a period of 4[1] hours. After this time, the mixture must still possess a brown color; if it does not, a further measured portion of the mixture of the two reagents should be added, and the mixture be again set aside. Finally, 20 Cc. of potassium iodide test-solution are added, followed by 50 Cc. of water, and tenth-normal sodium thiosulphate volumetric solution is then added in small successive portions, shaking thoroughly after each addition until the color of the mixture is discharged. The number of Cc. of the sodium thiosulphate volumetric solution consumed is noted. At the same time that this test is carried out a blank experiment is made in which exactly the same quantities of chloroform, iodine test-solution, and mercuric chloride test-solution are mixed, and after standing for 3 or more hours, the free iodine is estimated by titration with tenth-normal sodium thiosulphate volumetric solution as directed above. The number of Cc. of the thiosulphate volumetric solution consumed is noted, and from this is deducted the number of Cc. of the thiosulphate volumetric solution which was consumed in the test; the difference multiplied by 12.59, and this product divided by 3,[2] gives the iodine value of the fat or oil.

Iodine Test-solution.—For preparing the ordinary test-solution (as a reagent for starch, alcohol by iodoform test, etc.) iodine fulfilling the requirements of the Pharmacopœia is sufficiently pure. For this purpose dissolve 1 Gm. of iodine and 3 Gm. of potassium iodide in 50 Cc. of water.

For use in volumetric analysis, or in other cases where the ordinary impurities present in official iodine are objectionable, Purified Iodine must be employed.

Iodine Test-solution, Alcoholic.—Dissolve 25 Gm. of iodine in 500 Cc. of alcohol. This solution is employed in the determination of the iodine absorption value of fats and oils.

Iron, Metallic.—Bright and perfectly clean iron in the form of wire, sheet, or filings, according to the uses to be made of it. For making solutions of pure iron salts, fine, thin, bright wire (so-called florists' wire) should be used. For detecting copper, bright pieces of sheet-iron or knitting-needles are used; for detecting nitric acid by reduction to ammonia, iron-filings are preferable.

Lead Acetate Test-solution.—Dissolve 10 Gm. of clear, transparent crystals of lead acetate, free from adhering lead carbonate, in enough water to make 100 Cc. Preserve the solution in well-stoppered bottles.

Lead Acetate Test-solution, Basic.—Use the official solution of lead subacetate.

Litmus-paper and Test-solution.—See under INDICATORS.

Magnesia Mixture.—Dissolve 10 Gm. of magnesium sulphate and 20 Gm. of ammonium chloride in 80 Cc. of water, add 42 Cc. of ammonia-water, set the mixture aside for a few days in a well-stoppered vessel, and filter. It should never be used freshly made.

Magnesium Sulphate Test-solution.—Dissolve 10 Gm. of magnesium sulphate in enough water to make 100 Cc.

Mercuric Chloride Test-solution.—Dissolve 5 Gm. of mercuric chloride in enough water to make 100 Cc.

Mercuric Chloride Test-solution, Alcoholic.—Dissolve 30 Gm. of mercuric chloride in 500 Cc. of alcohol. This solution is employed in the determination of the iodine absorption value of fats and oils.

Mercuric Nitrate Test-solution, $Hg(NO_3)_2 + 4H_2O$.—Use the official solution of mercuric nitrate (*Liquor Hydrargyri Nitratis*, U. S. P.).

Mercuric Potassium Iodide Test-solution (*Mayer's Reagent*).—Dissolve 1.344 Gm. of mercuric chloride in 60 Cc. of water, and 5 Gm. of potassium iodide in 10 Cc. of water. Mix the two solutions, and then add sufficient water to make the mixture measure 100 Cc.

Mercuric Potassium Iodide Test-solution, Alkaline (*Nessler's Reagent*).—Dissolve 10 Gm. of potassium iodide in 10 Cc. of water, and add gradually, in portions, a saturated aqueous solution of mercuric chloride, with constant agitation, until a slight red precipitate remains undissolved; to this mixture add 30 Gm. of potassium hydroxide and, when solution has taken place, 1 Cc. more of the saturated aqueous solution of mercuric chloride. Dilute this solution with water until it measures 200 Cc. Allow the precipitate to subside, and draw off the clear fluid.

NOTE.—2 Cc. of this reagent, when added to 50 Cc. of water containing 0.05 milligramme of ammonia, should produce at once a yellowish brown coloration.

Mercurous Nitrate Test-solution, $Hg_2(NO_3)_2 + 2H_2O$.—Into a porcelain capsule put 1 Gm. of pure mercury with 0.5 Cc. of pure nitric acid and 0.5 Cc. of distilled water, and place it for 24 hours in a cool, dark room. Separate and drain the crystals, and dissolve them in 10 Cc. of water. Preserve the solution in a dark amber-colored bottle, into which a small globule of mercury has been placed.

Methyl Alcohol, CH_3OH.—For the identification of salicylic acid, the rectified, commercial wood-alcohol, having a specific gravity of about 0.820, is sufficiently pure, if it forms a clear, transparent mixture with an equal volume of distilled water.

Methyl-orange Test-solution.—See under INDICATORS.

Naphthylamine Acetate Test-solution, $C_{10}H_7NH_2.HC_2H_3O_2$.—Boil 0.1 Gm. of alpha-naphthylamine acetate in 20 Cc. of distilled water, filter through cotton, and mix the filtrate with 180 Cc. of diluted acetic acid (10 per cent. absolute acid). Only freshly distilled water should be employed in preparing this reagent, which must be kept in well-stoppered bottles, protected from the light.

Nitric Acid, Pure.—Use the official nitric acid.

Fuming Nitric Acid (Red Fuming Nitric Acid).—The commercial acid will answer, if it is of specific gravity of 1.450 or over. It should be carefully kept in glass-stoppered bottles in a cool place.

Oxalic Acid, Pure, $H_2C_2O_4 + 2H_2O$.—Pure oxalic acid is in the form of colorless, transparent, clinorhombic crystals; 10 Gm. on ignition upon platinum foil should leave no residue. One part of the acid is completely soluble in 12 parts of water at 25° C. (77° F.). For the preparation of test and volumetric solutions, commercial oxalic acid should be purified as follows:

To 1 part of the acid add 10 parts of cold water, and shake until the latter is saturated. Filter off the solution from the undissolved crystals, evaporate the filtrate to about ¾ of its volume, and set it

[1] Sixteen hours are required for accuracy in the case of linseed oil.

[2] When the quantity of the fat or oil used is not 0.3 Gm., then the product is not divided by 3, but by the figure corresponding to the quantity taken; thus, for linseed oil, 0.15 Gm. would be divided by 1.5.

aside so that the fixed salts which it contains may crystallize out. Carefully decant the liquid from the crystals, concentrate it by evaporation, and set it aside to crystallize, stirring occasionally to prevent the formation of large crystals which might enclose moisture. Drain the crystals in a funnel, dry them carefully on blotting-paper, and preserve them in well-stoppered bottles.

Oxalic Acid Test-solution.—Dissolve 10 Gm. of pure oxalic acid, $H_2C_2O_4 + 2H_2O$, in sufficient distilled water to measure 100 Cc.

Palladous Chloride Test-solution.—Dissolve 0.5 Gm. of palladous chloride, $PdCl_2$, in sufficient water to measure 10 Cc. Preserve in a glass-stoppered bottle.

Phenolphthalein Test-solution.—See under INDICATORS.

Picric Acid Test-solution.—Dissolve 1 Gm. of pure, distinctly crystalline picric acid (trinitrophenol), $C_6H_2(NO_2)_3OH$, in 100 Cc. of water, cool the solution, and filter, if necessary.

Platinic Chloride Test-solution.—Dissolve 2.6 Gm. of chloroplatinic acid, $H_2PtCl_6 + 6H_2O$, in 20 Cc. of water. On evaporating a small portion of the solution to dryness and igniting the residue, pure metallic platinum should remain, which should yield nothing soluble in nitric acid.

Potassium Bitartrate, $KHC_4H_4O_6$.—The purification of potassium bitartrate, to render it suitable for standardizing volumetric solutions of potassium and sodium hydroxide, is carried out as follows: To 100 Gm. of the salt contained in a beaker is added a mixture of 85 Cc. of water and 25 Cc. of diluted hydrochloric acid; the beaker is then placed upon a bath of boiling water and the mixture digested, with occasional stirring, for about 3 hours. After quickly cooling, the solution is drained off from the precipitate, which is washed by affusion and decantation with two successive portions of 100 Cc. each of water; after collecting the precipitate upon a plain filter, the washing with cold water is continued until the filtrate, after adding a few drops of nitric acid, ceases to become opalescent upon the addition of silver nitrate test-solution. The precipitate of potassium bitartrate is then dissolved in the smallest possible volume of boiling water (about 1500 Cc.), filtered, and the filtrate, while being rapidly cooled, is constantly stirred. When the mixture is cold, the crystalline precipitate is collected upon a plain filter, washed with 300 Cc. of cold water, and, after thoroughly draining, dried at 120° C. (248° F.) until of constant weight. It should be kept in dry, securely stoppered bottles.

Purified potassium bitartrate is employed for standardizing normal and tenth-normal potassium or sodium hydroxide volumetric solution.

Potassium Bromate, $KBrO_3$.—White cubical crystals or granular crystalline powder having a pungent, saline taste. Soluble in 15.5 parts of water at 25° C. (77° F.) and in 2 parts of boiling water; slightly soluble in alcohol. The aqueous solution has a neutral reaction, and upon the addition of diluted sulphuric acid no yellow color should at once be produced. When heated to 350° C. (662° F.) the salt undergoes decomposition with evolution of oxygen. Potassium bromate should not be triturated or heated with organic or easily oxidizable substances. The addition of nitric acid or sulphuric acid to the salt causes decomposition with evolution of bromine. If 0.1 Gm. of potassium bromate, dried at 100° C. (212° F.), and 2 Gm. of potassium iodide be dissolved in about 25 Cc. of water contained in a glass-stoppered bottle (of about 100 Cc. capacity) and, after the addition of 5 Cc. of hydrochloric acid, the bottle be securely stoppered and set aside for half an hour, not less than 36.1 Cc. of tenth-normal sodium thiosulphate volumetric solution should be required to discharge the color, corresponding to 99.8 per cent. of pure potassium bromate.

Potassium Carbonate Test-solution.—Dissolve 10 Gm. of anhydrous potassium carbonate, prepared by heating potassium carbonate to 130° C. (266° F.), in sufficient water to measure 100 Cc.

Potassium Chromate Test-solution.—Dissolve 10 Gm. of yellow potassium chromate in sufficient water to measure 100 Cc. On adding silver nitrate test-solution to a few drops of the solution diluted with a little distilled water, a red precipitate is produced which should be completely soluble in nitric acid (absence of chloride). Another portion of the solution, mixed with an equal volume of diluted hydrochloric acid, should yield no precipitate with barium chloride test-solution (absence of sulphate). Another portion of the solution should not become turbid upon the addition of ammonia-water or ammonium oxalate test-solution (absence of alkaline earths). A solution of 0.1 Gm. of the salt in 20 Cc. of water should not become red upon the addition of a few drops of phenolphthalein test-solution (limit of free alkalies).

Potassium Cyanide Test-solution.—Dissolve 1 Gm. of potassium cyanide in sufficient water to measure 10 Cc. This solution should be freshly prepared when required.

Potassium Dichromate, Pure, $K_2Cr_2O_7$.—In addition to the tests prescribed for this salt in the text of the Pharmacopœia, it is required to conform to more rigorous tests before it can be used in the preparation of the tenth-normal volumetric solution. In a solution of 0.5 Gm. of the salt in 10 Cc. of water rendered acid by 0.5 Cc. of nitric acid, no turbidity should be produced by barium chloride test-solution (absence of sulphates).

To 10 Cc. of the aqueous solution of the salt (1 in 20), the addition of 1 Cc. of ammonia-water, followed by 1 Cc. of ammonium oxalate test-solution, should produce no turbidity (absence of calcium).

If to a solution of 0.5 Gm. of the salt in 20 Cc. of water sufficient sulphurous acid be added to impart a strong odor of the reagent, and the mixture be boiled for about 3 minutes and cooled, the addition of 1 Cc. of nitric acid and a few drops of silver nitrate volumetric solution should produce no turbidity (absence of chlorides).

Potassium dichromate which fails to meet all of the above requirements may be purified by recrystallization, the hot, saturated aqueous solution of the salt being rapidly cooled with agitation. The granular crystals, after being collected on a plain filter and washed with sufficient cold water to remove the mother-liquor, are thoroughly drained and then dried at 120° C. (248° F.). This recrystallization should be repeated until the salt responds to all the above tests for purity.

Potassium Dichromate Test-solution.—Dissolve 10 Gm. of pure potassium dichromate in sufficient water to measure 100 Cc.

Potassium Ferricyanide Test-solution.—Dissolve 1 part of potassium ferricyanide in about 10 parts of water. This solution should be made freshly when required, as it is rapidly decomposed by light. A freshly prepared, aqueous solution, when mixed with some ferric chloride test-solution and diluted with water, should show a brown tint, free from turbidity or a shade of green.

Potassium Ferrocyanide, $K_4Fe(CN)_6 + 3H_2O$.—In the form of large, soft, transparent, yellow, four-sided, monoclinic tables, odorless, and having a mild, saline taste. Slightly efflorescent on exposure to dry air.

Soluble in 3 parts of water at 25° C. (77° F.) and in 2 parts of boiling water; insoluble in alcohol. The aqueous solution is neutral to litmus-paper. No effervescence should be caused by the addition of diluted sulphuric acid to a concentrated solution of the salt (absence of carbonate).

The aqueous solution (1 in 20), acidulated with hydrochloric acid, should, upon the addition of barium chloride test-solution, remain clear (absence of sulphate). If a mixture of 0.5 Gm. of the salt with 1.5 Gm. of pure potassium nitrate and 0.5 Gm. of pure anhydrous sodium carbonate be heated to redness in a porcelain crucible, the residue dissolved in water, and the filtered solution supersaturated with nitric acid, no turbidity should be produced upon the addition of silver nitrate test-solution (absence of chloride). The precipitate produced in the aqueous solution, acidulated with nitric acid by silver nitrate test-solution, should be of a pure white color, without a tinge of red (absence of ferricyanide).

Potassium Ferrocyanide Test-solution.—Dissolve 10 Gm. of potassium ferrocyanide, $K_4Fe(CN)_6 + 3H_2O$, in sufficient water to measure 100 Cc.

Potassium Hydroxide Test-solution.—Use the official solution of potassium hydroxide (see page 913). For use in Fleitmann's test for arsenic (see above), it should have previously been subjected, by itself, to this test for at least 2 hours, with negative result (absence of arsenic).

Potassium Hydroxide Test-solution, Alcoholic.—Use the half-normal alcoholic potassium hydroxide volumetric solution. (See SAPONIFICATION VALUE OF FATS AND OILS.)

Potassium Iodide Test-solution.—Dissolve 20 Gm. of official potassium iodide in enough water to make 100 Cc., and keep the solution in dark amber-colored, well-stoppered bottles to prevent the formation of iodate. The solution should be frequently renewed, or freshly prepared when required.

Potassium Nitrate.—The dry salt responding to the tests of purity required by the Pharmacopœia, particularly to those for absence of chloride and sulphate.

Potassium Permanganate Test-solution.—Use the tenth-normal volumetric solution.

Potassium Sulphate Test-solution.—Dissolve 1 Gm. of official potassium sulphate in enough water to make 100 Cc.

Potassium Sulphocyanate, KSCN.—Colorless, prismatic crystals, of cooling, saline taste, and hydroscopic in moist air. Readily soluble in less than its own weight of water; soluble in 10 parts of absolute alcohol.

The aqueous solution of the salt (1 in 20) should not become turbid within 5 minutes upon the addition of barium chloride test-solution (limit of sulphate).

The aqueous solution (1 in 20), after the addition of 1 Cc. of diluted hydrochloric acid, should remain colorless (absence of iron), and should not respond to the time-limit test for heavy metals (see below).

Potassium Sulphocyanate Test-solution.—Use the tenth-normal volumetric solution.

Resins, etc., Acid Number for.—Dissolve 1 Gm. of the resinous substance in alcohol, add a few drops of phenolphthalein test-solution, and titrate with normal potassium hydroxide volumetric solution, the amount of potassium hydroxide consumed (expressed in milligrammes) is termed the acid number. The reaction is often more distinct if an excess of normal potassium hydroxide volumetric solution be used and the solution titrated back with normal acid volumetric solution.

Saponification Value of Fats and Oils.—The determination of the saponification value is conducted as follows: Weigh out accurately, in a flask holding 150 to 200 Cc., 1.5–2 Gm. of the purified and filtered fat. Next run into the flask, with a burette, 25 Cc. of alcoholic potassium hydroxide test-solution (see above). While exactly 25 Cc. is not indispensable, in comparative tests precisely the same amount must be used, allowing the burette to drain in exactly the same way in each test. Then place a small funnel in the flask and heat it on a water-bath containing boiling water, for half an hour, so that the alcohol is simmering, frequently imparting a rotary motion to the contents of the flask. Then add 1 Cc. of phenolphthalein test-solution, and titrate back the excess of potassium hydroxide with half-normal hydrochloric acid volumetric solution. A blank test is made at the same time, using the alcoholic potassium hydroxide test-solution alone; the difference in the number of cubic centimeters of half-normal hydrochloric acid volumetric solution consumed by the blank test and the real test, multiplied by 27.87, and divided by the weight in grammes of the fat or oil, will give the saponification equivalent of the sample tested.

Silver Ammonium Nitrate Test-solution.— Dissolve 1 Gm. of official silver nitrate in 20 Cc. of water, and add ammonia-water drop by drop, until the precipitate first produced is almost, but not entirely, redissolved. Filter the solution, and preserve in dark amber-colored and well-stoppered bottles.

Silver Nitrate Test-solution.—For ordinary purposes use the tenth-normal volumetric solution.

Silver Sulphate Test-solution.—Dissolve 1 Gm. of official silver nitrate in 0.5 Cc. of warm water, and add 1.5 Cc. of pure, concentrated sulphuric acid. On cooling, small transparent crystals of silver sulphate separate. Carefully pour off the acid liquid, wash the crystals repeatedly, by decantation, with cold water, transfer them to a bottle, add 100 Cc. of water, and agitate so as to produce a saturated solution. For use decant a sufficient quantity of the latter.

Sodium Acetate Test-solution.—Dissolve 10 Gm. of official sodium acetate in enough water to make 100 Cc.

Sodium Bitartrate Test-solution, $NaHC_4H_4O_6 + H_2O$.—To a solution of 2.4 Gm. of tartaric acid in about 80 Cc. of boiling water, add gradually, in small portions, monohydrated sodium carbonate until the solution has a neutral reaction; to this liquid is now added 3.5 Gm. of tartaric acid, and after filtering and cooling, sufficient water is added to the solution to measure 100 Cc. This solution should be freshly prepared when required.

Sodium Carbonate.—The monohydrated salt, $Na_2CO_3 + H_2O$, conforming to the tests prescribed by the Pharmacopœia, but absolutely free from chloride and sulphate.

Sodium Carbonate Test-solution.—Dissolve 10 Gm. of monohydrated sodium carbonate in sufficient water to measure 100 Cc.

Sodium Cobaltic Nitrite Test-solution, $CO_2(NO_2)_6 6NaNo_2 + H_2O$.—Dissolve 4 Gm. of cobaltous nitrate, $Co(NO_3)_2 + 6H_2O$, and 10 Gm. of sodium nitrite, $NaNO_2$, in about 50 Cc. of water, add 2 Cc. of acetic acid, and dilute with enough water to make 100 Cc. Should any of the nitrous acid be lost by keeping the solution, a few drops of acetic acid may be added.

Sodium Hydroxide Test-solution.—Use the official solution of sodium hydroxide (see page 917).

Sodium Nitrite, $NaNO_2$.—The purest commercial salt, generally in form of pencils, is sufficiently pure.

Sodium Nitro-prusside Test-solution.—Dissolve 1 part of sodium nitro-prusside, $Na_2Fe(NO)(CN)_5 + 2H_2O$, in 19 parts of water immediately before using.

Sodium Phosphate Test-solution.—Dissolve 10 Gm. of official sodium phosphate, $Na_2HPO_4 + 12H_2O$, in enough water to make 100 Cc.

Sodium Tartrate Test-solution, $Na_2C_4H_4O_6 + 2H_2O$.—To a solution of 6.5 Gm. of tartaric acid in about 80 Cc. of boiling water, add gradually, in small portions, monohydrated sodium carbonate until the solution has a neutral reaction; after filtering and cooling, add sufficient water to measure 100 Cc. This solution should be freshly prepared when required.

Sodium Thiosulphate, $Na_2S_2O_3 + 5H_2O$.—In addition to the tests prescribed for this salt in the text of the Pharmacopœia, it is required to conform to the following more rigorous tests before it can be used in preparing the standard volumetric solution. If to a solution of the salt (1 in 20) in distilled water iodine test-solution be added, drop by drop, until it retains a faint but permanent brown color, no turbidity should be produced upon the addition of barium chloride test-solution (absence of sulphates and sulphites). The addition of 1 drop of phenolphthalein test-solution to the aqueous solution of the salt (1 in 10) should produce not more than a very faint rose tint (absence of free alkalies). The aqueous solution of the salt (1 in 20) should not become cloudy upon the addition of ammonium oxalate test-solution (absence of calcium salts).

Sodium Thiosulphate Test-solution.—Use the tenth-normal volumetric solution.

Stannous Chloride Test-solution.—Heat pure tin, in form of foil or granules, with concentrated hydrochloric acid, taking care that the metal be in excess. When the acid is saturated, crystals of stannous chloride, $SnCl_2 + 2H_2O$, begin to form. Remove and drain these, dissolve them in 10 parts of water, and preserve the solution in well-stoppered bottles, into each of which a granule of pure tin or a piece of pure tin-foil has previously been introduced.

For Bettendorf's test (see p. 249) pure concentrated hydrochloric acid is saturated with the freshly-prepared crystals.

Starch Test-solution.—Mix 1 Gm. of starch with 10 Cc. of cold water, and then add enough boiling water, with constant stirring, to make about 200 Cc. of a thin, transparent jelly. If it is desired to preserve this test-solution for any length of time, 10 Gm. of zinc chloride, $ZnCl_2$, should be added to it and the solution transferred to small bottles, which should be well-stoppered.

Sulphanilic Acid Test-solution.—Dissolve 0.5 Gm. of sulphanilic acid, $HC_6H_4(NH_2)SO_3$ (para-amido-benzenesulphonic acid), in 150 Cc. of diluted acetic acid (10 per cent. absolute acetic acid). Only freshly distilled water should be employed in preparing the diluted acetic acid.

This reagent should be kept in well-stoppered bottles.

Sulphuric Acid, Pure, for Tests, H_2SO_4.—The sulphuric acid of the Pharmacopœia, which has a specific gravity of 1.826 at 25° C. (77° F.), will answer as a reagent for most purposes, provided it is of the required degree of purity. But when "concentrated" sulphuric acid is specially directed in a test, it is intended that the strongest obtainable pure acid, of a specific gravity of not less than 1.834 at 25° C. (77° F.), be employed.

In addition to the tests prescribed for this acid in the text of the Pharmacopœia, it is required to conform to the following more rigorous tests before it can be employed as a reagent. If 1 Cc. of diphenylamine test-solution be carefully poured, as a separate layer, upon 5 Cc. of sulphuric acid, contained in a test-tube, no distinct blue color should appear in the zone of contact (absence of nitric acid).

Tannic Acid Test-solution.—Dissolve 1 Gm. of tannic acid in 1 Cc. of alcohol and enough water to make 10 Cc., immediately before use.

Tartaric Acid Test-solution.—Dissolve 1 part of tartaric acid in 3 parts of water. Since fungous growths rapidly destroy the solution of tartaric acid, it should be prepared only as wanted.

Time-limit Test for Heavy Metals.—This general test is to be used to detect the presence of poisonous or undesirable metallic impurities in official chemical substances or their solutions.

Ten cubic centimeters of a solution of the salt or acid in distilled water (1 in 20), contained in a test-tube of about 40-Cc. capacity, when acidulated with 1 Cc. of diluted hydrochloric acid (unless otherwise directed), and warmed to about 50° C. (122° F.), should not be colored or rendered turbid by the addition of an equal volume of freshly prepared hydrogen sulphide test-solution, after standing, well-stoppered, in a warm place, 35° C. (95° F.), for at least half an hour, nor should the further addition of ammonia-water to this solution cause a coloration or turbidity therein.

Before the addition of the ammonia-water, the mixture should still possess the odor of hydrogen sulphide; if not, it should be thoroughly saturated with the gas and again set aside for half an hour.

Any change in the color of the solution which is being tested should be noted by comparison with a like volume of the hydrogen sulphide test-solution, when viewed by reflected light while held against a white surface.

ANTIMONY yields, upon the addition of hydrogen sulphide test-solution to highly diluted solutions, a pale yellow to orange color, or, to more concentrated solutions, an orange precipitate, which is soluble in test-solutions of potassium hydroxide and ammonium sulphide, as well as in strong hydrochloric acid.

The precipitate is insoluble in test-solution of ammonium carbonate. The addition of ammonia-water to the highly diluted hydrogen sulphide solution of antimony slightly intensifies the coloration.

ARSENIC yields, upon the addition of hydrogen sulphide test-solution to highly diluted solutions, a pale-yellow color, or, to more concentrated solutions, a yellow precipitate, which is soluble in test-solutions of potassium hydroxide, ammonium sulphide, and ammonium carbonate, but is reprecipitated upon the addition of hydrochloric acid, insoluble in excess. The addition of ammonia-water to the highly-diluted hydrogen sulphide solution of arsenic slightly intensifies the yellow color.

CADMIUM in very dilute solutions gives, with hydrogen sulphide test-solution or ammonium sulphide test-solution, a pale-yellow color; it yields in more concentrated solutions (not excessively acid) a yellow precipitate, which is insoluble in cold diluted hydrochloric acid, potassium hydroxide test-solution, or ammonium sulphide test-solution (distinction from arsenic), and in solution of potassium cyanide. This precipitate is soluble in nitric and hydrochloric acids and in hot diluted hydrochloric and sulphuric acids.

COPPER yields, upon the addition of hydrogen sulphide test-solution to highly diluted solutions, a pale-brown color, or, to more concentrated solutions, a brownish-black precipitate, which is insoluble in

diluted hydrochloric acid and test-solution of potassium hydroxide, and is but very slightly soluble in test-solution of ammonium sulphide. The precipitate is soluble in warm diluted nitric acid, and also in solution of potassium or sodium cyanide. The addition of ammonia-water to the highly diluted hydrogen sulphide solution containing copper slightly intensifies the coloration.

IRON.—Acidified solutions of ferrous iron do not react with hydrogen sulphide test-solution, but yield a dark coloration or black precipitate with ammonium sulphide test-solution, or upon the addition of ammonia-water to the hydrogen sulphide mixture. This latter precipitate is soluble in cold diluted hydrochloric acid.

Acidified solutions of ferric iron yield a white turbidity or precipitate of sulphur upon the addition of hydrogen sulphide test-solution, but a dark coloration or black precipitate with ammonium sulphide test-solution, or upon the addition of ammonia-water to the hydrogen sulphide mixture. This precipitate is readily soluble in acetic and inorganic acids.

LEAD yields, upon the addition of hydrogen sulphide test-solution or ammonium sulphide test-solution to highly diluted solutions, a pale-brown coloration, or, to more concentrated solutions, a black precipitate, which is insoluble in diluted hydrochloric acid, and also in test-solutions of potassium hydroxide and ammonium sulphide.

ZINC yields, with ammonium sulphide test-solution, and with hydrogen sulphate test-solution, either in neutral solution or after acidulation with acetic acid (in the absence of free mineral acids), a white turbidity in highly diluted solutions, but with concentrated solutions a white precipitate soluble in hydrochloric acid and insoluble in acetic acid.

Tin.—Pure metallic tin, Sn, in the granulated or mossy condition. Its solution in hydrochloric acid should give no precipitate with potassium sulphate test-solution (absence of lead), and, when tested by the modified Gutzeit's test (see p. 248), replacing the zinc by tin, the diluted hydrochloric acid by hydrochloric acid, U. S. P., and adding 1 drop of platinic chloride test-solution, the mercuric chloride cap should not become colored within the time required for the solution of the metal (absence of arsenic).

Tumeric Paper and Tincture.—See under INDICATORS.

Zinc.—Metallic zinc, preferably in the form of thin pencils (about 5 Mm. in diameter), prepared by fusing the metal and casting it in molds, or in the form of thin sheets. It should respond to all the tests required by the Pharmacopœia, and in addition, when examined by Gutzeit's test, it should not cause the silver nitrate to become colored within 2 hours (absence of arsenic).

Zinc-Iodide-Starch Test-solution.—To 100 Cc. of freshly prepared starch test-solution add 5 Gm. of official zinc chloride and 3 Gm. of official zinc iodide. Preserve the colorless solution carefully in small, dark amber-colored and well-stoppered vials.

2. Indicators for Acidimetry, Alkalimetry, etc.

NOTE.—Each test-solution used as indicator should be examined as soon as prepared, and afterward, from time to time, as to its neutrality. If necessary, it should be brought, by the cautious addition of diluted sulphuric acid or of a dilute solution of an alkali, to such a point that, when a few drops of it are added to 25 Cc. of water, a single drop of a hundredth-normal acid or alkali solution, respectively, will distinctly develop the corresponding tints.

Since many of the colored test-solutions are injured by exposure to light, it is best to preserve them in dark, amber-colored vials. Papers prepared with them should be kept in dark bottles or paper boxes.

Brazil-wood Test-solution.—Boil 50 Gm. of finely-cut Brazil-wood [the heart-wood of Peltophorum dubium (*Sprengel*) *Britton*, nat. ord. Leguminosæ] with 100 Cc. of water during half an hour, replacing the water from time to time. Allow the mixture to cool, strain, wash the contents of the strainer with water until 100 Cc. of strained liquid are obtained, add 25 Cc. of alcohol, and filter. This solution turns purplish red with alkalies and yellow with acids.

Cochineal Test-solution.—Macerate 1 Gm. of unbroken cochineal during four days with 20 Cc. of alcohol and 60 Cc. of water. Then filter. The color of this test-solution turns violet with alkalies and yellowish red with acids. As an indicator it is used chiefly when ammonia or alkaline earths are present.

Hematoxylin Test-solution.—Dissolve 0.2 Gm. of hematoxylin [a crystalline substance derived from *Hæmatoxylon*, U. S. P.] in 100 Cc. of alcohol. Use about 5 drops for each titration. This indicator assumes a yellow to orange color in acid solutions, and a violet to purple color in alkaline solutions. The titration is complete when the change in color remains permanent upon the addition of 1 drop of the volumetric solution after stirring the liquid.

Iodeosin Test-solution.—Dissolve 0.1 Gm. of iodeosin, $C_{20}H_8I_4O_5$ (*tetraiodofluorescein*), in 100 Cc. of alcohol. This indicator becomes colorless in acid solutions, changing to pink in alkaline solutions. Dilute the solution to be titrated in a 200-Cc. flask with distilled water to about 100 Cc., add 20 Cc. of ether and 5 drops of the iodeosin test-solution, cork, and shake well. Then add the volumetric alkali solution gradually, shaking well after each addition. The titration is complete when the lower aqueous solution retains a faint pink color after shaking thoroughly. For assaying akaloidal residues, dissolve the latter in a measured excess of volumetric acid solution, and transfer the acid solution to a 200-Cc. flask, washing the container well with water until the contents of the flask measure about 100 Cc. Then proceed as above.

Litmus-paper and Test-solution.—Exhaust powdered litmus with three separate and successive portions (representing about 4 times its weight) of boiling alcohol (which removes the undesirable color erythrolitmin), each extraction lasting for about one hour. After draining off the alcohol, digest the residue with about an equal weight of cold water, and filter. (This blue solution, which contains some alkali, after being acidulated, may be used to make red litmus-paper.) Finally, extract the residue with about 5 times its weight of boiling water, and, after thoroughly cooling, filter. The addition of 1 drop of tenth-normal acid or alkali volumetric solution to 50 Cc. of water containing 5 drops of the indicator should produce a distinct change in color. Preserve the filtrate, as test-solution, in wide-mouthed bottles stoppered with loose plugs of cotton, so as to exclude dust but admit air. The blue color of litmus test-solution is changed by acids to red, and this red color by the addition of alkalies is restored to blue.

Litmus-paper, Blue.—Impregnate, with the test-solution just described, strips of white, unsized paper, free from wood-pulp, but not too porous, and dry them by suspending them on strings of clean twine.

Litmus-paper, Red.—Prepare this with the same kind of paper and in the same manner as described in the preceding paragraph. To impregnate the paper, either use the blue solution obtained from litmus, by treating the mass, after extraction of alcohol, with cold water, acidulating the same with just enough hydrochloric acid to impart to it a distinctly red tint; or use the regular test-solution, after acidulating it in the same manner.

Neither blue nor red litmus-paper should have a very intense color.

Preserve the test-paper in paper boxes or bottles, so as to exclude dust and acid or ammoniacal vapors.

Methyl-orange Test-solution.—Dissolve 1 Gm. of methyl-orange (the sodium or ammonium salt of dimethylamidoazobenzenesulphonic acid, $HC_{14}H_{14}N_3SO_3$; also known as helianthin, or tropæolin D, or Poirrier's Orange III.) in 1000 Cc. of water. Add to it carefully diluted sulphuric acid, in drops, until the liquid turns red and just ceases to be transparent. Then filter.

To distinguish methyl-orange from other orange colors of this class, which are unfit for use as indicators, it should respond to the following tests:

Methyl-orange should be completely soluble in distilled water, and the test-solution should be of an orange-yellow color, free from a brownish tint. No precipitate should form in this solution upon the addition of an alkali.

The addition of hydrochloric acid to a hot, concentrated solution of methyl-orange should produce a crystalline precipitate, composed of lustrous plates having a violet reflection and free from brown tint.

The addition of calcium chloride or barium chloride test-solution should produce no precipitate.

A few drops of gold chloride test-solution should produce a red coloration, free from either a violet or green tint.

Excessive quantities of this indicator should be avoided in titrating; from 1 to 3 drops are sufficient for a volume of from 50 to 100 Cc., or just enough is added to impart a faint tint to the solution, which if neutral should change to a red or yellow, respectively, upon the addition of 2 drops of tenth-normal acid or alkali volumetric solution.

Methyl-orange is suitable for titrating inorganic acids, alkalies, alkali carbonates or bicarbonates, also certain alkaloids, as morphine and quinine. It is not to be employed in titrating organic acids, nor in alcoholic or boiling solutions.

This indicator gives a yellow color with alkalies and red with acids.

Phenolphthalein Test-solution.—Dissolve 1 Gm. of phenolphthalein ($C_{20}H_{14}O_4$) in 50 Cc. of alcohol and dilute to 100 Cc. with water. About 3 drops are sufficient for 50 Cc. of the solution to be titrated; it gives a red color with alkali hydroxides or carbonates, while acids render the solution colorless. Phenolphthalein may be employed in hot titrations. It is not suitable as an indicator for ammonia, but is largely used for organic acids, alkali hydroxides, and for carbonates and bicarbonates in boiling solutions.

Phenolphthalein-paper is prepared by impregnating white, unsized paper with the test-solution and drying it.

Turmeric Tincture.—Digest any convenient quantity of ground turmeric root (from *Curcuma longa* Linné, Fam. *Zingiberaceæ*) repeatedly with small quantities of water and discard the liquids. Then digest the dried residue for several days with 6 times its weight of alcohol, and filter.

Turmeric-paper.—Impregnate white, unsized paper with the tincture, and dry it. The tincture, as well as the paper, turns brown with alkalies, and the original yellow color is restored by acids, with the exception of boric acid, which, even in the presence of hydrochloric acid, turns the color to reddish brown, and this is changed to bluish black by ammonia.

Rosolic Acid Test-solution.—Dissolve 1 Gm. of commercial rosolic acid [chiefly methylaurin, $C_{20}H_{16}O_3$] in 10 Cc. of diluted alcohol, and add enough water to make 100 Cc. The solution turns violet-red with alkalies, yellow with acids. In place of rosolic acid, commercial pæonin (also known as aurin R) [chiefly $C_{19}H_{14}O_3$] may be employed.

VOLUMETRIC SOLUTIONS.

NOTE.—It is absolutely necessary that the measuring vessels employed in the operations of volumetric analysis, consisting of burettes, flasks, mixing cylinders, pipettes, etc., should agree among themselves accurately in their graduation at the standard temperature selected. It is immaterial what standard temperature has been selected for the graduation of the vessels.

All volumetric solutions must be prepared at the standard temperature of 25° C. (77° F.), and the solutions must be used in the titrations at a temperature not below 21° C. (69.8° F.), nor above 29° C. (84.2° F.).

All bottles in which volumetric solutions are to be kept, as well as the burettes or pipettes in which they are to be measured, should, prior to use, be thoroughly rinsed with distilled water, then with 2 or 3 small portions of the solution that they are to contain. When not in use, burettes should be kept filled with distilled water.

Normal volumetric solutions are those which contain in 1 liter, in any stated reaction, the chemical equivalent of 1 gramme of hydrogen. If the molecule of the reagent is univalent, 1 liter will contain the weight in grammes equal to the molecular weight of the reagent; if bivalent, a weight in grammes equal to ½ its molecular weight; if trivalent, a weight in grammes equal to ⅓ its molecular weight.

Thus, hydrochloric acid, HCl = 36.18, having but 1 H atom replaceable by a basic element, has 36.18 Gm. of absolute HCl in 1000 Cc. of the normal volumetric solution; while sulphuric acid, H_2SO_4 = 97.35, having 2 replaceable H atoms, contains only ½ this number, or 48.675 grammes of absolute H_2SO_4 in 1000 Cc. of its normal solution. Potassium hydroxide, KOH = 55.74, has but 1 K to replace 1 H in acids, hence its normal solution contains 55.74 grammes of pure KOH in 1 liter. Again, 1 molecule of potassium dichromate in oxidation liberates 3 atoms of oxygen which are capable of oxidizing 6 atoms of ferrous to ferric iron. Therefore each molecule of the dichromate, yielding 3 atoms of oxygen, is equivalent to 6 atoms of hydrogen. Hence the normal solution should

contain $\frac{292.28}{6}$ or 48.713 Gm. in 1000 Cc. 2 Molecules of potassium permanganate, $2KMnO_4 = 313.96$, in oxidation, give off 5 atoms of O, which are equivalent to 10 atoms of H; hence its normal solution should contain $\frac{313.96}{10}$ or 31.396 Gm. in 1000 Cc.

Solutions containing in 1000 Cc. $\frac{1}{10}$ of the quantity of the active reagent in the normal solution are called tenth-normal; those containing $\frac{1}{100}$, hundredth-normal; $\frac{1}{50}$, fiftieth-normal; those containing twice the amount, double-normal; half the amount, half-normal.

Solutions containing quantities of the active reagent having no simple relation to the molecular weight are called empirical.

In the majority of the assays it has been directed that an integral quantity (1, 2, 5, or 10 Gm.) of the substance which is to be tested be weighed, dissolved in water, and made up to a definite volume, then an aliquot portion (representing the fractional weight of the substance required) is measured off for titration. Fractional parts of the Cc. may be measured by means of a 1-Cc. pipette graduated in $\frac{1}{10}$ or $\frac{1}{20}$ divisions.

Use of Empirical Solutions.—All standard volumetric solutions deteriorate in time, some very slowly, others rapidly, especially when not properly preserved. To restore the titer of such solutions (that is, to make them exactly normal, tenth- or hundredth-normal, as the case may be), each time they are to be used, involves an unnecessary waste of time. If one accurately standardized solution be always available, it is not necessary that the other volumetric solutions employed in conjunction with it be diluted to exactly correspond, Cc. for Cc., so long as the exact ratio is known.

The percentage strength of any empirical solution as compared with a standard volumetric solution is ascertained by experiment, then the number of Cc. of the empirical solution consumed in the titration of the substance is multiplied by its percentage strength, which result represents the equivalent volume of the true standard solution.

Example.—1 gramme of a sample of potassium carbonate required for neutralization 22 Cc. of an empirical solution of hydrochloric acid. In a trial experiment, 16 Cc. of this weak solution were required to neutralize 10 Cc. of a standard normal potassium hydroxide volumetric solution. The former is therefore of 62.5 per cent. strength (for $16 : 10 :: 100 : x$. $x = 62.5$), hence the 22 Cc. of empirical solution consumed represent 13.75 Cc. (62.5 per cent. of 22) of standard normal hydrochloric acid volumetric solution. Then if 1 Cc. of one-normal hydrochloric acid volumetric solution = 0.068635 Gm. of potassium carbonate, 13.75 Cc. would be equivalent to 13.75×0.068635, or 0.9436 + Gm. of carbonate.

Alkaline Cupric Tartrate Volumetric Solution, U. S. (*Fehling's Solution*).—*A. The Copper Solution.*—Dissolve 34.67 (34.6663) Gm. of carefully selected, small crystals of pure cupric sulphate, showing no trace of efflorescence or of adhering moisture, in a sufficient quantity of water to make the solution measure, at 25° C. (77° F.), exactly 500 Cc. Keep this solution in small, well-stoppered bottles.

B. The Alkaline Tartrate Solution.—Dissolve 173 Gm. of crystallized potassium and sodium tartrate and 75 Gm. of potassium hydroxide in a sufficient quantity of water to make the solution measure, at 25° C. (77° F.), exactly 500 Cc. Keep the solution in small, rubber-stoppered bottles.

For use, mix exactly equal volumes of the two solutions at the time required.

One Cubic Centimeter of the Mixed Solution is the equivalent of:

	Gramme.
Cupric sulphate, crystallized, $CuSO_4 + 5H_2O$	0.03467
Cupric tartrate, $CuC_4H_4O_6 + 3H_2O$	0.03688
Cane-sugar (Inverted)	0.00475
Glucose, anhydrous, $C_6H_{12}O_6$	0.00500
Milk-sugar, anhydrous, $C_{12}H_{22}O_{11}$	0.00678

Tenth-normal Bromine Volumetric Solution, U. S. (*Koppeschaar's Solution.*) (Br., 79.36; 7.936 Gm. in 1000 Cc.).—Dissolve 3.2 Gm. of potassium bromate and 50 Gm. of potassium bromide in sufficient water to measure, at or near 25° C. (77° F.), 900 Cc. Transfer 20 Cc. of this solution, by means of a pipette, into a bottle having a capacity of about 250 Cc. and provided with a glass stopper; add 75 Cc. of water and 5 Cc. of pure hydrochloric acid, and immediately insert the stopper. Shake the bottle a few times, then remove the stopper just sufficiently to quickly introduce 5 Cc. of potassium iodide test-solution, taking care that no bromine vapors escape, and immediately stopper the bottle. Agitate the bottle thoroughly, remove the stopper and rinse it and the neck of the bottle with a little water so that the washings flow into the bottle, and then add from a burette tenth-normal sodium thiosulphate volumetric solution until the brown iodine tint is just discharged. Note the number of Cc. of the sodium thiosulphate volumetric solution thus consumed, and then dilute the bromine solution so that equal volumes of it and of tenth-normal sodium thiosulphate volumetric solution will exactly correspond to each other under the conditions mentioned above.

Example.—Assuming that the 20 Cc. of the bromine solution have required 25.2 Cc. of the sodium thiosulphate volumetric solution to completely discharge the iodine tint, then each 20 Cc. of the bromine solution must be diluted to 25.2 Cc. Thus, if 850 Cc. of the solution remain, it must be diluted with water to measure 1071 Cc.

After the solution is thus diluted a new trial should be made in the manner above described, in which 25 Cc. of the tenth-normal sodium thiosulphate volumetric solution should just discharge the tint of the iodine liberated by the bromine set free from 25 Cc. of the standard bromine solution.

Keep the solution in dark amber-colored, glass-stoppered bottles.

One Cubic Centimeter of Tenth-normal Bromine Volumetric Solution is the Equivalent of:

	Gramme.
Bromine, Br.	0.007936
Phenol, C_6H_5OH	0.001556

Normal Hydrochloric Acid Volumetric Solution, U. S. (HCl, 36.18; 36.18 Gm. in 1000 Cc.).—Mix 130 Cc. of hydrochloric acid of specific gravity 1.158 with sufficient water to measure 1000 Cc. Of this liquid (which is still too concentrated) carefully measure, from a burette, 10 Cc. into a flask or porcelain dish, and after diluting with about double its volume of water add 2 drops of methyl-orange test-solution, then gradually add, from a burette, a freshly standardized normal potassium hydroxide volumetric solution, until the red tint of the solution changes, after vigorous shaking, to a permanent pale yellow. Note the number of Cc. of potassium hydroxide volumetric solution consumed, and then dilute the acid solution so that equal volumes of this and of the normal potassium hydroxide volumetric solution neutralize each other at 25° C. (77° F.).

Example.—Assuming that 10 Cc. of the acid solution first prepared required exactly 11 Cc. of normal potassium hydroxide volumetric solution, each 10 Cc. of the former must be diluted to 11 Cc., or the whole of the remaining acid solution in the same proportion at 25° C. (77° F.). Thus, if 950 Cc. should remain, 95 Cc. of water must be added.

After the liquid is thus diluted a new trial should be made in the manner above described, in which 50 Cc. of the acid solution should require for neutralization exactly 50 Cc. of normal potassium hydroxide volumetric solution. If necessary, a new adjustment should then be made to render the correspondence perfect at 25° C. (77° F.).

One Cubic Centimeter of Normal Hydrochloric Acid Volumetric Solution is the Equivalent of:

	Gramme.
Hydrochloric acid, absolute, HCl	0.03618

Note.—Normal hydrochloric acid is in every respect equivalent in neutralizing power to normal sulphuric acid (which see), and may be employed, except in special cases, for the same purposes. However, preference is generally given to the normal sulphuric acid volumetric solution.

Half-normal Hydrochloric Acid Volumetric Solution, U. S. (HCl, 36.18; 18.09 Gm. in 1000 Cc.).—Dilute 500 Cc. of normal hydrochloric acid volumetric solution with sufficient distilled water to measure exactly 1000 Cc. at 25° C. (77° F.).

One Cubic Centimeter of Half-normal Hydrochloric Acid Volumetric Solution is the Equivalent of:

	Gramme.
Hydrochloric acid, absolute, HCl	0.01809
Benzaldehyde, C_7H_6O	0.0526
Cinnamic aldehyde, C_9H_8O	0.0333
Citral, $C_{10}H_{16}O$	0.03802
Potassium acetate, $KC_2H_3O_2$ (after ignition)	0.04872
Potassium bicarbonate, $KHCO_3$	0.049705
Potassium bitartrate, $KHC_4H_4O_6$ (after ignition)	0.09339
Potassium carbonate, anhydrous, K_2CO_3	0.034318
Potassium citrate, cryst., $K_3C_6H_5O_7 + H_2O$ (after ignition)	0.05368
Potassium hydroxide, KOH	0.02787
Potassium and sodium tartrate, $KNaC_4H_4O_6 + 4H_2O$ (after ignition)	0.070045
Sodium acetate, $NaC_2H_3O_2 + 3H_2O$ (after ignition)	0.06755
Sodium benzoate, $NaC_7H_5O_2$ (after ignition)	0.071505
Sodium bicarbonate, $NaHCO_3$	0.041715
Sodium carbonate, anhydrous, Na_2CO_3	0.026328
Sodium carbonate, monohydrated, $Na_2CO_3 + H_2O$	0.030798
Sodium citrate, $2Na_3C_6H_5O_7 + 11H_2O$ (after ignition)	0.0591
Sodium hydroxide, NaOH	0.01988
Sodium salicylate, $NaC_7H_5O_3$ (after ignition)	0.079445

Tenth-normal Iodine Volumetric Solution, U. S. (I, 125.9; 12.59 Gm. in 1000 Cc.).—Tenth-normal iodine volumetric solution may be prepared according to either of the following methods:

I. Dissolve 12.59 Gm. of pure iodine (see below) in a solution of 18 Gm. of potassium iodide in 300 Cc. of water. Then add sufficient water to make the solution measure, at 25° C. (77° F.), exactly 1000 Cc. Unless freshly prepared, its strength should always be determined anew at the time it is used. Transfer the solution to glass-stoppered vials.

Preparation of Pure Iodine.—Heat powdered iodine in a porcelain dish placed over a bath of boiling water for twenty minutes, and stir it constantly with a glass rod, so that adhering moisture, cyanogen iodide, and most of the iodine bromide and iodine chloride, if present, may be vaporized. Then transfer the iodine to porcelain or other non-metallic mortar, and triturate it with about 5 per cent.

of its weight of dry potassium iodide, so as to decompose any remaining iodine bromide and iodine chloride. Then return the mass to the dish, cover it with a glass funnel, and heat the dish carefully on a sand-bath. Detach the sublimed, pure iodine, and, after pulverizing and drying for twenty-four hours over calcium chloride, keep it in well-stoppered bottles in a cool place.

II. Tenth-normal iodine volumetric solution may also be prepared as follows:

Dissolve about 14 Gm. of iodine in a solution of 18 Gm. of potassium iodide in about 300 Cc. of water, diluting finally to 1000 Cc. Of this solution (which is too concentrated), carefully measure from a burette 10 Cc. into a flask, then add gradually and cautiously, from a burette, tenth-normal sodium thiosulphate volumetric solution (shaking constantly) until the color of the solution is discharged. Note the number of Cc. of the sodium thiosulphate volumetric solution consumed, and then dilute the iodine solution so that any known volume of the latter will require for decolorization exactly the same volume of the tenth-normal sodium thiosulphate volumetric solution.

Example.—Assuming that 10 Cc. of the iodine solution required 10.8 Cc. of the tenth-normal sodium thiosulphate volumetric solution for decolorization, then each 10 Cc. of the former must be diluted to 10.8 Cc., or each 100 Cc. of the iodine solution to 108 Cc. at 25° C. (77° F.). After the solution is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the tenth-normal iodine volumetric solution should require exactly 50 Cc. of the tenth-normal sodium thiosulphate volumetric solution for complete decolorization. If necessary, a new adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Tenth-normal Iodine Volumetric Solution is the Equivalent of:

	Gramme.
Iodine, I	0.01259
Arsenic, As	0.00372
Arsenic trioxide (arsenous acid), As_2O_3	0.004911
Iron, Fe	0.002775
Potassium sulphite, crystallized, $K_2SO_3 + 2H_2O$	0.009648
Sodium bisulphite, $NaHSO_3$	0.005168
Sodium thiosulphate (hyposulphite), crystals, $Na_2S_2O_3 + 5H_2O$	0.024646
Sodium sulphite, crystallized, $Na_2SO_3 + 7H_2O$	0.012520
Sulphur dioxide, SO_2	0.003180
Antimony and potassium tartrate, crystallized, $2K(SbO)C_4H_4O_6 + H_2O$	0.016495

Tenth-normal Oxalic Acid Volumetric Solution, U. S. ($H_2C_2O_4 + 2H_2O$, 125.10; 6.255 Gm. in 1000 Cc.).—Dissolve 6.4 Gm. of pure oxalic acid in sufficient water to measure 1000 Cc.

Into a flask, accurately measure, from a burette, 10 Cc. of a *freshly standardized* tenth-normal potassium hydroxide volumetric solution, dilute with about 20 Cc. of water, add 3 to 5 drops of phenolphthalein test-solution, and heat to boiling. From a burette gradually add the oxalic acid solution (which is still too concentrated) until the red tint of the alkali solution fails to reappear after vigorous shaking and boiling. Note the number of Cc. of the oxalic acid solution consumed, and then dilute it so that equal volumes of this and of the tenth-normal potassium hydroxide volumetric solution neutralize each other at 25° C. (77° F.). It deteriorates on standing.

Example.—Assuming that the 10 Cc. of the tenth-normal potassium hydroxide volumetric solution required exactly 9.5 Cc. of the oxalic acid solution, then each 9.5 Cc. of the latter must be diluted to 10 Cc., or the whole of the remaining acid solution in the same proportion at 25° C. (77° F.). Thus, if 950 Cc. of the oxalic acid solution should remain, 50 Cc. of water must be added.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of tenth-normal potassium hydroxide volumetric solution should require for neutralization exactly 50 Cc. of the oxalic acid solution at 25° C. (77° F.). If necessary, a new adjustment should then be made to render the correspondence perfect.

NOTE.—Tenth-normal oxalic acid volumetric solution is in every respect equivalent in neutralizing power to any other tenth-normal acid volumetric solution with either litmus or phenolphthalein test-solution as indicator. Its most important use is in standardizing tenth-normal potassium permanganate volumetric solution.

One Cubic Centimeter of Tenth-normal Oxalic Acid Volumetric Solution is Equivalent of:

	Gramme.
Oxalic acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006255
Ammonia gas, NH_3	0.001693
Calcium hydroxide, $Ca(OH)_2$	0.003678
Lead subacetate, $Pb_2O(C_2H_3O_2)_2$	0.0135935
Manganese dioxide, precipitated, MnO_2	0.004318
Potassium hydroxide, KOH	0.005574
Potassium permanganate, $KMnO_4$	0.0031396
Sodium hydroxide, NaOH	0.003976

Tenth-normal Potassium Dichromate Volumetric Solution, U. S. ($K_2Cr_2O_7$, 292.28; 4.8713 Gm. in 1000 Cc.).—Dissolve 4.8713 Gm. of pure potassium dichromate, which has been pulverized and dried at 120° C. (248° F.) in sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc.

When used with phenolphthalein as indicator, to neutralize alkalies, the volumetric solution of potassium dichromate is tenth-normal when it contains 14.614 Gm. in 1000 Cc. It is then the exact

equivalent of any tenth-normal acid volumetric solution, each Cc. being equivalent to the amounts of alkalies quoted under such acids.

When used as an oxidizing agent to convert ferrous into ferric salts, or to liberate iodine from potassium iodide, the solution just mentioned (containing 14.614 Gm. in 1000 Cc.) has the effect of a three-tenth-normal volumetric solution, and a solution of one-third of this strength, containing 4.8713 Gm. in 1000 Cc., has the value of a tenth-normal solution, and is the equivalent of an equal volume of tenth-normal potassium permanganate volumetric solution, or, in the case of iodine liberated from potassium iodide, it is the equivalent of an equal volume of tenth-normal sodium thiosulphate volumetric solution. For titrating iron in *ferrous* compounds, it is used in the following manner: Introduce the aqueous solution of the ferrous salt into a flask and, if it is not already acid, render it so with sulphuric acid. Now add, gradually, tenth-normal potassium dichromate volumetric solution from a burette, with agitation, until a drop taken out upon a white surface no longer becomes blue when mixed with a drop of freshly prepared potassium ferricyanide test-solution.

Tenth-normal potassium dichromate volumetric solution may also be used, in conjunction with potassium iodide (from which it liberates iodine) and sulphuric acid, for adjusting the titer of sodium thiosulphate volumetric solution and thus that of the iodine volumetric solution.

One Cubic Centimeter of Tenth-normal Potassium Dichromate Volumetric Solution is the Equivalent of:

	Gramme.
Potassium dichromate, $K_2Cr_2O_7$	0.0048713
Iron, Fe, in ferrous compounds	0.00555
Ferrous carbonate, $FeCO_3$	0.011505
Ferrous sulphate, anhydrous, $FeSO_4$	0.015085
Ferrous sulphate, crystallized, $FeSO_4 + 7H_2O$	0.027601
Ferrous sulphate, dried, $2FeSO_4 + 3H_2O$	0.017767
Sodium thiosulphate, $Na_2S_2O_3 + 5H_2O$	0.024646

Normal Potassium Hydroxide Volumetric Solution, U. S. (KOH, 55.74; 55.74 Gm. in 1000 Cc.).—Dissolve 75 Gm. of potassium hydroxide in sufficient water to measure about 1050 Cc., and fill a burette with a portion of this liquid.

Into a flask of the capacity of about 300 Cc. introduce 9.339 Gm. of potassium bitartrate, which has been purified and dried as directed under Reagents, and 160 Cc. of distilled water. Boil the liquid until solution has taken place, add from 3 to 5 drops of phenolphthalein test-solution, followed by the cautious addition, from a burette, of the potassium hydroxide solution, frequently agitating the flask, boiling, and, toward the end of the operation, reducing the flow to drops until the red color produced by its influx no longer disappears on shaking, but is not deeper than pale pink. Note the number of Cc. of the potassium hydroxide solution consumed, and then dilute the remainder of the solution so that exactly 50 Cc. of the diluted liquid at 25° C. (77° F.) shall be required to neutralize the 9.339 Gm. of potassium bitartrate used.

Example.—Assuming that 40 Cc. of the stronger solution of potassium hydroxide first prepared had been consumed in the trial, then each 40 Cc. must be diluted to 50 Cc., or the whole of the remaining solution in the same proportion at 25° C. (77° F.). Thus, if 1000 Cc. should be still remaining, this must be diluted with water to 1250 Cc.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the diluted solution should exactly neutralize 9.339 Gm. of potassium bitartrate at 25° C. (77° F.). If necessary, a new adjustment should then be made to render the correspondence perfect.

NOTE.—Solutions of caustic alkalies absorb carbon dioxide from the atmosphere, and thereby change their titer when used with litmus test-solution, or phenolphthalein test-solution, as indicator (methyl-orange test-solution is not affected by the presence of carbonic acid). Hence the volumetric solutions should be preserved in bottles provided with well-fitting rubber stoppers, or, better still, these should be provided with tubes filled with soda-lime (a mixture of caustic soda and lime); the tubes pass through a perforation in the rubber stoppers, and thus absorb the carbon dioxide and prevent its access to the solution. If the solution is kept in a burette for any length of time, the same provision with a soda-lime tube should be observed.

In place of potassium hydroxide volumetric solution, sodium hydroxide volumetric solution may be used, in the same manner and in the same quantity. Potassium hydroxide volumetric solution, however, is preferable, since it foams less and attacks glass more slowly.

One Cubic Centimeter of Normal Potassium Hydroxide Volumetric Solution is the Equivalent of:

	Gramme.		Gramme.
Potassium hydroxide, KOH	0.05574	Lactic acid, absolute, $HC_3H_5O_3$	0.08937
Acetic acid, absolute, $HC_2H_3O_2$	0.05958	Nitric acid, absolute, HNO_3	0.06257
Ammonia gas, NH_3	0.01693	Oxalic acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.06255
Ammonium chloride, NH_4Cl	0.05311	Phosphoric acid, H_3PO_4 (to form K_2HPO_4; with phenolphthalein)	0.048645
Boric acid, H_3BO_3	0.06154	Potassium dichromate, $K_2Cr_2O_7$	0.14614
Citric acid, crystallized, $H_3C_6H_5O_7 + H_2O$	0.06950	Sodium hydroxide, NaOH	0.03976
Hydriodic acid, absolute, HI	0.12690	Sulphuric acid, absolute, H_2SO_4	0.048675
Hydrobromic acid, absolute, HBr	0.08036	Tartaric acid, crystallized, $H_2C_4H_4O_6$	0.07446
Hydrochloric acid, absolute, HCl	0.03618	Trichloracetic acid, CCl_3COOH	0.16212
Hypophosphorous acid, HPH_2O_2	0.06553		

Tenth-normal Potassium Hydroxide Volumetric Solution, U. S. (KOH, 55.74; 5.574 Gm. in 1000 Cc.)—Dilute 100 Cc. of freshly standardized normal potassium hydroxide volumetric solution with sufficient distilled water to measure, at 25° C. (77° F.), exactly 1000 Cc.

This solution may also be prepared and standardized directly with potassium bitartrate, as directed under normal potassium hydroxide volumetric solution, employing for this purpose 0.9339 Gm. of the former and a solution of about 7.5 Gm. of potassium hydroxide in 1000 Cc. of distilled water. 50 Cc. of the prepared tenth-normal solution of 25° C. (77° F.) should exactly neutralize 0.9339 Gm. of potassium bitartrate.

NOTE.—The same precautions should be taken for protecting this solution from carbon dioxide of the air as are directed under normal potassium hydroxide volumetric solution.

One Cubic Centimeter of Tenth-normal Potassium Hydroxide Volumetric Solution is the Equivalent of:

	Gramme.
Potassium hydroxide, KOH	0.005574
Sulphuric acid, absolute, H_2SO_4	0.0048675

Fiftieth-normal Potassium Hydroxide Volumetric Solution, U.S. (KOH, 55.74; 1.1148 Gm. in 1000 Cc.).—Dilute 20 Cc. of a freshly standardized normal or 200 Cc. of tenth-normal potassium hydroxide volumetric solution with sufficient distilled water to measure, at 25° C. (77° F.), exactly 1000 Cc. This standard solution is employed in conjunction with the tenth-normal sulphuric acid volumetric solution in the titration of alkaloids, with hematoxylin, cochineal, or iodeosin test-solution as indicators.

NOTE.—The same precautions should be taken for protecting this solution from carbon dioxide of the air as are directed under normal potassium hydroxide volumetric solution. It should be renewed at frequent intervals.

One Cubic Centimeter of Fiftieth-normal Potassium Hydroxide Volumetric Solution is the Equivalent of:

	Gramme.		Gramme.
Potassium hydroxide, KOH	0.0011148	Coniine, $C_8H_{17}N$	0.002524
Sulphuric acid, absolute, H_2SO_4	0.0009735	Hydrastine, $C_{21}H_{21}NO_6$	0.007606
Aconitine, $C_{34}H_{47}NO_{11}$	0.012811	Morphine, crystallized, $C_{17}H_{19}NO_3 + H_2O$	0.006018
Atropine, $C_{17}H_{23}NO_3$	0.005741	Morphine anhydrous, $C_{17}H_{19}NO_3$	0.005661
Cinchonidine, $C_{19}H_{22}N_2O$	0.005841	Physostigmine, $C_{15}H_{21}N_3O_2$	0.005464
Cinchonine, $C_{19}H_{22}N_2O$	0.005841	Pilocarpine, $C_{11}H_{16}N_2O_2$	0.004133
Combined alkaloids of cinchona bark	0.006139	Quinine, $C_{20}H_{24}N_2O_2$	0.006436
Combined alkaloids of ipecac	0.004768	Strychnine, $C_{21}H_{22}N_2O_2$	0.006635
Cocaine, $C_{17}H_{21}NO_4$	0.006018		

Hundredth-normal Potassium Hydroxide Volumetric Solution, U. S. (KOH, 55.74; 0.5574 Gm. in 1000 Cc.).—Dilute 10 Cc. of normal or 100 Cc. of tenth-normal potassium hydroxide volumetric solution with sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc. The solution must be frequently renewed.

One Cubic Centimeter of Hundredth-normal Potassium Hydroxide Volumetric Solution is the Equivalent of:

	Gramme.
Potassium hydroxide, KOH	0.0005574
Sulphuric acid, absolute, H_2SO_4	0.00048675

Half-normal Alcoholic Potassium Hydroxide Volumetric Solution, U. S. (KOH, 55.74; 27.87 Gm. in 1000 Cc.).—Dissolve about 40 Gm. of potassium hydroxide, which has been broken into small pieces in about 20 Cc. of water, and add sufficient alcohol, to measure 1000 Cc. After setting aside in a well-stoppered bottle for 1 day, the clear supernatant solution should be quickly decanted into a bottle provided with a well-fitted rubber stopper.

Into a flask of the capacity of about 300 Cc., introduce 1.8678 Gm. of potassium bitartrate, which has been purified and dried, as directed under Reagents, and about 100 Cc. of distilled water. Heat the solution to the boiling point, add 5 drops of phenolphthalein test-solution, followed by the cautious addition, from a burette, of the potassium hydroxide solution, frequently agitating the flask, boiling, and, toward the end of the operation, reducing the flow to drops until the red color produced by its influx no longer disappears on shaking, but is not deeper than pale pink. Note the number of Cc. of the alcoholic potassium hydroxide solution consumed, and then dilute the remainder of the solution with alcohol so that exactly 20 Cc. of the diluted liquid shall be required to neutralize the 1.8678 Gm. of potassium bitartrate used.

Example.—Assuming that 12.5 Cc. of the stronger alcoholic solution of potassium hydroxide first prepared had been consumed in the trial, then each 12.5 Cc. must be diluted with alcohol to 20 Cc., or the whole of the remaining solution in the same proportion at 25° C. (77° F.). Thus, if 980 Cc. should remain, this must be diluted with alcohol to measure 1568 Cc.

Half-normal alcoholic potassium hydroxide volumetric solution may also be prepared as follows: Of the above-described concentrated alcoholic potassium hydroxide solution, carefully measure, from

a burette, 20 Cc. into a flask, and, after diluting with about 50 Cc. of water, add about 5 drops of phenolphthalein test-solution, heat to a boiling temperature, and add, from a burette, half-normal hydrochloric acid volumetric solution, frequently agitating the flask, and, toward the end of the operation, reducing the flow to drops until the red color is just discharged. Note the number of Cc. of the half-normal hydrochloric acid volumetric solution consumed, then dilute the remainder of the solution with alcohol, so that equal volumes of this and of the half-normal hydrochloric acid volumetric solution neutralize each other at 25° C. (77° F.).

Should half-normal hydrochloric acid volumetric solution not be available, standardization can be carried out in the same manner with normal hydrochloric acid volumetric solution, 2 volumes of the alcoholic potassium hydroxide being made to correspond with 1 volume of the standard acid.

NOTE.—This solution should be kept in bottles provided with a well-fitted rubber stopper and protected from the light. Owing to the readiness with which this standard solution loses its titer, blank tests should be performed whenever it is employed in titrations.

One Cubic Centimeter of Half-normal Alcoholic Potassium Hydroxide Volumetric Solution is the Equivalent of:

	Gramme.
Potassium hydroxide, KOH	0.02787
Borneol, $C_{10}H_{18}O$	0.07649
Bornyl acetate, $C_{10}H_{17}O.C_2H_3O$	0.09734
Menthol, $C_{10}H_{20}O$	0.07749
Menthyl acetate, $C_{10}H_{19}O.C_2H_3O$	0.09834
Santalol, $C_{15}H_{26}O$	0.11026

Tenth-normal Potassium Permanganate Volumetric Solution, U. S. ($2KMnO_4$, 313.96; 3.1396 Gm.[1] in 1000 Cc.).—Introduce about 3.3 Gm. of pure, crystallized potassium permanganate into a flask, add 1000 Cc. of distilled water, and boil for about 5 minutes. Close the flask with a plug of absorbent cotton, and set aside for at least 2 days, so that suspended matter may deposit. After the lapse of this time pour off the clear portion of the solution into a glass-stoppered bottle.

The water to be employed for diluting this solution (which is still too concentrated) should be prepared as directed under DISTILLED WATER, adding, however, about 1 Gm. of potassium permanganate to the water in the retort before beginning the distillation.

I. Introduce into a flask 10 Cc. of an accurately standardized tenth-normal oxalic acid volumetric solution, add 1 Cc. of pure, concentrated sulphuric acid, and before this mixture cools gradually add, from a burette provided with a glass stop-cock, small quantities of the permanganate solution to be standardized, shaking the flask after each addition and reducing the flow to drops toward the end of the operation. When the last drop of the permanganate solution added is no longer decolorized but imparts a pinkish tint to the liquid, which remains permanent for one-half minute, note the number of Cc. consumed, and then dilute the trial permanganate solution with the specially prepared distilled water so that it will correspond, volume for volume, at 25° C. (77° F.), with the tenth-normal oxalic acid volumetric solution (note example under II.).

II. Tenth-normal potassium permanganate volumetric solution may also be standardized as follows:

To a solution of about 1 Gm. of potassium iodide, in 10 Cc. of diluted sulphuric acid, contained in a flask, add, from a burette provided with a glass stop-cock, 20 Cc. of the potassium permanganate solution to be standardized; then dilute the mixture at once with about 200 Cc. of distilled water. An accurately standardized tenth-normal sodium thiosulphate volumetric solution is then slowly added from a burette, while the mixture is vigorously shaken, until the color is discharged. Note the number of Cc. of the latter consumed, then dilute the permanganate solution so that equal volumes of the two solutions correspond to each other under the same conditions at 25° C. (77° F.).

Example.—Assuming that 25 Cc. of the tenth-normal sodium thiosulphate volumetric solution were required to decolorize the liberated iodine of the mixture, then each 20 Cc. of the potassium permanganate solution must be diluted with the specially prepared distilled water to 25 Cc., or the whole of the remaining solution in the same proportion. Thus, if 920 Cc. remain, it should be diluted to measure 1150 Cc. at 25° C. (77° F.).

After the potassium permanganate solution is thus diluted, a new trial should be made in the manner above described, in which 20 Cc. of this solution should require exactly 20 Cc. of the tenth-normal sodium thiosulphate volumetric solution to decolorize the mixture. If necessary a new adjustment should be made to render the correspondence perfect.

NOTE.—When potassium permanganate volumetric solution is to be prepared for immediate use, this may be done as follows: Dissolve about 3.3 Gm. of pure, crystallized potassium permanganate in 1000 Cc. of recently boiled and cooled pure water. This is then standardized by either of the above methods and diluted accordingly with recently boiled and cooled pure water. Potassium permanganate volumetric solution made by this method without the preliminary boiling and standing deteriorates readily, hence it should be verified each time it is used.

Potassium permanganate volumetric solution should be kept in well-closed glass-stoppered bottles, and only burettes provided with glass stop-cocks should be employed in titrating with it. Even when properly prepared and preserved, this solution should be restandardized frequently.

[1] The exact quantity is never weighed, but the solution is adjusted directly by oxalic acid or indirectly with sodium thiosulphate.

One Cubic Centimeter of Tenth-normal Potassium Permanganate Volumetric Solution is the Equivalent of:

	Gramme.		Gramme.
Potassium permanganate, $KMnO_4$	0.0031396	Ferrous sulphate, crystals, $FeSO_4 + 7H_2O$	0.027601
Calcium oxide, CaO (as oxalate)	0.002784	Ferrous sulphate, dried, $2FeSO_4 + 3H_2O$	0.017767
Iron, Fe, in ferrous compounds	0.005550	Hydrogen dioxide, H_2O_2	0.001688
Ferrous carbonate, $FeCO_3$	0.011505	Oxalic acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006255
Ferrous oxide, FeO	0.007138	Oxygen, O	0.000794
Ferrous sulphate, anhydrous, $FeSO_4$	0.015085	Sodium nitrite, $NaNO_2$	0.0034285

Tenth-normal Potassium Sulphocyanate Volumetric Solution, U. S. [*Volhard's Solution*].—(KSCN, 96.53; 9.653 Gm. in 1000 Cc.).—Dissolve 10 Gm. of crystals of pure potassium sulphocyanate in 1000 Cc. of water.

This solution is too concentrated, and has to be adjusted so as to correspond in strength exactly with tenth-normal silver nitrate volumetric solution. For this purpose, introduce into a flask 10 Cc. of tenth-normal silver nitrate volumetric solution, 3 Cc. of ferric ammonium sulphate test-solution, and 3 Cc. of nitric acid (free from nitrous compounds), and dilute the liquid with about 100 Cc. of distilled water. To this mixture add, from a burette, in small portions at a time, the sulphocyanate solution. At first a white precipitate of silver sulphocyanate appears, then every drop falling from the burette is surrounded by a deep brownish-red color produced by ferric sulphocyanate, which disappears on vigorous shaking of the flask as long as any of the silver nitrate remains unchanged. When all the silver has been converted into sulphocyanate, a single additional drop of the potassium sulphocyanate solution produces a brownish-red color which no longer disappears on shaking, but communicates a perceptible pale reddish-brown tint to the contents of the flask. Note the number of Cc. of the potassium sulphocyanate solution used, and dilute the whole of the remaining solution so that equal volumes of this and of the tenth-normal silver nitrate volumetric solution, at 25° C. (77° F.), will be required to produce the permanent reddish-brown tint. (The same depth of pale reddish-brown tint to which the volumetric solution is adjusted must be attained when the solution is used for volumetric assays.)

After the dilution, a new trial should be made, in which 50 Cc. of tenth-normal silver nitrate volumetric solution, 5 Cc. of ferric ammonium sulphate test-solution, 5 Cc. of nitric acid, and 200 Cc. of water are used, and there should be required exactly 50 Cc. of the potassium sulphocyanate solution, at 25° C. (77° F.), to produce the same depth of a permanent pale reddish-brown tint.

If necessary, a new adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Tenth-normal Potassium Sulphocyanate Volumetric Solution is the Equivalent of:

	Gramme.
Potassium sulphocyanate, KSCN	0.009653
Silver, Ag	0.010712
Silver nitrate, $AgNO_3$	0.016869

Tenth-normal Silver Nitrate Volumetric Solution, U. S. ($AgNO_3$, 168.69; 16.869 Gm. in 1000 Cc.).—Dissolve 16.869 Gm. of silver nitrate, which, previous to weighing, has been pulverized and dried in a covered porcelain crucible in an air-bath at 130° C. (266° F.) for 1 hour, in sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc.

Keep the solution in dark amber-colored, glass-stoppered vials, carefully protected from dust and sunlight.

NOTE.—Titration by tenth-normal silver nitrate volumetric solution may be conducted in various ways, adapted to the special preparation to be tested:

a. The titration of soluble chlorides and bromides.—To the solution of an accurately weighed quantity of the salt, contained in either a porcelain dish or a flask placed on a white surface, sufficient potassium chromate test-solution is added to impart a yellow tint, then the tenth-normal silver nitrate volumetric solution is slowly added from a burette, stirring or agitating constantly until the mixture acquires a permanent red tint, due to the formation of red silver chromate. This method is only suitable for neutral solutions.

b. The titration of free hydrobromic, hydrochloric, and hydriodic acids or their salts in acid solution, known as the Volhard or Thiocyanate (Sulphocyanate) method of residual titration.—An accurately measured excess of tenth normal silver nitrate volumetric solution is added to the solution of the halogen acid or its salt, and then acidified with pure nitric acid, and the indicator (ferric ammonium sulphate test-solution) added; then the uncombined excess of the silver nitrate volumetric solution is determined by titrating back with tenth-normal potassium sulphocyanate volumetric solution, the end-reaction being the formation of a permanent pale reddish-brown tint (due to ferric sulphocyanate). The volume of the silver nitrate volumetric solution originally added, less that of the potassium sulphocyanate volumetric solution consumed, will give the number of Cc. of the former which were required for the precipitation of the halogen. The quantity of nitric acid added should be sufficient to remove the yellow color produced by the addition of the indicator.

c. Titration till the first appearance of a permanent precipitate.—This method is applicable in the estimation of the alkali cyanides and hydrocyanic acid. When the solution is used by this method it is fifth-normal instead of tenth-normal solution.

One Cubic Centimeter of Tenth-normal Silver Nitrate Volumetric Solution is the Equivalent of:

	Gramme.
Silver nitrate, $AgNO_3$	0.016869
Allyl isothiocyanate, $CS.NC_3H_5$	0.00492
Ammonium bromide, NH_4Br	0.009729
Ammonium chloride, NH_4Cl	0.005311
Ammonium iodide, NH_4I	0.014383
Bromine, Br	0.007936
Calcium bromide, $CaBr_2$	0.009926
Chlorine, Cl	0.003518
Ferrous bromide, anhydrous, $FeBr_2$	0.010711
Ferrous iodide, FeI_2	0.015365
Hydriodic acid, HI	0.012690
Hydrobromic acid, HBr	0.008036
Hydrochloric acid, HCl	0.003618
Hydrocyanic acid, HCN, to first formation of precipitate	0.005368
Hydrocyanic acid, HCN, potassium chromate as indicator	0.002684
Iodine, I	0.012590
Lithium bromide, LiBr	0.008634
Potassium bromide, KBr	0.011822
Potassium chloride, KCl	0.007404
Potassium cyanide, KCN, to first formation of precipitate	0.012940
Potassium iodide, KI	0.016476
Potassium sulphocyanate, KSCN	0.009653
Sodium bromide, NaBr	0.010224
Sodium chloride, NaCl	0.005806
Sodium iodide, NaI	0.014878
Strontium bromide, $SrBr_2 + 6H_2O$	0.017647
Strontium iodide, $SrI_2 + 6H_2O$	0.022301
Zinc bromide, $ZnBr_2$	0.011181
Zinc chloride, $ZnCl_2$	0.006763
Zinc iodide, ZnI_2	0.015835

Tenth-normal Sodium Chloride Volumetric Solution, U. S. (NaCl, 58.06; 5.806 Gm. in 1000 Cc.).—Dissolve 5.806 Gm. of pure sodium chloride (see below) in sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc.

Pure sodium chloride may be prepared by passing a current of dry hydrochloric acid gas into a saturated aqueous solution of the purest commercial sodium chloride, collecting the crystalline precipitate on a filter, washing with a little pure concentrated hydrochloric acid, draining, pulverizing, and igniting it gently in a crucible heated to low redness, to expel all traces of free acid. Care should be taken to avoid fusion.

One Cubic Centimeter of Tenth-normal Sodium Chloride Volumetric Solution is the Equivalent of:

	Gramme.
Sodium chloride, NaCl	0.005806
Silver, Ag	0.010712
Silver nitrate, $AgNO_3$	0.016869
Silver oxide, Ag_2O	0.011506

Double-normal Sodium Hydroxide Volumetric Solution, U. S. (NaOH, 39.76; 79.52 Gm. in 1000 Cc.).—Dissolve 90 Gm. of sodium hydroxide in sufficient water to measure about 1000 Cc.

For the standardization of this approximate solution of sodium hydroxide proceed as directed under normal potassium hydroxide volumetric solution; 25 Cc. of the volumetric solution, at 25° C. (77° F.), should exactly neutralize 9.339 Gm. of pure potassium bitartrate (see Reagents).

NOTE.—The same precautions should be taken for protecting this solution from the carbon dioxide of the air as are prescribed for normal potassium hydroxide volumetric solution.

Normal Sodium Hydroxide Volumetric Solution, U. S. (NaOH, 39.76; 39.76 Gm. in 1000 Cc.).—Dissolve 54 Gm. of sodium hydroxide in sufficient water to measure about 1050 Cc., and fill a burette with a portion of this liquid.

For the standardization of this approximate solution of sodium hydroxide, proceed as directed under normal potassium hydroxide volumetric solution (which see); 50 Cc. of the volumetric solution, at 25° C. (77° F.), must exactly neutralize 9.339 Gm. of pure potassium bitartrate.

NOTE.—The same precautions should be taken for protecting this solution from the carbon dioxide of the air as are prescribed for normal potassium hydroxide volumetric solution.

This solution may be employed in place of the normal potassium hydroxide volumetric solution volume for volume.

One Cubic Centimeter of Normal Sodium Hydroxide Volumetric Solution is the Equivalent of:

	Gramme.
Sodium hydroxide, NaOH	0.03976
Boric acid, H_3BO_3	0.06154
Formaldehyde, CH_2O	0.02979
Trichloracetic acid, $HC_2Cl_3O_2$	0.16212

Tenth-normal Sodium Thiosulphate Volumetric Solution, U. S. ($Na_2S_2O_3 + 5H_2O$, 246.46; 24.646 Gm. in 1000 Cc.).—Dissolve 30 Gm. of sodium thiosulphate in sufficient distilled water to measure 1000 Cc. This trial solution, which is too concentrated, is standardized as follows:

To a solution of about 1 Gm. of potassium iodide in 10 Cc. of diluted sulphuric acid contained in a flask of about 500 Cc. capacity, add slowly, from a burette, 20 Cc. of tenth-normal potassium dichromate volumetric solution, shaking after each addition. Place a watch-glass on the mouth of the flask and allow it to stand for 5 minutes, then dilute the solution with about 250 Cc. of distilled water, add

some starch test-solution, and then, from a burette, the trial solution of sodium thiosulphate, in small portions at a time, shaking after each addition, and, toward the end of the operation, reducing the flow to drops, until the blue color of the mixture changes to a light green; note the number of Cc. of the trial sodium thiosulphate solution consumed. Then dilute the sodium thiosulphate solution so that equal volumes of it and the tenth-normal potassium dichromate volumetric solution will exactly correspond to each other under the above conditions, at 25° C. (77° F.).

Example.—Assuming that 16 Cc. of the trial sodium thiosulphate solution were required to decolorize the liberated iodine of the mixture, then each 16 Cc. of this solution must be diluted to 20 Cc. so that it will correspond in volume to the tenth-normal potassium dichromate volumetric solution added, or the whole of the remaining solution in the same proportion at 25° C. (77° F.). Thus, if 984 Cc. of the sodium thiosulphate solution are remaining, this should be diluted to measure 1230 Cc. After the sodium thiosulphate solution is thus diluted, a new trial should be made in the manner above described, in which exactly 20 Cc. of this solution should be required to decolorize the iodine liberated by 20 Cc. of the tenth-normal dichromate volumetric solution. If necessary, a new adjustment should be made to render the correspondence perfect.

Keep the solution in glass-stoppered bottles, carefully protected from dust.

NOTE.—When this solution is to be used fill a burette with it, place the liquid to be tested either for the free iodine it already contains, or for that which it liberates from an excess of potassium iodide added to it, in a flask, and gradually add small portions of the solution from the burette, shaking after each addition, and, toward the end of the operation, reducing the flow to drops, until the color is discharged.

One Cubic Centimeter of Tenth-normal Sodium Thiosulphate Volumetric Solution is the Equivalent of:

	Gramme.
Sodium thiosulphate (hyposulphite), $Na_2S_2O_3 + 5H_2O$	0.024646
Bromine, Br.	0.007936
Chlorine, Cl	0.003518
Chromium trioxide, CrO_3	0.003311
Iodine, I	0.01259
Iron, Fe, in ferric salts	0.00555
Potassium bromate, $KBrO_3$	0.002764

Normal Sulphuric Acid Volumetric Solution, U. S. (H_2SO_4, 97.35; 48.675 Gm. in 1000 Cc.).—Carefully mix 30 Cc. of pure, concentrated sulphuric acid (of specific gravity 1.826 at 25° C. (77° F.) with sufficient water to measure about 1050 Cc., and allow the liquid to cool to 25° C. (77° F.). Measure from a burette 10 Cc. of this liquid (which is yet too concentrated) into a flask, add 2 drops of methyl-orange test-solution, and afterwards, from a burette, a freshly standardized normal potassium hydroxide volumetric solution, shaking after each addition, and, toward the end of the operation, reducing the flow to drops, until the red tint of the solution changes to a permanent pale yellow after thorough shaking. Note the number of Cc. of normal potassium hydroxide volumetric solution consumed. Then dilute the sulphuric acid solution so that equal volumes of this and of normal potassium hydroxide volumetric solution, at 25° C. (77° F.), exactly neutralize each other.

Example.—Assuming that 10 Cc. of the acid solution first prepared had required exactly 11.2 Cc. of normal potassium hydroxide volumetric solution, each 10 Cc. of the former must be diluted to 11.2 Cc., or each 1000 Cc. to 1120 Cc.

After the liquid is thus diluted a new trial should be made in the manner above described, in which 50 Cc. of the acid solution should require for neutralization exactly 50 Cc. of normal potassium hydroxide volumetric solution, at 25° C. (77° F.). If necessary, a new adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Normal Sulphuric Acid Volumetric Solution is the Equivalent of:

	Gramme.
Sulphuric acid, absolute, H_2SO_4	0.048675
Ammonia gas, NH_3	0.01693
Ammonium carbonate, $(NH_4)_2CO_3$	0.047705
Ammonium carbonate [U. S. P.], $NH_4HCO_3.NH_4NH_2CO_2$	0.052003
Calcium hydroxide, $Ca(OH)_2$	0.03678
Lead acetate, crystallized, $Pb(C_2H_3O_2)_2 + 3H_2O$	0.188075
Lead subacetate, assumed as $Pb_2O(C_2H_3O_2)_2$	0.135935
Lithium carbonate, Li_2CO_3	0.036755
Magnesium carbonate, $(MgCO_3)_4(MgO\text{-}H)_2 + 5H_2O$	0.048226
Magnesium oxide, MgO	0.02003
Potassium acetate, $KC_2H_3O_2$ (after ignition)	0.09744
Potassium bicarbonate, $KHCO_3$	0.09941
Potassium bitartrate, $KHC_4H_4O_6$ (after ignition)	0.18678
Potassium carbonate, anhydrous, K_2CO_3	0.068635
Potassium citrate, crystallized, $K_3C_6H_5O_7 + H_2O$ (after ignition)	0.10736
Potassium hydroxide, KOH	0.05574
Potassium and sodium tartrate, $KNaC_4H_4O_6 + 4H_2O$ (after ignition)	0.14009
Sodium acetate, $NaC_2H_3O_2 + 3H_2O$ (after ignition)	0.13510
Sodium benzoate, $NaC_7H_5O_2$ (after ignition)	0.14301
Sodium bicarbonate, $NaHCO_3$	0.08343
Sodium borate, crystallized, $Na_2B_4O_7 + 10H_2O$	0.18966
Sodium hydroxide, NaOH	0.03976
Sodium salicylate, $NaC_7H_5O_3$ (after ignition)	0.15889
Zinc oxide, ZnO	0.04039

Half-normal Sulphuric Acid Volumetric Solution, U. S. (H_2SO_4, 97.35; 24.3375 Gm. in 1000 Cc.).—Dilute 500 Cc. of normal sulphuric acid with sufficient water to measure 1000 Cc. at 25° C. (77° F.).

This standard solution is chiefly employed in the titration of the organic salts of sodium and potassium in conjunction with methyl-orange as indicator. For this purpose a special experiment should be made in which an accurately measured volume of 10 Cc. of normal potassium hydroxide volumetric solution should, after adding 2 drops of methyl-orange test-solution, require exactly 20 Cc. of the half-normal sulphuric acid volumetric solution for neutralization.

If necessary, an adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Half-normal Sulphuric Acid Volumetric Solution is the Equivalent of:

	Gramme.		Gramme.
Sulphuric acid, absolute, H_2SO_4	0.0243375	Sodium acetate, $NaC_2H_3O_2 + 3H_2O$ (after ignition)	0.06755
Ammonia gas, NH_3 (spirit of ammonia)	0.008465	Sodium benzoate, $NaC_7H_5O_2$ (after ignition)	0.07150
Potassium acetate, $KC_2H_3O_2$ (after ignition)	0.04872	Sodium carbonate, anhydrous, Na_2CO_3	0.026327
Potassium bicarbonate, $KHCO_3$	0.049705	Sodium carbonate, monohydrated, $Na_2CO_3 + H_2O$	0.030797
Potassium bitartrate, $KHC_4H_4O_6$ (after ignition)	0.09339	Sodium citrate, $2Na_3C_6H_5O_7 + 11H_2O$ (after ignition)	0.0591
Potassium citrate, anhydrous, $K_3C_6H_5O_7$ (after ignition)	0.0507	Sodium salicylate, $NaC_7H_5O_3$ (after ignition)	0.079445
Potassium citrate, crystallized, $K_3C_6H_5O_7 + H_2O$ (after ignition)	0.05368		
Potassium and sodium tartrate, $KNaC_4H_4O_6 + 4H_2O$ (after ignition)	0.070045		

Tenth-normal Sulphuric Acid Volumetric Solution, U. S. (H_2SO_4, 97.35; 4.8675 Gm. in 1000 Cc.)—Dilute 100 Cc. of normal sulphuric acid with sufficient water to measure 1000 Cc. at 25° C. (77° F.).

This standard solution is employed in conjunction with the fiftieth-normal potassium hydroxide volumetric solution in the titration of alkaloids, with hematoxylin, cochineal, or iodeosin test solution as an indicator. For this purpose a special experiment should be made, in which an accurately measured volume of 10 Cc. of the tenth-normal sulphuric acid, after adding 1 Cc. of hematoxylin test-solution (or a sufficient quantity of the indicator to be employed), should require 50 Cc. of the fiftieth-normal potassium hydroxide volumetric solution for complete neutralization, at 25° C. (77° F.). If necessary, an adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Tenth-normal Sulphuric Acid Volumetric Solution is the Equivalent of:

	Gramme.		Gramme.
Sulphuric acid, absolute, H_2SO_4	0.0048675	Cocaine, $C_{17}H_{21}NO_4$	0.03009
Potassium hydroxide, KOH	0.005574	Coniine, $C_8H_{17}N$	0.01262
Aconitine, $C_{34}H_{47}NO_{11}$	0.06406	Emetine, $C_{15}H_{21}NO_2$	0.02453
Atropine, $C_{17}H_{23}NO_3$	0.02870	Hydrastine, $C_{21}H_{21}NO_6$	0.03803
Brucine, $C_{23}H_{26}N_2O_4$	0.03913	Morphine, crystallized, $C_{17}H_{19}NO_3 + H_2O$	0.03009
Calcium Hydroxide, $Ca(OH)_2$	0.003678	Morphine, anhydrous, $C_{17}H_{19}NO_3$	0.02830
Cephaëline, $C_{14}H_{19}NO_2$	0.02314	Physostigmine, $C_{15}H_{21}N_3O_2$	0.02732
Cinchonidine, $C_{19}H_{22}N_2O$	0.02920	Pilocarpine, $C_{11}H_{16}N_2O_2$	0.02066
Cinchonine, $C_{19}H_{22}N_2O$	0.02920	Quinine, $C_{20}H_{24}N_2O_2$	0.03218
Combined alkaloids of cinchona	0.03069	Strychnine, $C_{21}H_{22}N_2O_2$	0.03317
Combined alkaloids of ipecac	0.02384		

Fiftieth-normal Sulphuric Acid Volumetric Solution, U. S. (H_2SO_4, 97.35; 0.9735 Gm. in 1000 Cc.).—Dilute 20 Cc. of normal sulphuric acid volumetric solution, or 200 Cc. of tenth-normal sulphuric acid volumetric solution, with sufficient distilled water to measure, at 25° C. (77° F.), 1000 Cc. This standard solution may be employed in the titration of alkaloids, with hematoxylin, cochineal, or iodeosin test-solution as an indicator.

One Cubic Centimeter of Fiftieth-normal Sulphuric Acid Volumetric Solution is the Equivalent of:

	Gramme.		Gramme.
Sulphuric acid, absolute, H_2SO_4	0.0009735	Hydrastine, $C_{21}H_{21}NO_6$	0.007606
Aconitine, $C_{34}H_{47}NO_{11}$	0.012811	Morphine, crystallized, $C_{17}H_{19}NO_3 + H_2O$	0.006018
Atropine, $C_{17}H_{23}NO_3$	0.005741	Morphine, anhydrous, $C_{17}H_{19}NO_3$	0.005661
Cinchonidine, $C_{19}H_{22}N_2O$	0.005841	Physostigmine, $C_{15}H_{21}N_3O_2$	0.005464
Cinchonine, $C_{19}H_{22}N_2O$	0.005841	Pilocarpine, $C_{11}H_{16}N_2O_2$	0.004133
Combined alkaloids of cinchona	0.006139	Quinine, $C_{20}H_{24}N_2O_2$	0.006436
Combined alkaloids of ipecac	0.004768	Strychnine, $C_{21}H_{22}N_2O_2$	0.006635
Cocaine, $C_{17}H_{21}NO_4$	0.006018		
Coniine, $C_8H_{17}N$	0.002524		

ALPHABETICAL LIST OF VOLUMETRIC ASSAYS DIRECTED BY THE U. S. PHARMACOPŒIA.

Name.	Quantity taken.	Cubic Centimeters of Volumetric Solution required.		Indicator.	Percentage Strength of Product.	
Acidum Aceticum	5.96 Gm.	36.0	Normal KOH	Phenolphthalein	36.0	Absolute Acid.
Acidum Aceticum Dilutum	23.80 Gm.	24.0	Normal KOH	Phenolphthalein	6.0	Absolute Acid.
Acidum Aceticum Glaciale	3.0 Cc.*		Normal KOH	Phenolphthalein	99.0	Absolute Acid.
Acidum Boricum	1.00 Gm.	16.2	Normal NaOH	Phenolphthalein	99.8	Pure Acid.
Acidum Citricum	1.737 Gm.	24.87	Normal KOH	Phenolphthalein	99.5	Pure Acid.
Acidum Hydriodicum Dilutum	2.54 Gm.	20.0	Tenth-n. $AgNO_3$†	$FeNH_4(SO_4)_2$	10.0	Absolute Acid.
Acidum Hydrobromicum Dilutum	0.804 Gm.	10.0	Tenth-n. $AgNO_3$	K_2CrO_4	10.0	Absolute Acid.
Acidum Hydrochloricum	3.0 Cc.*		Normal KOH	Methyl-orange	31.9	Absolute Acid.
Acidum Hydrochloricum Dilutum	3.62 Gm.	10.0	Normal KOH	Methyl-orange	10.0	Absolute Acid.
Acidum Hydrocyanicum Dilutum	2.684 Gm.	10.0	Tenth-n. $AgNO_3$	KI	2.0	Absolute Acid.
Acidum Hypophosphorosum	6.55 Gm.	30.0	Normal KOH	Methyl-orange	30.0	Absolute Acid.
Acidum Hypophosphorosum Dilutum	6.55 Gm.	10.0	Normal KOH	Methyl-orange	10.0	Absolute Acid.
Acidum Lacticum	4.47 Gm.	37.5	Normal KOH	Phenolphthalein	75.0	Absolute Acid.
Acidum Nitricum	3.0 Cc.*		Normal KOH	Methyl-orange	68.0	Absolute Acid.
Acidum Nitricum Dilutum	6.257 Gm.	10.0	Normal KOH	Methyl-orange	10.0	Absolute Acid.
Acidum Phosphoricum	0.973 Gm.	17.0	Normal KOH	Phenolphthalein	85.0	Absolute Acid.
Acidum Phosphoricum Dilutum	4.87 Gm.	10.0	Normal KOH	Phenolphthalein	10.0	Absolute Acid.
Acidum Sulphuricum	3.0 Cc.*		Normal KOH	Methyl-orange	92.5	AbsoluteAcid..
Acidum Sulphuricum Aromaticum	4.868 Gm.	20.0	Normal KOH‡	Methyl-orange	20.0	Absolute Acid.
Acidum Sulphuricum Dilutum	4.868 Gm.	10.0	Normal KOH	Methyl-orange	10.0	Absolute Acid.
Acidum Sulphurosum	2.0 Cc.*		Tenth-n. Iodine §	. . . . .	6.0	SO_2.
Acidum Tartaricum	3.723 Gm.	49.8	Normal KOH	Phenolphthalein	99.5	Pure Acid.
Acidum Trichloraceticum	1.0 Gm.	6.1	Normal NaOH	Phenolphthalein	98.9	Absolute Acid.
Aconitum	10.0 Gm.	0.78	Tenth-n. H_2SO_4	Hematoxylin	0.5	Aconitine.
Ammonii Bromidum	0.3 Gm.	31.6	Tenth-n. $AgNO_3$	K_2CrO_4	97.0	Pure Salt.
Ammonii Carbonas	2.0 Gm.	37.3	Normal H_2SO_4¶	Litmus	97.0	Pure Salt.
Ammonii Chloridum	0.1 Gm.	18.73	Tenth-n. $AgNO_3$	K_2CrO_4	99.5	Pure Salt.
Antimonii et Potassii Tartras	0.33 Gm.	19.9	Tenth-n. Iodine	Starch	99.5	Pure Salt.
Aqua Ammoniæ	3.0 Cc.*		Normal H_2SO_4	Litmus or methyl-orange	10.0	NH_3.
Aqua Ammoniæ Fortior	3.0 Cc.*		Normal H_2SO_4	Litmus or methyl-orange	28.0	NH_3.
Aqua Hydrogenii Dioxidi	1.69 Cc.	30.0	Tenth-n. $KMnO_4$	. . . . .	3.0	H_2O_2.
Argenti Nitras	0.5 Gm.	29.6	Tenth-n. NaCl **	K_2CrO_4	99.9	Pure Salt.
Argenti Nitras Fusus	0.5 Gm.	28.1	Tenth-n. NaCl **	K_2CrO_4	94.8	$AgNO_3$.
Argenti Nitras Mitigatus	1.0 Gm.	19.7	Tenth-n. NaCl **	K_2CrO_4	33.3	$AgNO_3$.
Arseni Iodidum	0.5 Gm.	21.9	Tenth-n. Iodine	. . . . .	82.7	Iodine; 16.3 Metallic Arsenic.
Arseni Trioxidum	0.1 Gm.	20.3	Tenth-n. Iodine	. . . . .	99.8	As_2O_3.
Belladonnæ Folia	10.0 Gm.	1.22	Tenth-n. H_2SO_4	Hematoxylin	0.35	Alkaloids.
Belladonnæ Radix	10.0 Gm.	1.74	Tenth-n. H_2SO_4	Hematoxylin	0.5	Alkaloids.
Benzaldehydum	(Special process, see page 288.)			. . . . .	85.0	C_7H_6O.
Calx Chlorinata	about 0.35 Gm.‖		Tenth-n. $Na_2S_2O_3$	. . . . .	30.0	Chlorine.
Chromii Trioxidum	0.0828 Gm.	22.5	Tenth-n. $Na_2S_2O_3$	Starch	90.0	CrO_3.

Cinnaldehydum	(Special process, see page 439.)						
Coca	10.0	Gm.	1.66	Tenth-n. H_2SO_4	Hematoxylin	0.5	E.-s. Alkaloids.
Emplastrum Belladonnæ	about 10.0	Gm.‖		Tenth-n. H_2SO_4	Hematoxylin	0.38–0.42	Alkaloids.
Extractum Belladonnæ Foliorum	5.0	Gm.	2.44	Tenth-n. H_2SO_4	Hematoxylin	1.4	Alkaloids.
Extractum Hyoscyami	10.0	Gm.	1.04	Tenth-n. H_2SO_4	Hematoxylin	0.3	Alkaloids.
Extractum Nucis Vomicæ	2.0	Gm.	3.01	Tenth-n. H_2SO_4	Iodeosin	5.0	Strychnine.
Extractum Physostigmatis	0.5	Gm.	0.37	Tenth-n. H_2SO_4	Iodeosin	2.0	E.-s. Alkaloids.
Extractum Scopolæ	2.0	Gm.	1.39	Tenth-n. H_2SO_4	Hematoxylin	2.0	Alkaloids.
Extractum Stramonii	5.0	Gm.	2.44	Tenth-n. H_2SO_4	Hematoxylin	1.4	Alkaloids.
Ferri Carbonas Saccharatus	1.15	Gm.	15.0	Tenth-n. $KMnO_4$	. . . . .	15.0	$FeCO_3$.
Ferri Chloridum	0.555	Gm.	22.0	Tenth-n. $Na_2S_2O_3$	. . . . .	22.0	Metallic Iron.
Ferri Citras	0.555	Gm.	16.0	Tenth-n. $Na_2S_2O_3$	Starch	16.0	Metallic Iron.
Ferri et Ammonii Citras	0.555	Gm.	16.0	Tenth-n. $Na_2S_2O_3$	Starch	16.0	Metallic Iron.
Ferri et Ammonii Sulphas	0.555	Gm.	11.5	Tenth-n. $Na_2S_2O_3$	. . . . .	11.5	Metallic Iron.
Ferri et Ammonii Tartras	0.555	Gm.	13.0	Tenth-n. $Na_2S_2O_3$	Starch	13.0	Metallic Iron.
Ferri et Potassii Tartras	0.555	Gm.	15.0	Tenth-n. $Na_2S_2O_3$	Starch	15.0	Metallic Iron.
Ferri et Quininæ Citras	0.555	Gm.	13.5	Tenth-n. $Na_2S_2O_3$	Starch	13.5	Metallic Iron.
Ferri et Quininæ Citras Solubilis	0.555	Gm.	13.5	Tenth-n. $Na_2S_2O_3$	Starch	13.5	Metallic Iron.
Ferri et Strychninæ Citras	1.11	Gm.	32.0	Tenth-n. $Na_2S_2O_3$	Starch	16.0	Metallic Iron.
Ferri Phosphas Solubilis	0.555	Gm.	12.0	Tenth-n. $Na_2S_2O_3$	. . . . .	12.0	Metallic Iron.
Ferri Pyrophosphas Solubilis	0.555	Gm.	10.0	Tenth-n. $Na_2S_2O_3$	. . . . .	10.0	Metallic Iron.
Ferri Sulphas (cryst. and gran.)	1.38	Gm.	49.75	Tenth-n. $KMnO_4$	. . . . .	99.5	Pure Crystals.
Ferrum Reductum	(Special process, see page 643.)				. . . . .	90.0	Metallic Iron.
Fluidextractum Aconiti	10.0	Cc.	0.62	Tenth-n. H_2SO_4	Hematoxylin	0.4	Gm. Aconitine in 100 Cc.
Fluidextractum Belladonnæ Radicis	10.0	Cc.	1.74	Tenth-n. H_2SO_4	Hematoxylin	0.5	Gm. Alkaloids in 100 Cc.
Fluidextractum Cocæ	10.0	Cc.	1.66	Tenth-n. H_2SO_4	Hematoxylin	0.5	Gm. E.-s. Alkaloids in 100 Cc.
Fluidextractum Hyoscyami	50.0	Cc.	1.30	Tenth-n. H_2SO_4	Hematoxylin	0.075	Gm. Alkaloids in 100 Cc.
Fluidextractum Ipecacuanhæ	10.0	Cc.	7.34	Tenth-n. H_2SO_4	Hematoxylin	1.75	Gm. Alkaloids in 100 Cc.
Fluidextractum Nucis Vomicæ	20.0	Cc.	6.02	Tenth-n. H_2SO_4	Iodeosin	1.0	Gm. Strychnine in 100 Cc.
Fluidextractum Pilocarpi	10.0	Cc.	1.936	Tenth-n. H_2SO_4	Cochineal	0.4	Gm. Alkaloids in 100 Cc.
Fluidextractum Scopolæ	10.0	Cc.	1.74	Tenth-n. H_2SO_4	Hematoxylin	0.5	Gm. Alkaloids in 100 Cc.
Fluidextractum Stramonii	10.0	Cc.	1.22	Tenth-n. H_2SO_4	Hematoxylin	0.35	Gm. Alkaloids in 100 Cc.
Hyoscyamus	25.0	Gm.	0.69	Tenth-n. H_2SO_4	Hematoxylin	0.08	Alkaloids.
Iodum	about 0.5	Gm.‖		Tenth-n. $Na_2S_2O_3$	. . . . .	99.0	Iodine.
Ipecacuanha	10.0	Gm.	8.03	Tenth-n. H_2SO_4	Hematoxylin	2.0	Ipecac Alkaloids.
Liquor Acidi Arsenosi	24.6	Gm.	50.0	Tenth-n. Iodine	. . . . .	1.0	As_2O_3.
Liquor Calcis	50.0	Cc.	19.0	Tenth-n. H_2SO_4	Phenolphthalein	0.14	$Ca(OH)_3$.
Liquor Ferri Chloridi	1.11	Gm.	20.0	Tenth-n. $Na_2S_2O_3$	Starch	10.0	Metallic Iron.
Liquor Ferri Subsulphatis	1.11	Gm.	27.15	Tenth-n. $Na_2S_2O_3$	Starch	13.57	Metallic Iron.
Liquor Ferri Tersulphatis	1.11	Gm.	20.6	Tenth-n. $Na_2S_2O_3$	Starch	10.0	Metallic Iron.
Liquor Formaldehydi	3.0	Cc.*		Normal NaOH ††	Litmus	37.0	CH_2O.

* Weighed and calculated.
† Determined by residual titration with tenth-normal potassium sulphocyanate volumetric solution.
‡ Determined by residual titration with normal sulphuric acid volumetric solution.
⁂ Determined by residual titration with tenth-normal sodium thiosulphate volumetric solution.
¶ Determined by residual titration with normal potassium hydroxide volumetric solution.
‖ Afterward weighed and calculated.
** Determined by residual titration with tenth-normal silver nitrate volumetric solution.
†† Determined by oxidation to formic acid and residual titration with normal sulphuric acid volumetric solution.

ALPHABETICAL LIST OF VOLUMETRIC ASSAYS DIRECTED BY THE U. S. PHARMACOPŒIA.—*Continued.*

Name.	Quantity taken.	Cubic Centimeters of Volumetric Solution required.	Indicator.	Percentage Strength of Product.
Liquor Iodi Compositus	6.3 Gm.	24.75 Tenth-n. $Na_2S_2O_3$	. . . . .	5.0 Iodine.
Liquor Plumbi Subacetatis	0.272 Gm.	5.0 Tenth-n. $H_2C_2O_4$ ‡‡	. . . . .	25.0 Basic Salt.
Liquor Potassii Arsenitis	24.6 Gm.	50.0 Tenth-n. Iodine	. . . . .	1.0 As_2O_3.
Liquor Potassii Citratis (to be ignited)	10.14 Gm.	16.0 Half-n. H_2SO_4	Methyl-orange	8.0 $K_3C_6H_5O_7$.
Liquor Potassii Hydroxidi	27.87 Gm.	25.0 Normal H_2SO_4	Methyl-orange	5.0 KOH.
Liquor Sodæ Chlorinatæ	7.0 Gm.	48.0 Tenth-n. $Na_2S_2O_3$	. . . . .	2.4 Chlorine.
Liquor Sodii Hydroxidi	19.9 Gm.	25.0 Normal H_2SO_4	Methyl-orange	5.0 NaOH.
Lithii Bromidum	0.2 Gm.	22.5–23.9 Tenth-n. $AgNO_3$	K_2CrO_4	97.0 Pure Salt.
Lithii Carbonas	0.5 Gm.	13.4 Normal H_2SO_4	Methyl-orange	98.5 Pure Salt.
Magnesii Carbonas (to be ignited)	1.0 Gm.	19.2 Normal H_2SO_4	Methyl-orange	38.4 MgO.
Magnesii Oxidum (to be ignited)	0.4 Gm.	19.2 Normal H_2SO_4	Methyl-orange	96.0 MgO.
Magnesii Oxidum Ponderosum.	(See Magnesii Oxidum.)			
Mangani Dioxidum Precipitatum	0.2 Gm.	37.05 Tenth-n. $H_2C_2O_4$ ‡‡	. . . . .	80.0 MnO_2.
Nux Vomica	10.0 Gm.	3.76 Tenth-n. H_2SO_4	Iodeosin	1.25 Strychnine.
Oleum Amygdalæ Amaræ	(Special process, see page 1055.)		. . . . .	85.0 Benzaldehyde.
Oleum Amygdalæ Amaræ	1.0 Gm.	7.5–14.9 Tenth-n. $AgNO_3$	K_2CrO_4	2.0 to 4.0 HCN.
Oleum Limonis	(Special process, see page 1080.)		. . . . .	4.0 Citral.
Oleum Menthæ Piperitæ	(Special process, see page 1085.)		. . . . .	8.0 Menthyl Acetate.
Oleum Menthæ Piperitæ	(Special process, see page 1085.)		. . . . .	50.0 Total Menthol.
Oleum Rosmarini	(Special process, see page 1103.)		. . . . .	5.0 Bornyl Acetate.
Oleum Rosmarini	(Special process, see page 1103.)		. . . . .	15.0 Total Borneol.
Oleum Santali	(Special process, see page 1105.)		. . . . .	90.0 Santalol.
Oleum Sinapis Volatile	(Special process, see page 1109.)		. . . . .	92.0 Allyl-iso-thiocyanate.
Phenol	0.0389 Gm.	24.0 Tenth-n. Bromine §	. . . . .	96.0 Pure Phenol.
Physostigma	10.0 Gm.	0.55 Tenth-n. H_2SO_4	Iodeosin	0.15 E.-s. Alkaloids.
Pilocarpus	10.0 Gm.	2.42 Tenth-n. H_2SO_4	Cochineal	0.5 Alkaloids.
Potassii Acetas (to be ignited)	1.0 Gm.	20.1 Half-n. H_2SO_4	Methyl-orange	98.0 Pure Salt.
Potassii Bicarbonas	1.0 Gm.	19.9 Half-n. H_2SO_4	Methyl-orange	99.0 Pure Salt.
Potassii Bitartras (to be ignited)	1.0 Gm.	10.6 Half-n. H_2SO_4	Methyl-orange	99.0 Pure Salt.
Potassii Bromidum	0.3 Gm.	24.6–25.85 Tenth-n. $AgNO_3$	K_2CrO_4	97.0 Pure Salt.
Potassii Carbonas (after drying)	1.0 Gm.	14.28 Normal H_2SO_4	Methyl-orange	98.0 Pure Salt.
Potassii Citras (to be ignited)	1.0 Gm.	18.4 Half-n. HCl	Methyl-orange	99.0 Pure Salt.
Potassii Cyanidum	0.647 Gm.	47.5 Tenth-n. $AgNO_3$	KI	95.0 Pure Salt.
Potassii et Sodii Tartras (to be ignited)	1.0 Gm.	14.1 Half-n. HCl	Methyl-orange	99.0 Pure Salt.
Potassii Hydroxidum	about 1.0 Gm.‖	Normal H_2SO_4	Methyl-orange	85.0 KOH.
Potassii Iodidum	0.5 Gm.	30.0–30.8 Tenth-n. $AgNO_3$	K_2CrO_4	99.0 Pure Salt.
Potassii Permanganas	0.1 Gm.	31.5 Tenth-n. $H_2C_2O_4$	. . . . .	99.0 $KMnO_4$.
Scopola	10.0 Gm.	1.74 Tenth-n. H_2SO_4	Hematoxylin	0.5 Alkaloids.
Sodii Acetas (to be ignited)	1.0 Gm.	14.74 Half-n. H_2SO_4	Methyl-orange	99.5 Pure Salt.
Sodii Benzoas (to be ignited)	1.0 Gm.	13.85 Half-n. HCl	Methyl-orange	99.0 Pure Salt.
Sodii Bicarbonas	2.0 Gm.	23.74 Normal H_2SO_4	Methyl-orange	99.0 Pure Salt.

Sodii Bisulphis	0.25	Gm.	43.55	Tenth-n. Iodine ‡	. . . . .	90.0	Pure Salt.
Sodii Bromidum	0.3	Gm.	28.5–30.0	Tenth-n. $AgNO_3$	K_2CrO_4	97.0	Pure Salt.
Sodii Carbonas Monohydratus	1.0	Gm.	32.3	Half-n. H_2SO_4	Methyl-orange	85.0	Anhydrous Salt.
Sodii Chloridum	0.1	Gm.	17.0	Tenth-n. $AgNO_3$	K_2CrO_4	99.0	Pure Salt.
Sodii Citras (to be ignited)	1.0	Gm.	16.4	Half-n. H_2SO_4	Methyl-orange	97.0	Pure Salt.
Sodii Hydroxidum	about 1.0	Gm.‖		Normal H_2SO_4	Methyl-orange	90.0	NaOH.
Sodii Iodidum	0.5	Gm.	33.0–34.6	Tenth-n. $AgNO_3$	K_2CrO_4	98.0	Pure Salt.
Sodii Nitris	0.1	Gm.	26.25	Tenth-n. $KMnO_4$‖ ‖	. . . . .	90.0	Pure Salt.
Sodii Salicylas (to be ignited)	1.0	Gm.	12.52	Half-n. H_2SO_4	Methyl-orange	99.5	Pure Salt.
Sodii Sulphis	0.5	Gm.	38.35	Tenth-n. Iodine ‡	. . . . .	96.0	Pure Salt.
Sodii Thiosulphas	1.0	Gm.	39.75	Tenth-n. Iodine	. . . . .	98.0	Pure Salt.
Spiritus Ammoniæ	2.0	Cc.‖		Half-n. H_2SO_4	Litmus	10.0	NH_3.
Strontii Bromidum	0.5	Gm.	27.48–29.4	Tenth-n. $AgNO_3$	K_2CrO_4	97.0	Pure Salt.
Strontii Iodidum	0.5	Gm.	21.9 –23.3	Tenth-n. $AgNO_3$†	$FeNH_4(SO_4)_2$	98.0	Pure Salt.
Sulphuris Iodidum	0.5	Gm.	28.0	Tenth-n. $Na_2S_2O_3$	Starch	80.0	Iodine (approximately).
Syrupus Acidi Hydriodici	6.345	Gm.	5.0	Tenth-n. $AgNO_3$†	$FeNH_4(SO_4)_2$	1.0	HI.
Syrupus Ferri Iodidi	1.536	Gm.	5.0	Tenth-n. $AgNO_3$†	$FeNH_4(SO_4)_2$	5.0	FeI_2.
Tinctura Aconiti	100.0	Cc.	0.70	Tenth-n. H_2SO_4	Hematoxylin	0.045	Gm. Aconitine in 100 Cc.
Tinctura Belladonnæ Foliorum	100.0	Cc.	1.22	Tenth-n. H_2SO_4	Hematoxylin	0.035	Gm. Alkaloids in 100 Cc.
Tinctura Ferri Chloridi	2.22	Gm.	18.3	Tenth-n. $Na_2S_2O_3$	Starch	4.58	Metallic Iron.
Tinctura Hyoscyami	100.0	Cc.	0.24	Tenth-n. H_2SO_4	Hematoxylin	0.007	Gm. Alkaloids in 100 Cc.
Tinctura Iodi	5.0	Cc.	27.25	Tenth-n. $Na_2S_2O_3$	. . . . .	6.86	Gm. Iodine in 100 Cc.
Tinctura Physostigmatis	100.0	Cc.	0.51	Tenth-n. H_2SO_4	Iodeosin	0.014	Gm. E.-s. Alkaloids in 100 Cc.
Tinctura Stramonii	100.0	Cc.	1.05	Tenth-n. H_2SO_4	Hematoxylin	0.03	Gm. Alkaloids in 100 Cc.
Vinum Album	50.0	Cc.	3.0– 5.2	Normal KOH	Litmus	0.45–0.77	Acid.
Vinum Rubrum	50.0	Cc.	3.0– 5.2	Normal KOH	Litmus	0.45–0.77	Acid.
Zinci Bromidum	0.3	Gm.	26.0–26.8	Tenth-n. $AgNO_3$	K_2CrO_4	97.0	Pure Salt.
Zinci Iodidum	0.5	Gm.	31.0–31.6	Tenth-n. $AgNO_3$†	$FeNH_4(SO_4)_2$	98.0	Pure Salt.
Zinci Oxidum	1.0	Gm.	24.6	Normal HCl¶	Methyl-orange	99.5	ZnO.

† Determined by residual titration with tenth-normal potassium sulphocyanate volumetric solution.
‡ Determined by residual titration with tenth-normal sodium thiosulphate volumetric solution.
¶ Determined by residual titration with normal potassium hydroxide volumetric solution.
†† Determined by residual titration with tenth-normal potassium permanganate volumetric solution.
‖ ‖ Determined by residual titration with tenth-normal oxalic acid volumetric solution.

‖ Afterward weighed and calculated.

GASOMETRIC ESTIMATIONS.

In certain cases the Pharmacopœia directs the strength of a product or chemical substance to be determined by the volume of gas (nitrogen dioxide) given off during a definite reaction. This volume is to be determined by the nitrometer in the following manner:

Arrange a nitrometer consisting of a measuring tube (graduated for at least 50 Cc.) connected by stout rubber tubing, with an open equilibrium tube (both tubes, preferably, provided with a globular expansion near the lower end), in such a manner, by suitable clamps attached to a stand, that either tube may be readily and quickly clamped at a higher or lower level. The stop-cock of the measuring tube having been opened, and the open equilibrium tube having been raised to a higher level, pour into the latter a saturated aqueous solution of sodium chloride, until the measuring tube, including the bore of the stop-cock, is completely filled. Then close the latter and fix the equilibrium tube at a low level. Having ascertained that the stop-cock is closed air-tight, and having, if necessary, wiped out the graduated funnel tube of the nitrometer, introduce into it the prescribed quantity of the liquid to be tested, and allow this to flow slowly into the measuring tube, being careful not to admit any air. Follow it by the prescribed quantities of the several reagents (potassium iodide test-solution, and normal sulphuric acid volumetric solution). When the reaction, which takes place at once, moderates, remove the measuring tube from its clamp, and, being careful to hold it constantly so that the liquid contained in it stands at a higher level than in the equilibrium tube, shake its contents, without permitting any gas to pass into the open tube. When the reaction has completely ceased, restore the tube to its fastening, and allow the apparatus and contents to acquire the ordinary temperature of the room, which is assumed to be at or about 25° C. (77° F.). Then adjust the two tubes so that the liquid columns are at exactly the same level, and read off the volume of gas in the measuring tube. Multiply this figure by the weight of the substance, which is the equivalent of 1 Cc. of nitrogen dioxide (see next page). The result will be the weight of the pure substance (nitrite) contained in the amount taken for the assay.

For pharmacopœial purposes the determination will be sufficiently exact if the evolved gas be measured at or near 25° C. (77° F.).

Since temperature and barometric pressure materially affect the volume of the gas, the following correction factors must be used to obtain reasonably exact results when the temperature and pressure are not nearly normal. The barometer correction is important at any locality more than 250 meters above sea-level.

Factors for Temperature Corrections.

(Normal Temperature, 25° C.)

Temperature.	Factor.	Temperature.	Factor.	Temperature.	Factor.
15° C.	1.035	22° C.	1.010	29° C.	0.987
16° C.	1.031	23° C.	1.007	30° C.	0.983
17° C.	1.028	24° C.	1.003	31° C.	0.980
18° C.	1.024	25° C.	1.000	32° C.	0.977
19° C.	1.021	26° C.	0.997	33° C.	0.974
20° C.	1.017	27° C.	0.993	34° C.	0.971
21° C.	1.014	28° C.	0.990	35° C.	0.968

Example.—Assuming that the volume of gas read off was 44.5 Cc. at 32° C. (89° F.), and it is desired to ascertain the corresponding volume at 25° C. (77° F.), barometric pressure not being taken into consideration, then the 44.5 Cc. must be reduced in the proportion of 1 to 0.977 (see temperature correction factors above), or 44.5 must be multiplied by 0.977. The result will be 43.48 (43.4765) Cc. as the equivalent volume of gas at 25° C. (77° F.).

Factors for Correction for Barometric Pressure.

(Normal Barometer, 760 Mm.)

Barometer Reading.		Factor.	Barometer Reading.		Factor.
Mm.	Inches.		Mm.	Inches.	
790	31.10	1.039	660	25.98	0.868
780	30.71	1.026	650	25.59	0.855
770	30.31	1.013	640	25.20	0.842
760	29.92	1.000	630	24.80	0.829
750	29.53	0.987	620	24.41	0.816
740	29.13	0.974	610	24.02	0.803
730	28.74	0.961	600	23.62	0.789
720	28.35	0.947	590	23.23	0.776
710	27.95	0.934	580	22.83	0.763
700	27.56	0.921	570	22.44	0.750
690	27.17	0.907	560	22.05	0.737
680	26.77	0.895	550	21.65	0.724
670	26.38	0.882			

Example.—Assuming that the volume of gas read off was 43.48 (43.4765) Cc. at 590 Mm. barometric pressure, and it is desired to ascertain the corresponding volume at normal barometric pressure (760 Mm.), temperature not being taken into consideration, then the 43.48 Cc. must be reduced in the proportion of 1 to 0.776 (see barometric correction factors above), or 43.48 must be multiplied by 0.776. The result will be 33.74 Cc. as the equivalent volume of gas at normal barometric pressure.

Estimation of Nitrogen Dioxide (NO, 29.81) 1 liter at 0° C. and 760 Mm., 1.3396 Gm.; at 25° C. and 760 Mm., 1.2272 Gm.

One Cubic Centimeter Nitrogen of Dioxide is the equivalent of:

		At 0° C. and 760 Mm.	At 25° C. and 760 Mm.
		Gramme.	Gramme.
Nitrogen dioxide, NO	= 29.81	0.0013396	0.0012272
Amyl nitrite, $C_5H_{11}NO_2$	= 116.24	0.0052234	0.0047851
Ethyl nitrite, $C_2H_5NO_2$	= 74.51	0.0033482	0.0030673
Sodium nitrite, $NaNO_2$	= 68.57	0.0030813	0.0028227

ALKALOIDAL ASSAY BY IMMISCIBLE SOLVENTS.

Nearly all alkaloids are practically insoluble in water, but they are soluble in alcohol, chloroform, ether, amyl alcohol, benzene, petroleum benzin, or mixtures of several of these. The salts of these alkaloids, however, are soluble in water, but practically insoluble in the above-mentioned solvents. The process of assay by immiscible solvents, which is generally known as the "shaking out" process, is based on this property of alkaloids, and it is carried out by treating liquid extracts that have been freed from alcohol, with an immiscible solvent in the presence of an excess of alkali. This liberates the alkaloid, and, on becoming free, if not so previously, it is dissolved by the immiscible solvent. This solution is then separated, transferred to another container, and shaken with an excess of acid largely diluted with water. The acid combining with the free alkaloid forms a salt, which now leaves the immiscible solvent and is found in the aqueous solution. This process is sometimes repeated, in case the alkaloidal solution is still colored. The apparatus used in this operation of shaking out is termed a "separator," and consists of an oval or pear-shaped glass vessel, with an opening at the top supplied with a well-ground glass stopper, and an outlet tube at the bottom, provided with an accurately fitting glass stop-cock. The solvents directed to be used in this Pharmacopœia are alcohol, chloroform, ether, and various mixtures of both, containing at least 75 parts of ether in 100 parts of solvent by volume. In the case of chloroform, the solvent will collect at the bottom of the separator, and can be drawn off, but the ethereal or ether-chloroform mixture will form the upper portion of the liquid in the separator, and the aqueous layer must first be drawn off into a suitable vessel, and the ethereal layer then transferred to another vessel. It is not necessary or desirable to shake the mixture of immiscible solvent and water violently, for a rotation of the separator or a gentle shaking for about a minute will answer all purposes. At times, an emulsion of the water and the solvent is formed, especially if the shaking is too violent, and in order to separate this it is advisable to proceed as follows: If the solvent is heavier than the water, add more of the former, a little water, and a slight amount of alcohol; if the solvent is lighter than the water, add sufficient saturated sodium chloride solution or crystals of sodium chloride. A safe procedure to avoid the forming of emulsions is to invert the separator several times, and then to at once begin rotating to keep the solvents well mixed. To insure a complete extraction of the alkaloid, it is desirable to treat the liquid three times with the immiscible solvent, and this is to be followed by a rinsing of the empty separator with repeated small portions of the same solvent. The separator should not be filled to more than two-thirds of its capacity at any time, and if its contents should become heated by the neutralization of acid by alkali, or *vice versa*, it should be cooled to the temperature of the room, before opening the stopper, by immersing it in running water. The final operation must always be the collection of the free alkaloid by the use of a portion of the immiscible solvent, drawing this off into a beaker, rinsing with small portions of the solvent to prevent possible loss. The beaker is then placed on a water-bath and gently heated, to remove the solvent by evaporation, leaving the alkaloids in the beaker in the dry form, and usually in the condition of a resinous or varnish-like mass. It is then either weighed as such or dissolved in volumetric acid solution, delivered in measured quantity from a burette, and the excess of the acid titrated with volumetric alkali solution with the use of an indicator. Should the final residual alkaloids still be slightly colored, it is preferable to employ iodeosin as the indicator, as the alkaloidal solution contains ether and the ethereal layer retains in solution coloring matter or impurity which may be present. If the alkaloids are not colored, hematoxylin or cochineal may safely be used.

The quantity of alkaloid is found by multiplying the number of cubic centimeters of volumetric acid consumed by a constant factor, depending upon the molecular weight of the individual alkaloid. These factors will be found in this Appendix, on page 1687, under Tenth-normal Sulphuric Acid Volumetric Solution, and are used throughout the text without explanation. The factor in each case represents the weight in grammes of the alkaloid required to neutralize 1 Cc. of volumetric acid.

DETERMINATION OF THE OPTICAL ROTATION OF ORGANIC SUBSTANCES.

Many organic substances either liquid by nature or in solution in suitable solvents, when examined in a specially constructed polarizing apparatus or polaristrobometer, exhibit the property of circular polarization, or, in other words, are capable of rotating the plane of polarization of a ray of light either to the right or to the left. Such substances are termed "optically active," and when rotating to the right are designated as "dextro-rotatory" or "dextrogyrate," and when rotating to the left, as "lævo-rotatory" or "lævogyrate." Substances which do not possess this property of optical rotation are termed "optically inactive."

Among the substances recognized by the U. S. Pharmacopœia, there are several, particularly certain essential or volatile oils, and related bodies, for which the determination of the angle of rotation of a ray of polarized light, or, in some cases, the proof of their optical inactivity, affords the most simple and positive evidence of their identity or purity.

The instruments used for this purpose vary somewhat in their construction. Those which are most generally adapted for the examination of the substances mentioned above are the Polaristrobometer of Wild, in which the optical activity of the substance is manifested by the appearance or disappearance of dark, parallel stripes, or the so-called "half-shadow" instrument of Laurent, in which the two sides of the field of vision are capable of becoming unequally illuminated. Both of the instruments permit the angle of rotation to be read off in degrees or fractions of a degree of a circle.

These optical determinations are best made in a dark room, and by means of homogeneous or monochromatic light, the latter being obtained by introducing into a non-luminous flame, on a loop of platinum wire, a small bead of fused sodium chloride. The light thus radiated corresponds with the line D of the solar spectrum.

Since the deviation of the plane of polarization either to the right or to the left of the zero point is directly proportional to the length of the column of liquid, it is important that the observations should be made with tubes of a definite length, such as 100, 50, or 25 Mm. The selection of the length of the tube to be employed is, however, usually dependent upon the depth of color of the liquid and the extent of its optical rotation.

The rotatory power of an optically active, liquid substance, observed with sodium light, and referred to the ideal density 1, and in a tube having a length of 1 decimeter (100 Mm.), is designated as its *specific rotatory power*. This is usually expressed by the term $[a]_D$. Since, however, not only the density of an optically active liquid, but also its rotation, is influenced by the temperature, the specific rotation varies with the latter. In stating the specific rotation it is, therefore, necessary to indicate at what temperature the rotation and the density of the liquid have been determined. But for the same temperature the specific rotation of a pure, optically active liquid is always a constant number. The temperature used in the text of the Pharmacopœia is 25° C. (77° F.).

For calculating the specific rotatory power of an optically active liquid substance, or solution of an optically active solid, the following formulas are of general application:

I. For liquid substances $$[a]_D = \frac{100 \times a}{L \times d}$$

II. For solutions of solids $$[a]_D = \frac{10000 \times a}{L \times p \times d}$$

or $$[a]_D = \frac{10000 \times a}{L \times c}$$

For calculating these formulas the determination of the following factors is necessary:

a = the angle of rotation of the liquid or solid observed with sodium light.

L = the length of the tube in millimeters.

d = the density or specific gravity of the active liquid.

p = the amount of active substance in 100 parts by weight of the solution.

c = the number of grammes of active substance in 100 cubic centimeters of the solution.

Table Showing the Quantity of Official Alkalies Required to Saturate 100 Parts of an Official Acid, Together with the Quantity of Product.

ACIDS.		AMMONIUM.				POTASSIUM.					SODIUM.				
		Ammon. Carbonate, 97 per cent.	Ammonia Water, 10 per cent.	Ammonia Water, 28 per cent.	Product.	Potassium Hydroxide, 85 per cent.	Solution of Potassium Hydroxide, 5 per cent.	Potassium Bicarbonate, 99 per cent.	Potassium Carbonate, 98 per cent.	Product.	Sodium Hydroxide, 90 per cent.	Solution of Sodium Hydroxide, 5 per cent.	Sodium Bicarbonate, 99 per cent.	Monohydrated Sodium Carbonate, 99.5 per cent.	Product.
	Official Percent.														
Acetic	36.0	32.39	102.30	36.53	**46.23**	39.62	673.60	60.67	42.32	**58.88**	26.69	480.48	50.92	37.40	**81.63**
" diluted	6.0	5.40	17.05	6.09	**7.70**	6.60	112.27	10.11	7.05	**9.81**	4.45	80.08	8.40	6.23	**13.61**
" glacial	99.0	89.08	281.31	100.47	**127.13**	108.96	1852.38	166.85	116.37	**161.91**	73.41	1321.33	140.03	102.86	**224.49**
Benzoic	100.0	44.26	139.77	49.92	**113.98**	54.14	920.33	82.90	57.82	**175.54**	36.47	656.48	69.57	51.11	**118.06**
Citric	99.5	76.75	242.38	86.56	**115.21**	93.88	1596.01	143.76	100.27	**153.70**	63.25	1138.45	120.65	88.63	**169.22**
Hydrobromic, diluted	10.0	6.67	21.07	7.52	**12.11**	8.16	138.73	12.50	8.72	**14.71**	5.50	98.95	10.49	7.70	**12.72**
Hydrochloric	31.9	47.27	149.27	53.31	**46.83**	57.82	982.92	88.54	61.75	**65.28**	38.95	701.13	74.30	54.58	**51.19**
" diluted	10.0	14.82	46.79	16.71	**14.68**	18.13	308.13	27.75	19.36	**20.46**	12.21	219.79	23.29	17.11	**16.05**
Lactic	75.0	44.99	142.08	50.74	**89.21**	55.03	935.55	84.27	58.77	**106.77**	37.07	667.34	70.72	51.95	**93.36**
Nitric	68.0	58.26	183.99	65.71	**86.40**	71.27	1211.55	109.13	76.11	**109.15**	48.01	864.21	91.58	67.28	**91.78**
" diluted	10.0	8.57	27.06	9.66	**12.71**	10.48	178.17	16.05	11.19	**16.05**	7.06	127.09	13.47	9.89	**13.50**
Phosphoric	85.0	93.68	295.83	105.65	**114.58**	114.59	1947.95	175.46	122.38	**151.15**	77.19	1389.50	147.25	108.17	**310.69**
" diluted	10.0	11.02	34.80	12.43	**13.48**	13.48	229.17	20.64	14.40	**17.78**	9.08	163 47	17.32	12.73	**36.55**
Salicylic	100.0	39.13	123.57	44.13	**112.36**	47.86	813.66	73.29	51.12	**127.63**	32.24	580.40	61.51	45.18	**115.97**
Sulphuric	92.5	101.88	321.73	114.90	**124.67**	124.62	2118.52	190.82	133.09	**164.45**	83.95	1511.17	160.15	117.64	**303.97**
" diluted	10.0	11.01	34.78	12.42	**13.48**	13.47	229.03	20.63	14.39	**17.78**	9.08	163.37	17.31	12.72	**32.86**
Tartaric	99.5	71.64	226.23	80.80	**122.12**	87.63	1489.69	134.18	93.59	**156.07**	59.03	1062.62	112.61	82.72	**152.63**
Arsenic Trioxide	99.8	54.47	172.02	61.44	**126.09**	66.63	1132.73	102.03	71.16	**147.35**	44.89	807.99	85.63	62.90	**131.12**

Table Showing the Quantity of Official Acids Required to Saturate 100 Parts of an Official Alkali, together with the Quantity of Product.

ACIDS.

ALKALIES.		ACETIC.				BENZOIC.		CITRIC.		HYDROBROMIC.		HYDROCHLORIC.			LACTIC.	
		36 per ct.	6 per cent.	99 per ct.	Product.	100 per cent.	Product.	99.5 per cent.	Product.	10 per cent.	Product.	31.9 per ct.	10 per ct.	Product.	75 per cent.	Product.
	Official per cent.															
Ammonium Carbonate	97.0	308.70	1852.21	112.26	**142.71**	225.94	**257.52**	130.29	**150.10**	1498.93	**181.47**	211.55	674.85	**99.06**	222.26	**198.28**
Ammonia-water	10.0	97.76	586.53	35.55	**45.19**	71.55	**81.55**	41.26	**47.53**	474.66	**57.47**	66.99	213.70	**31.37**	70.38	**62.79**
Ammonia-water, Stronger	28.0	273.72	1642.29	99.53	**126.54**	200.33	**228.33**	115.52	**133.09**	1329.05	**160.90**	187.58	598.37	**87.84**	197.08	**175.81**
Potassium Hydroxide	85.0	252.38	1514.26	91.77	**148.59**	184.72	**324.25**	106.52	**163.72**	1225.44	**180.28**	172.95	551.72	**112.91**	181.71	**194.02**
Solution of Potassium Hydroxide	5.0	14.85	89.07	5.40	**8.74**	10.87	**19.07**	6.27	**9.63**	72.08	**10.60**	10.17	32.45	**6.64**	10.69	**11.41**
Potassium Bicarbonate	99.0	164.82	988.90	59.93	**97.04**	120.63	**211.75**	69.56	**106.92**	800.29	**117.73**	112.95	360.31	**73.73**	118.67	**126.71**
Potassium Carbonate	99.0	236.31	1417.85	85.93	**139.13**	172.95	**303.60**	99.73	**153.29**	1147.41	**168.80**	161.94	516.59	**105.72**	170.14	**181.66**
Sodium Hydroxide	90.0	374.62	2247.74	136.23	**305.81**	274.19	**323.71**	158.11	**267.56**	1819.01	**231.43**	256.73	818.96	**131.42**	269.73	**251.82**
Solution of Sodium Hydroxide	5.0	20.81	124.87	7.57	**16.99**	15.23	**17.98**	8.78	**14.86**	101.06	**12.86**	14.26	45.50	**7.30**	14.98	**13.99**
Sodium Bicarbonate	99.0	196.39	1178.32	71.41	**160.31**	143.74	**169.70**	82.89	**140.26**	953.57	**121.31**	134.58	429.32	**68 90**	141.40	**132.01**
Monohydrated Sodium Carbonate	99.5	267.35	1604.08	97.22	**218.24**	195.67	**231.02**	112.83	**190.94**	1298.13	**165.16**	183.21	584.45	**93.79**	192.49	**179.71**

ALKALIES.		NITRIC.			PHOSPHORIC.			SALICYLIC.		SULPHURIC.			TARTARIC.		ARSENIC TRIOXIDE.	
		68 per ct.	10 per cent.	Product.	85 per ct.	10 per cent.	Product.	100 per ct.	Product.	92.5 per ct.	10 per cent.	Product.	99.5 per ct.	Product.	99.8 per ct.	Product.
	Official per cent															
Ammonium Carbonate	97.0	171.63	1167.10	**148.29**	106.75	907.36	**122.32**	255.56	**287.14**	98.15	907.92	**122.37**	139.59	**170.47**	183.57	**231.46**
Ammonia-water	10.0	54.35	369.58	**46.96**	33.80	287.33	**38.73**	80.93	**90.93**	31.08	287.51	**38.75**	44.20	**53.98**	58.13	**73.30**
Ammonia-water, Stronger	28.0	152.18	1034.83	**131.48**	94.65	804.52	**108.45**	226.60	**254.60**	87.03	805.02	**108.50**	123.77	**151.15**	162.77	**205.23**
Potassium Hydroxide	85.0	140.32	954.15	**153.15**	87.27	741.81	**131.91**	208.93	**266.67**	80.24	742.26	**131.96**	114.12	**178.10**	150.08	**221.15**
Solution of Potassium Hydroxide	5.0	8.25	56.13	**9.01**	5.13	43.64	**7.76**	12.29	**15.69**	4.72	43.66	**7.76**	6.71	**10.48**	8.83	**13.01**
Potassium Bicarbonate	99.0	91.64	623.12	**100.02**	56.99	484.44	**86.15**	136.44	**174.15**	52.40	484.74	**86.18**	74.53	**116.31**	98.01	**144.42**
Potassium Carbonate	98.0	131.38	893.40	**143.40**	81.71	694.57	**123.52**	195.63	**249.69**	75.14	695.00	**123.56**	106.85	**166.76**	140.52	**207.07**
Sodium Hydroxide	90.0	208.28	1416.32	**191.15**	129.54	1101.12	**402.48**	310.13	**359.66**	119.11	1101.80	**362.07**	169.39	**258.55**	222.77	**292.09**
Solution of Sodium Hydroxide	5.0	11.57	78.68	**10.62**	7.20	61.17	**22.36**	17.23	**19.98**	6.62	61.21	**20.12**	9.41	**14.36**	12.38	**16.23**
Sodium Bicarbonate	99.0	109.19	742.47	**100.21**	67.91	577.23	**210.99**	162.58	**188.54**	62.44	577.59	**189.81**	88.80	**135.54**	116.78	**153.12**
Monohydrated Sodium Carbonate	99.5	148.64	1010.75	**136.42**	92.45	785.81	**287.22**	221.32	**256.67**	85.00	786.29	**258.39**	120.89	**184.51**	158.98	**208.45**

Table Showing the Quantity of Official Alkalies and Acids Required to Make 100 Parts of the Corresponding Salts.

Ammonium Salts.

AMMONIUM SALTS.			Parts of Alkali required.			Parts.	Parts of Acid required.	
			Ammonium Carbonate 97 per cent.	Ammonia-water 10 per cent.	Ammonia-water 28 per cent.			Official per cent.
Ammonium	Acetate	$NH_4C_2H_3O_2$ = 76.51	70.07	221.28	79.03	216.31	Acetic Acid	36.0
						1297.87	" " Diluted	6.0
						78.66	" " Glacial	99.0
"	Arsenite	NH_4AsO_2 = 124.09	43.20	136.43	48.73	79.31	Arsenic Trioxide	99.8
"	Benzoate	$NH_4C_7H_5O_2$ = 138.06	38.83	122.63	43.80	87.74	Benzoic Acid	100.0
"	Bromide	NH_4Br = 97.29	55.11	174.01	62.15	825.97	Hydrobromic Acid, Diluted	10.0
"	Chloride	NH_4Cl = 53.11	100.94	318.77	113.85	213.55	Hydrochloric Acid	31.9
						681.23	" " Diluted	10.0
"	Citrate	$(NH_4)_3C_6H_5O_7$ = 241.41	66.62	210.39	75.14	86.80	Citric Acid	99.5
"	Lactate	$NH_4C_3H_5O_3$ = 106.30	50.43	159.27	56.88	112.10	Lactic Acid	75.0
"	Nitrate	NH_4NO_3 = 79.50	67.44	212.96	76.06	115.74	Nitric Acid	68.0
						787.04	" " Diluted	10.0
"	Phosphate	$(NH_4)_2HPO_4$ = 131.15	81.76	258.18	92.21	87.27	Phosphoric Acid	85.0
						741.82	" " Diluted	10.0
"	Salicylate	$NH_4C_7H_5O_3$ = 153.94	34.83	109.98	39.28	89.00	Salicylic Acid	100.0
"	Sulphate	$(NH_4)_2SO_4$ = 131.21	81.72	258.06	92.16	80.21	Sulphuric Acid	92.5
						741.95	" " Diluted	10.0
"	Tartrate	$(NH_4)_2C_4H_4O_6$ = 182.78	58.66	185.25	66.16	81.88	Tartaric Acid	99.5

Table Showing the Quantity of Official Alkalies and Acids Required to Make 100 Parts of the Corresponding Salts.—*Continued.*

Potassium Salts.

POTASSIUM SALTS.	Parts of Alkali required.				Parts.	Parts of Acid required.	
	Potassium Hydroxide 85 per cent.	Solution of Potassium Hydroxide 5 per cent.	Potassium Bicarbonate 99 per cent.	Potassium Carbonate 98 per cent.			Official per cent.
Potassium Acetate . . . $KC_2H_3O_2$ = 97.44	67.30	1144.09	103.05	71.88	169.85	Acetic Acid	36.0
					1019.09	" " Diluted	6.0
					61.76	" " Glacial	99.0
" Arsenite . . . $KAsO_2$ = 145.02	45.22	768.72	69.24	48.29	67.86	Arsenic Trioxide	99.8
" Benzoate . . . $KC_7H_5O_2 + 3H_2O$ = 212.63	30.84	524.29	47.22	32.94	56.97	Benzoic Acid	100.0
" Bromide . . . KBr = 118.22	55.47	943.00	84.94	59.22	679.76	Hydrobromic Acid, Diluted	10.0
" Chloride . . . KCl = 74.04	88.57	1505.67	135.62	94.59	153.18	Hydrochloric Acid	31.9
					488.66	" " Diluted	10.0
" Citrate . . . $K_3C_6H_5O_7 + H_2O$ = 322.08	61.08	1038.37	93.53	65.23	65.06	Citric Acid	99.5
" Lactate . . . $KC_3H_5O_3$ = 127.23	51.54	876.21	78.92	55.05	93.66	Lactic Acid	75.0
" Nitrate . . . KNO_3 = 100.43	65.30	1110.03	99.98	69.74	91.62	Nitric Acid	68.0
					623.02	" " Diluted	10.0
" Phosphate . . K_2HPO_4 = 173.01	75.81	1288.71	116.08	80.96	66.16	Phosphoric Acid	85.0
					562.33	" " Diluted	10.0
" Salicylate . . $KC_7H_5O_3$ = 174.87	37.50	637.50	57.42	40.05	78.35	Salicylic Acid	100.0
" Sulphate . . . K_2SO_4 = 173.07	75.78	1288.26	116.04	80.93	60.81	Sulphuric Acid	92.5
					562.49	" " Diluted	10.0
" Tartrate . . . $2K_2C_4H_4O_6 + H_2O$ = 467.16	56.15	954.53	85.98	59.97	64.08	Tartaric Acid	99.5

Table Showing the Quantity of Official Alkalies and Acids Required to Make 100 Parts of the Corresponding Salts.—*Continued.*

Sodium Salts.

SODIUM SALTS.		Parts of Alkali required.				Parts.	Parts of Acid required.	
		Sodium Hydroxide 90 per cent.	Solution of Sodium Hydroxide 5 per cent.	Sodium Bicarbonate 99 per cent.	Monohydrated Sodium Carbonate 99.5 per cent.			Official per cent.
Sodium Acetate	$NaC_2H_3O_2 + 3H_2O$ = 135.10	32.70	588.60	62.38	45.82	122.50	Acetic Acid	36.0
						735.01	" " Diluted	6.0
						44.55	" " Glacial	99.0
" Arsenite	$NaAsO_2$ = 129.04	34.24	616.24	65.31	47.97	76.27	Arsenic Trioxide	99.8
" Benzoate	$NaC_7H_5O_2$ = 143.01	30.89	556.04	58.93	43.29	84.70	Benzoic Acid	100.0
" Bromide	$NaBr$ = 102.24	43.21	777.78	82.43	60.55	786.00	Hydrobromic Acid, Diluted	10.0
" Chloride	$NaCl$ = 58.06	76.09	1369.62	145.15	106.62	195.34	Hydrochloric Acid	31.9
						623.15	" " Diluted	10.0
" Citrate	$2Na_3C_6H_5O_7 + 11H_2O$ = 709.20	37.38	672.76	71.30	52.37	59.09	Citric Acid	99.5
" Lactate	$NaC_3H_5O_3$ = 111.25	39.71	714.78	75.75	55.65	107.11	Lactic Acid	75.0
" Nitrate	$NaNO_3$ = 84.45	52.31	941.62	99.79	73.30	108.96	Nitric Acid	68.0
						740.91	" " Diluted	10.0
" Phosphate	$Na_2HPO_4 + 12H_2O$ = 355.61	24.84	447.23	47.40	34.81	32.19	Phosphoric Acid	85.0
						273.59	" " Diluted	10.0
" Salicylate	$NaC_7H_5O_3$ = 158.89	27.80	500.47	53.04	38.96	86.22	Salicylic Acid	100.0
" Sulphate	$Na_2SO_4 + 10H_2O$ = 319.91	27.62	497.14	52.68	38.70	32.90	Sulphuric Acid	92.5
						304.30	" " Diluted	10.0
" Tartrate	$Na_2C_4H_4O_6 + 2H_2O$ = 228.44	38.67	696.20	73.78	54.20	65.52	Tartaric Acid	99.5

Table of Atomic Weights

Adopted by the International Committee on Atomic Weights (1904).

H = 1.000.

Name.	Symbol.	Atomic Weight.	Name.	Symbol.	Atomic Weight.
Aluminum	Al	26.9	Neodymium	Nd	142.5
Antimony	Sb	119.3	Neon	Ne	19.9
Argon	Ar	39.6	Nickel	Ni	58.3
Arsenic	As	74.4	Nitrogen	N	13.93
Barium	Ba	136.4	Osmium	Os	189.6
Bismuth	Bi	206.9	Oxygen	O	15.88
Boron	B	10.9	Palladium	Pd	105.7
Bromine	Br	79.36	Phosphorus	P	30.77
Cadmium	Cd	111.6	Platinum	Pt	193.3
Cæsium	Cs	131.9	Potassium	K	38.86
Calcium	Ca	39.8	Praseodymium[3]	Pr	139.4
Carbon	C	11.91	Radium	Ra	223.0
Cerium	Ce	139.2	Rhodium	Rh	102.2
Chlorine	Cl	35.18	Rubidium	Rb	84.8
Chromium	Cr	51.7	Ruthenium	Ru	100.9
Cobalt	Co	58.56	Samarium	Sm	148.9
Columbium[1]	Cb	93.3	Scandium	Sc	43.8
Copper	Cu	63.1	Selenium	Se	78.6
Erbium	Er	164.8	Silicon	Si	28.2
Fluorine	F	18.9	Silver	Ag	107.12
Gadolinium	Gd	155.0	Sodium	Na	22.88
Gallium	Ga	69.5	Strontium	Sr	86.94
Germanium	Ge	71.9	Sulphur	S	31.83
Glucinum[2]	Gl	9.03	Tantalum	Ta	181.6
Gold	Au	195.7	Tellurium	Te	126.6
Helium	He	4.0	Terbium	Tb	158.8
Hydrogen	H	1.000	Thallium	Tl	202.6
Indium	In	113.1	Thorium	Th	230.8
Iodine	I	125.90	Thulium	Tu	169.7
Iridium	Ir	191.5	Tin	Sn	118.1
Iron	Fe	55.5	Titanium	Ti	47.7
Krypton	Kr	81.2	Tungsten	W	182.6
Lanthanum	La	137.9	Uranium	U	236.7
Lead	Pb	205.35	Vanadium	V	50.8
Lithium	Li	6.98	Xenon	Xe	127.0
Magnesium	Mg	24.18	Ytterbium	Yb	171.7
Manganese	Mn	54.6	Yttrium	Yt	88.3
Mercury	Hg	198.5	Zinc	Zn	64.9
Molybdenum	Mo	95.3	Zirconium	Zr	89.9

[1] Also called Niobium, Nb = 93.3. [2] Also called Beryllium, Be = 9.03.
[3] Also called Didymium, Di = 139.4.

ALPHABETICAL LIST OF FORMULAS AND MOLECULAR WEIGHTS OF THE PRINCIPAL CHEMICALS AND REAGENTS.

		Mol. Weight.
Acetaldehyde. (See Aldehyde, Acetic.)		
Acetanilide (Phenylacetamide)	$C_6H_5NHC_2H_3O$	134.09
Acetone	$(CH_3)_2CO$	57.61
Acetparaphenetidin. (See Acetphenetidin.)		
Acetphenetidin (Acetparaphenetidin)	$C_{10}H_{13}NO_2$	177.79
Acid, Acetic	$HC_2H_3O_2$	59.58
" Arsenic	H_3AsO_4	140.92
" Arsenous. (See Arsenic Trioxide.)		
" Aurochloric. (See Acid, Chlorauric.)		
" Benzoic	$HC_7H_5O_2$	121.13
" Boric	H_3BO_3	61.54
" Camphoric	$H_2C_{10}H_{14}O_4$	198.62
" Carbolic. (See Phenol.)		
" Carbonic (in solution)	H_2CO_3	61.55
" Chlorauric (Aurochloric)	$HAuCl_4 + 4H_2O$	408.94
" Chlorauric (anhydrous) (Gold Chloride)	$AuCl_3$	301.24
" Chloroplatinic	$H_2PtCl_6 + 6H_2O$	513.66

		Mol. Weight.
Acid Cinnamic	$HC_9H_7O_2$	146.95
" Citric	$H_3C_6H_5O_7 + H_2O$	208.50
" " (anhydrous)	$H_3C_6H_5O_7$	190.62
" Formic	$HCHO_2$	45.67
" Gallic	$HC_7H_5O_5 + H_2O$	186.65
" " (anhydrous)	$HC_7H_5O_5$	168.77
" Hydriodic	HI	126.9
" Hydrobromic	HBr	80.36
" Hydrochloric	HCl	36.18
" Hydrocyanic	HCN	26.84
" Hydroferricyanic	$H_3Fe(CN)_6$	312.54
" Hydroferrocyanic	$H_4Fe(CN)_6$	214.54
" Hydrofluoric	HF	19.9
" Hydrosulphuric. (See Hydrogen Sulphide.)		
" Hypophosphorous	HPH_2O_2	65.53
" Kinic	$HC_7H_{11}O_6$	109.65
" Lactic	$HC_3H_5O_3$	89.37
" Meconic	$C_7H_4O_7$	198.53
" Metaphosphoric	HPO_3	79.41
" Molybdic	H_2MoO_4	160.82
" " (cryst.)	$H_2MoO_4 + H_2O$	178.70
" Nitric	HNO_3	62.57
" Nitrous	HNO_2	46.69
" Oleic	$HC_{18}H_{33}O_2$	280.14
" Oxalic	$H_2C_2O_4 + 2H_2O$	125.10
" " (anhydrous)	$H_2C_2O_4$	89.34
" Palmitic	$HC_{16}H_{31}O_2$	254.32
" Phosphoric	H_3PO_4	97.29
" Phosphorous	H_2HPO_3	81.41
" Picric	$C_6H_2(NO_2)_3OH$	227.41
" Pyroboric (Tetraboric Acid)	$H_2B_4O_7$	156.76
" Pyrogallic. (See Pyrogallol.)		
" Pyrophosphoric	$H_4P_2O_7$	176.70
" Salicylic	$HC_7H_5O_3$	137.01
" Silicic	H_2SiO_3	77.84
" Stearic	$HC_{18}H_{35}O_2$	282.14
" Succinic	$H_2C_4H_4O_4$	117.16
" Sulphanilic	$HC_6H_4(NH_2)SO_3 + 3H_2O$	225.5
" " (anhydrous)	$HC_6H_4(NH_2)SO_3$	171.86
" Sulphuric	H_2SO_4	97.35
" Sulphurous	H_2SO_3	81.47
" Tannic	$HC_{14}H_9O_9$	319.66
" Tartaric	$H_2C_4H_4O_6$	148.92
" Tetraboric (Pyroboric)	$H_2B_4O_7$	156.76
" Trichloracetic	$HC_2Cl_3O_2$	162.12
" Tungstic (crystallized)	$H_2WO_4 + H_2O$	266.0
" Uric	$C_5H_4N_4O_3$	166.91
" Valeric (Valerianic)	$H_5CH_9O_2$	101.31
Aconitine	$C_{34}H_{47}NO_{11}$	640.55
Agaracin	$C_{16}H_{30}O_5 + H_2O$	317.84
Alcohol, Amylic	$C_5H_{11}OH$	87.43
" Ethylic	C_2H_5OH	45.70
" Methylic	CH_3OH	31.79
Aldehyde, Acetic	C_2H_4O	43.70
" Benzoic. (See Benzaldehyde.)		
" Cinnamic. (See Cinnamic Aldehyde.)		
" Formic. (See Formaldehyde.)		
Allyl-iso-thiocyanate	$CSNC_3H_5$	98.40
Allyl-sulphocarbamide. (See Thiosinamine.)		
Alum (Aluminum and Potassium Sulphate)	$AlK(SO_4)_2 + 12H_2O$	471.02
" anhydrous	$AlK(SO_4)_2$	256.46
Aluminum Hydroxide	$Al(OH)_3$	77.54
" and Ammonium Sulphate	$AlNH_4(SO_4)_2 + 12H_2O$	450.09
" and Potassium Sulphate. (See Alum.)		
" Oxide	Al_2O_3	101.44
" Silicate	$H_2Al_2Si_2O_8 + H_2O$	257.12
" Sulphate	$Al_2(SO_4)_3 + 16H_2O$	625.93
" " (anhydrous)	$Al_2(SO_4)_3$	339.85
Ammonia	NH_3	16.93
Ammonium Acetate	$NH_4C_2H_3O_2$	76.51
" Arsenite (Metarsenite)	NH_4AsO_2	124.09
" Benzoate	$NH_4C_7H_5O_2$	138.06
" Bromide	NH_4Br	97.29
" Carbonate (normal)	$(NH_4)_2CO_3$	95.41

		Mol. Weight.
Ammonium Carbonate (U. S. P.)	$NH_4HCO_3.NH_4NH_2CO_2$	156.01
" Chloride	NH_4Cl	53.11
" Chloroplatinate	$(NH_4)_2PtCl_6$	440.24
" Citrate	$(NH_4)_3C_6H_5O_7$	241.41
" Hydrogen Sulphide	NH_4HS	50.76
" Iodide	NH_4I	143.83
" Lactate	$NH_4C_3H_5O_3$	106.30
" Molybdate	$(NH_4)_6Mo_7O_{24} + 4H_2O$	1227.32
" Nitrate	NH_4NO_3	79.50
" Oxalate	$(NH_4)_2C_2O_4 + H_2O$	141.08
" " (anhydrous)	$(NH_4)_2C_2O_4$	123.20
" Phosphate	$(NH_4)_2HPO_4$	131.15
" Salicylate	$NH_4C_7H_5O_3$	153.94
" and Sodium Phosphate	$NH_4NaHPO_4 + 4H_2O$	207.62
" Sulphate	$(NH_4)_2SO_4$	131.21
" Sulphide	$(NH_4)_2S$	67.69
" Sulphhydrate	NH_4HS	50.76
" Tartrate	$(NH_4)_2C_4H_4O_6$	182.78
" Valerate (Valerianate)	$NH_4C_5H_9O_2$	118.24
Amyl Acetate	$C_5H_{11}C_2H_3O_2$	129.13
" Nitrite	$C_5H_{11}NO_2$	116.24
Amylene Hydrate	$C_5H_{12}O$	87.43
Anethol	$C_{10}H_{12}O$	146.98
Aniline	$C_6H_5NH_2$	92.39
Antimony Oxide. (See Antimony Trioxide.)		
" Pentasulphide	Sb_2S_5	397.75
" and Potassium Tartrate	$2K(SbO)C_4H_4O_6 + H_2O$	659.80
" " " " (anhydrous)	$K(SbO)C_4H_4O_6$	320.96
" Trioxide (Antimony Oxide)	Sb_2O_3	286.24
" Trisulphide	Sb_2S_3	334.09
Antipyrine	$C_{11}H_{12}N_2O$	186.75
Apomorphine Hydrochloride	$C_{17}H_{17}NO_2HCl$	301.34
Arsenic Trioxide	As_2O_3	196.44
Arsenous Iodide	AsI_3	452.10
" (Penta-) Sulphide	As_2S_5	307.95
Atropine	$C_{17}H_{23}NO_3$	287.04
" Sulphate	$(C_{17}H_{23}NO_3)_2H_2SO_4$	671.43
Barium Carbonate	$BaCO_3$	195.95
" Chloride	$BaCl_2 + 2H_2O$	242.52
" " (anhydrous)	$BaCl_2$	206.76
" Chromate	$BaCrO_4$	251.62
" Dioxide	BaO_2	168.16
" Hydroxide	$Ba(OH)_2 + 8H_2O$	313.20
" " (anhydrous)	$Ba(OH)_2$	170.16
" Nitrate	$Ba((NO_3)_2$	259.54
" Sulphate	$BaSO_4$	231.75
" Sulphide	BaS	168.23
Benzaldehyde (Benzoic Aldehyde)	C_7H_6O	105.25
Benzene (Benzol)	C_6H_6	77.46
Benzosulphinide	$C_7H_5NSO_3$	181.77
Benzoyl-sulphonic-imide. (See Benzosulphinide.)		
Betanaphthol (Naphthol)	$C_{10}H_7OH$	142.98
Bismuth Citrate	$BiC_6H_5O_7$	394.52
" Nitrate (Normal)	$Bi(NO_3)_3 + 5H_2O$	481.01
" Oxychloride	$BiOCl$	257.96
" Subcarbonate (approximately)	$(BiO)_2CO_3$	505.11
" Subgallate (approximately)	$Bi(OH)_2C_7H_5O_5$	408.43
" Subnitrate (approximately)	$Bi(OH)_2NO_3$	302.23
" Subsalicylate (approximately)	$Bi(OH)_2C_7H_5O_3$	376.67
" Sulphide	Bi_2S_3	509.29
" Trioxide	Bi_2O_3	461.44
Borneol	$C_{10}H_{18}O$	152.98
Bornyl Acetate	$C_{10}H_{17}C_2H_3O_2$	194.68
Boron Trioxide	B_2O_3	69.44
Bromoform	$CHBr_3$	250.99
Brucine	$C_{23}H_{26}N_2O_4 + 4H_2O$	462.83
" (anhydrous)	$C_{23}H_{26}N_2O_4$	391.31
Cadmium Iodide	CdI_2	363.40
" Sulphate	$3CdSO_4 + 8H_2O$	763.89
" Sulphide	CdS	143.43
Caffeine	$C_8H_{10}N_4O_2 + H_2O$	210.64
" (anhydrous)	$C_8H_{10}N_4O_2$	192.76
Calcium Acetate	$Ca(C_2H_3O_2)_2$	156.96
" Bromide	$CaBr_2$	198.52

		Mol. Weight.
Calcium Carbonate	$CaCO_3$	99.35
" Chloride	$CaCl_2 + 6H_2O$	217.44
" " (anhydrous)	$CaCl_2$	110.16
" Fluoride	CaF_2	77.6
" Hydroxide	$Ca(OH)_2$	73.56
" Hypochlorite	$Ca(ClO)_2$	141.82
" Hypophosphite	$Ca(PH_2O_2)_2$	168.86
" Iodide	CaI_2	291.60
" Oxalate	$CaC_2O_4 + H_2O$	145.02
" Oxide	CaO	55.68
" Phosphate	$Ca_3(PO_4)_2$	307.98
" Sulphate (Gypsum)	$CaSO_4 + 2H_2O$	170.91
" " (anhydrous)	$CaSO_4$	135.15
" Sulphide (Monosulphide)	CaS	71.63
" Sulphite	$CaSO_3 + 2H_2O$	155.03
" Tartrate	$CaC_4H_4O_6$	186.72
Camphor	$C_{10}H_{16}O$	150.98
" Monobromated	$C_{10}H_{15}BrO$	229.34
Carbon Dioxide	CO_2	43.67
" Disulphide	CS_2	75.57
Carvone	$C_{10}H_{14}O$	148.98
Cephaëline	$C_{14}H_{19}NO_2$	231.43
Cerium Oxalate	$Ce_2(C_2O_4)_3 + 10H_2O$	719.22
" " (anhydrous)	$Ce_2(C_2O_4)_3$	540.42
Chloral (anhydrous)	C_2HCl_3O	146.24
" Hydrated	$C_2HCl_3O + H_2O$	164.12
Chloralformamide	$C_3H_4Cl_3NO_2$	190.96
Chloroform	$CHCl_3$	118.45
Chrome Alum	$CrK(SO_4)_2 + 12H_2O$	495.82
Chromium Oxide	Cr_2O_3	151.04
" Trioxide (Chromic Acid)	CrO_3	99.34
Chrysarobin	$C_{30}H_{26}O_7$	494.46
Cinchonidine	$C_{19}H_{22}N_2O$	292.03
" Salicylate	$C_{19}H_{22}N_2OC_7H_6O_3$	429.04
" Sulphate	$(C_{19}H_{22}N_2O)_2H_2SO_4 + 3H_2O$	735.05
" " (anhydrous)	$(C_{19}H_{22}N_2O)_2H_2SO_4$	681.41
Cinchonine	$C_{19}H_{22}N_2O$	292.03
" Sulphate	$(C_{19}H_{22}N_2O)_2H_2SO_4 + 2H_2O$	717.17
" " (anhydrous)	$(C_{19}H_{22}N_2O)_2H_2SO_4$	681.41
Cineol (Eucalyptol)	$C_{10}H_{18}O$	152.98
Cinnamic Aldehyde	C_9H_8O	131.07
Citral	$C_{10}H_{16}O$	150.98
Cobaltous Nitrate	$Co(NO_3)_2 + 6H_2O$	288.98
" Sulphate	$CoSO_4 + 7H_2O$	279.07
Cocaine	$C_{17}H_{21}NO_4$	300.92
" Hydrochloride	$C_{17}H_{21}NO_4HCl$	337.10
Codeine	$C_{18}H_{21}NO_3 + H_2O$	314.83
" (anhydrous)	$C_{18}H_{21}NO_3$	296 95
" Phosphate	$C_{18}H_{21}NO_3H_3PO_4 + 2H_2O$	430.00
" " (anhydrous)	$C_{18}H_{21}NO_3H_3PO_4$	394.24
" Sulphate	$(C_{18}H_{21}NO_3)_2H_2SO_4 + 5H_2O$	780.65
" " (anhydrous)	$(C_{18}H_{21}NO_3)_2H_2SO_4$	691.25
Colchicine	$C_{22}H_{25}NO_6$	396.23
Coniine	$C_8H_{17}N$	126.21
Cresol	$C_6H_4(CH_3)OH$	107.25
Cupric Acetate	$Cu(C_2H_3O_2)_2 + H_2O$	198.14
" " (basic)	$Cu(C_2H_3O_2)_2 + 6H_2O$	366.52
" Ammonium Sulphate	$Cu(NH_3)_4SO_4 + H_2O$	244.05
" Oxide	CuO	78.98
" Sulphate	$CuSO_4 + 5H_2O$	247.85
" " (anhydrous)	$CuSO_4$	158.45
" Sulphide	CuS	94.93
" Tartrate	$CuC_4H_4O_6 + 3H_2O$	263.66
Cuprous Oxide	Cu_2O	142.08
Cyanogen	$(CN)_2$	51.68
Diethylsulphone-dimethyl-methane. (See Sulphonmethane.)		
Diethylsulphone-methyl-ethyl-methane. (See Sulphonethylmethane.)		
Diphenylamine	$(C_6H_5)_2NH$	167.85
Dithymol-diiodide. (See Thymol Iodide.)		
Elaterin	$C_{20}H_{28}O_5$	345.60
Emetine	$C_{15}H_{21}NO_2$	245.34
Ether (Ethyl Oxide)	$(C_2H_5)_2O$	73.52
Ethyl Acetate	$C_2H_5C_2H_3O_2$	87.40
" Carbamate	$C_3H_7NO_2$	88.42

		Mol. Weight
Ethyl Chloride	C_2H_5Cl	64.00
" Hydroxide. (See Alcohol, Ethylic.)		
" Nitrite	$C_2H_5NO_2$	74.51
" Oxide. (See Ether.)		
Eucalyptol (Cineol)	$C_{10}H_{18}O$	152.98
Eugenol	$C_{10}H_{12}O_2$	162.86
Ferric Acetate	$Fe(C_2H_3O_2)_3$	231.24
" Ammonium Sulphate	$FeNH_4(SO_4)_2 + 12H_2O$	478.69
" " " (anhydrous)	$FeNH_4(SO_4)_2$	264.13
" Chloride	$FeCl_3 + 6H_2O$	268.32
" " (anhydrous)	$FeCl_3$	161.04
" Hydroxide	$Fe(OH)_3$	106.14
" Hypophosphite	$Fe(PH_2O_2)_3$	249.09
" Nitrate	$Fe(NO_3)_3$	240.21
" Oxide	Fe_2O_3	158 64
" Phosphate (normal, not U. S. P.)	$Fe(PO_4)$	149.79
" Pyrophosphate (normal, not U. S. P.)	$Fe_4(P_2O_7)_3$	740.10
" Subsulphate (variable).		
" Sulphate. (Tersulphate)	$Fe_2(SO_4)_3$	397.05
" Tersulphate. (See Ferric Sulphate.)		
Ferrous Bromide	$FeBr_2 + 6H_2O$	321.50
" " (anhydrous)	$FeBr_2$	214.22
" Carbonate	$FeCO_3$	115.05
" Iodide	FeI_2	307.30
" Lactate	$Fe(C_3H_5O_3)_2 + 3H_2O$	285.88
" Oxalate	$FeC_2O_4 + H_2O$	160.72
" Sulphate	$FeSO_4 + 7H_2O$	276.01
" " (anhydrous)	$FeSO_4$	150.85
" Sulphide	FeS	87.33
Formaldehyde (Formic Aldehyde)	CH_2O	29.79
Glucose. (See Sugar, Grape.)		
Glycerin	$C_3H_5(OH)_3$	91.37
Glyceryl Trinitrate	$C_3H_5(NO_3)_3$	225.44
Gold Chloride (anhydrous)	$AuCl_3$	301.24
Guaiacol	$C_7H_8O_2$	123.13
" Carbonate	$(C_7H_7O)_2CO_3$	272.05
Heroine Hydrochloride	$C_{17}H_{17}(C_2H_3O_2)_2NOHCl$	402.62
Hexamethylenamine	$C_6H_{12}N_4$	139.18
Hexamethylene Tetramine. (See Hexamethylenamine.)		
Homatropine Hydrobromide	$C_{16}H_{21}NO_3HBr$	353.49
Hydrastine	$C_{21}H_{21}NO_6$	380.32
" Hydrochloride	$C_{21}H_{21}NO_6HCl$	416.50
Hydrastinine Hydrochloride	$C_{11}H_{11}NO_2HCl$	223.88
Hydrogen Dioxide	H_2O_2	33.76
" Sulphide (Hydrosulphuric Acid)	H_2S	33.83
Hyoscine Hydrobromide	$C_{17}H_{21}NO_4HBr + 3H_2O$	434.92
" " (anhydrous)	$C_{17}H_{21}NO_4HBr$	381.28
Hyoscyamine Hydrobromide	$C_{17}H_{23}NO_3HBr$	367.40
" Sulphate	$(C_{17}H_{23}NO_3)_2H_2SO_4$	671.43
Iodeosin (Tetraiodo-fluorescein)	$C_{20}H_8I_4O_5$	829.20
Iodoform	CHI_3	390.61
Iodol (Tetraiodopyrrol)	C_4I_4NH	566.17
Iron Salts. (See under Ferric and Ferrous.)		
Lead Acetate	$Pb(C_2H_3O_2)_2 + 3H_2O$	376.15
" " (anhydrous)	$Pb(C_2H_3O_2)_2$	322.51
" Carbonate	$(PbCO_3)_2Pb(OH)_2$	768.91
" Chloride	$PbCl_2$	275.71
" Chromate	$PbCrO_4$	320.57
" Iodide	PbI_2	457.15
" Nitrate	$Pb(NO_3)_2$	328.49
" Oxide	PbO	221.23
" Subacetate (approximately)	$Pb_2O(C_2H_3O_2)_2$	543.74
" Sulphate	$PbSO_4$	300.70
" Sulphide	PbS	237.18
Lime (Calcium Oxide)	CaO	55.68
Limonene	$C_{10}H_{16}$	135.10
Linalyl Acetate	$C_{10}H_{17}C_2H_3O_2$	194.68
Lithium Benzoate	$LiC_7H_5O_2$	127.11
" Bromide	$LiBr$	86.34
" Carbonate	Li_2CO_3	73.51
" Citrate	$Li_3C_6H_5O_7 + 4H_2O$	280.08
" Phosphate (dried at 100° C.)	Li_3PO_4	115.23
" Salicylate	$LiC_7H_5O_3$	142.99
Magnesia. (See Magnesium Oxide.)		

		Mol. Weight.
Magnesium Carbonate (approximately)	$(MgCO_3)_4Mg(OH)_2 \cdot 5H_2O$	482.26
" " (pure)	$MgCO_3$	83.73
" Lactate	$Mg(C_3H_5O_3)_2$	200.92
" Oxide (Magnesia)	MgO	40.06
" Pyroarsenate	$Mg_2As_2O_7$	308.32
" Pyrophosphate	$Mg_2P_2O_7$	221.06
" Sulphate	$MgSO_4 + 7H_2O$	244.69
" " (anhydrous)	$MgSO_4$	119.53
" Sulphite	$MgSO_3 + 6H_2O$	210.93
Manganese Dioxide	MnO_2	86.36
" Hypophosphite	$Mn(PH_2O_2)_2 + H_2O$	201.54
Manganous Oxide	MnO	70.48
" Sulphate	$MnSO_4 + 4H_2O$	221.47
" " (anhydrous)	$MnSO_4$	149.95
Menthol	$C_{10}H_{19}OH$	154.98
Menthyl Acetate	$C_{10}H_{19}C_2H_3O_2$	196.68
Mercuricammonium Chloride	$HgNH_2Cl$	249.61
Mercuric Chloride	$HgCl_2$	268.86
" Cyanide	$Hg(CN)_2$	250.18
" Iodide	HgI_2	450.30
" Nitrate	$Hg(NO_3)_2 + 4H_2O$	393.16
" " (anhydrous)	$Hg(NO_3)_2$	321.64
" Oxide	HgO	214.38
" Potassium Iodide	$HgI_2 + 2KI$	779.82
" Subsulphate	$Hg(HgO)_2SO_4$	722.61
" Sulphate	$HgSO_4$	293.85
" Sulphide	HgS	230.33
Mercurous Chloride	$HgCl$	233.68
" Iodide	HgI	324.40
" Nitrate	$HgNO_3 + H_2O$	277.95
" Sulphate	Hg_2SO_4	492.35
Methylacetanilide	$C_6H_5N(CH_3)C_2H_3O$	148.00
Methylene Blue. (See Methylthionine Hydrochloride.)		
Methyl-orange (Sodium Dimethylamidoazo-benzene-sulphonate	$NaC_{14}H_4N_3SO_3$	324.88
Methyl Salicylate	$CH_3C_7H_5O_3$	150.92
Methylthionine Hydrochloride (Methylene Blue)	$C_{16}H_{18}N_3SCl$	317.36
Molybdenum Trioxide	MoO_3	142.94
Morphine	$C_{17}H_{19}NO_3 + H_2O$	300.92
" (anhydrous)	$C_{17}H_{19}NO_3$	283.04
" Acetate	$C_{17}H_{19}NO_3C_2H_4O_2 + 3H_2O$	396.26
" Hydrochloride	$C_{17}H_{19}NO_3HCl + 3H_2O$	372.86
" " (anhydrous)	$C_{17}H_{19}NO_3HCl$	319.22
" Sulphate	$(C_{17}H_{19}NO_3)_2H_2SO_4 + 5H_2O$	752.83
" " (anhydrous)	$(C_{17}H_{19}NO_3)_2H_2SO_4$	663.43
Naphthalene	$C_{10}H_8$	127.10
Naphthol (Betanaphthol)	$C_{10}H_7(OH)$	142.98
Naphthylamine Acetate	$C_{10}H_7NH_2HC_2H_3O_2$	201.61
Narceine	$C_{23}H_{23}NO_9$	453.78
Narcotine	$C_{22}H_{23}NO_7$	410.11
Nickelous Bromide	$NiBr + 3H_2O$	266.16
" Oxide	NiO	74.18
" Sulphate	$NiSO_4 + 7H_2O$	278.81
Nicotine	$C_{10}H_{14}N_2$	160.96
Nitrogen Dioxide	NO	29.81
Nitroglycerin. (See Glyceryl Trinitrate.)		
Orthoform	$C_8H_9NO_3$	165.85
Palladous Chloride	$PdCl_2$	176.06
Paracyanogen	$(CN)_3$	77.52
Paraldehyde	$C_6H_{12}O_3$	131.10
Phenacetin	$C_{10}H_{13}NO_2$	177.79
Phenol (Carbolic Acid)	C_6H_5OH	93.34
Phenolphthalein	$C_{20}H_{14}O_4$	315.72
Phenylacetamide. (See Acetanilide.)		
Phenyl Salicylate (Salol)	$C_6H_3C_6H_4OHCO_2$	212.47
Phosphorus Oxychloride	$POCl_3$	152.19
" Pentachloride	PCl_5	206.67
" Trichloride	PCl_3	136.31
Physostigmine	$C_{15}H_{21}N_3O_2$	273.20
" Salicylate	$C_{15}H_{21}N_3O_2C_7H_6O_3$	410.21
" Sulphate	$(C_{15}H_{21}N_3O_2SO_4$	643.75
Picrotoxin	$C_{30}H_{34}O_{13}$	597.74
Pilocarpine	$C_{11}H_{16}N_2O_2$	206.63
" Hydrochloride	$C_{11}H_{16}N_2O_2HCl$	242.81

		Mol. Weight.
Pilocarpine Nitrate	$C_{11}H_{16}N_2O_2HNO_3$	269.20
Piperine	$C_{17}H_{19}NO_3$	283.04
Platinic Chloride	$PtCl_4$	334.02
Potassa. (See Potassium Hydroxide.)		
Potassium Acetate	$KC_2H_3O_2$	97.44
" Arsenite (Metarsenite)	$KAsO_2$	145.02
" Benzoate	$KC_7H_5O_2 + 3H_2O$	212.63
" " (anhydrous)	$KC_7H_5O_2$	158.99
" Bicarbonate	$KHCO_3$	99.41
" Bichromate. (See Dichromate.)		
" Bisulphate	$KHSO_4$	135.21
" Bitartrate	$KHC_4H_4O_6$	186.78
" Bromate	$KBrO_3$	165.86
" Bromide	KBr	118.22
" Carbonate	K_2CO_3	137.27
" Chlorate	$KClO_3$	121.68
" Chloride	KCl	74.04
" Chloroplatinate	K_2PtCl_6	482.10
" Chromate	K_2CrO_4	192.94
" Citrate	$K_3C_6H_5O_7 + H_2O$	322.08
" " (anhydrous)	$K_3C_6H_5O_7$	304.20
" Cyanide	KCN	64.70
" Dichromate	$K_2Cr_2O_7$	292.28
" Ferricyanide	$K_3Fe(CN)_6$	327.12
" Ferrocyanide	$K_4Fe(CN)_6 + 3H_2O$	419.62
" " (anhydrous)	$K_4Fe(CN)_6$	365.98
" Hydroxide (Potassa)	KOH	55.74
" Hypophosphite	KPH_2O_2	103.39
" Iodide	KI	164.76
" Lactate	$KC_3H_5O_3$	127.23
" Nitrate	KNO_3	100.43
" Permanganate	$KMnO_4$	156.98
" Phosphate	K_2HPO_4	173.01
" Salicylate	$KC_7H_5O_3$	174.87
" and Sodium Tartrate	$KNaC_4H_4O_6 + 4H_2O$	280.18
" " " " (anhydrous)	$KNaC_4H_4O_6$	208.66
" Sulphate	K_2SO_4	173.07
" Sulphite	$K_2SO_3 + 2H_2O$	192.95
" " (anhydrous)	K_2SO_3	157.19
" Sulphocyanate	$KSCN$	96.53
" Tartrate	$2K_2C_4H_4O_6 + H_2O$	467.16
" " (anhydrous)	$K_2C_4H_4O_6$	224.64
Propenyl Trinitrate. (See Glyceryl Trinitrate.)		
Pyrogallol	$C_6H_3(OH)_3$	125.10
Quinidine	$C_{20}H_{24}N_2O_2$	321.82
" Sulphate	$(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 2H_2O$	776.75
" " (anhydrous)	$(C_{20}H_{24}N_2O_2)_2H_2SO_4$	740.99
Quinine	$C_{20}H_{24}N_2O_2 + 3H_2O$	375.46
" (anhydrous)	$C_{20}H_{24}N_2O_2$	321.82
" Bisulphate	$C_{20}H_{24}N_2O_2H_2SO_4 + 7H_2O$	544.33
" " (anhydrous)	$C_{20}H_{24}N_2O_2H_2SO_4$	419.17
" Hydrobromide	$C_{20}H_{24}N_2O_2HBr + H_2O$	420.06
" " (anhydrous)	$C_{20}H_{24}N_2O_2HBr$	402.18
" Hydrochloride	$C_{20}H_{24}N_2O_2HCl + 2H_2O$	393.76
" " (anhydrous)	$C_{20}H_{24}N_2O_2HCl$	358.00
" Salicylate	$2C_{20}H_{24}N_2O_2C_7H_6O_3 + H_2O$	935.54
" Sulphate	$(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 7H_2O$	866.15
" " (anhydrous)	$(C_{20}H_{24}N_2O_2)_2H_2SO_4$	740.99
" Valerate (Valerianate)	$C_{20}H_{24}N_2O_2C_5H_{10}O_2 + H_2O$	441.01
Resorcinol (Resorcin)	$C_6H_4(OH)_2$	109.22
Saccharin	$C_6H_4COSO_2NH$	181.77
Safrol	$C_{10}H_{10}O_2$	160.86
Salicin	$C_{13}H_{18}O_7$	289.99
Salol (Phenyl Salicylate)	$C_6H_4OHCO_2C_6H_5$	212.47
Santalol	$C_{15}H_{26}O$	220.53
Santonin	$C_{15}H_{18}O_3$	244.29
Scopolamine Hydrobromide	$C_{17}H_{21}NO_4HBr + 3H_2O$	434.92
" " (anhydrous)	$C_{17}H_{21}NO_4HBr$	381.28
Silica (Silicic Oxide)	SiO_2	59.96
Silver Bromide	$AgBr$	186.48
" Chloride	$AgCl$	142.30
" Cyanide	$AgCN$	132.96
" Iodide	AgI	233.02
" Nitrate	$AgNO_3$	168.69

		Mol. Weight.
Silver Oxide	Ag_2O	230.12
" Sulphate	Ag_2SO_4	309.59
" Sulphide	Ag_2S	246.07
Soda. (See Sodium Hydroxide.)		
Sodium Acetate	$NaC_2H_3O_2 + 3H_2O$	135.10
" " (anhydrous)	$NaC_2H_3O_2$	81.46
" Arsenate	$Na_2HAsO_4 + 7H_2O$	309.84
" " (anhydrous)	Na_2HAsO_4	184.68
" Arsenite (Metarsenite)	$NaAsO_2$	129.04
" Benzoate	$NaC_7H_5O_2$	143.01
" Bicarbonate	$NaHCO_3$	83.43
" Bisulphite	$NaHSO_3$	103.35
" Bitartrate	$NaHC_4H_4O_6 + H_2O$	188.68
" Borate	$Na_2B_4O_7 + 10H_2O$	379.32
" " (anhydrous)	$Na_2B_4O_7$	200.52
" Bromate	$NaBrO_3$	149.88
" Bromide	$NaBr$	102.24
" Carbonate	$Na_2CO_3 + 10H_2O$	284.11
" " (anhydrous)	Na_2CO_3	105.31
" " (monohydrated)	$Na_2CO_3 + H_2O$	123.19
" Chlorate	$NaClO_3$	105.70
" Chloride	$NaCl$	58.06
" Citrate	$2Na_3C_6H_5O_7 + 11H_2O$	709.20
" " (anhydrous)	$Na_3C_6H_5O_7$	256.26
" Cobaltic Nitrite	$Co_2(NO_2)_6 6NaNO_2 + H_2O$	820.56
" Dimethylamidoazo-benzene-sulphonate.	(See Methyl-orange.)	
" Hydroxide (Soda)	$NaOH$	39.76
" Hypophosphite	$NaPH_2O_2 + H_2O$	105.29
" Hyposulphite. (See Thiosulphate.)		
" Iodide	NaI	148.78
" Lactate	$NaC_3H_5O_3$	111.25
" Molybdate	$Na_2MoO_4 + H_2O$	222.46
" Nitrate	$NaNO_3$	84.45
" Nitrite	$NaNO_2$	68.57
" Nitro-prusside	$Na_2Fe(NO)(CN)_5 + 2H_2O$	296.03
" Phenolsulphonate (Sodium Sulphocarbolate)	$NaC_6H_5O_4S + 2H_2O$	230.45
" Phosphate	$Na_2HPO_4 + 12H_2O$	355.61
" " (anhydrous)	Na_2HPO_4	141.05
" Pyrophosphate	$Na_4P_2O_7 + 10H_2O$	443.02
" " (anhydrous)	$Na_4P_2O_7$	264.22
" Salicylate	$NaC_7H_5O_3$	158.89
" Santoninate	$2NaC_{15}H_{19}O_4 + 7H_2O$	693.26
" Sulphate	$Na_2SO_4 + 10H_2O$	319.91
" " (anhydrous)	Na_2SO_4	141.11
" Sulphite	$Na_2SO_3 + 7H_2O$	250.39
" " (anhydrous)	Na_2SO_3	125.23
" Sulphocarbolate. (See Sodium Paraphenolsulphonate.)		
" Tartrate	$Na_2C_4H_4O_6 + 2H_2O$	228.44
" Thiosulphate (Hyposulphite)	$Na_2S_2O_3 + 5H_2O$	246.46
" " (anhydrous)	$Na_2S_2O_3$	157.06
Sparteine Sulphate	$C_{15}H_{26}N_2H_2SO_4 + 5H_2O$	419.26
" " (anhydrous)	$C_{15}H_{26}N_2H_2SO_4$	329.86
Stannic Chloride	$SnCl_4$	258.82
Stannous Chloride	$SnCl_2 + 2H_2O$	224.22
Strontium Bromide	$SrBr_2 + 6H_2O$	352.94
" " (anhydrous)	$SrBr_2$	245.66
" Carbonate	$SrCO_3$	146.49
" Iodide	$SrI_2 + 6H_2O$	446.02
" " (anhydrous)	SrI_2	338.74
" Lactate	$Sr(C_3H_5O_3)_2 + 3H_2O$	317.32
" " (anhydrous)	$Sr(C_3H_5O_3)_2$	263.68
" Nitrate	$Sr(NO_3)_2 + 4H_2O$	281.60
" Salicylate	$Sr(C_7H_5O_3)_2 + 2H_2O$	394.72
" Sulphate	$SrSO_4$	182.29
Strychnine	$C_{21}H_{22}N_2O_2$	331.73
" Nitrate	$C_{21}H_{22}N_2O_2.HNO_3$	394.30
" Sulphate	$(C_{21}H_{22}N_2O_2)_2H_2SO_4 + 5H_2O$	850.21
" " (anhydrous)	$(C_{21}H_{22}N_2O_2)_2H_2SO_4$	760.81
Sugar, Cane	$C_{12}H_{22}O_{11}$	339.60
" Grape	$C_6H_{12}O_6$	178.74
" Milk	$C_{12}H_{22}O_{11} + H_2O$	357.48
Sulphonal	$(CH_3)_2C(SO_2C_2H_5)_2$	226.55

		Mol. Weight.
Sulphonethylmethane (Diethylsulphone-methylethylmethane)	$C_8H_{18}S_2O_4$	240.46
Sulphonmethane Diethylsulphone-dimethylmethane)	$C_7H_{16}S_2O_4$	226.55
Sulphur Dioxide	SO_2	63.59
Terebene	$C_{10}H_{16}$	135.10
Terpin Hydrate	$C_{10}H_{18}(OH)_2 + H_2O$	188.74
Tetraiodo-fluorescein. (See Iodeosin.)		
Tetraiodopyrrol. (See Iodol.)		
Tetramethylthionine Hydrochloride. (See Methylthionine Hydrochloride.)		
Thiosinamine (Allyl-sulphocarbamide)	$(C_3H_5)CH_3N_2S$	115.33
Thymol	$C_{10}H_{14}O$	148.98
" Iodide (Dithymol-diiodide)	$C_{20}H_{24}O_2I_2$	545.76
Tin Salts. (See under Stannic and Stannous.)		
Tungsten Trioxide	WO_3	230.24
Vanillin	$C_8H_8O_3$	150.92
Water	H_2O	17.88
Zinc Acetate	$Zn(C_2H_3O_2)_2 + 2H_2O$	217.82
" " (anhydrous)	$Zn(C_2H_3O_2)_2$	182.06
" Bromide	$ZnBr_2$	223.62
" Carbonate (normal, not U. S. P.)	$ZnCO_3$	124.45
" Chloride	$ZnCl_2$	135.26
" Iodide	ZnI_2	316.70
" Oxide	ZnO	80.78
" Phenolsulphonate (Zinc Sulphocarbolate)	$Zn(C_6H_5O_4S)_2 + 8H_2O$	551.56
" Phosphide	Zn_3P_2	256.24
" Sulphate	$ZnSO_4 + 7H_2O$	285.41
" " (anhydrous)	$ZnSO_4$	160.25
" Sulphide	ZnS	96.73
" Sulphocarbolate. (See Zinc Phenolsulphonate.)		
" Valerate (Valerianate)	$Zn(C_5H_9O_2)_2 + 2H_2O$	301.28

List of Abbreviations Used in the Following Table.

abs. = absolute.	dif. = difference.	sp. gr. = specific gravity.
alc. = alcohol.	frac. = fractional.	vol. = volume.
appt. = apparent.	gal. = gallon.	wt. = weight.
cor. = correction.		

Alcohol Table.

Per cent. vol. abs. alc.[1]	Sp. gr. 15.6° C.[2] / 15.6° C.	Dif. of appt. sp. gr. for 1° C.[3]	Frac. per cent.[4]	Vol. in gal. of 100 lbs. av.[5]	Cor. on foregoing for 0.1 per cent.	No. of gal. official alc. in 100 lbs. av.[5]	Cor. on foregoing for 0.1 per cent.	Wt. in lbs. av. of 1 gal. U. S.[6]	Per cent. by wt. abs. alc.	Sp gr. 15.6° C. / 15.6° C.	Cor. of Sp. gr. for 1° C.[7]
1	0.9985	0.00017	0.067	12.024	0.0018	0.127	0.0127	8.3164	1	0.9981	0.00017
2	0.9970	0.00018	0.071	12.043	0.0017	0.254	0.0127	8.3039	2	0.9963	0.00018
3	0.9956	0.00018	0.071	12.060	0.0017	0.381	0.0128	8.2922	3	0.9945	0.00019
4	0.9942	0.00019	0.071	12.077	0.0017	0.509	0.0128	8.2805	4	0.9928	0.00020
5	0.9928	0.00020	0.077	12.094	0.0016	0.637	0.0128	8.2689	5	0.9912	0.00021
6	0.9915	0.00021	0.077	12.109	0.0015	0.765	0.0129	8.2581	6	0.9896	0.00022
7	0.9902	0.00021	0.083	12.125	0.0015	0.894	0.0129	8.2472	7	0.9881	0.00023
8	0.9890	0.00022	0.083	12.140	0.0015	1.023	0.0129	8.2372	8	0.9867	0.00024
9	0.9878	0.00023	0.083	12.155	0.0015	1.152	0.0130	8.2272	9	0.9853	0.00025
10	0.9866	0.00024	0.091	12.170	0.0014	1.282	0.0130	8.2172	10	0.9839	0.00026

[1] Multiply these figures by 1.0535 for the volume per cent. of official alcohol.

[2] Also approximately the weight in kilogrammes of 1 liter of the spirit.

[3] Add if the temperature is above, subtract if below, 15.6° C. (60° F.). If the temperature is taken in Fahrenheit degrees, multiply these figures by 0.555.

[4] Corresponding with a difference in apparent specific gravity of 0.0001.

[5] For the volume in pints of 100 pounds of the spirit multiply these figures by 8; for the volume in fluidounces, multiply by 128; for the volume in liters, multiply by 3.7854. For the volume of 100 ounces avoirdupois in gallons, divide the figures of the table by 16; for the volume in pints, divide by 2; for the volume in fluidounces, multiply by 8. For the volume of 100 grains in fluidounces, multiply by 0.01829; in minims, by 8.777.

[6] For the weight of 1 gallon in ounces avoirdupois, multiply these figures by 16; in grains, by 7000; in grammes, by 453.59. For the weight of 1 pint in pounds, divide these figures by 8; for the weight of 1 pint in ounces, multiply by 2; in grains, multiply by 875. For the weight of 1 fluidounce in ounces avoirdupois, divide these figures by 8; in grains, multiply by 54.69.

Alcohol Table—*Continued.*

Per cent. vol. abs. alc.[1]	Sp. gr. 15.6° C.[2] / 15.6° C.	Dif. of appt. sp. gr. for 1° C.[3]	Frac. per cent.[4]	Vol. in gal. of 100 lbs. av.[5]	Cor. on foregoing for 0.1 per cent.	No. of gal. official alc. in 100 lbs. av.[5]	Cor. on foregoing for 0.1 per cent.	Wt. in lbs. av. of 1 gal. U. S.[6]	Per cent. by wt. abs. alc.	Sp. gr. 15.6° C. / 15.6° C.	Cor. of sp. gr. for 1° C.[3]
11	0.9855	0.00025	0.091	12.183	0.0013	1.412	0.0130	8.2081	11	0.9826	0.00027
12	0.9844	0.00025	0.091	12.197	0.0014	1.542	0.0130	8.1989	12	0.9813	0.00029
13	0.9833	0.00026	0.091	12.210	0.0013	1.672	0.0131	8.1898	13	0.9800	0.00030
14	0.9822	0.00027	0.091	12.224	0.0013	1.803	0.0131	8.1806	14	0.9788	0.00031
15	0.9811	0.00028	0.100	12.238	0.0013	1.934	0.0131	8.1714	15	0.9776	0.00033
16	0.9801	0.00029	0.100	12.250	0.0013	2.065	0.0131	8.1631	16	0.9764	0.00034
17	0.9791	0.00031	0.100	12.263	0.0013	2.196	0.0132	8.1548	17	0.9752	0.00036
18	0.9781	0.00032	0.100	12.275	0.0012	2.328	0.0132	8.1464	18	0.9740	0.00038
19	0.9771	0.00034	0.100	12.288	0.0013	2.460	0.0132	8.1381	19	0.9727	0.00040
20	0.9761	0.00035	0.100	12.300	0.0013	2.592	0.0132	8.1298	20	0.9715	0.00042
21	0.9751	0.00037	0.100	12.313	0.0012	2.724	0.0133	8.1215	21	0.9703	0.00044
22	0.9741	0.00038	0.091	12.326	0.0013	2.857	0.0133	8.1131	22	0.9690	0.00046
23	0.9730	0.00040	0.100	12.340	0.0013	2.990	0.0133	8.1740	23	0.9677	0.00048
24	0.9720	0.00041	0.100	12.352	0.0014	3.123	0.0134	8.0956	24	0.9663	0.00049
25	0.9710	0.00043	0.091	12.365	0.0013	3.257	0.0134	8.0873	25	0.9649	0.00051
26	0.9699	0.00044	0.091	12.379	0.0014	3.391	0.0134	8.0782	26	0.9635	0.00053
27	0.9688	0.00046	0.091	12.393	0.0014	3.525	0.0135	8.0690	27	0.9621	0.00055
28	0.9677	0.00047	0.091	12.407	0.0015	3.660	0.0135	8.0598	28	0.9606	0.00057
29	0.9666	0.00049	0.083	12.421	0.0015	3.795	0.0136	8.0507	29	0.9590	0.00058
30	0.9654	0.00051	0.083	12.437	0.0015	3.931	0.0136	8.0407	30	0.9574	0.00060
31	0.9642	0.00052	0.083	12.452	0.0016	4.067	0.0136	8.0307	31	0.9558	0.00061
32	0.9630	0.00054	0.077	12.468	0.0017	4.203	0.0137	8.0207	32	0.9542	0.00063
33	0.9617	0.00055	0.077	12.485	0.0017	4.340	0.0138	8.0099	33	0.9524	0.00064
34	0.9604	0.00056	0.077	12.502	0.0017	4.478	0.0138	7.9990	34	0.9507	0.00065
35	0.9591	0.00058	0.071	12.518	0.0018	4.616	0.0139	7.9882	35	0.9489	0.00066
36	0.9577	0.00059	0.071	12.537	0.0018	4.755	0.0139	7.9765	36	0.9471	0.00067
37	0.9563	0.00060	0.071	12.555	0.0019	4.894	0.0140	7.9649	37	0.9452	0.00067
38	0.9549	0.00062	0.067	12.574	0.0020	5.034	0.0140	7.9532	38	0.9433	0.00068
39	0.9534	0.00063	0.067	12.593	0.0020	5.174	0.0141	7.9407	39	0.9414	0.00069
40	0.9519	0.00064	0.063	12.613	0.0021	5.315	0.0142	7.9282	40	0.9394	0.00070
41	0.9503	0.00065	0.063	12.634	0.0021	5.457	0.0143	7.9149	41	0.9374	0.00070
42	0.9487	0.00066	0.059	12.656	0.0022	5.600	0.0143	7.9016	**41.48**	0.9364	0.00071
43	0.9470	0.00067	0.059	12.678	0.0023	5.743	0.0144	7.8874	42	0.9353	0.00071
44	0.9453	0.00068	0.059	12.701	0.0023	5.888	0.0145	7.8733	43	0.9332	0.00072
45	0.9436	0.00069	0.059	12.724	0.0024	6.032	0.0146	7.8591	44	0.9311	0.00072
46	0.9419	0.00069	0.056	12.747	0.0024	6.178	0.0146	7.8449	45	0.9290	0.00073
47	0.9401	0.00070	0.053	12.771	0.0025	6.324	0.0147	7.8300	46	0.9269	0.00073
48	0.9382	0.00070	0.053	12.797	0.0026	6.471	0.0148	7.8141	47	0.9247	0.00074
48.95	0.9364	0.00071	0.053	12.822	0.0026	6.612	0.0148	7.7991	48	0.9225	0.00074
49	9.9363	0.00071	0.053	12.823	0.0026	6.620	0.0148	7.7983	49	0.9203	0.00075
50	9.9344	0.00071	0.053	12.849	0.0027	6.768	0.0150	7.7825	50	0.9181	0.00076
51	0.9324	0.00072	0.050	12.877	0.0028	6.919	0.0150	7.7658	51	0.9159	0.00076
52	0.9304	0.00073	0.050	12.905	0.0029	7.069	0.0152	7.7492	52	0.9137	0.00076
53	0.9284	0.00073	0.050	12.932	0.0028	7.221	0.0152	7.7325	53	0.9114	0.00077
54	0.9264	0.00074	0.047	12.960	0.0029	7.373	0.0154	7.7158	54	0.9092	0.00077
55	0.9243	0.00074	0.047	12.990	0.0030	7.527	0.0154	7.6984	55	0.9069	0.00077
56	0.9222	0.00075	0.045	13.019	0.0031	7.681	0.0156	7.6809	56	0.9047	0.00077
57	0.9200	0.00075	0.045	13.051	0.0031	7.837	0.0156	7.6625	57	0.9024	0.00078
58	0.9178	0.00075	0.045	13.082	0.0032	7.993	0.0158	7.6442	58	0.9002	0.00078
59	0.9156	0.00076	0.045	13.113	0.0032	8.151	0.0158	7.6259	59	0.8979	0.00078
60	0.9134	0.00076	0.045	13.145	0.0032	8.309	0.0160	7.6076	60	0.8956	0.00079
61	0.9111	0.00076	0.043	13.178	0.0033	8.469	0.0160	7.5884	61	0.8934	0.00079
62	0.9089	0.00077	0.043	13.210	0.0033	8.628	0.0162	7.5701	62	0.8910	0.00079
63	0.9066	0.00077	0.043	13.243	0.0033	8.790	0.0162	7.5509	63	0.8887	0.00080
64	0.9043	0.00077	0.043	13.277	0.0034	8.952	0.0163	7.5318	64	0.8863	0.00080
65	0.9020	0.00078	0.042	13.311	0.0035	9.115	0.0165	7.5126	65	0.8839	0.00080

Alcohol Table—*Continued.*

Per cent. vol. abs. alc.[1]	Sp. gr. 15.6° C.[2] / 15°.6 C.	Dif. of appt. sp. gr. for 1° C.[3]	Frac. per cent.[4]	Vol. in gal. of 100 lbs. av.[5]	Cor. on foregoing for 0.1 per cent.	No. of gal. official alc. in 100 lbs. av.[5]	Cor. on foregoing for 0.1 per cent.	Wt. in lbs. av. of 1 gal. U. S.[6]	Per cent. by wt. abs. alc.	Sp. gr. 15.6° C. / 15.6° C.	Cor. of sp. gr. for 0° C.[3]
66	0.8996	0.00078	0.043	13.346	0.0035	9.280	0.0165	7.4926	66	0.8815	0.00080
67	0.8973	0.00078	0.042	13.381	0.0036	9.445	0.0166	7.4735	67	0.8791	0.00080
68	0.8949	0.00079	0.040	13.417	0.0036	9.611	0.0169	7.4535	68	0.8767	0.00081
69	0.8924	0.00079	0.042	13.454	0.0037	9.780	0.0169	7.4327	69	0.8743	0.00081
70	0.8900	0.00079	0.040	13.490	0.0038	9.948	0.0171	7.4127	70	0.8719	0.00081
71	0.8875	0.00079	0.038	13.528	0.0039	10.119	0.0173	7.3919	71	0.8696	0.00081
72	0.8849	0.00080	0.038	13.568	0.0040	10.292	0.0173	7.3702	72	0.8672	0.00081
73	0.8823	0.00080	0.038	13.608	0.0041	10.465	0.0175	7.3485	73	0.8648	0.00081
74	0.8797	0.00080	0.037	13.648	0.0042	10.640	0.0177	7.3269	74	0.8624	0.00081
75	0.8770	0.00081	0.038	13.690	0.0042	10.817	0.0177	7.3044	75	0.8600	0.00081
76	0.8744	0.00081	0.037	13.731	0.0042	10.994	0.0179	7.2827	76	0.8576	0.00081
77	0.8717	0.00081	0.037	13.774	0.0043	11.173	0.0180	7.2603	77	0.8552	0.00081
78	0.8690	0.00081	0.037	13.816	0.0043	11.353	0.0182	7.2378	78	0.8527	0.00080
79	0.8663	0.00081	0.037	13.859	0.0044	11.535	0.0183	7.2153	79	0.8503	0.00080
80	0.8636	0.00081	0.036	13.903	0.0045	11.718	0.0184	7.1928	80	0.8478	0.00080
81	0.8608	0.00081	0.036	13.948	0.0046	11.902	0.0187	7.1695	81	0.8454	0.00080
82	0.8580	0.00081	0.034	13.994	0.0046	12.089	0.0189	7.1462	82	0.8429	0.00080
83	0.8551	0.00080	0.034	14.041	0.0048	12.278	0.0190	7.1220	83	0.8404	0.00080
84	0.8522	0.00080	0.034	14.089	0.0049	12.468	0.0191	7.0978	84	0.8378	0.00080
85	0.8493	0.00080	0.033	14.137	0.0050	12.659	0.0195	7.0737	85	0.8353	0.00080
86	0.8463	0.00080	0.032	14.187	0.0052	12.854	0.0197	7.0487	86	0.8328	0.00080
87	0.8432	0.00080	0.031	14.239	0.0054	13.051	0.0200	7.0229	87	0.8302	0.00080
88	0.8400	0.00080	0.031	14.293	0.0054	13.251	0.0202	6.9962	88	0.8276	0.00080
89	0.8368	0.00080	0.031	14.348	0.0055	13.453	0.0203	6.9696	89	0.8250	0.00080
90	0.8336	0.00080	0.030	14.403	0.0057	13.656	0.0207	6.9429	90	0.8223	0.00080
91	0.8303	0.00080	0.029	14.460	0.0060	13.863	0.0210	6.9154	91	0.8196	0.00080
92	0.8269	0.00080	0.028	14.520	0.0063	14.073	0.0215	6.8871	92	0.8168	0.00080
93	0.8233	0.00080	0.027	14.583	0.0067	14.288	0.0219	6.8571	**92.3**	0.8160	0.00080
94	0.8196	0.00080	0.026	14.649	0.0069	14.507	0.0224	6.8263	93	0.8141	0.00080
94.92	0.8160	0.00080	0.026	14.714	0.0070	14.714	0.0224	6.7963	94	0.8113	0.00080
95	0.8157	0.00080	0.026	14.719	0.0070	14.731	0.0227	6.7938	95	0.8085	0.00080
96	0.8118	0.00080	0.024	14.790	0.0076	14.958	0.0234	6.7614	96	0.8056	0.00080
97	0.8076	0.00080	0.024	14.867	0.0080	15.192	0.0237	6.7264	97	0.8026	0.00080
98	0.8034	0.00080	0.021	14.945	0.0087	15.429	0.0249	6.6914	98	0.7997	0.00080
99	0.7987	0.00080	0.019	15.033	0.0099	15.678	0.0263	6.6523	99	0.7967	0.00080
100	0.7935	0.00080	. .	15.131	. . .	15.941	. . .	6.6089	100	0.7935	0.00080

SPECIFIC GRAVITY OF ALCOHOL AT $\frac{25^\circ\ C.}{25^\circ\ C.}$[1]

Percent. volume absolute alcohol.[2]	Specific gravity.	Percent. weight absolute alcohol.	Specific gravity.	Percent. volume official alcohol.	Specific gravity.
1	0.9985	1	0.9981	1	0.9986
2	0.9970	2	0.9963	2	0.9971
3	0.9955	3	0.9944	3	0.9957
4	0.9940	4	0.9926	4	0.9943
5	0.9926	5	0.9909	5	0.9929
6	0.9912	6	0.9892	6	0.9916
7	0.9898	7	0.9876	7	0.9903
8	0.9885	8	0.9861	8	0.9890
9	0.9872	9	0.9846	9	0.9878
10	0.9860	10	0.9831	10	0.9866
11	0.9848	11	0.9816	11	0.9854
12	0.9836	12	0.9802	12	0.9843
13	0.9825	13	0 9788	13	0.9832
14	0.9813	14	0.9774	14	0.9821
15	0.9801	15	0.9761	15	0.9810
16	0.9790	16	0.9747	16	0.9799
17	0.9778	17	0.9734	17	0.9788
18	0.9767	18	0.9720	18	0.9777
19	0.9756	19	0.9705	19	0.9767
20	0.9744	20	0.9691	20	0.9756
21	0.9733	21	0.9677	21	0.9745
22	0.9721	22	0.9663	22	0.9734
23	0.9709	23	0.9648	23	0.9722
24	0.9697	24	0.9633	24	0.9712
25	0.9685	25	0.9617	25	0.9700
26	0.9673	26	0.9601	26	0.9689
27	0.9660	27	0.9585	27	0.9677
28	0.9648	28	0.9568	28	0.9665
29	0.9635	29	0.9551	29	0.9653
30	0.9622	30	0.9533	30	0.9641
31	0.9608	31	0.9516	31	0.9629
32	0.9594	32	0.9498	32	0.9616
33	0.9580	33	0.9479	33	0.9603
34	0.9566	34	0.9461	34	0.9590
35	0.9552	35	0.9442	35	0.9576
36	0.9537	36	0.9423	36	0.9563
37	0.9521	37	0.9403	37	0.9550
38	0.9506	38	0.9383	38	0.9536
39	0.9490	39	0.9364	39	0.9521
40	0.9474	40	0.9344	40	0.9506
41	0.9457	41	0.9323	41	0.9491
42	0.9440	42	0.9301	42	0.9475
43	0.9422	43	0.9280	43	0.9459
44	0.9404	44	0.9258	44	0.9443
45	0.9386	45	0.9236	45	0.9426
46	0.9368	46	0.9214	46	0.9410
47	0.9350	47	0.9192	47	0.9393
48	0.9331	48	0.9170	48	0.9376
49	0.9311	49	0.9147	49	0.9359
50	0.9291	50	0.9124	50	0.9341
51	0.9271	51	0.9102	51	0.9323
52	0.9250	52	0.9079	52	0.9304
53	0.9230	53	0.9056	53	0.9285
54	0.9209	54	0.9034	54	0.9266
55	0.9187	55	0.9011	55	0.9246

[1] Based upon the figures used by Dr. E. R. Squibb's table.
[2] These volume percentages are strictly accurate only at 15.6° C the standard temperature for alcohol.

SPECIFIC GRAVITY OF ALCOHOL AT $\frac{25° C.}{25° C.}$ — *Continued.*

Percent. volume absolute alcohol.[2]	Specific gravity.	Percent. weight absolute alcohol.	Specific gravity.	Percent. volume official alcohol.	Specific gravity.
56	0.9165	56	0.8988	56	0.9227
57	0.9143	57	0.8965	57	0.9207
58	0.9121	58	0.8943	58	0.9186
59	0.9099	59	0.8920	59	0.9165
60	0.9077	60	0.8897	60	0.9144
61	0.9054	61	0.8874	61	0.9123
62	0.9031	62	0.8850	62	0.9102
63	0.9008	63	0.8826	63	0.9081
64	0.8984	64	0.8802	64	0.9060
65	0.8961	65	0.8778	65	0.9038
66	0.8937	66	0.8754	66	0.9016
67	0.8913	67	9.8730	67	0.8994
68	0.8889	68	0.8705	68	0.8972
69	0.8864	69	0.8681	69	0.8949
70	0.8840	70	0.8657	70	0.8926
71	9.8814	71	0.8634	71	0.8904
72	0.8788	72	0.8610	72	0.8881
73	0.8762	73	0.8586	73	0.8857
74	0.8736	74	0.8562	74	0.8834
75	0.8709	75	9.8538	75	0.8809
76	0.8682	76	0.8514	76	0.8784
77	0.8655	77	0.8490	77	0.8760
78	0.8628	78	0.8465	78	0.8735
79	0.8601	79	0.8441	79	0.8709
80	0.8574	80	0.8416	80	0.8684
81	0.8546	81	0.8392	81	0.8658
82	0.8518	82	0.8367	82	0.8632
83	0.8489	83	0.8342	83	0.8607
84	0.8460	84	0.8316	84	0.8581
85	0.8431	85	0.8291	85	0.8555
86	.08401	86	0.8266	86	0.8528
87	0.8370	87	0.8240	87	0.8501
88	0.8338	88	0.8214	88	0.8474
89	0.8306	89	0.8188	89	0.8446
90	0.8274	90	0.8161	90	0.8418
91	0.8241	91	0.8134	91	0.8389
92	0.8207	92	0.8106	92	0.8359
93	0.8171	92.3	0.8098	93	0.8329
94	0.8134	93	0.8079	94	0.8299
94.9	0.8098	94	0.8051	95	0.8269
95	0.8095	95	0.8023	96	0.8237
96	.08055	96	0.7994	97	0.8204
97	0.8014	97	0.7964	98	0.8170
98	0.7972	98	0.7935	99	0.8135
99	0.7925	99	0.7905	100	0.8098
100	0.7873	100	0.7873		

EQUIVALENTS OF WEIGHTS AND MEASURES, U. S. P.

CUSTOMARY AND METRIC.

The values given in the following tables for the relation of weight to measure apply to water at its greatest density (temperature 4° C. or 39.2° F.) *in vacuo*, and for ordinary purposes may be used without correction. If intended to be applied to liquids having a higher or lower specific gravity than water, the weight in grammes of such liquid must be divided by the specific gravity of the liquid in order to ascertain the volume in cubic centimeters corresponding to the given weight; the customary fluid measure can then be found by reference to the tables. For instance, to find the volume in fluidounces of 875 grammes of official alcohol, divide 875 by 0.816, which yields 1072.30 cubic centimeters, and 1072.30 Cc. of water at 4° C. equal 36.259 fluidounces, for 1000 : 33.814 : : 1072.30 : x. $x = 36.259$; hence 875 Gm. of alcohol U. S. P. measure practically 36.259 fluidounces.

Weights, customary.						Metric Weight and Measure.	Measures, customary.		
Grains.	Troy		Avoirdupois				Fluid		Fluidounces and fractions.
	oz.	grains.	lbs.	oz.	grains.	Gm.] [Cm.	ounces.	minims.	
15432.4	32	72.4	2	3	119.9	**1000**	33	390.6	33.814
15360	**32**	. .	2	3	47.5	995.312	33	314.5	33.655
15060.9	31	180.9	2	. .	185.9	975.932	**33**	. .	**33**
15046.6	31	166.6	2	2	171.6	**975**	32	464.9	32.968
14880	**31**	. .	2	2	5	964.208	32	289.7	32.604
14660.8	30	260.8	2	1	223.3	**950**	32	59.1	32.123
14604.5	30	204.5	2	1	167	946.358	**32**	. .	**32**
14400	**30**	. .	2	. .	400	933.104	31	264.9	31.552
14275	29	350	2	. .	275	**925**	31	133.3	31.278
14148.2	29	228.2	2	. .	148.2	916.785	**31**	. .	**31**
14000	29	80.	**2**	. .	. .	907.185	30	324.2	30.675
13920	**29**	. .	1	15	357.5	902.001	30	240	30.500
13889.1	28	449.1	1	15	326.6	**900**	30	207.6	30.432
13691.8	28	251.8	1	15	129.3	887.211	**30**	. .	**30**
13562.5	28	122.5	**1**	**15**	. .	878.835	29	344.1	29.717
13503.4	28	63.4	1	14	378.4	**875**	29	281.8	29.587
13440	**28**	. .	1	14	315	870.897	29	215.2	29.448
13235.4	27	275.4	1	14	110.4	857.637	**29**	. .	**29**
13125	27	165	**1**	**14**	. .	850.486	28	363.9	28.758
13117.5	27	157.5	1	13	430	**850**	28	356	28.742
12960	**27**	. .	1	13	272.5	839.794	28	190.4	28.397
12779	26	299	1	13	91.5	828.064	**28**	. .	**28**
12731.7	26	251.7	1	13	44.2	**825**	27	430.3	27.896
12687.5	26	207.5	**1**	**13**	. .	822.136	27	383.8	27.800
12480	**26**	. .	1	12	230	808.690	27	165.6	27.345
12345.9	25	345.9	1	12	95.9	**800**	27	24.5	27.051
12322.6	25	322.6	1	12	72.6	798.490	**27**	. .	**27**
12250	25	250	**1**	**12**	. .	793.787	26	403.7	26.841
12000	**25**	. .	1	11	187.5	777.587	26	140.7	26.293
11960.1	24	440.1	1	11	147.6	**775**	26	98.7	26.206
11866.2	24	346.2	1	11	53.7	768.916	**26**	. .	**26**
11812.5	24	292.5	**1**	**11**	. .	765.437	25	423.5	25.882
11574.3	24	54.3	1	10	199.3	**750**	25	173	25.360
11520	**24**	. .	1	10	145	746.483	25	115.9	25.241
11409.8	23	369.8	1	10	34.8	739.343	**25**	. .	**25**
11375	23	335	**1**	**10**	. .	737.088	24	443.4	24.924
11188.5	23	148.5	1	9	251	**725**	24	247.2	24.515
11040	**23**	. .	1	9	102.5	715.380	24	91.1	24.190
10953.4	22	393.4	1	9	15.9	709.769	**24**	. .	**24**
10937.5	22	377.5	**1**	**9**	. .	708.738	23	463.3	23.965
10802.6	22	242.6	1	8	302.6	**700**	23	321.4	23.670
10560	**22**	. .	1	8	60	684.277	23	66.2	23.138
10500	21	420	**1**	**8**	. .	680.389	23	3.1	23.007
10497.0	21	417	1	7	434.5	680.195	**23**	. .	**23**
10416.9	21	336.9	1	7	354.3	**675**	22	395.7	22.824
10080	**21**	. .	1	7	17.5	653.173	22	41.4	22.086
10062.5	20	462.5	**1**	**7**	. .	652.039	22	23.0	22.048
10040.6	20	440.6	1	6	415.6	650.621	**22**	. .	**22**
10031.0	20	431	1	6	406.1	**650**	21	469.9	21.979
9645.2	20	45.3	1	6	20.3	**625**	21	64.1	21.134
9625	20	25	**1**	**6**	. .	623.690	21	42.9	21.089
9600	**20**	. .	1	5	412.5	622.069	21	16.6	21.035
9584.2	19	464.2	1	5	396.7	621.048	**21**	. .	**21**

EQUIVALENTS OF WEIGHTS AND MEASURES.—*Continued.*

Weights, customary.						Metric Weight and Measure.	Measures, customary.		
Grains.	Troy		Avoirdupois				Fluid		Fluidounces and fractions.
	oz.	grains.	lbs.	oz.	grains.	Gm.] [Cm.	ounces.	minims.	
9259.4	19	139.4	1	5	71.9	**600**	20	138.4	20.288
9187.5	19	67.5	**1**	**5**	. .	595.340	20	62 7	20.131
9127.8	19	7.8	1	4	377.8	591.474	**20**	. .	**20**
9120	**19**	. .	1	4	370	590.966	19	471.8	19.983
8873.6	18	233.6	1	4	123.6	**575**	19	212.6	19.443
8750	18	110	**1**	**4**	. .	566.991	19	82.6	19.172
8671.4	18	31.4	1	3	358.9	561.900	**19**	. .	**19**
8640	**18**	. .	1	3	327.5	559.862	18	446.9	18.931
8487.8	17	327.8	1	3	175	**550**	18	286.8	18.598
8312.5	17	152.5	**1**	**3**	. .	538.641	18	102.5	18.214
8215.1	17	55.1	1	2	340.1	532.327	**18**	. .	**18**
8160	**17**	. .	1	2	285	528.759	17	422.1	17.879
8102	16	422	1	2	227	**525**	17	361.1	17.752
7875	16	195.0	**1**	**2**	. .	510.291	17	122.4	17.255
7758.7	16	78.7	1	1	321.2	502.753	**17**	. .	**17**
7716.2	16	36.2	1	1	278.7	**500**	16	435.3	16.907
7680	**16**	. .	1	1	242.5	497.656	16	397.3	16.828
7437.5	15	237.5	**1**	**1**	. .	481.942	16	142.2	16.296
7330.4	15	130.4	1	. .	330.4	**475**	16	29.6	16.062
7302.3	15	102.3	1	. .	302.3	473.179	**16**	. .	**16**
7200	**15**	. .	1	. .	200	466.552	15	372.4	15.776
7000	14	280	**1**	. .	. .	453.592	15	162.1	15.338
6944.6	14	224.6	. .	15	382.1	**450**	15	103.8	15.216
6845.9	14	125.9	. .	15	283.4	443.606	**15**	. .	**15**
6720	**14**	. .	. .	15	157.5	435.449	14	347.6	14.724
6562.4	13	322.5	. .	**15**	. .	425.243	14	182	14.379
6558.8	13	318.8	. .	14	433.8	**425**	14	178.0	14.371
6389.5	13	149.5	. .	14	264.5	414.032	**14**	. .	**14**
6240	**13**	. .	.	14	115	404.345	13	322.8	13.672
6173	12	412.9	. .	14	48	**400**	13	252.3	13.526
6125	12	365	. .	**14**	. .	396.893	13	201.8	13.420
5933.1	12	173.1	. .	13	245.6	384.458	**13**	. .	**13**
5787.2	12	27.2	. .	13	99.7	**375**	12	326.5	12.680
5760	**12**	. .	. .	13	72.5	373.242	12	298	12.621
5687.5	11	407.5	. .	**13**	. .	368.544	12	221.7	12.462
5476.7	11	196.7	. .	12	226.7	354.884	**12**	. .	**12**
5401.3	11	121.3	. .	12	151.3	**350**	11	400.7	11.835
5280	**11**	. .	. .	12	30	342.138	11	273.1	11.569
5250	10	450	. .	**12**	. .	340.194	11	241.6	11.503
5020.3	10	220.3	. .	11	207.8	325.311	**11**	. .	**11**
5015.5	10	215.5	. .	11	203	**325**	10	475	10.989
4812.5	10	12.5	. .	**11**	. .	311.845	10	261.4	10.545
4800	**10**	. .	. .	10	425	311.035	10	248.3	10.517
4629.7	9	399.7	. .	10	254.7	**300**	10	69.2	10.144
4563.9	9	243.9	. .	10	188.9	295.737	**10**	. .	**10**
4375	9	55	. .	**10**	. .	283.495	9	281.3	9.586
4320	**9**	. .	. .	9	382.5	279.931	9	223.5	9.466
4244	8	404	. .	9	306.5	**275**	9	143.4	9.299
4107.5	8	267.5	. .	9	170	266.163	**9**	. .	**9**
3937.5	8	97.5	. .	**9**	. .	255.146	8	301.2	8.627
3858.1	8	18.1	. .	8	358.1	**250**	8	217.7	8.453
3840	**8**	. .	. .	8	340	248.828	8	198.6	8.414
3651.1	7	291.1	. .	8	151.1	236.590	**8**	. .	**8**
3500	7	140	. .	**8**	. .	226.796	7	321.0	7.669
3472.3	7	112.3	. .	7	409.8	**225**	7	291.9	7.608
3360	**7**	. .	. .	7	297.5	217.724	7	173.8	7.362
3194.7	6	314.7	. .	7	132.2	207.016	**7**	. .	**7**

EQUIVALENTS OF WEIGHTS AND MEASURES.—*Continued.*

Weights, customary.						Metric Weight and Measure.	Measures, customary.		
Grains.	Troy		Avoirdupois				Fluid		Fluidounces and fractions.
	oz.	grains.	lbs.	oz.	grains.	Gm.] [Cm.	ounces.	minims.	
3086.5	6	206.5	. .	7	24	**200**	6	366.1	6.763
3062.5	6	182.5	. .	**7**	. .	198.447	6	340.9	6.710
2880	**6**	. .	. .	6	255	186.621	6	149	6.310
2738.4	5	338.4	. .	6	113.4	177.442	**6**	. .	**6**
2700.7	5	300.7	. .	6	75.7	**175**	5	440.4	5.917
2625	5	225	. .	**6**	. .	170.097	5	360.8	5.752
2400	**5**	. .	. .	5	212.5	155.517	5	124.1	5.259
2314.9	4	394.9	. .	5	127.4	**150**	5	34.6	5.072
2282	4	362	. .	5	94.5	147.869	**5**	. .	**5**
2187.5	4	267.5	. .	**5**	. .	141.748	4	380.7	4.793
1929.1	4	9.1	. .	4	179.1	**125**	4	108.8	4.227
1920	**4**	. .	. .	4	170	124.414	4	99.3	4.207
1825.6	4	385.6	. .	4	75.6	118.295	**4**	. .	**4**
1750	3	310	. .	**4**	. .	113.398	3	400.5	3.834
1543.2	3	103.2	. .	3	230.7	**100**	3	183.1	3.382
1440	**3**	. .	. .	3	127.5	93.310	3	74.5	3.155
1388.9	2	428.9	. .	3	76.4	**90**	3	20.8	3.043
1369.2	2	409.2	. .	3	56.7	88.721	**3**	. .	**3**
1312.5	2	352.5	. .	**3**	. .	85.049	2	420.4	2.876
1234.6	2	274.6	. .	2	359.6	**80**	2	338.5	2.705
1157.4	2	197.4	. .	2	282.4	**75**	2	257.3	2.536
1080.3	2	120.3	. .	2	205.3	**70**	2	176.1	2.367
960	**2**	. .	. .	2	85	62.207	2	49.7	2.103
925.9	1	445.9	. .	2	50.9	**60**	2	13.8	2.029
912.8	1	432.8	. .	2	37.8	59.147	**2**	. .	**2**
875	1	395	. .	**2**	. .	56.699	1	440.3	1.917
771.6	1	291.6	. .	1	334.1	**50**	1	331.5	1.691
617.3	1	137.3	. .	1	179.8	**40**	1	169.2	1.353
480	**1**	. .	. .	1	42.5	31.1035	1	24.8	1.052
463	. .	. .	. .	1	25.5	**30**	1	6.9	1.014
456.392	. .	. .	. .	1	18.89	29.5737	**1**	. .	**1**
437.5	. .	. .	. .	**1**	. .	28.350	. .	460.1307	0.959
385.8	. .	. .	. .	. .	. .	**25**	. .	405.8	0.845
308.6	. .	. .	. .	. .	. .	**20**	. .	324.61	0.676
154.3	. .	. .	. .	. .	. .	**10**	. .	162.31	0.338
15.4324	. .	. .	. .	. .	. .	**1**	. .	16.23	0.0338
1	. .	. .	. .	. .	. .	0.06479	. .	1.0517	0.0022
0.9508	. .	. .	. .	. .	. .	0.06161	. .	**1**	0.0021

EQUIVALENTS OF WEIGHTS FROM 480 GRAINS DOWN.

Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims (of Water at 4° C.).	Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims (of Water at 4° C.).
480 [1 ℥	31.103	504.8	**420** [7 ʒ	27.216	441.7
478.4	**31**	503.1	416.7	**27**	438.2
475.4	30.805	**500**	401.2	**26**	422
463.0	**30**	486.9	399.3	25.876	**420**
456.4	29.573	**480**	**390**	25.272	410.2
450	29.160	473.3	385.8	**25**	405.7
447.5	**29**	470.7	380.3	24.644	**400**
437.5 [1 av. oz.	28.350	460.1	370.8	24.028	**390**
432.1	**28**	454.4	370.4	**24**	389.5
427.9	27.725	**450**			

EQUIVALENTS OF WEIGHTS AND MEASURES.—*Continued.*

Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims (of Water at 4° C.).	Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims (of Water at 4° C.).
360 [6 ʒ	23.328	378.6	**60** [1 ʒ	3.888	63.1
354.9	**23**	373.3	57.0	3.697	**60**
342.3	22.180	**360**	**54.69** [⅛ av. oz.	3.544	57.5
339.5	**22**	357.1	47.5	3.081	**50**
330	21.384	347.1	**50**	3.240	52.6
324.1	**21**	340.8	46.3	**3**	48.7
313.8	20.331	**330**	42.8	2.772	**45**
308.6	**20**	324.6	**40**	2.592	42.1
			38.0	2.464	**40**
			33.3	2.156	**35**
			30.9	**2**	32.5
300 [5 ʒ	19.440	315.5	**30** [½ ʒ	1.944	31.55
293.2	**19**	308.4	28.52	1.848	**30**
285.2	18.483	**300**	23.77	1.540	**25**
277.8	**18**	292.2	**20**	1.296	21.0
270	17.496	284.0	19.0	1.232	**20**
262.4	**17**	275.9	15.4324	**1**	16.23
256.7	16.635	**270**			
246.9	**16**	259.7			
240 [4 ʒ	15.552	252.4	**15**	0.972	15.78
231.5	**15**	243.5	14.26	0.924	**15**
228.2	14.786	**240**	**14**	0.907	14.72
218.75 [½ av. oz.	14.175	230.1	13.31	0.863	**14**
216.1	**14**	227.2	**13**	0.842	13.67
210	13.608	220.9	12.36	0.801	**13**
200.6	**13**	211	**12**	0.778	12.62
199.7	12.938	**210**	11.41	0.739	**12**
185.2	**12**	194.8	**11**	0.713	11.57
			10.46	0.678	**11**
180 [3 ʒ	11.664	189.3	**10**	0.648	10.52
171.1	11.090	**180**	9.51	0.616	**10**
169.8	**11**	178.5	**9**	0.583	9.47
154.3	**10**	162.3	8.56	0.554	**9**
150	9.720	157.8	**8**	0.518	8.41
142.6	9.242	**150**	7.71	**0.5**	8.12
138.9	**9**	146.1	7.61	0.493	**8**
123.5	**8**	129.8	**7**	0.454	7.36
			6.66	0.431	**7**
			6	0.389	6.31
			5.7	0.370	**6**
120 [2 ʒ	7.776	126.2	**5**	0.324	5.26
114.1	7.393	**120**	4.75	0.308	**5**
109.37 [¼ av. oz.	7.087	115.0	**4**	0.259	4.21
108.0	**7**	113.6	3.8	0.246	**4**
100	6.480	105.2	**3**	0.194	3.16
95.1	6.161	**100**	2.85	0.185	**3**
92.6	**6**	97.4	**2**	0.130	2.1
80	5.184	84.1	1.9	0.123	**2**
77.2	**5**	81.2	**1**	0.0648	1.0517
76.1	4.929	**80**	0.9508	0.06161	**1**
61.7	**4**	64.9			

EQUIVALENTS OF WEIGHTS AND MEASURES.—*Concluded.*

EQUIVALENTS OF WEIGHTS FROM 5 GRAINS DOWN.

GRAMMES.	Grains		GRAMMES.	Grains	
	in decimal fractions.	in common fractions (approximate).		in decimal fractions.	in common fractions (approximate).
0.324	**5**	**5**	0.0285	0.44	$\frac{7}{16}$
0.291	4.5	$4\frac{1}{2}$	0.0259	0.40	$\frac{2}{5}$
0.259	**4**	**4**	0.0246	0.38	$\frac{3}{8}$
0.226	3.5	$3\frac{1}{2}$	0.0201	0.31	$\frac{5}{16}$
0.194	**3**	**3**	0.0162	0.25	$\frac{1}{4}$
0.162	2.5	$2\frac{1}{2}$	0.0123	0.19	$\frac{3}{16}$
0.130	**2**	**2**	0.0084	0.13	$\frac{1}{8}$
0.097	1.5	$1\frac{1}{2}$	0.0039	0.06	$\frac{1}{16}$
0.065	**1**	**1**	0.0032	0.05	$\frac{1}{20}$
			0.0026	0.04	$\frac{1}{25}$
0.0609	0.94	$\frac{15}{16}$	0.0022	0.033	$\frac{1}{30}$
0.0583	0.90	$\frac{9}{10}$	0.0018	0.028	$\frac{1}{36}$
0.057	0.88	$\frac{7}{8}$	0.0016	0.025	$\frac{1}{40}$
0.0531	0.82	$\frac{13}{16}$	0.0013	0.02	$\frac{1}{50}$
0.0518	0.80	$\frac{4}{5}$	0.0011	0.017	$\frac{1}{60}$
0.0486	0.75	$\frac{3}{4}$	0.001	0.015	$\frac{1}{64}$
0.0447	0.69	$\frac{11}{16}$	0.0006	0.01	$\frac{1}{100}$
0.0408	0.63	$\frac{5}{8}$	0.0005	0.008	$\frac{1}{128}$
0.0363	0.56	$\frac{9}{16}$	0.0004	0.0065	$\frac{1}{150}$
0.0324	**0.5**	$\frac{1}{2}$	0.0003	0.005	$\frac{1}{210}$
			0.0002	0.003	$\frac{1}{320}$
			0.0001	0.0015	$\frac{1}{640}$

Equivalents of Measures of Length.

CUSTOMARY AND METRIC.

CENTIMETERS.	Inches.	CENTIMETERS.	Inches.	MILLIMETERS.	Inches in decimal fractions.	Inches in 32ds.
150	59.06	**55**	21.65	25.4	1.	$\frac{32}{32}$
145	57.09	53.3	**21**	**25**	0.98	
140	55.12	50.8	**20**	24	0.94	
139.7	**55**	**50**	19.69	23.8	0.94	$\frac{30}{32}$
135	53.15	48.3	**19**	23	0.90	$\frac{29}{32}$
130	51.18	45.7	**18**	22.2	0.87	$\frac{28}{32}$
127.0	**50**	**45**	17.72	22	0.87	
125	49.21	43.2	**17**	21	0.83	
120	47.24	40.6	**16**	20.6	0.81	$\frac{26}{32}$
115	45.28	**40**	15.75	**20**	0.79	
114.3	**45**	38.1	**15**	19.1	0.75	$\frac{24}{32}$
110	43.31	35.6	**14**	19	0.75	
105	41.34	**35**	13.78	18	0.71	
101.6	**40**	33.0	**13**	17.5	0.69	$\frac{22}{32}$
100	39.37	30.5	**12**	17	0.67	
99.0	**39**	**30**	11.81	16	0.63	
96.5	**38**	27.9	**11**	15.9	0.62	$\frac{20}{32}$
95	37.40	25.4	**10**	**15**	0.59	
93.9	**37**	**25**	9.84	14.3	0.56	$\frac{18}{32}$
91.4	**36**	22.9	**9**	14	0.55	
90	35.43	20.3	**8**	13	0.51	
88.9	**35**	**20**	7.87	12.7	0.50	$\frac{16}{32}$
86.4	**34**	17.8	**7**	12	0.47	
85	33.46	15.2	**6**	11.1	0.44	$\frac{14}{32}$
83.8	**33**	**15**	5.91	11	0.43	
81.3	**32**	12.7	**5**	**10**	0.39	
80	31.50	10.2	**4**	9.5	0.37	$\frac{12}{32}$
78.7	**31**	**10**	3.94	**9**	0.35	
76.2	**30**	**9**	3.54	8.7	0.34	$\frac{11}{32}$
75	29.53	**8**	3.15	**8**	0.31	
73.6	**29**	7.6	**3**	7.9	0.31	$\frac{10}{32}$
71.1	**28**	**7**	2.76	7.1	0.28	$\frac{9}{32}$
70	27.56	**6**	2.36	**7**	0.28	
68.6	**27**	5.1	**2**	6.4	0.25	$\frac{8}{32}$
66.0	**26**	**5**	1.97	**6**	0.24	
65	25.59	**4**	1.57	5.6	0.22	$\frac{7}{32}$
63.5	**25**	**3**	1.18	**5**	0.20	
61.0	**24**	2.54	**1**	4.8	0.19	$\frac{6}{32}$
60	23.62	**2**	0.78	**4**	0.16	
58.4	**23**	**1**	0.39	3.2	0.13	$\frac{4}{32}$
55.9	**22**			**3**	0.12	
				2.4	0.09	$\frac{3}{32}$
				2	0.08	
				1.6	0.06	$\frac{2}{32}$
				1	0.04	
				0.8	0.03	$\frac{1}{32}$
				0.1	0.0039	

Measures of Length.

METRIC.

	Inches.
1 millimeter (Mm.)	.039370
10 millimeters " = 1 centimeter (Cm.)	.393704
100 " " = 10 centimeters " = 1 decimeter (Dm.)	3.937043
1000 " " = 100 " " = 10 decimeters " = 1 meter (M.)	39.370432
10 meters = 1 dekameter	32 feet 9.7 inches.
100 " = 10 dekameters = 1 hektometer	328 " 1 inch.
1000 " = 100 " = 10 hektometers = 1 kilometer	3280 " 10.4 inches.

1 kilometer = 4 furlongs 213 yards 1 foot 10.43 inches.

10 kilometers = 1 myriameter = 6.2137 miles.

ENGLISH.

1 inch						0.0254 meter.
12 inches	= 1	foot				0.3048 "
36 "	= 3	feet	= 1	yard		0.9144 "
198 "	= 16½	"	= 5½	yards	= 1 rod	5.0292 meters.
220 yards	= 40	rods	= 1	furlong		201.1662 "
1760 "	= 320	"	= 8	furlongs	= 1 mile	1609.3297 "

Measures of Surface.

METRIC.

Hektare	10,000 square meters	= 2.471	acres.
Are	100 "	= 119.6	square yards.
Centare	1 square meter	= 1550	square inches.

TABLE SHOWING THE RELATION OF THE DEGREES OF BAUME'S HYDROMETERS TO SPECIFIC GRAVITIES.

The hydrometers most frequently used in the United States are those constructed upon the plan of Baumé. For liquids *heavier* than water the point to which the instrument sinks in pure water is 0, and the point to which it sinks in a solution of 15 parts of dry table-salt in 85 parts of water is marked 15, the distance between the two points being divided into 15 equal parts, and the scale continued with divisions of the same size. For liquids *lighter* than water the instrument is floated in a solution of 10 parts of dry table-salt in 90 parts of water, and afterward in pure water, the distance being divided into 10 equal parts, and the scale continued in like manner; the point indicating the density of water is marked 10. The hydrometers were originally constructed at a *medium* temperature. In the United States they are made for the temperature of 60° F. (15.55° C.), and the scales as originally published by Henry Pemberton (1852) are recognized. They agree closely with the determinations made by Schober and Pescher for liquids heavier than water, and differ but little for liquids lighter than water.

Cartier's hydrometer, which is occasionally employed in France, agrees with Baumé's scale for liquids lighter than water, except that 16° of the latter are equal to 15° Cartier.

For Liquids Heavier than Water.

Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.
0	1.0000	16	1.1240	32	1.2831	48	1.4949	64	1.7901
1	1.0069	17	1.1328	33	1.2946	49	1.5104	65	1.8125
2	1.0139	18	1.1417	34	1.3063	50	1.5263	66	1.8354
3	1.0211	19	1.1507	35	1.3181	51	1.5425	67	1.8589
4	1.0283	20	1.1600	36	1.3302	52	1.5591	68	1.8831
5	1.0357	21	1.1693	37	1.3425	53	1.5760	69	1.9079
6	1.0431	22	1.1788	38	1.3551	54	1.5934	70	1.9333
7	1.0507	23	1.1885	39	1.3679	55	1.6111	71	1.9595
8	1.0583	24	1.1983	40	1.3809	56	1.6292	72	1.9863
9	1.0661	25	1.2083	41	1.3942	57	1.6477	73	2.0139
10	1.0740	26	1.2184	42	1.4077	58	1.6666	74	2.0422
11	1.0820	27	1.2288	43	1.4215	59	1.6860	75	2.0714
12	1.0902	28	1.2393	44	1.4356	60	1.7058		
13	1.0984	29	1.2500	45	1.4500	61	1.7261		
14	1.1068	30	1.2608	46	1.4646	62	1.7469		
15	1.1153	31	1.2719	47	1.4795	63	1.7682		

For Liquids Lighter than Water.

Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.
10	1.0000	23	0.9150	36	0.8433	49	0.7821	62	0.7290
11	0.9929	24	0.9090	37	0.8383	50	0.7777	63	0.7253
12	0.9859	25	0.9032	38	0.8333	51	0.7734	64	0.7216
13	0.9790	26	0.8974	39	0.8284	52	0.7692	65	0.7179
14	0.9722	27	0.8917	40	0.8235	53	0.7650	66	0.7142
15	0.9655	28	0.8860	41	0.8187	54	0.7608	67	0.7106
16	0.9589	29	0.8805	42	0.8139	55	0.7567	68	0.7070
17	0.9523	30	0.8750	43	0.8092	56	0.7526	69	0.7035
18	0.9459	31	0.8695	44	0.8045	57	0.7486	70	0.7000
19	0.9395	32	0.8641	45	0.8000	58	0.7446	71	0.6965
20	0.9333	33	0.8588	46	0.7954	59	0.7407	72	0.6930
21	0.9271	34	0.8536	47	0.7909	60	0.7368	73	0.6896
22	0.9210	35	0.8484	48	0.7865	61	0.7329	74	0.6863

Relative Value of Wine or Apothecaries' and Imperial Measures.

Wine measure.	Imperial measure. Pints.	Floz.	Fldr.	Minims.	Imperial measure.	Wine measure. Galls.	Pints.	f3.	f3.	Minims.
1 minim	...	...	...	1.04	1 minim	...	...	...	...	0.96
1 fluidrachm	...	...	1	2.5	1 fluidrachm	...	...	...	...	58
1 fluidounce	...	1	0	20.	1 fluidounce	...	...	...	7	41
1 pint	...	16	5	19.	1 pint	...	1	3	1	38
1 gallon	6	13	2	32.	1 gallon	1	1	9	5	4

24 fluidounces wine measure = 25 fluidounces Imperial measure (difference 1 grain).

Approximate Measures.

In Great Britain prescriptions are compounded by weighing the solids and measuring the liquids, and the same course is very generally followed in the United States; but on the continent of Europe weights alone are employed in the making of preparations as well as in the compounding of prescriptions. Medicines are, however, taken by familiar domestic measures, which are subject to considerable variations, but are usually estimated as having the following capacity:

	In the United States.	In France.
A teaspoonful	1 fluidrachm	5 grams of water.
A desertspoonful	2 fluidrachms	10 " " "
A tablespoonful	½ fluidounce	15 " " "
A wineglassful	2 fluidounces	———
A glassful	———	150 grams of water.
A teacupful	4 fluidounces	———
A tumblerful	8 fluidounces	———

The approximate measures by the *handful* (Fr. *poignée*) and pinch (Fr. *pincée*) are almost completely discarded, or employed only for the least active drugs.

The measuring of small quantities of liquids by drops gives very uncertain and variable results, which are influenced by the viscidity of the liquid, the size, shape, and fulness of the vessel, the curvature of the lip, the temperature, the rapidity of dropping, and probably by other circumstances. As a rule, it may be said that aqueous liquids yield larger drops than those containing little or no water; but very different results are obtained with the same liquid dropped from different bottles, or even from the same bottle under different conditions; the differences amount frequently to 50, and occasionally to 200, per cent. For these reasons medicated liquids should not be ordered in drops, but preferably by weight or measure; and whenever it is desirable for the patient to take a medicine by drops, the dose may be approximated by estimating each minim to contain of—

Ether and ethereal solutions	2½ to 3 drops.
Tinctures, alcoholic solutions, and volatile oils	1½ to 2 or 2½ drops.
Medicated wines	1 to 1½ drops.
Water and aqueous solutions	¾ to 1 drop.

In order to avoid to some extent the discrepancies resulting from the dropping of liquids under various conditions, dropping-measures (*compte-gouttes*) have been constructed in France, yielding at 15° C. drops of distilled water, 20 of which weigh 1 Gm.. at least within a limit of 2 per cent. The French Codex gives a table containing the weight of 1 drop, and the number of drops for 1 Gm. of various liquids, dropped under the conditions stated, which may be summarized as follows:

Number of drops	for 1 Gm. of the following liquids:
20	Hydrocyanic acid, Diluted sulphuric acid, Aqueous solutions of the salts of metals and the alkaloids.
21–26	Mineral acids, Ammonia-water, Glycerin, Fowler's solution, Vinegars.
31	Solution of chloral (⅕).
33	Wine (Grenache) and medicated wines.
43	Creasote.
48	Fixed oils.
50–57	Glacial acetic acid, Carbolic acid (alcoholic solution), Alcohol (sp. gr. .864 and over), Chloroform, Volatile oils, Tinctures, Spirit of nitrous ether.
61	Alcohol (sp. gr. .834), Tincture of iodine.
72	Spirit of ether.
90	Ether.

TABLES OF WEIGHTS AND MEASURES.

Apothecaries' or Troy Weight, U. S.

One pound,	℔	= 12 troyounces	= 5760 grains	= 13 ounces avoirdupois	72.5 grains.
One troyounce,	℥	= 8 drachms	= 480 "	= 1 ounce "	42.5 "
One drachm,	ʒ	= 3 scruples	= 60 "		
One scruple,	℈		= 20 "		
One grain,	gr.		= 1 grain.		

Apothecaries' or Wine Measure, U. S.

						Cubic inches.	Troy grains of water at 60° F.
1 minim, ♏						0.00376	0.95
60 minims =	1 fluidrachm, ʒ					0.2256	56.96
480 " =	8 fluidrachms =	1 fluidounce, f℥				1.8047	455.69
7680 " =	128 " =	16 fluidounces =	1 pint, O			28.875	7291.11
61440 " =	1024 " =	128 " =	8 pts. = 1 gal., Cong.			231.	58328.88

Weights and Measures of the British Pharmacopœia.

One pound,	℔	= 16 ounces	= 7000 troy grains	= ℔i ℥ij ʒiv gr. xl.
One ounce,	oz.	= 437.5 "	=	℥vij gr. xvijss.
One grain,	gr.	= 1 grain.		

The pound and ounce of the British Pharmacopœia are identical with the same denominations of *avoirdupois weight*. The avoirdupois ounce is subdivided into 16 drachms (1 drachm = 27.34 troy grains); but the British Pharmacopœia recognizes no subdivisions between the ounce and grain. It is, however, optional with the physician *in prescribing* to use the symbols ℈ and ʒ, the former representing 20 and the latter 60 grains, if such be found to conduce to accuracy or convenience.

						Troy grains.	Avoirdupois.
1 minim, *min.*						0.91	
60 minims =	1 fluidrachm, *fdr.*					54.7	
480 " =	8 fluidrachms =	1 fluidounce, *foz.*				437.5 =	1 ounce.
9600 " =	160 " =	20 fluid ozs. =	1 pint, O			8750. =	1.25 pound.
76800 " =	1280 " =	160 " =	8 pints =	70000. =	10 pounds.		

Metric Weights and Measures.

				Troy weight.
1 milligram (Mgm.) =	0.001 gram (Gm.)			.015 grain.
10 milligrams =	1 centigram (Cgm.) =	0.010 gram (Gm.)		.154 "
100 " =	10 centigrams " =	1 decigram (Dgm.) =	0.100 gram (Gm.)	1.543 "
1000 " =	100 " " =	10 decigrams " =	1.000 "	15.432 "

				Troy grains.	Av. weight.
1 gram (weight of 1 cubic centimeter of water at 40° C.).					
10 grams =	1 dekagram			154.323	.3527 ounce.
100 " =	10 dekagrams =	1 hektogram		1543.235	3.5274 ounces.
1000 " =	100 " =	10 hektograms =	1 kilogram (Kgm.).	15432.350	35.274 "
10 kilograms =	1 myriagram =	22.046 lb. av.			
100 " =	1 quintal =	220.46 "			
1000 " =	1 millier or tonnean =	2204.6 "			

				Apothecaries' measure.
1 milliliter (or 1 cubic centimeter, Ccm.)	= 0.001 liter			16.23 minims.
10 milliliters =	1 centiliter =	0.010 "		2.71 fluidrachms.
100 " =	10 centiliters =	1 deciliter =	0.100 liter	3.38 fluidounces.
1000 " =	100 " =	10 deciliters =	1.000 "	33.81 "

				Wine measure.
1 liter (or 1 cubic decimeter)				1.0567 quarts.
10 liters =	1 dekaliter			2.6417 gallons.
100 " =	10 dekaliters =	1 hektoliter		26.417 "
1000 " =	100 " =	10 hektoliters =	1 kiloliter or stere	264.17 "

The unit of all metric measures is the *meter* (French, *mètre*), and this is the ten-millionth part of the quadrant or fourth part of the terrestrial meridian, the quadrant being the distance from the equator to the pole. The cube of the tenth part of a meter, denominated *liter* (Fr. *litre*), was adopted as the unit of measures of capacity. The weight of the one-thousandth part of a liter of distilled water at its greatest density (4° C.) was denominated *gram* (Fr. *gramme*), and adopted as the unit of weight. The subdivisions of all measures are named by prefixing to the name of the unit the Latin numerals *deci* (.1), *centi* (.01), and *milli* (.001), and the larger denominations by prefixing the Greek numerals *deka* (10), *hekto* (100), *kilo* (1000), and *myria* (10000).

TABLE OF WEIGHT AND VOLUME RELATIONS.

Specific gravity apparent 25° C. 25° C.	Specific volume (volume of 1 kilogramme in liters).[1]	Weight of 1 U. S. gallon in pounds avoirdupois.[2]	Weight of 100 fluid-ounces in ounces avoirdupois.	Weight of 1 fluidounce in grains.	Volume in U. S. gallons of 100 pounds avoirdupois.[3]	Volume in fluidounces of 100 ounces avoirdupois.	Volume in fluidounces of 1000 grains.
0.700	1.4286	5.819	72.74	318.2	17.185	137.48	3.143
0.710	1.4085	5.902	73.78	322.8	16.943	135.54	3.099
0.720	1.3889	5.985	74.82	327.3	16.707	133.66	3.056
0.730	1.3699	6.068	75.85	331.9	16.479	131.83	3.014
0.740	1.3514	6.151	76.89	336.4	16.256	130.05	2.973
0.750	1.3333	6.235	77.93	341.0	16.039	128.31	2.933
0.760	1.3158	6.318	78.97	345.5	15.828	126.62	2.894
0.770	1.2987	6.401	80.01	350.0	15.623	124.98	2.857
0.780	1.2821	6.484	81.05	354.6	15.422	123.38	2.820
0.790	1.2658	6.567	82.09	359.1	15.227	121.82	2.784
0.800	1.2500	6.650	83.13	363.7	15.037	120.30	2.750
0.810	1.2346	6.733	84.17	368.2	14.851	118.81	2.716
0.820	1.2195	6.817	85.21	372.8	14.670	117.36	2.683
0.830	1.2049	6.900	86.25	377.3	14.494	115.95	2.651
0.840	1.1905	6.983	87.28	381.9	14.321	114.57	2.619
0.850	1.1765	7.066	88.32	386.4	14.152	113.22	2.588
0.860	1.1628	7.149	89.36	391.0	13.988	111.90	2.558
0.870	1.1494	7.232	90.40	395.5	13.827	110.62	2.528
0.880	1.1364	7.315	91.44	400.1	13.670	109.36	2.500
0.890	1.1236	7.398	92.48	404.6	13.516	108.13	2.472
0.900	1.1111	7.481	93.52	409.1	13.366	106.93	2.444
0.910	1.0989	7.565	94.56	413.7	13.219	105.75	2.417
0.920	1.0870	7.648	95.60	418.2	13.075	104.60	2.391
0.930	1.0753	7.731	96.64	422.8	12.935	103.48	2.365
0.940	1.0638	7.814	97.68	427.3	12.797	102.38	2.340
0.950	1.0526	7.897	98.71	431.9	12.663	101.30	2.315
0.960	1.0417	7.980	99.75	436.4	12.531	100.25	2.291
0.970	1.0309	8.063	100.79	441.0	12.401	99.21	2.268
0.980	1.0204	8.147	101.83	445.5	12.275	98.20	2.245
0.990	1.0101	8.230	102.87	450.1	12.151	97.21	2.222
1.00	1.0000	8.313	103.91	454.6	12.029	96.23	2.200
1.02	0.9804	8.479	105.99	463.7	11.794	94.35	2.157
1.04	0.9615	8.645	108.07	472.8	11.567	92.54	2.115
1.06	0.9434	8.812	110.15	481.9	11.348	90.78	2.075
1.08	0.9259	8.978	112.22	491.0	11.138	89.10	2.037
1.10	0.9091	9.144	114.30	500.1	10.936	87.49	2.000
1.12	0.8929	9.310	116.38	509.2	10.741	85.93	1.964
1.14	0.8772	9.477	118.46	518.3	10.552	84.42	1.930
1.16	0.8621	9.643	120.54	527.4	10.370	82.96	1.897
1.18	0.8475	9.809	122.61	536.4	10.194	81.55	1.865
1.20	0.8333	9.975	124.69	545.5	10.025	80.20	1.833
1.22	0.8197	10.142	126.77	554.6	9.860	78.88	1.803
1.24	0.8065	10.308	128.85	563.7	9.701	77.61	1.774
1.26	0.7937	10.474	130.93	572.8	9.547	76.38	1.746
1.28	0.7823	10.640	133.01	581.9	9.398	75.18	1.719
1.30	0.7692	10.807	135.08	591.0	9.253	74.02	1.692
1.32	0.7576	10.973	137.16	600.1	9.113	72.90	1.667
1.34	0.7463	11.139	139.24	609.2	8.977	71.82	1.642
1.36	0.7353	11.305	141.32	618.3	8.845	70.76	1.618
1.38	0.7246	11.472	143.40	627.4	8.717	69.74	1.594

[1] Or of one gramme in cubic centimeters; strictly true only at 0° C. in vacuo.
[2] Multiply these figures by 2 for weight of one U. S. pint in ounces avoirdupois.
[3] Divide these figures by 2 for volume in pints of 100 ounces avoirdupois.

TABLE OF WEIGHT AND VOLUME RELATIONS.—Continued.

Specific gravity apparent 25° C. 25° C.	Specific volume (volume of 1 kilogramme in liters).	Weight of 1 U. S. gallon in pounds avoirdupois.	Weight of 100 fluid-ounces in ounces avoirdupois.	Weight of 1 fluidouuce in grains.	Volume in U. S. gallons of 100 pounds avoirdupois.	Volume in fluidounces of 100 ounces avoirdupois.	Volume in fluidounces of 1000 grains.
1.40	0.7143	11.638	145.47	636.4	8.592	68.74	1.571
1.42	0.7042	11.804	147.55	645.5	8.471	67.77	1.549
1.44	0.6944	11.970	149.63	654.6	8.354	66.83	1.528
1.46	0.6849	12.137	151.71	663.7	8.239	65.91	1.507
1.48	0.6757	12.303	153.79	672.8	8.128	65.02	1.486
1.50	0.6667	12.469	155.87	681.9	8.020	64.16	1.466
1.52	0.6579	12.635	157.94	691.0	7.914	63.31	1.447
1.54	0.6494	12.802	160.02	700.1	7.811	62.49	1.428
1.56	0.6410	12.968	162.10	709.2	7.711	61.69	1.410
1.58	0.6329	13.134	164.18	718.3	7.614	60.91	1.392
1.60	0.6250	13.300	166.26	727.4	7.519	60.14	1.375
1.62	0.6173	13.467	168.33	736.5	7.426	59.41	1.358
1.64	0.6098	13.633	170.41	745.6	7.335	58.69	1.341
1.66	0.6025	13.799	172.49	754.6	7.247	57.98	1.325
1.68	0.5952	13.966	174.57	763.7	7.160	57.28	1.309
1.70	0.5882	14.132	176.65	772.8	7.076	56.61	1.294
1.72	0.5814	14.298	178.73	781.9	6.994	55.95	1.279
1.74	0.5747	14.464	180.80	791.0	6.913	55 31	1.264
1.76	0.5682	14.631	182.88	800.1	6.835	54.68	1.250
1.78	0.5618	14.797	184.96	809.2	6.758	54.06	1.236
1.80	0.5556	14.963	187.04	818.3	6.683	53.46	1.222
1.82	0.5495	15.129	189.12	827.4	6.610	52.88	1.209
1.84	0.5435	15.296	191.19	836.5	6.538	52.31	1.196
1.86	0.5376	15.462	193.27	845.6	6.467	51.74	1.183
1.88	0.5319	15.628	195.35	854.7	6.399	51.19	1.170
1.90	0.5263	15.794	197.43	863.8	6.331	50.65	1.158
1.92	0.5208	15.961	199.51	872.8	6.265	50.12	1.146
1.94	0.5155	16.127	201.59	881.9	6.201	49.61	1.134
1.96	0.5102	16.293	203.66	891.0	6.137	49.10	1.122
1.98	0.5051	16.459	205.74	900.1	6.075	48.60	1.111
2.00	0.5000	16.626	207.82	909.2	6.015	48.12	1.100

TABLE OF THERMOMETRIC EQUIVALENTS.

ACCORDING TO THE CENTIGRADE AND FAHRENHEIT SCALES.

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
—40	—40	—14.4444	6	5.5556	42	30.5556	87
—39.4444	—39	—14	6.8	6	42.8	31	87.8
—39	—38.2	—13.8889	7	6.1111	43	31.1111	88
—38.8889	—38	—13.3333	8	6.6667	44	31.6667	89
—38.3333	—37	—13	8.6	7	44.6	32	89.6
—38	—36.4	—12.7778	9	7.2222	45	32.2222	90
—37.7778	—36	—12.2222	10	7.7778	46	32.7778	91
—37.2222	—35	—12	10.4	8	46.4	33	91.4
—37	—34.6	—11.6667	11	8.3333	47	33.3333	92
—36.6667	—34	—11.1111	12	8.8889	48	33.8889	93
—36.1111	—33	—11	12.2	9	48.2	34	93.2
—36	—32.8	—10.5556	13	9.4444	49	34.4444	94
—35.5556	—32	—10	14	10	50	35	95
—35	—31						
—34.4444	—30	—9.4444	15	10.5556	51	35.5556	96
—34	—29.2	—9	15.8	11	51.8	36	96.8
—33.8889	—29	—8.8889	16	11.1111	52	36.1111	97
—33.3333	—28	—8.3333	17	11.6667	53	36.6667	98
—33	—27.4	—8	17.6	12	53.6	37	98.6
—32.7778	—27	—7.7778	18	12.2222	54	37.2222	99
—32.2222	—26	—7.2222	19	12.7778	55	37.7778	100
—32	—25.6	—7	19.4	13	55.4	38	100.4
—31.6667	—25	—6.6667	20	13.3333	56	38.3333	101
—31.1111	—24	—6.1111	21	13.8889	57	38.8889	102
—31	—23.8	—6	21.2	14	57.2	39	102.2
—30.5556	—23	—5.5556	22	14.4444	58	39.4444	103
—30	—22	—5	23	15	59	40	104
—29.4444	—21	—4.4444	24	15.5556	60	40.5556	105
—29	—20.2	—4	24.8	16	60.8	41	105.8
—28.8889	—20	—3.8889	25	16.1111	61	41.1111	106
—28.3333	—19	—3.3333	26	16.6667	62	41.6667	107
—28	—18.4	—3	26.6	17	62.6	42	107.6
—27.7778	—18	—2.7778	27	17.2222	63	42.2222	108
—27.2222	—17	—2.2222	28	17.7778	64	42.7778	109
—27	—16.6	—2	28.4	18	64.4	43	109.4
—26.6667	—16	—1.6667	29	18.3333	65	43.3333	110
—26.1111	—15	—1.1111	30	18.8889	66	43.8889	111
—26	—14.8	—1	30.2	19	66.2	44	111.2
—25.5556	—14	—0.5556	31	19.4444	67	44.4444	112
—25	—13	0	32	20	68	45	113
—24.4444	—12			20.5556	69	45.5556	114
—24	—11.2			21	69.8	46	114.8
—23.8889	—11			21.1111	70	46.1111	115
—23.3333	—10			21.6667	71	46.6667	116
—23	—9.4			22	71.6	47	116.6
—22.7778	—9			22.2222	72	47.2222	117
—22.2222	—8			22.7778	73	47.7778	118
—22	—7.6			23	73.4	48	118.4
—21.6667	—7			23.3333	74	48.3333	119
—21.1111	—6			23.8889	75	48.8889	120
—21	—5.8			24	75.2	49	120.2
—20.5556	—5			24.4444	76	49.4444	121
—20	—4			25	77	50	122
—19.4444	—3	0.5556	33	25.5556	78	50.5556	123
—19	—2.2	1	33.8	26	78.8	51	123.8
—18.8889	—2	1.1111	34	26.1111	79	51.1111	124
—18.3333	—1	1.6667	35	26.6667	80	51.6667	125
—18	—0.4	2	35.6	27	80.6	52	125.6
—17.7778	0	2.2222	36	27.2222	81	52.2222	126
—17.2222	1	2.7778	37	27.7778	82	52.7778	127
—17	1.4	3	37.4	28	82.4	53	127.4
—16.6667	2	3.3333	38	28.3333	83	53.3333	128
—16.1111	3	3.8889	39	28.8889	84	53.8889	129
—16	3.2	4	39.2	29	84.2	54	129.2
—15.5556	4	4.4444	40	29.4444	85	54.4444	130
—15	5	5	41	30	86	55	131

TABLE OF THERMOMETRIC EQUIVALENTS.—*Continued.*

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
55.5556	132	80.5556	177	105.5556	222	130.5556	267
56	132.8	81	177.8	106	222.8	131	267.8
56.1111	133	81.1111	178	106.1111	223	131.1111	268
56.6667	134	81.6667	179	106.6667	224	131.6667	269
57	134.6	82	179.6	107	224.6	132	269.6
57.2222	135	82.2222	180	107.2222	225	132.2222	270
57.7778	136	82.7778	181	107.7778	226	132.7778	271
58	136.4	83	181.4	108	226.4	133	271.4
58.3333	137	83.3333	182	108.3333	227	133.3333	272
58.8889	138	83.8889	183	108.8889	228	133.8889	273
59	138.2	84	183.2	109	228.2	134	273.2
59.4444	139	84.4444	184	109.4444	229	134.4444	274
60	140	85	185	110	230	135	275
60.5556	141	85.5556	186	110.5556	231	135.5556	276
61	141.8	86	186.8	111	231.8	136	276.8
61.1111	142	86.1111	187	111.1111	232	136.1111	277
61.6667	143	86.6667	188	111.6667	233	136.6667	278
62	143.6	87	188.6	112	233.6	137	278.6
62.2222	144	87.2222	189	112.2222	234	137.2222	279
62.7778	145	87.7778	190	112.7778	235	137.7778	280
63	145.4	88	190.4	113	235.4	138	280.4
63.3333	146	88.3333	191	113.3333	236	138.3333	281
63.8889	147	88.8889	192	113.8889	237	138.8889	282
64	147.2	89	192.2	114	237.2	139	282.2
64.4444	148	89.4444	193	114.4444	238	139.4444	283
65	149	90	194	115	239	140	284
65.5556	150	90.5556	195	115.5556	240	140.5556	285
66	150.8	91	195.8	116	240.8	141	285.8
66.1111	151	91.1111	196	116.1111	241	141.1111	286
66.6667	152	91.6667	197	116.6667	242	141.6667	287
67	152.6	92	197.6	117	242.6	142	287.6
67.2222	153	92.2222	198	117.2222	243	142.2222	288
67.7778	154	92.7778	199	117.7778	244	142.7778	289
68	154.4	93	199.4	118	244.4	143	289.4
68.3333	155	93.3333	200	118.3333	245	143.3333	290
68.8889	156	93.8889	201	118.8889	246	143.8889	291
69	156.2	94	201.2	119	246.2	144	291.2
69.4444	157	94.4444	202	119.4444	247	144.4444	292
70	158	95	203	120	248	145	293
70.5556	159	95.5556	204	120.5556	249	145.5556	294
71	159.8	96	204.8	121	249.8	146	294.8
71.1111	160	96.1111	205	121.1111	250	146.1111	295
71.6667	161	96.6667	206	121.6667	251	146.6667	296
72	161.6	97	206.6	122	251.6	147	296.6
72.2222	162	97.2222	207	122.2222	252	147.2222	297
72.7778	163	97.7778	208	122.7778	253	147.7778	298
73	163.4	98	208.4	123	253.4	148	298.4
73.3333	164	98.3333	209	123.3333	254	148.3333	299
73.8889	165	98.8889	210	123.8889	255	148.8889	300
74	165.2	99	210.2	124	255.2	149	300.2
74.4444	166	99.4444	211	124.4444	256	149.4444	301
75	167	100	212	125	257	150	302
75.5556	168	100.5556	213	125.5556	258	150.5556	303
76	168.8	101	213.8	126	258.8	151	303.8
76.1111	169	101.1111	214	126.1111	259	151.1111	304
76.6667	170	101.6667	215	126.6667	260	151.6667	305
77	170.6	102	215.6	127	260.6	152	305.6
77.2222	171	102.2222	216	127.2222	261	152.2222	306
77.7778	172	102.7778	217	127.7778	262	152.7778	307
78	172.4	103	217.4	128	262.4	153	307.4
78.3333	173	103.3333	218	128.3333	263	153.3333	308
78.8889	174	103.8889	219	128.8889	264	153.8889	309
79	174.2	104	219.2	129	264.2	154	309.2
79.4444	175	104.4444	220	129.4444	265	154.4444	310
80	176	105	221	130	266	155	311

TABLE OF THERMOMETRIC EQUIVALENTS.—*Continued.*

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
155.5556	**312**	180.5556	**357**	205.5556	**402**	230.5556	**447**
156	312.8	**181**	357.8	**206**	402.8	**231**	447.8
156.1111	**313**	181.1111	**358**	206.1111	**403**	231.1111	**448**
156.6667	**314**	181.6667	**359**	206.6667	**404**	231.6667	**449**
157	314.6	**182**	359.6	**207**	404.6	**232**	449.6
157.2222	**315**	182.2222	**360**	207.2222	**405**	232.2222	**450**
157.7778	**316**	182.7778	**361**	207.7778	**406**	232.7778	**451**
158	316.4	**183**	361.4	**208**	406.4	**233**	451.4
158.3333	**317**	183.3333	**362**	208.3333	**407**	233.3333	**452**
158.8889	**318**	183.8889	**363**	208.8889	**408**	233.8889	**453**
159	318.2	**184**	363.2	**209**	408.2	**234**	453.2
159.4444	**319**	184.4444	**364**	209.4444	**409**	234.4444	**454**
160	**320**	**185**	**365**	**210**	**410**	**235**	**455**
160.5556	**321**	185.5556	**366**	210.5556	**411**	235.5556	**456**
161	321.8	**186**	366.8	**211**	411.8	**236**	456.8
161.1111	**322**	186.1111	**367**	211.1111	**412**	236.1111	**457**
161.6667	**323**	186.6667	**368**	211.6667	**413**	236.6667	**458**
162	323.6	**187**	368.6	**212**	413.6	**237**	458.6
162.2222	**324**	187.2222	**369**	212.2222	**414**	237.2222	**459**
162.7778	**325**	187.7778	**370**	212.7778	**415**	237.7778	**460**
163	325.4	**188**	370.4	**213**	415.4	**238**	460.4
163.3333	**326**	188.3333	**371**	213.3333	**416**	238.3333	**461**
163.8889	**327**	188.8889	**372**	213.8889	**417**	238.8889	**462**
164	327.2	**189**	372.2	**214**	417.2	**239**	462.2
164.4444	**328**	189.4444	**373**	214.4444	**418**	239.4444	**463**
165	**329**	**190**	**374**	**215**	**419**	**240**	**464**
165.5556	**330**	190.5556	**375**	215.5556	**420**	240.5556	**465**
166	330.8	**191**	375.8	**216**	420.8	**241**	465.8
166.1111	**331**	191.1111	**376**	216.1111	**421**	241.1111	**466**
166.6667	**332**	191.6667	**377**	216.6667	**422**	241.6667	**467**
167	332.6	**192**	377.6	**217**	422.6	**242**	467.6
167.2222	**333**	192.2222	**378**	217.2222	**423**	242.2222	**468**
167.7778	**334**	192.7778	**379**	217.7778	**424**	242.7778	**469**
168	334.4	**193**	379.4	**218**	424.4	**243**	469.4
168.3333	**335**	193.3333	**380**	218.3333	**425**	243.3333	**470**
168.8889	**336**	193.8889	**381**	218.8889	**426**	243.8889	**471**
169	336.2	**194**	381.2	**219**	426.2	**244**	471.2
169.4444	**337**	194.4444	**382**	219.4444	**427**	244.4444	**472**
170	**338**	**195**	**383**	**220**	**428**	**245**	**473**
170.5556	**339**	195.5556	**384**	220.5556	**429**	245.5556	**474**
171	339.8	**196**	384.8	**221**	429.8	**246**	474.8
171.1111	**340**	196.1111	**385**	221.1111	**430**	246.1111	**475**
171.6667	**341**	196.6667	**386**	221.6667	**431**	246.6667	**476**
172	341.6	**197**	386.6	**222**	431.6	**247**	476.6
172.2222	**342**	197.2222	**387**	222.2222	**432**	247.2222	**477**
172.7778	**343**	197.7778	**388**	222.7778	**433**	247.7778	**478**
173	343.4	**198**	388.4	**223**	433.4	**248**	478.4
173.3333	**344**	198.3333	**389**	223.3333	**434**	248.3333	**479**
173.8889	**345**	198.8889	**390**	223.8889	**435**	248.8889	**480**
174	345.2	**199**	390.2	**224**	435.2	**249**	480.2
174.4444	**346**	199.4444	**391**	224.4444	**436**	249.4444	**481**
175	**347**	**200**	**392**	**225**	**437**	**250**	**482**
175.5556	**348**	200.5556	**393**	225.5556	**438**	250.5556	**483**
176	348.8	**201**	393.8	**226**	438.8	**251**	483.8
176.1111	**349**	201.1111	**394**	226.1111	**439**	251.1111	**484**
176.6667	**350**	201.6667	**395**	226.6667	**440**	251.6667	**485**
177	350.6	**202**	395.6	**227**	440.6	**252**	485.6
177.2222	**351**	202.2222	**396**	227.2222	**441**	252.2222	**486**
177.7778	**352**	202.7778	**397**	227.7778	**442**	252.7778	**487**
178	352.4	**203**	397.4	**228**	442.4	**253**	487.4
178.3333	**353**	203.3333	**398**	228.3333	**443**	253.3333	**488**
178.8889	**354**	203.8889	**399**	228.8889	**444**	253.8889	**489**
179	354.2	**204**	399.2	**229**	444.2	**254**	489.2
179.4444	**355**	204.4444	**400**	229.4444	**445**	254.4444	**490**
180	**356**	**205**	**401**	**230**	**446**	**255**	**491**

TABLE OF THERMOMETRIC EQUIVALENTS.—*Concluded.*

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
255.5556	**492**	275.5556	**528**	295.5556	**564**	315.5556	**600**
256	492.8	**276**	528.8	**296**	564.8	**316**	600.8
256.1111	**493**	276.1111	**529**	296.1111	**565**	316.1111	**601**
256.6667	**494**	276.6667	**530**	296.6667	**566**	316.6667	**602**
257	494.6	**277**	530.6	**297**	566.6	**317**	602.6
257.2222	**495**	277.2222	**531**	297.2222	**567**	317.2222	**603**
257.7778	**496**	277.7778	**532**	297.7778	**568**	317.7778	**604**
258	496.4	**278**	532.4	**298**	568.4	**318**	604.4
258.3333	**497**	278.3333	**533**	298.3333	**569**	318.3333	**605**
258.8889	**498**	278.8889	**534**	298.8889	**570**	318.8889	**606**
259	498.2	**279**	534.2	**299**	570.2	**319**	606.2
259.4444	**499**	279.4444	**535**	299.4444	**571**	319.4444	**607**
260	**500**	**280**	**536**	**300**	**572**	**320**	**608**
260.5556	**501**	280.5556	**537**	300.5556	**573**	320.5556	**609**
261	501.8	**281**	537.8	**301**	573.8	**321**	609.8
261.1111	**502**	281.1111	**538**	301.1111	**574**	321.1111	**610**
261.6667	**503**	281.6667	**539**	301.6667	**575**	321.6667	**611**
262	503.6	**282**	539.6	**302**	575.6	**322**	611.6
262.2222	**504**	282.2222	**540**	302.2222	**576**	322.2222	**612**
262.7778	**505**	282.7778	**541**	302.7778	**577**	322.7778	**613**
263	505.4	**283**	541.4	**303**	577.4	**323**	613.4
263.3333	**506**	283.3333	**542**	303.3333	**578**	323.3333	**614**
263.8889	**507**	283.8889	**543**	303.8889	**579**	323.8889	**615**
264	507.2	**284**	543.2	**304**	579.2	**324**	615.2
264.4444	**508**	284.4444	**544**	304.4444	**580**	324.4444	**616**
265	**509**	**285**	**545**	**305**	**581**	**325**	**617**
265.5556	**510**	285.5556	**546**	305.5556	**582**	325.5556	**618**
266	510.8	**286**	546.8	**306**	582.8	**326**	618.8
266.1111	**511**	286.1111	**547**	306.1111	**583**	326.1111	**619**
266.6667	**512**	286.6667	**548**	306.6667	**584**	326.6667	**620**
267	512.6	**287**	548.6	**307**	584.6	**327**	620.6
267.2222	**513**	287.2222	**549**	307.2222	**585**	327.2222	**621**
267.7778	**514**	287.7778	**550**	307.7778	**586**	327.7778	**622**
268	514.4	**288**	550.4	**308**	586.4	**328**	622.4
268.3333	**515**	288.3333	**551**	308.3333	**587**	328.3333	**623**
268.8889	**516**	288.8889	**552**	308.8889	**588**	328.8889	**624**
269	516.2	**289**	552.2	**309**	588.2	**329**	624.2
269.4444	**517**	289.4444	**553**	309.4444	**589**	329.4444	**625**
270	**518**	**290**	**554**	**310**	**590**	**330**	**626**
270.5556	**519**	290.5556	**555**	310.5556	**591**	330.5556	**627**
271	519.8	**291**	555.8	**311**	591.8	**331**	627.8
271.1111	**520**	291.1111	**556**	311.1111	**592**	331.1111	**628**
271.6667	**521**	291.6667	**557**	311.6667	**593**	331.6667	**629**
272	521.6	**292**	557.6	**312**	593.6	**332**	629.6
272.2222	**522**	292.2222	**558**	312.2222	**594**	332.2222	**630**
272.7778	**523**	292.7778	**559**	312.7778	**595**	332.7778	**631**
273	523.4	**293**	559.4	**313**	595.4	**333**	631.4
273.3333	**524**	293.3333	**560**	313.3333	**596**	333.3333	**632**
273.8889	**525**	293.8889	**561**	313.8889	**597**	333.8889	**633**
274	525.2	**294**	561.2	**314**	597.2	**334**	633.2
274.4444	**526**	294.4444	**562**	314.4444	**598**	334.4444	**634**
275	**527**	**295**	**563**	**315**	**599**	**335**	**635**

PHYSIOLOGICAL TESTING.

E. M. Houghton.

Physiological Testing is necessary for the proper determination of the activity of many important drugs which cannot be satisfactorily tested by chemical methods. It is the determination of the change in function "induced in living organisms by the administration in the state of minute division of such unorganized substances as do not act merely as foods," for the purpose of identifying and adjusting the strength of medicinal substances, and may be qualitative or quantitative in kind. It is a well-known fact that the protoplasm of the cells forming the different tissues of the animal body varies in its chemical and physical composition according to the function of the organ in which they are found.

The elective affinity of drugs which enables the physician to increase or decrease the activity of a particular organ in order to combat the pathological effects of disease processes is best explained by assuming that physiological action is the result of some sort of chemical union between the drug and certain constituents of the protoplasm of the cell, and that the greatest change in function will occur in those organs whose protoplasm contains the largest amount of substances which combine with the drug. This view clearly explains why ergot has a specific action on the uterus, as this organ is composed largely of unstriped muscle tissue, and ergot has a special affinity for such muscle tissue wherever found. Cocaine exhibits a special affinity for the protoplasm of the terminations of sensory nerves, while strychnine possesses a similar affinity for the protoplasm of the spinal cord.

The function of an organ is specialized to accomplish some particular purpose and always remains the same in kind, but may be altered in degree.

Those drugs which increase the lability of the protoplasm of the cells augment the specialized function of the organ, and are called stimulants, while other drugs producing the opposite effects, by rendering the protoplasm more stable are termed depressants.

The term irritation is often employed in a loose sense as meaning the same as stimulant. This should be avoided, as it applies more especially to changes produced in protoplasms generally, as changes in growth, nutrition, etc.

Certain drugs, as cocaine, act as depressants to some portions of the animal body and as stimulants to other portions; other drugs, chloral, ether, etc., depress from the beginning of their action, and end in paralyzing directly or indirectly one or all of the organs of the animal body, while still other drugs, strychnine, digitalis, etc., primarily stimulate one or more organs directly or indirectly, but ultimately, if the action is sufficiently prolonged, their terminal effect is depressant, comparable to the effect of fatigue, and finally may end in complete or general paralysis.

As already intimated in the definition, physiological assays may be either qualitative or quantitative. It is not possible in this paper to give minute descriptions of methods for conducting qualitative analysis by pharmacological reactions, as it would be necessary to consider a great number of drugs of therapeutic importance, and besides such a discussion is unnecessary, as the peculiar pharmacological reactions of each drug are mentioned under the heading of physiological action in almost every text-book on the subject of materia medica, which will enable each investigator to apply the usual methods of pharmacological practice to problems as they arise.

The elective affinity of drugs for certain kinds of protoplasm offers in some instances a more certain means of identification than a chemical analysis. The peculiar reaction between digitalin and other heart tonics and the heart muscle brings about, when applied to the laid-bare frog's heart, greatly lessened rhythm and a tendency for the organ to cease beating in the systolic condition. Atropine by paralyzing the terminations of certain peripheral nerve-endings causes the pupil of the eye to dilate in a characteristic manner, while muscarine, acting upon certain other nerve-endings, produces exactly the opposite change in function. Innumerable examples might be given of characteristic

physiological reactions, but these will suffice to show the nature of these reactions. The determination of these special reactions between drugs and protoplasm is just as truly a study in qualitative analysis as an observation of the reaction of drugs to ordinary chemical reagents.

That the reactions between drugs and protoplasm is quantitative in nature has been recognized since the dawn of medicine by the gradual working out of the dosage of each drug. In a study of the quantitative reactions between drugs and protoplasms, by observing the changes in function produced in living animals, the greatest attention must be paid to the details of the experiments. The most important general rules to be observed in order to obtain reliable results are the following:

The reaction chosen as a measure should be the most constant and characteristic obtainable for each given drug.

The kind of animal chosen for making the observation should be the one in which the reaction is most clearly discernible.

The animals employed for making a test should be of the same species, differing as little as possible from one another in weight, temperament, etc., in order that the resistance of the several animals employed for making a test shall be as uniform as possible.

The animals employed for the experiments should be kept under identically the same conditions just before and while the experiments are being made: the same food, the same degree of temperature, etc.

The strength of each preparation in making a quantitative assay should be compared with the strength of a standard preparation, the assay of both being made at the same time, and the conditions of the experiments being precisely the same in both cases.

The standard adopted should possess the pharmacological activity of a preparation representing the activity of an average sample of a first-class drug, as found by taking an average of the strength of several samples of the product, prepared from as many different samples of a drug of first-class quality, as determined by botanical or chemical methods; each sample being prepared according to the same formula.

The action of the drug being assayed should, if possible, be compared with the action of the standard upon the same animal, and, in those cases where it cannot be done, a sufficient number of animals of uniform resistance should be employed to rule out any individual idiosyncrasy.

An outline of the methods devised and employed by the author for some of the most important medicinal preparations, which are not amenable to chemical assay, may be given as follows:

ERGOT.

For centuries it has been observed that fowls, swine, and other animals, as well as man, feeding upon ergotized rye, develop sooner or later gangrene and sloughing of peripheral parts, as the combs and wattles of fowls, ears of swine, etc. This reaction is so constant, especially upon fowls, that it has been found a reliable indication of the presence of the active constituents of ergot, desired for therapeutic purposes, in the various pharmaceutical preparations of the drug (Kobert, Houghton, Jacobi, etc.).

While the chemistry of ergot is not clearly worked out, it is generally believed that the cornutin and sphacelinic acid contained in ergot are the active principles which produce the desired therapeutic action.

Extensive experiments have shown that a preparation of ergot that produces blackening of the the cock's comb, when given in suitable doses, will likewise produce abortion in pregnant animals. An investigation by the writer covering several years has shown that the blackening produced in the rooster's comb varies in intensity and rapidity of development in proportion to the quantity of the drug administered and the rapidity of absorption. Considerable difficulty is encountered in determining the reaction, owing to the variability in the resistance of individual fowls, as found in the market, but by careful breeding of thoroughbred chickens and great attention to methods of feeding, conditions under which the fowls are kept, etc., and by comparing the reaction obtained by the administration of a certain quantity of the ergot, or preparation of ergot, with the reaction produced by the feeding of a given quantity of the standard preparation, reliable results are obtained.

HEART TONICS.

Pharmacologists generally are agreed that the active constituents (which are probably all glucosides) of the various heart tonics—digitalis, strophanthus, etc.—possess the same general physiological action upon the factors concerned in the maintenance of the circulation of the blood, differing mainly in degree. The most important phenomena observable in animals and man when under the influence of these drugs are the slowing and strengthening of the heart-beats and an increase in blood-pressure.

Two series of experiments will show in a characteristic manner the qualitative reaction, viz., the application of a solution of the drug to the laid-bare frog's heart, which is followed by gradual slowing of heart-beats and a tendency for the organ to dilate less and less until it finally ceases to beat, and remains in the systolic condition; and the intravenous or subcutaneous injection of solutions of the drugs into dogs, rabbits, or other animals, which produce a characteristic increase in blood-pressure and slowing of the heart. These reactions are best shown by graphic tracings recorded by the kymograph.

A quantitative assay is more difficult, Several methods have been tried, but the method proposed for the assay of strophanthus (Houghton, *Jour. Amer. Med. Assoc.*, 1899), slightly modified for the other members of the group (digitalis, convallaria majalis, squill, etc.), has been extensively employed, and gives quite accurate results. This method is based upon the fact that the killing power of the heart tonics for frogs of definite size and species, kept under proper conditions, is constant per gramme of body-weight. The frogs employed for making a test should be of the same size and species, but since it is practically impossible to obtain upon the market frogs of exactly the same size, it is best to sort the frogs into several groups according to size, using one size for one particular drug, another size for another, etc. Frogs weighing 12 to 30 grammes are large enough, and can usually be obtained at a very reasonable price.

The application of the method may be briefly described as follows:

Apparatus.—Small wire frog baskets with legs and covers, or frog glasses and plates, will do, care being taken not to set the baskets too deeply in water and not to fill the plates sufficiently full of water to drown the animals. The water should cover the bottom of the baskets or plates about one-fourth inch.

Small balance for weighing the frogs.

Volumetric flasks for diluting the preparations to be assayed, and glass pipettes, graduated into hundredths of a cubic centimeter, with long narrow points, or supplied with needle-points, for injecting the frogs.

The strength of the preparation being assayed is to be compared with the strength of a standard preparation of the drug, the two being tested at the same time and under the same conditions. An illustration will best show how this is done, as, for example, tincture of strophanthus.

A standard preparation is obtained according to the method outlined in the general remarks, which is of the strength of an average sample of tincture strophanthus prepared from first-class strophanthus Kombé seeds.

One Cc. of the tincture to be assayed is measured out and diluted with normal saline solution, to make the dilution such that the amount to be injected into each frog shall be about 0.5 Cc., the same care being exercised in making the solution as would be exercised in making up volumetric solutions for chemical assays.

The frogs which are of the same species and have been kept under the same conditions are weighed out, and the weights recorded, the frogs being marked so that they can be readily identified. The frogs should not differ more than 3 grammes in weight, but may be of any size, the aim being to have the resistance uniform. It will be necessary to inject several series of frogs on as many different days, approximately as follows:

First Series:

A. *Frogs Injected with Standard.*

Number of Frogs.	Weight of Frogs.	Amount of Tincture Injected per Gm. body-weight.	Result at End of 12 hours.
1	15 Gm.	0.0001	Alive.
2	16 "	0.00015	"
3	15 "	0.0002	Dead.
4	17 "	0.00025	"

The killing dose is between 0.00015 and 0.0002.

B. *Frogs Injected with Tincture to be Assayed.*

Number of Frogs.	Weight of Frogs.	Amount of Tincture Injected per Gm. body-weight.	Result at End of 12 hours.
1	16 Gm.	0.0001	Alive.
2	15 "	0.00015	"
3	17 "	0.0002	"
4	15 "	0.00025	Dead.

The killing dose is between 0.0002 and 0.00025.

Second Series:

A. *Standard.*

Number of Frogs.	Weight of Frogs.	Amount of Tincture Injected per Gm. body-weight.	Result at End of 12 hours.
1	15 Gm.	0.00015	Alive.
2	16 "	0.00016	Dead.
3	15 "	0.00017	"
4	17 "	0.00018	"
5	16 "	0.00019	"

The killing dose is between 0.00015 and 0.00016.

B. *Tincture being Assayed.*

Number of Frogs.	Weight of Frogs.	Amount of Tincture Injected per Gm. body-weight.	Result at End of 12 hours.
1	16 Gm.	0.0002	Alive.
2	17 "	0.00021	"
3	15 "	0.00022	Dead.
4	16 "	0.00023	"
5	17 "	0.00024	"

The killing dose is between 0.00021 and 0.00022.

Third Series:

A. *Standard.*

Number of Frogs.	Weight of Frogs.	Amount of Tincture Injected per Gm. body-weight.	Result at End of 12 hours.
1	15 Gm.	0.00016	Alive.
2	16 "	0.00016	Dead.
3	16 "	0.00016	"
4	17 "	0.00016	"
5	16 "	0.00016	Alive.

Minimum fatal dose, 0.00016.

B. *Tincture being Assayed.*

Number of Frogs.	Weight of Frogs.	Amount of Tincture Injected per Gm. body-weight.	Result at End of 12 hours.
1	16 Gm.	0.00022	Dead.
2	17 "	0.00022	"
3	15 "	0.00022	Alive.
4	16 "	0.00022	"
5	17 "	0.00022	Dead.

Minimum fatal dose, 0.00022.

According to the results obtained from the injection of the three series of frogs, 0.00016 Cc. of the standard tincture (a tincture of 100 per cent.) has the same killing power as 0.00022 Cc. of the tincture being assayed. Hence, the tincture possesses a strength of $\frac{0.00016}{0.00022} = \frac{16}{22} = 72+\%$ of standard.

INDIAN CANNABIS.

No drug in the entire Pharmacopœia has been found more frequently to produce variable therapeutic results than Indian Cannabis.

An examination of the effects on dogs and other animals by the internal administration of a large number of samples of crude Indian Cannabis and its pharmaceutical preparations showed conclusively that when the drug was active it produced a characteristic intoxication varying in degree with the quantity and activity of the drug, rapidity of absorption, individual susceptibility of the animal, etc.

Practical application of this reaction (Houghton), for the purpose of testing preparations of Indian Cannabis, by feeding them in suitable doses to dogs, and comparing the effects produced with the intoxication resulting from known doses of preparations of definite strength, has proved of much value, as is evidenced by the uniformly favorable reports of physicians employing preparations of the drug so tested.

SUPRARENAL GLANDS.

Seldom in the history of medicine has a substance so quickly demonstrated for itself a place in therapeutics as the preparations of the suprarenal glands and their active constituent, Adrenalin; but so readily is this active principle decomposed that no satisfactory method of chemical assay has been devised for it, hence the need of a pharmacological method.

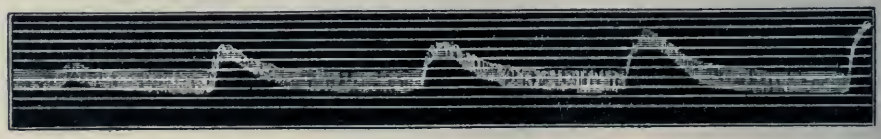
The following method (Houghton, *Jour. Amer. Med. Assoc.*) was devised as the result of extended study of the chemical and pharmacological properties of the active principle (Adrenalin), and the various preparations obtained from these glands has given quite satisfactory results.

The application of this method depends upon the fact that intravenous injections of Adrenalin, or preparations containing Adrenalin, produce a transitory rise in blood-pressure, such increase in blood-pressure, within certain limits, varying according to the amount of the active principle injected.

The standard with which a given preparation is compared is a 1 : 1000 freshly made solution of chemically pure Adrenalin. Hypodermic syringes, pipettes, surgical instruments of various kinds, glass cannulæ, and a large-sized kymograph, with manometer arranged for making blood-pressure tracings on smoked paper, etc., are required. Everything needed will usually be found in a well-equipped pharmacological laboratory.

Various animals may be employed, but dogs of medium size give the best results. Whatever animal is employed, it is carefully anesthetized, preferably with chloretone given per os. Chloretone is much better for experiments of this kind, as its action is long continued, and it has little or no effect upon the circulatory system. After the animal becomes completely unconscious he is fastened in the dorsal position to a holder, the hair is clipped from the throat and groin, and glass cannulæ of suitable size are tied into the carotid artery and femoral vein. The cannula tied in the carotid artery is connected in turn with an inelastic tube, filled with a half-saturated solution of sodium carbonate or other solution to prevent the blood from clotting, leading to the manometer of the kymograph. The drum of the kymograph is set in motion, the clamp removed from the carotid, and a tracing made, showing the normal height of the blood pressure. The smoked paper should have linear rulings, for convenience in reading results, one-half a centimeter apart. Two kinds of tracings may be obtained, complete ones, several sheets of paper being used if necessary, where the drum is kept in constant motion; or abbreviated ones where the drum remains at rest during each reaction, recording only the maximum blood-pressure, which are more convenient for practical purposes (see tracings Nos. 1 and 2).

When a tracing showing the normal blood-pressure has been taken, a definite quantity of the diluted 1 : 1000 solution of Adrenalin, properly diluted with physiological



No. 1.—Complete tracing, showing variations in the blood-pressure from the intravenous injection of different amounts of adrenalin.

saline solution, is slowly injected into the femoral vein; within a few moments the blood-pressure rapidly rises (possibly several centimeters) and as quickly subsides to the normal. Allowing a few minutes' rest to the animal, an injection of a small portion of the preparation which is being assayed is made, care being taken to remove as far as possible inert substances from the preparation for injection. Care must also be taken that the

quantity of fluid and time required in making the injection be the same as that of the standard. Repeated injections of the same amount of fluid, but containing a varying quantity of the active principle, are made of the preparation being assayed until the rise in blood-pressure produced by the unknown is equal to the rise in blood-pressure

No. 2.—Abbreviated blood-pressure tracing, showing the comparative action of two solutions of adrenalin. The solutions were of exactly the same strength, but the person making the assay supposed they were of different strengths until he had proven by experiment that they had the same influence on blood-pressure.

produced by a definite quantity of the 1 : 1000 adrenalin. The quantity of the preparation injected must always be less than sufficient to produce the maximum rise in blood-pressure. Observation of the effects produced by different quantities of the preparation will show whether the maximum effect has been produced. Suppose that one finds that the same effect on the blood-pressure is produced by 1 Cc. of standard 1 : 1000 solution of Adrenalin and 1 Cc. of the preparation being assayed, diluted 1 : 1200, then the strength of the preparation being assayed equals $\frac{1000}{1200} = \frac{5}{6} = 83+$ per cent.

BOTANICAL NAMES.

A failure to employ accurately the botanical names of plants is responsible for many failures in the investigation of, and errors in recording, the properties of drugs. The meaning of names recognized in the Pharmacopœia is accurately defined and firmly established, but usage of names of unofficial drugs is lamentably loose, and the correct uses of the botanical names is the only certain safeguard against error.

Each plant has two names: one indicates the genus or group to which it belongs, and corresponds to a person's family name, as *Acer*, the maples, and *Salix*, the willows. The other indicates the species and corresponds to the Christian name of a person, as, in Salix *alba*, the White willow, and *nigra*, the Black willow. The two names applied together to a plant, as *Salix nigra*, or *S. alba*, comprise the binomial. In writing successively several binomials pertaining to the same genus, it is customary to abbreviate to the first letter the generic name in all except the first binomial, as in the last two names given above.

Each of these names was given to its genus or species, respectively, by some botanist, who is thus known as the author of the genus or species. It has frequently happened that another botanist has subsequently assigned the same name in a different application, so that the meaning is uncertain unless the author's name be subjoined to the plant name or binomial; thus, *Electra* DC. and *Electra* Panzer, or *Acer saccharinum* L. and *A. saccharinum* Wang. The author's name and the plant name are printed in different type, or in Ms. one is underlined. Writing the name of the author in parentheses indicates that he is not the author of the binomial, but of the species-name only, which he improperly connected with some other genus; as *Calotropis gigantea* (L.), which Linné had called "*Asclepias gigantea*." If another author's name follows the parenthesis, as *Calotropis gigantea* (L.) Dryander, it indicates that the second-named author (Dryander) referred the species to its proper genus and is the author of the binomial. When no other author's name follows the parenthesis it indicates that no one has previously referred the name to its proper genus, and that the author of the article is then doing so.

Occasionally a trinomial is used, thus, "*Polygonatum multiflorum pubescens*" Wood, indicating a peculiar form of the species, but not a distinct species.

ABBREVIATIONS OF NAMES OF AUTHORS OF BOTANICAL NAMES.

Adans.	Adanson.
Ait.	W. Aiton.
Ait. *f.*	W. T. Aiton.
Ag.	Agardh.
All.	Allioni.
Andr.	Andrews.
A. Rich.	A. Richard.
Aubl.	Aublet.
Baill.	Baillon.
Bak.	John G. Baker.
Bak. *f.*	Edmund Baker.
Bart.	Barton.
Bart. et Wend.	Bartling et Wendland.
Beauv.	Beauvois.
Benth.	Bentham.
B. et H.	Bentham et Hooker.
Berg.	Bergius.
Berl.	Berlandier.
Bernh.	Bernhardi.
Bigel.	Bigelow.
Bl.	Blume.
Boehm.	Boehmer.
Boiss.	Boissier.
Borckh.	Borckhausen.
Br.	Braun.
Britt.	Britton.
Brogn.	Brogniart.
Brot.	Brotero.
Bur.	Bureau.
Burm.	Burman.
Carr.	Carrière.
Cass.	Cassine.
Cav.	Cavanilles.
C. DC.	Casimir de Candolle.
Cerv.	Cervantes.
Cham.	Chamisso.
C. et S.	Chamisso et Schlechtendal.
Chois.	Choisey.
Corr.	Corréa de Serra.
Coult.	Coulter.
Coult. et R.	Coulter et Rose.
DC.	Alphonse de Candolle.
Decne.	Decaisne.
Desf.	Desfontaines.
Desr.	Desroussaux.
Desv.	Desvaux.
Dill.	Dillenius.
Dougl.	Douglas.
Dry.	Dryander.
Duh.	Duhamel.
Dumort.	Dumortier.
Dun.	Dunal.
Ehrh.	Ehrhard.
Ell.	Elliott.
Engl.	Engler.
E. et P.	Engler et Prantl.
Engelm.	Engelmann.
F. Muell.	Ferdinand von Müller
Fisch.	Fischer.
Fisch. et Mey. (or F. et M.)	Fischer et Meyer.
Forst.	Forster.
Franch.	Franchet.
Froel.	Fröelich.
Gaert.	Gaertner.
Gaud.	Gaudichaud-Beaupré.
Gilib. (or Gil.)	Gilibert.
Gmel.	Gmelin.
Grev.	Greville.
Griseb.	Grisebach.
Gron.	Gronovius.
Hassk.	Hasskarl.
Haw.	Haworth.
H. B. K.	Humboldt, Bompland et Kunth.
Hedw.	Hedwig.
Herb.	Herbert.
Hoffm.	Hoffmann.
Hook.	W. J. Hooker.
Hook. *f.*	J. D. Hooker.
H. et A.	Hooker et Arnott.
Hort.	A garden name.
Houtt.	Houttuyn.
Huds.	Hudson.
Jacq.	Jacquin.
Juss.	A. L. Jussieu.
Kauffm.	Kauffman.
Kaulf.	Kaulfuss.
Kze.	Kunze.
L.	Linné or Linnæus.
L. *f.*	Linné the son.
Labill.	Labillardière.
Lag.	Lagasca.
Lam.	Lamarck.
Lem. et Dec.	Le Maout et Decaisne.
Ledeb.	Ledebour.
Lehm.	Lehmann.
Lem.	Lemaire.
L'Her.	L'Heritiér.
Lind.	Linden.
Lindl.	Lindley.
Lois.	Loiseleur-Deslonchamps.
Lour.	Loureiro.
Mart.	Martius.
Maxim.	Maximowicz.
Meissn.	Meissner.
Mey.	Meyer.
Michx. or Mx.	Michaux.
Mill.	Miller.
Miq.	Miquel.
Mirb.	Mirbel.
Moc. et Ses.	Mocino et Sesse.
Moench.	Moenchausen.
Mol.	Molino.
Moq.	Moquin-Tandon.
Muell. Arg.	J. Mueller, of Argau.
Muhl.	Muhlenberg.
Murr.	Murray.
Nees.	Nees von Esenbeck.
Nutt.	Nuttall.
Pall.	Pallas.
Pav.	Pavon.
P. Br.	Patrick Browne.
Pers.	Persoon.
Planch.	Planchon.
Pluk.	Plukenet.
Plum.	Plumier.
Poepp.	Poeppig.
Poepp. et Endl.	Poeppig et Endlicher.
Poir.	Poiret.
Raf.	Rafinesque-Schmalz.
R. Br.	Robert Brown.
R. et P.	Ruiz Lopez et Pavon.
R. et S.	Roemer et Schultes.
Reichb.	Reichenbach.
Reichb. *f.*	Reichenbach the son.
Roem.	Roemer.
Rosc.	Roscoe.
Roxb.	Roxburgh.
Rupr.	Ruprecht.
Salisb.	Salisbury.
Schlecht.	Schlechtendal.
Sch. et Endl.	Schott et. Endlicher.

Schrad.	Schrader.
Schult.	Schultes.
Schwein.	Schweinitz.
Scop.	Scopoli.
Seem.	Seeman.
Sieb.	Siebold.
Sieb. et Zucc.	Siebold et Zuccarini.
Soland.	Solander.
Sonn.	Sonnerat.
Spr.	Sprengel.
Steud.	Steudel.
St. Hil.	St. Hilaire.
Sud.	Sudworth.
Sw. or Swz.	Swartz.
T. et G.	Torrey et Gray.
Thunb.	Thunberg.
Thurb.	Thurber.
Torr.	Torrey.
Tourn.	Tournefort.
Traut.	Trautvetter.
Trev.	Treviranus.
Trin.	Trinius.
Tul.	Tulasne.
Vaill.	Vaillant.
Vell.	Vellozzi.
Vent.	Ventenat.
Vill.	Villars.
W. et A.	Wight et Arnott.
Wahl.	Wahlenberg.
Walt.	Walters.
Wang.	Wangenheim.
Wats.	Watson.
Wedd.	Weddell.
Wende.	Wenderoth.
Wendl.	Wendland.
Willd.	Willdenow.
With.	Withering.
Zucc.	Zuccarini.

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